



Hydrocephalus Society

International Society for Hydrocephalus
and Cerebrospinal Fluid Disorders



2025 HYDROCEPHALUS WORLD CONGRESS

5-8 September | Toulouse, France

www.hydrocephalus-meeting.com

CONGRESS BOOK

Become a Member Now

The Hydrocephalus Society is an open community that encourages collaboration, partnerships and networking between all professionals related to the field of Hydrocephalus and CSF Disorders.

As a member of the Hydrocephalus Society, you will join a community of peers that fosters an environment of cooperation and works towards ensuring ethical, high-quality care for patients, and increasing awareness regarding Hydrocephalus and CSF disorders on a global scale.

Hydrocephalus Society members enjoy several benefits related to personal and professional development, as well as to the creation of opportunities for collaborations and partnerships.

The benefits we offer to our members are the following:



EDUCATION

- Exclusive access to the video minutes of all Hydrocephalus World Congresses
- Exclusive access to the recordings of the Hydrocephalus Society Global Webinar Series (2021,2022,2023,2024,2025)
- Exclusive access to all abstract books of previous Hydrocephalus World Congresses



DISCOUNTS

- Significant Members' discount for the Annual Hydrocephalus World Congress (€200+ depending on registration category)
- Special Discount for scientific paper publications at the Fluids & Barriers of the CNS Journal with impact factor 6.2



PROFESSIONAL DEVELOPMENT & NETWORKING

- Observership opportunities in high volume Hydrocephalus departments
- Right to participate and vote at the General Assembly of the Hydrocephalus Society
- Right to be elected as Board Director
- The chance to host the Hydrocephalus World Congress in your country
- Access (by request) to the Members' Directory of the Society



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READY TO JOIN? VISIT THE HYDROCEPHALUS SOCIETY WEBSITE

ishcsf.com

HYDROCEPHALUS SOCIETY



Hydrocephalus Society

International Society for Hydrocephalus
and Cerebrospinal Fluid Disorders

The Hydrocephalus Society was inaugurated in September 2008 and registered as a nonprofit organization in December of the same year. From the beginning, its mission has been to advance the art and science of the field of clinical care and research in

hydrocephalus and CSF disorders, and thereby promote the best possible care for patients with these disorders. You are encouraged to join the Society to promote international exchanges, worldwide representation, and stimulating research and debate.

The Hydrocephalus World Congress is held annually in different locations around the globe, bringing together experts, researchers, and professionals to advance knowledge and collaboration in the field. In recent years, the congress has taken place in Gothenburg, Sweden (2022), Hamburg, Germany (2023) and Nagoya, Japan (2024). Looking forward, we are excited to host future congresses in Toulouse, France (2025), São Paulo, Brazil (2026), Baltimore, USA (2027), and Rome, Italy (2028).

FLUIDS AND BARRIERS OF THE CNS



FLUIDS AND BARRIERS
OF THE CNS

The Hydrocephalus Society has entered into a partnership with BioMed Central's open access journal Fluids and Barriers of the CNS (FBCNS), in which FBCNS is now an official journal of our Society. The open access publishing model provides articles for free to the general public as well as scientists, clinicians and

other healthcare practitioners throughout the world. FBCNS provides a dedicated avenue for the dissemination of research into all molecular, physiological and pharmacological aspects of brain fluids and barrier systems and their role in neurological disorders.

Members are eligible for a 15% discount on the article-processing charge when publishing with FBCNS and should log into the society's members area to obtain the reference code to use at submission.

HYDROCEPHALUS 2025 ABSTRACTS PUBLICATION

Fluids and Barriers of the CNS is an open access, peer-reviewed, online journal that considers manuscripts on all CNS fluids and barrier systems in health and disease.

Fluids and Barriers of the CNS is affiliated to the International Brain Barriers Society (IBBS) and the International Society for Hydrocephalus and CSF Disorders.

The presented abstracts of the Hydrocephalus 2025 World Congress, September 5-8, 2025, will be published in the online journal Fluids and Barriers of the CNS.

CONGRESS PRESIDENT'S WELCOME ADDRESS



Dear Colleagues and Friends,

It is with immense pleasure and honor that we welcome you to France, and to the radiant city of Toulouse, for the 2025 Hydrocephalus World Congress. Toulouse, nestled in the heart of the Occitanie region, is a city that gracefully balances heritage and progress. Known as “La Ville Rose” for its luminous pink-hued façades, it is equally celebrated for its art de vivre, where science, gastronomy, music, and conviviality flourish side by side. With the Garonne river and the Canal du Midi, a UNESCO world heritage treasure, Toulouse is a place where life and inspiration flow.

But more than its charm, Toulouse stands as a beacon of innovation and science. It is the beating heart of Europe’s aerospace and engineering industries, home to Airbus and an ecosystem of research, design, and technological audacity. This spirit of modernity drives Hydrocephalus 2025.

This year’s congress embraces a resolutely avant-garde vision of hydrocephalus. Our scientific program challenges boundaries, fosters multidisciplinary, and dares to ask the questions to explore new territories of our field. The Educational Seminar “Beyond Idiopathic Normal Pressure Hydrocephalus” invites participants to reframe their assumptions, confront uncertainty, and think ahead. Our dedicated session on “Fundamental Physics Applied to Hydrocephalus” will exemplify how mathematical modelling, physical sciences and engineering, now stand at the forefront of innovation.

We welcome not only neurosurgeons, neurologists, pediatricians, geriatricians, radiologists, and psychiatrists, but also engineers, physicists, neuropsychologists, nurses, therapists, data scientists and others. But crucially, we celebrate this year the voices of patients and advocates, especially through our collaboration with the Hydrocephalus Association and the CSF Leak Association, because true progress is always patient-centered.

On behalf of the Hydrocephalus Society, we invite you to experience a truly avant-garde congress, one that is both scientifically bold and deeply human. A time to connect, challenge ideas, and dream over a glass of wine of new frontiers in hydrocephalus and CSF-related care, all in the spirit of Toulouse.

Warm regards,

Eric Schmidt

President of the Hydrocephalus 2025 World Congress

HYDROCEPHALUS SOCIETY PRESIDENT'S WELCOME ADDRESS



Dear Colleagues & Friends,

It is my honour and sincere pleasure to welcome you to Hydrocephalus 2025, the 17th World Hydrocephalus Congress arranged by the Hydrocephalus Society (The International Society for Hydrocephalus and Cerebrospinal Fluid Disorders).

The Hydrocephalus Society was formed in 2007 with a goal to create an International Society that addressed the entire field of hydrocephalus. During these past 18 years, the Society has grown, engaging more member scientists and clinicians around the world to advance hydrocephalus research and clinical care. Hydrocephalus Society is increasingly engaged in different activities including the educational Global Webinar Series presently running its fourth season, efforts to increase awareness as well as collaborations with other societies. Our Society has worked with the Society Secretariat (Artion) since late 2015 for management of both Society affairs and the Annual Meeting. Fluids and Barriers of the CNS is the official journal of the Hydrocephalus Society and now has an impact factor of 7.3. Over the years, we have witnessed significant progress with our understanding of what hydrocephalus and other cerebrospinal fluid disorders are and do to children and adults and how to improve the care of affected patients. Please consider becoming a full member of the Hydrocephalus Society if you presently are not one.

The peak of our year is the Annual World Congress bringing together experts within this exciting field for some intense days when we share scientific advances and new developments as well as network to foster collaboration. The Young Investigators Award competition has become a crown jewel of the meeting highlighting junior researchers and our annual Keynote speakers are exceptional world experts.

We are very grateful to our host and meeting president Prof. Eric Schmidt and his entire team, to our secretariat Artion and to all people who have contributed to this conference. This year, we have prepared a very exciting scientific program that includes the new, cutting-edge developments in adult and paediatric hydrocephalus and CSF disorders within both clinical and experimental research. Our Keynote speakers are selected for their outstanding records. However, to make the conference a real success, we need your participation, your input, your questions and participation in discussions, i.e. your contributions to the congress. We thank you for making this conference a special, fruitful, and inspiring event.

On behalf of the Hydrocephalus Society, I wish you great days in the lovely city of Toulouse and hope you will bring many new insights and enjoyable memories back home.

Mats Tullberg, Professor
President of the Hydrocephalus Society

CONGRESS PRESIDENT

Eric Schmidt

CONGRESS SCIENTIFIC CHAIR

Carolyn Harris

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ARTION

conferences & events •

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HYDROCEPHALUS 2025 WORLD CONGRESS

TOULOUSE, FRANCE | 5-8 SEPTEMBER 2025

WWW.HYDROCEPHALUS-MEETING.COM

The Hydrocephalus World Congress - the 17th Meeting of the Hydrocephalus Society Toulouse, France, 05/09/2025 - 08/09/2025 organized by International Society for Hydrocephalus and Cerebrospinal Fluid Disorders - Hydrocephalus Society has been accredited by the European Accreditation Council for Continuing Medical Education (EACCME®) for a maximum of 19.0 European CME credits (ECMEC®s).

Each medical specialist should claim only those credits that he/she actually spent in the educational activity.

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Through an agreement between the European Union of Medical Specialists and the American Medical Association, physicians may convert EACCME® credits to an equivalent number of AMA PRA Category 1 Credits™. Information on the process to convert EACCME® credits to AMA credits can be found at <https://edhub.ama-assn.org/pages/applications>.

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For other countries, please contact the relevant national/regional accreditation authority.

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2025 HYDROCEPHALUS
World Congress
5-8 September | Toulouse, France

www.hydrocephalus-meeting.com

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14:00-14:30	Coffee Break
14:30-15:45	Educational Seminar: Beyond Idiopathic Normal Pressure Hydrocephalus
15:45-16:15	Award Ceremony

Program Overview

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ARIANE FOYER					
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AUDITORIUM DE SAINT EXUPÉRY		CASSIOPÉE		SPOT	
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10:30-11:50	SESSION 5: YOUNG INVESTIGATORS AWARDS I Chairs: Fabian Flürenbrock, Hannah Botfield				
11:50-12:30	Hydrocephalus Society Annual General Meeting				
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Program Overview

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		09:20-10:20	SESSION 24: INTRACRANIAL PRESSURE Chairs: Fernando Pinto, Anne Benninghaus	09:20-10:20	SESSION 25: ADULT HYDROCEPHALUS Chairs: Ignacio Jusue Torres, Shigeki Yamada
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DETAILED PROGRAM

Friday, 5 September 2025

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13:00-13:15	After Hydrocephalus: Redefining CSF-Related Diseases Mats Tullberg
13:15-13:30	iNPH in the Modern Landscape of Neurodegenerative Diseases Chifumi Iseki
13:30-13:45	Functional Neurosurgery iNPH. A Neuromodulation Hypothesis Benjamin Elder
13:45-14:00	Hallmarks and Biomarkers of NPH: Moving Towards Precision Medicine Eric Schmidt
14:00-14:30	Coffee Break
14:30-14:45	Neuroradiology of iNPH: Beyond Conventional Images Olivier Baledent
14:45-15:00	Neurophysiology in NPH: Measuring What Matters Ahmed Toma
15:00-15:15	Beyond iNPH: A Holistic Approach to Patient Care Sevil Yasar
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Saturday, 6 September 2025	
ARIANE FOYER	
07:00-08:00	Registrations
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08:15-08:30	Welcome to Toulouse Eric Schmidt , <i>Hydrocephalus 2025 World Congress Congress President</i>
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09:00-10:00	SESSION 2: FUNDAMENTAL PHYSICS APPLIED TO HYDROCEPHALUS Chairs: Eric Schmidt, Carolyn Harris
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09:15-09:30	Fluid Mechanics of the Neurovascular System Sylvie Lorthois
09:30-09:45	Measuring Neural Dynamics with MRI John Oshinski
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- 09:20-09:30

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- 09:30-09:40

Idiopathic Normal Pressure Hydrocephalus:
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- 09:40-09:50

Cerebrospinal Fluid Flow within Ventricles and Perivascular Subarachnoid Space Evaluated by Velocity Selective Spin Labeling MRI
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- 09:50-10:00

Phase-Contrast MRI Assessment of Venous Flow in Chiari Syndrome
Heimiri Monnier

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SESSION 4:
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Early Shunt Surgery in Patients with Probable Idiopathic Normal Pressure Hydrocephalus
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- 09:20-09:30

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Analysis of Prevalence, Mortality, and Treatment Trends.
Minju Kim
- 09:40-09:50

Patient Symptomatic Self-Assessment in Idiopathic Normal Pressure Hydrocephalus; Flawed or Future Framework?
Oskar Ekman
- 09:50-10:00

Cognitive Assessment Methods and Outcomes Following Shunt Surgery in Idiopathic Normal Pressure Hydrocephalus (iNPH):
A Systematic Review and Meta-Analysis
Lisa Healy

EXHIBITION AREA

- 10:00-10:30

Coffee Break & Exhibition

Detailed Program

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10:40-10:50	Cognitive-Linguistic Improvements after Shunt Surgery in Idiopathic Normal Pressure Hydrocephalus: Insights from Eye-Tracking during Lexical Retrieval Tasks Seongeun Kwon
10:50-11:00	Bioinspired Anti-Fouling Catheter Material and Design Haritosh Patel
11:00-11:10	Comparison of Gray Matter Alterations Between Normal Pressure Hydrocephalus and Alzheimer’s Disease Hongliang Li
11:10-11:20	Ventriculosubgaleal Shunting May Reduce Shunt Dependency in Preterm Post-Hemorrhagic Hydrocephalus: Evidence from a Single Tertiary Center Rafael Tiza Fernandes
11:20-11:30	Real-time symptom–ICP Correlation Enabled by Long-Term Home Monitoring Sang Ho Kim
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Brain Elastance
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- 13:50-14:00 **Brain Functional Networks in NPH. A Systems Approach**
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- 14:40-14:50 DTI-ALPS index in idiopathic Normal Pressure Hydrocephalus Before and After
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Detailed Program

- 15:10-15:20 Non-Invasive Tap Test (Pumping) to Replace Invasive Diagnostics in Underdrained Shunted NPH Patients?
Uwe Kehler
- 15:20-15:30 Outcomes in 481 Patients with iNPH Shunt Operated With or Without a Previous Cerebrospinal Fluid Tap Test – a Single Center Longitudinal Follow-Up Study
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SPOT

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- 13:50-14:00 Genetic and Molecular Determinants of the Human CSF-Ventricular System
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Mama You Esperance Broalet
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- 14:40-14:50 Optimization of Human Neural Stem Cells in Transparent Anionic Nanofibrillar Hydrogel as a Model for the Ventricular and Subventricular Xone.
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- 15:10-15:20 Predicting Endoscopic Third Ventriculostomy with Choroid Plexus Cauterization (ETV/CPC) Outcome in Infant Hydrocephalus
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EXHIBITION AREA	
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16:35-16:45	Cerebrospinal Fluid Redistribution After Shunt Placement Marcel Wrantjes
16:45-16:55	Are Arachnoid Granulations Necessary for CSF Physiology? Milan Rados
16:55-17:05	Diagnostic Accuracy of Artificial Intelligence-Based Imaging for Idiopathic Normal Pressure Hydrocephalus: Systematic Review and Meta-Analysis Stefeson Gomes Cabral Junior
17:05-17:15	Validating Post-Operative Trans-Burr Hole Ultrasound to Measure Cerebral Ventricular Size in Hydrocephalus: Comparison of Ultrasound to Computed Tomography Ryan Lee
17:15-17:25	Distinct White Matter Connectivity Profiles in iNPH Revealed by Quantitative Anisotropy Connectometry Daniele Piccolo
17:25-17:35	CDESH Decreases After Shunting and Changes Correlate Strongly with Measures of Gait Improvement Jeffrey Gunter
CASSIOPÉE	
16:15-17:45	SESSION 10: EXPERIMENTAL HYDROCEPHALUS Chairs: Pat McAllister, Richard Edwards
Abstracts for this session are on pages 96 - 105	
16:15-16:25	Influence of CSF System Experimental Blockade on Hydrocephalus Development Ivana Jurjevic

Detailed Program

- 16:25-16:35

Inhibition of TRPV4 as a Pharmacological Treatment of Posthemorrhagic Hydrocephalus

Trine L. Toft-Bertelsen
- 16:35-16:45

Brain Pathology in the Model Mice of Chronic Hydrocephalus Concomitant with Alzheimer's Disease

Kaito Kawamura
- 16:45-16:55

Shunt-Related CSF Overdrainage – A Multicenter Consensus Definition

Marianne Juhler
- 16:55-17:05

Alteration of Neuroinflammation and Intracranial Microbiome with Antibiotic Impregnated Catheters

Mark Luciano
- 17:05-17:15

CSF Proteomics in Spontaneous Intracranial Hypotension: A metabolic disease?

Amir El Rahal
- 17:15-17:25

Effect of Anesthesia and Blood Oxygenation on Rodent CSF Secretion.

Thomas Nielsen
- 17:25-17:35

Aquaporin 1 is not Required for CSF Secretion and Brain Fluid Homeostasis in Mice

Nana Macaulay
- 17:35-17:45

Role of the Choroid Plexus in Amyloid- β Clearance in PTPN20 Knockout Mice

Ryo Miyahara

SPOT

- 16:15-17:30

SESSION 11:
YOUNG INVESTIGATORS SPECIAL SESSION

Chairs: Anne Benninghaus, Fabian Flürenbrock & Monica Chau

- 16:15-16:20

Session Introduction

Anne Benninghaus & Fabian Flürenbrock
- 16:20-16:30

Problem-Solving with Purpose: Navigating a Career in Bioengineering and Hydrocephalus

Carolyn Harris
- 16:30-16:40

Not All Who Wander Are Lost

Michael Williams
- 16:40-16:50

Cerebral Hydrodynamics and Translational Engineering: Toward a Smarter Future for Hydrocephalus Management

Eric Schmidt

- 16:50-17:10

Panel Discussion and Q&A with Speakers

- 17:10-17:30

Networking Activity

Sunday, 7 September 2025	
AUDITORIUM DE SAINT EXUPÉRY	
08:30-09:20	SESSION 12: HYDROCEPHALUS SOCIETY & HYDROCEPHALUS ASSOCIATION JOINT SESSION - STRONGER TOGETHER: HOW PATIENT - PROFESSIONAL ALLIANCES CAN IMPROVE HYDROCEPHALUS CARE Chairs: Mats Tullberg, Diana Gray
08:30-08:45	Strengthening Hydrocephalus Care, Research and Awareness Through Collaboration Diana Gray , <i>Hydrocephalus Association President</i>
08:45-09:00	The Significance of Collaborations with Patient Associations. Lessons from Sweden Mats Tullberg , <i>Hydrocephalus Society President</i>
09:00-09:20	Roundtable Discussion: Diana Gray, Monica Chau, Ahmed Toma, Mats Tullberg
AUDITORIUM DE SAINT EXUPÉRY	
09:20-10:50	SESSION 13: YOUNG INVESTIGATORS AWARDS II Chairs: Carolyn Harris, Monica Chau
Abstracts for this session are on pages 106 - 114	
09:20-09:30	Exploring the Role of Lateral Ventricle Geometric Features in Detecting Extracellular Deposition of Amyloid- β Peptides in Patients with Idiopathic Normal Pressure Hydrocephalus Andrius Penkauskas
09:30-09:40	Normal Pressure Hydrocephalus: The Role of Emergency Services and Primary Care in its Early Diagnosis Lucia Rodriguez
09:40-09:50	Evaluating the Additive Properties of Differential Pressure Valves in a Novel Benchtop Shunt Model Sai Chandan Reddy
09:50-10:00	Brain Tissue Mimicking Hydrogel for Benchtop Investigation of Hydrocephalus Mechanisms Gwendolyn Williams
10:00-10:10	Postoperative Delirium Following CSF Shunt Surgery for Normal Pressure Hydrocephalus: A 5-Year Retrospective Analysis of 326 Patients Aimilia Moraiti
10:10-10:20	Gait Outcomes of Wheelchair Dependent Patients with Idiopathic Normal Pressure Hydrocephalus Following Shunt Placement Rahul Kumar
10:20-10:30	Quantitative Gait Analysis Using a Deep Learning-Based Application Reveals Distinct Upper and Lower Limb Movement Patterns in Hakim's and Parkinson's Disease Atsuhito Taishaku

Detailed Program

10:30-10:40 **Hyponatremia in Pediatric Patients Under 2 Years Wth Non-Tumour Hydrocephalus Seen at the Kenyatta National Hospital**
Robert Tabu

10:40-10:50 **Discussion**

EXHIBITION AREA

10:50-11:20 **Coffee Break & Exhibition**

AUDITORIUM DE SAINT EXUPÉRY

11:20-12:45 **SESSION 14:**
CHARTING NEW DIRECTIONS IN HYDROCEPHALUS
Chairs: **Uwe Kehler, Romain Manet**

Abstracts for this session are on pages 115 - 120

11:20-11:35 **Update on Basal Ganglia Circuit Dysfunction in NPH**
Fredrik Lundin

11:35-11:45 **The Neurological Foundations of Hydrocephalus: A Critical Perspective**
Cristopher Carswell

11:45-11:55 **Feasibility and Safety of the Non-Invasive Tap Test (Pumping-Test) in Shunted NPH-Patients**
Uwe Kehler

11:55-12:05 **Home ICP Monitoring – A New Paradigm for Management of Patients with Hydrocephalus**
Simon Malpas

12:05-12:15 **How Low Can We Go? The Optimal Initial Opening Pressure Setting for Idiopathic Normal Pressure Hydrocephalus**
Rodolfo Reis

12:15-12:25 **The Textbooks were Right - The Intracranial Pressure-Volume Relationship Holds Up in Long-Term, at-Home ICP Monitoring of Hydrocephalus.**
Simon Malpas

12:25-12:35 **A Link Between Radiological Features and Intracranial Pressure Waveform Components in Normal Pressure Hydrocephalus**
Magdalena Kasprowicz

12:35-12:45 **Upright Cerebral Venous Pressure and Its Implications for Glymphatic Driving Forces and Sulcal Narrowing in Normal Pressure Hydrocephalus**
Yoshinaga Kajimoto

CASSIOPÉE

11:20-12:45 **SESSION 15:**
ADULT HYDROCEPHALUS
Chairs: **Nicole Keong, Sevil Yasar**

Abstracts for this session are on pages 121 - 127

11:20-11:35 **NPH: A Silent Challenge with Far-Reaching Societal Consequences**
Fernando Pinto

- 11:35-11:45

A Study on Optimal Valve Pressure After Ventriculoatrial Shunt in Patients with Normal Pressure Hydrocephalus
Ryosuke Takagi
- 11:45-11:55

Necessity of the Tap Test in Patients with DESH: Validation of the Japanese Treatment Guidelines
Ryo Oike
- 11:55-12:05

From MRI Imaging to Infusion: Investigating the Role of Convexity Tightness in CSF Circulation Impairment
Afroditì Lalou
- 12:05-12:15

Stability Analysis of Intracranial Pressure
Michael Egnor
- 12:15-12:25

Spontaneous Intracranial Hypotension (SIH) Affects all Ages and Body Types: Results from 397 Patients.
Katharina Wolf
- 12:25-12:35

DRAIN – Double-blind Randomized Acetazolamide trial in Idiopathic Normal pressure hydrocephalus
Johan Virhamar
- 12:35-12:45

Advancing Hydrocephalus Patient Education and Support: Implementing and Assessing Improvements in a Virtual Normal Pressure Hydrocephalus Support Group
Jeff Chen

SPOT

- 11:20-12:45

SESSION 16:
TECHNICAL ADVANCES IN TREATMENT AND DIAGNOSIS
Chairs: **Anne Benninghaus, Sylvie Lorthois**

Abstracts for this session are on pages 128 - 134

- 11:20-11:30

Brain and Eye in Space: Impact of Real and Simulated Microgravity
Anne Pavy le Traon
- 11:30-11:40

The Brain in Space: MRI Quantification of Structural Changes to the Cerebrospinal Fluid, Brain and Eye in Astronauts
Bryn Martin
- 11:40-11:50

CSFsim: A Simulation Framework for Cerebrospinal Fluid Dynamics and Hydrocephalus Shunt Systems
Fabian Fluerebrock
- 11:50-12:00

New Ce-Authorized Non Invasive Adjustable CSF Flow Device with a Real off Function for the Treatment of Complex Hydrocephalus
Jan Muegel
- 12:00-12:10

Endoscopic Ventricular Lavage Versus Conventional External Drainage in Spontaneous Intraventricular Haemorrhage: Matched-Cohort Evidence of Superior Clot Clearance and Outcomes
Thomas Radovnický
- 12:10-12:20

Management of Chronic Subdural Hematoma in Spontaneous Intracranial Hypotension
Amir El Rahal

Detailed Program

12:20-12:30	Quantitative Analysis of Neurofluid Dynamics in Chiari Syndrome: Toward a Better Understanding of Symptom Genesis Pauline Carlier
12:30-12:40	Diagnostic Accuracy of Shuntography in Suspected Cerebrospinal Fluid Shunt Malfunction: A Safe and Effective Non-Invasive Imaging Modality Hassan Bin Ajmal
12:45-14:00	Industry Sponsored Lunch Seminar (CARAVELLE 1)
AUDITORIUM DE SAINT EXUPÉRY	
14:00-15:30	SESSION 17: YOUNG INVESTIGATOR AWARDS III Chairs: Sara Qvarlander, Jürgen Beck
Abstracts for this session are on pages 135- 143	
14:00-14:10	Assessing Intracranial Fluid Dynamics Using Fundoscopy Mathias Just Notrvig
14:10-14:20	Cognitive Reasoning in Adult Ventriculoperitoneal (VP) Shunt Surgery: A Human Factors Pilot Study Yuewei Tao
14:20-14:30	Valve-Agnostic Cranial Implant in Normal Pressure Hydrocephalus Ventriculoperitoneal Shunting: A Case Series Cristopher Lane
14:30-14:40	Management of Shunted Hydrocephalus During Transition from Childhood to Adulthood: Is Routine Clinic Review Required? Taufiq Khan
14:40-14:50	Assessing Cognitive Change in iNPH Using the Sound Symbolic Words Texture Recognition Test (SSWTRT) Chihiro Kamohara
14:50-15:00	Idiopathic Normal Pressure Hydrocephalus Diffusion Imaging Abnormalities in Relation to a Biomechanical Model of Ventricular Expansion Martina Del Giovane
15:00-15:10	Early Cranioplasty as a Risk Factor for Post-Traumatic Hydrocephalus Emily Blakeney
15:10-15:20	Endoscopic Third Ventriculostomy versus Ventriculoperitoneal Shunt for Idiopathic Normal Pressure Hydrocephalus: A Systematic Review and Updated Meta-analysis Raphael Bertani
15:20-15:30	Application of Machine Learning-Based Clustering to Identify Clinical Subgroups and Treatment Outcomes in Normal Pressure Hydrocephalus Emalee Burrows
EXHIBITION AREA	
15:30-16:10	Coffee Break & Exhibition

AUDITORIUM DE SAINT EXUPÉRY	
16:10-17:20	SESSION 18: PEDIATRIC HYDROCEPHALUS Chairs: Richard Edwards, Mats Tullberg
Abstracts for this session are on pages 144 - 148	
16:10-16:30	Genotype vs Phenotypes of Hydrocephalus Kristopher Kahle
16:30-16:40	Research Priorities for Improving Cognitive and Neuropsychological Outcomes in Hydrocephalus Monica Chau
16:40-16:50	Dual-Approach Surface Engineering of Ventricular Catheters to Reduce Cellular Occlusion in the Treatment of Hydrocephalus Seunghyun Lee
16:50-17:00	Proximal Hole Disocclusion via Retrograde Flushing: In Vitro Evaluation Michael Le
17:00-17:10	Change in Optic Nerve Sheath Diameter and Cerebrospinal Fluid Shunt Failure in Children Brian Hanak
17:10-17:20	Long-term Clinical Outcomes of the Flow Ventricular Catheter for Hydrocephalus: A Follow-up Study Raphael Bertani
CASSIOPÉE	
16:10-17:30	SESSION 19: NEUROIMAGING Chairs: John Oshinski, Karin Kockum
Abstracts for this session are on pages 149 - 156	
16:10-16:20	Diagnostic Utility and Clinical Correlates of Automated MRI Indices in Normal Pressure Hydrocephalus (NPH) Padraig Osuilleabhain
16:20-16:30	Comparison of Infusion-Derived and Physiological Craniospinal Compliance in Chronic Hydrocephalus Patients Kimi Owashi
16:30-16:40	Volumes and Velocities: Meta Analysis of PC MRI Studies in Normal Pressure hydrocephalus Petr Skalicky
16:40-16:50	Can Semi-Automated Brain Morphometrics Distinguish Between Asymptomatic and Symptomatic Type I Chiari Malformation, and Age and Gender Matched Controls? Mark Luciano
16:50-17:00	Cardiac Frequency by Itself can Change CSF Dynamics in the Brain Compartments. A New Realistic 2D Numerical Model Investigation Olivier Baledent
17:00-17:10	The Utility of Phase-Contrast MRI and ICP Monitoring in Chiari I Malformations: A Systematic Review Shivani Rajkumar

Detailed Program

- 17:10-17:20 Age-Related Changes in Venous Drainage in Adults with Chiari Syndrome Assessed by Phase-Contrast MRI
Heimiri Monnier
- 17:20-17:30 Study Protocol: A randomized Clinical Trial on Non-Invasive Evaluation of Shunt Obstruction in Adult Hydrocephalus at Two Hydrocephalus Research Centers in Sweden
Rebecca Groenning

SPOT

- 16:10-17:30 **SESSION 20:**
GERIATRIC HYDROCEPHALUS
Chairs: **Sevil Yasar, Lawrence Bories**

Abstracts for this session are on pages 157 - 163

- 16:10-16:20 **From Home to Care Home: The Role of Hydrocephalus in Loss of Independence**
Lawrence Bories
- 16:20-16:30 Bridging Gaps in Geriatric Neurosurgery: A Public and Professional Perspective on Normal Pressure Hydrocephalus in Brazil
Caio Arruda Maciel
- 16:30-16:40 Role of Multidisciplinary Approach in the Diagnosis and Therapy of Normal Pressure Hydrocephalus: A Single Center Experience
Stefano Borsa
- 16:40-16:50 Correlation Between Cerebrospinal Fluid Tau Biomarkers and CSF Tap Test Responsiveness in iNPH Patients
Yan Xing
- 16:50-17:00 Cerebral Blood and CSF Flow Dynamics in Healthy Elderly Subjects and Chronic Hydrocephalus Patients
Kimi Owashi
- 17:00-17:10 A Minimally Invasive Approach for Disconnection of Cerebrospinal Fluid Venous Fistula
David Rowland
- 17:10-17:20 Was Foramen Magnum Decompression Surgery Inappropriately Performed in Patients with Spontaneous Intracranial Hypotension?
Gillian Pace
- 17:20-17:30 Orthostatic Headache: Treatment Response Stratified by Spinal Imaging Findings
Olga Fermo

Monday, 8 September 2025

AUDITORIUM DE SAINT EXUPÉRY

08:00-10:30 **SESSION 21:**
HYDROCEPHALUS SOCIETY-EANS-CSF LEAK ASSOCIATION SESSION

Chairs: **Jürgen Beck, Manjit Mantharu**

Abstracts for this session are on pages 164 - 168

08:00-08:20 **Introduction to SIH: Clinical Presentation & Differential Diagnosis**
Manjit Mantharu

08:20-08:40 **Imaging Basics and Recent Advances**
Lalani Carlton Jones

08:40-09:00 **From Bloodpatch to Endovascular Therapy**
Tomas Dobrocky

09:00-09:20 **Surgical Treatment of Spinal CSF Leaks**
Jürgen Beck

09:20-09:40 Roundtable Discussion:
How to get Started in SIH; How to Build a Center; What Convinced you to Take up
the Cause of SIH Leak Patients; Post-Treatment
Headaches-What do we Miss?

Moderated by Rigmor Højland Jensen and Eric Schmidt

09:40-09:50 Socioeconomic Effect of Surgical Treatment of Spinal CSF Leaks in Spontaneous
Intracranial Hypotension
Amir El Rahal

09:50-10:00 Spinal CSF Volumetry in Patients with SIH Before and after Treatment
Eike Immo Piechowiak

10:00-10:10 Locating Spinal Leaks in Spontaneous Intracranial Hypotension: How Many
Dynamic Myelographies Does It Take?
Toma Dobrocky

10:10-10:20 Evaluation of Finger Function in iNPH: A Comparative Cueing Study
Yoko Shimizu

10:20-10:30 Investigation of Coexisting Disproportionately Enlarged Subarachnoid Space
Hydrocephalus (DESH) on Imaging in Cases of Dementia with Lewy Bodies (DLB)
Chifumi Iseki

CASSIOPÉE

08:00-09:20 **SESSION 22:**
TECHNICAL ADVANCES IN TREATMENT AND DIAGNOSTICS

Chairs: **Olivier Baledent, Andreas Spiegelberg**

Abstracts for this session are on pages 169 - 174

08:00-08:10 **Delivering High-Quality Care with Low-Tech Solutions for Hydrocephalus
Management?**
Romain Manet

08:10-08:20 **Optimizing Hydrocephalus Surgery: Preoperative Simulation and Symptom
Improvement Prediction**
Shigeki Yamada

Detailed Program

- 08:20-08:30

B-waves in Non-Invasive Capacitance Signal Correlate with B-waves in ICP in Recordings of 51 Patients
Andreas Spiegelberg
- 08:30-08:40

Laparoscopic Peel-Away Sheath Technique versus Mini-Open Laparotomy for Lumboperitoneal Shunt in Idiopathic Normal Pressure Hydrocephalus: A Prospective Comparative Cohort Study
Xuhao Fang
- 08:40-08:50

Wearable, Non-Invasive Spot Check Measurements of Shunt Flow via Thermal Anisotropy: Device Advancements for Improving Depth of Measurement
R. Chad Webb
- 08:50-09:00

Shunt Flow Throughout Daily Life: Data from the First use of Continuously Worn Cerebrospinal Fluid Shunt Flow Monitors on 25 Shunted Hydrocephalus Subjects Over 30-Day Periods.
R. Chadd Webb
- 09:00-09:10

Beyond Monitoring at Rest: Real-Life Insights into ICP Dynamics
Andreas Bunge
- 09:10-09:20

Higher Harmonic Centroid in Hydrocephalus: Early Insights from Telemetric Intracranial Pressure Monitoring.
Sang Ho Kim

SPOT

- 08:00-09:20

SESSION 23:
ADULT HYDROCEPHALUS
Chairs: **Sevil Yasar, Giulia Bommarito**

Abstracts for this session are on pages 175 - 181

- 08:00-08:10

Predictive Value of Risk Analysis Index and Modified Frailty Index for Gait Outcomes Following Shunt Surgery in Idiopathic Normal Pressure Hydrocephalus
Abdelrahman Hamouda
- 08:10-08:20

Impact of Volume Input Frequency on Craniospinal Compliance: A Spectral Approach
Agnieszka Kazimierska
- 08:20-08:30

Is ICP Really Normal in NPH? - First Insights from Home-Based Telemetric Monitoring
Sang ho Kim
- 08:30-08:40

Feasibility of Patient-Led Home ICP Monitoring
Sang Ho Kim
- 08:40-08:50

Effect of a Structured Exercise Program on Center of Mass Variables During Walking in Individuals with Idiopathic Normal Pressure Hydrocephalus: A Preliminary Study
Sunee Bovonsunthonchai
- 08:50-09:00

Handwriting Analysis in Patients with Normal Pressure Hydrocephalus: A Study on 18 Patients
Gianpaolo Petrella
- 09:00-09:10

Pre- and Post-Shunt Evaluation of Auditory Signs in Patients with Normal Pressure Hydrocephalus
Juan Daniel Ramirez Munoz
- 09:10-09:20

Validation of a Prognostic Prediction Table for Hakim disease (iNPH)
Teruo Kimura

CASSIOPÉE	
09:20-10:20	SESSION 24: INTRACRANIAL PRESSURE Chairs: Fernando Pinto, Anne Benningahus
Abstracts for this session are on pages 182 - 187	
09:20-09:30	Beyond the Cardiac Pulse Waves: Gait-Related Oscillations in Intracranial Pressure Profiles Andreas Bunge
09:30-09:40	Establishing a Standard Protocol for Telemetric ICP Monitoring: Learning Points from Externalized Shunt Systems Hassan Bin Ajmal
09:40-09:50	Neurosurgical Management of Idiopathic Intracranial Hypertension (IIH): Preliminary Insights From the European Association of Neurosurgical Societies Guidelines Filippos Chelmis
09:50-10:00	Impact of Distal Catheter Tip Placement on Ventriculoperitoneal Shunt Dynamics Martina Roncoroni
10:00-10:10	What Happens to the Brain after a CSF Tap-Test? Marcel Warntjes
10:10-10:20	Investigating the Utility of ICP Monitoring in Chiari I Malformation: Insights from a Long-Term Observational Study Shivani Rajkumar (Virtual)
SPOT	
09:20-10:20	SESSION 25: ADULT HYDROCEPHALUS Chairs: Ignacio Jusue Torres, Shigeki Yamada
Abstracts for this session are on pages 188 - 192	
09:20-09:30	Hydrocephalus Does not Matter Gianpaolo Petrella
09:30-09:40	Physical Therapy-Evaluated Shunt Taps in the Management of Incomplete Response and Relapse in Shunted Idiopathic Normal Pressure Hydrocephalus Ryan Lee
09:40-09:50	Challenges in Neuropsychological Improvement After Shunt Surgery for Idiopathic Normal Pressure Hydrocephalus Ondrej Bradac
09:50-10:00	Implementing a Clinical Pathway for Normal Pressure Hydrocephalus (NPH): A Standardized Approach for the Care of NPH Patients Undergoing Ventriculoperitoneal Shunt Insertion Jeff Chen
10:00-10:10	The Economic Impact of Underdiagnosis in Idiopathic Normal Pressure Hydrocephalus Gianpaolo Petrella
10:10-10:20	Identifying Secondary Hydrocephalus in Post-Intensive Care Patients: An Infusion Study Approach Laurent Gergele

Detailed Program

EXHIBITION AREA	
10:30-11:00	Coffee Break & Exhibition
AUDITORIUM DE SAINT EXUPÉRY	
11:00-12:30	SESSION 26: HYDROCEPHALUS SOCIETY-SOCIETY FOR RESEARCH INTO HYDROCEPHALUS AND SPINA BIFIDA JOINT SESSION Chairs: Carolyn Harris, Hannah Botfield
Abstracts for this session are on pages 193 - 198	
11:00-11:15	Session Introduction Pat MacAllister
11:15-11:30	Modulating CSF Dynamics for Hydrocephalus Therapy Hannah Botfield
11:30-11:40	Benchtop Investigation of Tissue Pull-In of Shunt Catheters in Hydrocephalus Kenae Thompson
11:40-11:50	A Material-Mediated Decrease in Neurological Cell Adhesion to Hydrocephalus Shunt Catheters Quentin Aten (Virtual)
11:50-12:00	Ventricular and Choroid Plexus Volume Changes in Alzheimer's and Non-Alzheimer's Dementias: Implications for Shared Pathological Features and Cerebrospinal Fluid Dynamics Yuyue Qiu
12:00-12:10	Investigating Choroid Plexus Organogenesis Using an Organoid Model Celine Thao-Quyen
12:10-12:20	Changes in Choroid Plexus Macrophages Across Neonatal Development in a Genetic Model of Hydrocephalus Audrey Kruse
12:20-12:30	Biomarkers of Neurodegeneration: Comparison Between iNPH, Lova, and Other Neurodegenerative Diseases
CASSIOPÉE	
11:00-12:35	SESSION 27: ORAL FLASH PRESENTATIONS OF EPOSTERS Chairs: Shigeki Yamada, Zofia Czosnyka
Abstracts for this session are on pages 213 - 231	
11:00-11:05	Hydrocephalus in Leptomeningeal Metastasis May Lack Typical Imaging Features of Normal Pressure Hydrocephalus Ko-Ting Chen
11:05-11:10	No Correlation Between Functional Dopaminergic Imaging, Iron Load and CSF Outflow Resistance in Suspected Idiopathic Normal Pressure Hydrocephalus Lubin Klotz
11:10-11:15	Transmission of Pulsatility Across the Level of the Foramen Magnum in Chiari Syndrome: Alteration of Mobile Compliance? Pauline Carlier

- 11:15-11:20 Diagnostic Accuracy of Thermal Transcutaneous Flow Compared with Radionuclide Shunt Patency Study to Detect Shunt Obstruction in Adults with Hydrocephalus- A Cross Sectional Analytic Study
Naomi Abel
- 11:20-11:25 Continuous Telemetric Intracranial Pressure Measurement (ctICPM) Assessing the Effect of Different Body Positions, Activity, Time and Shunt Valve Adjustments
Vincent Prinz
- 11:25-11:30 Pure Endoscopic Cysto Ventriculostomy for Arachnoid and Gliopendymal Cysts: Technical Aspects in a Cohort Series with Long Follow up
Francesco Tuniz
- 11:30-11:35 Fluid Dynamics Model of the Cerebral Ventricle System
Haritosh Patel
- 11:35-11:40 Wireless Monitoring of CSF Flow Rate, Pressure, and Device Patency for Timely Diagnosis of Hydrocephalus Shunt Failure
Sascha Lee
- 11:40-11:45 Lumboperitoneal Shunt Is Comparable to Ventriculoperitoneal Shunt for the Treatment of Idiopathic Normal Pressure Hydrocephalus
Yasuaki Inoue
- 11:45-11:50 Predictive Accuracy of a Clinical Model for Pathogenic Gene Carriage in PUMCH Dementia Patients with a Positive Family History
Jialu Bao
- 11:50-11:55 Lack of Correlation Between Functional Imaging and Brain Volumetry in Idiopathic Normal Pressure Hydrocephalus: A Multimodal Diagnostic Study
Lubin Klotz
- 11:55-12:00 Treatment-Responsive Changes in Positional Cerebral Compliance in Patients with Idiopathic Normal Pressure Hydrocephalus Demonstrated by Non-Invasive Monitoring
Giana Fote
- 12:00-12:05 Spacing Shunt Valves In Series: A Novel Strategy to Mitigate Siphon-Induced Overdrainage
Michael Le
- 12:05-12:10 MRI Evidence of Choroid Plexus Enlargement in Post-Hemorrhagic Pediatric Hydrocephalus
Leandro Castaneyra Ruiz
- 12:10-12:15 Determining the Utility of Baseline Gait and Cognitive Assessments in the Decision for Trial of CSF Drainage in Suspected Normal Pressure Hydrocephalus
Matthew Boissaud-Cooke
- 12:15-12:20 Utility of Blood Biomarkers in Prediction of Post-Operative Outcomes in Patients with Idiopathic Normal Pressure Hydrocephalus
Abdelrahman Hamouda
- 12:20-12:25 Evaluating the Effect of the Tap Test on Cognitive Test Scores in Suspected Idiopathic NPH
Matthew Boissaud-Cooke

Detailed Program

12:25-12:30 Quantifying Changes in Measures of Gait Following Tap Test to Validate Clinical Decision Making for Shunt Surgery in Suspected Idiopathic Normal Pressure Hydrocephalus

Matthew Boissaud-Cooke

12:30-12:35 Hierarchical Bayesian Modeling Improves Shunting Outcome Prediction in NPH Patients

Jeremi Chabros

SPOT

11:00-12:35 **SESSION 28:
ORAL FLASH PRESENTATIONS OF EPOSTERS**

Chairs: **Masakazu Miyajima, Snejana Jurici**

Abstracts for this session are on pages 231 - 247

11:00-11:05 Is Davson's Equation Reliable in Hydrocephalus? A Systematic Review and Meta-Analysis

Ihsane Olakorede

11:05-11:10 Adjusting the Unknown: Intracranial Pressure and Clinical Outcomes in Idiopathic Intracranial Hypertension Using Non-Invasive Telemetric Monitoring

Hannah Eskender

11:10-11:15 Telemetric Intracranial Pressure Monitors: Current Status and Future Trends – A Systematic Review

Andreas Bunge

11:15-11:20 Surgical Findings in Chronic Post Dural Puncture Headache Syndrome

Amir El Rahal

11:20-11:25 Influence of CSF Volume Changes and Body Position on Cranial and Spinal CSF Pressure in Patients with iNPH

Nenad Kudelic

11:25-11:30 Application of Lumboperitoneal Shunting in the Treatment of Complex Cranial Wound Healing Disorders

Vincent Prinz

11:30-11:35 Expanding Hakim's Triad: Shunting Enhances Upper-Limbs Function in Idiopathic Normal Pressure Hydrocephalus – The Pro Hydro Study

Arianna Vignaroli

11:35-11:40 Effects of a Ventriculoperitoneal Shunt on Hearing in Patients with Normal Pressure Hydrocephalus – Interim Results of a Prospective Cohort Study

Emily Wang

11:40-11:45 Clinical Outcomes of Lumboperitoneal Shunt Surgery for Normal Pressure Hydrocephalus: A 5-Year Single-Center Retrospective Study of Patients with at Least 1 Year of Follow-Up

Ki-Su Park

11:45-11:50 Geriatrics and Normal Pressure Hydrocephalus: A Science Mapping Review

Liliana Mazza

11:50-11:55 Desh Score Reliability In Chronic Hydrocephalus

Cyrille Capel

- 11:55-12:00 Elevated CSF Acceleration at the Craniospinal Junction Suggests Reduced Spinal Compliance in iNPH: A Phase-Contrast MRI Study
Katharina Wolf
- 12:00-12:05 The Impact on the Caregiver in the Treatment in Patients with Normal Pressure Hydrocephalus
Gianpaolo Petrella
- 12:05-12:10 Creative Strategies in Managing Complex Cerebrospinal Fluid Dynamics: A Case Series on Multi-Valve Shunt Systems
Alexandra Ramos Marquez
- 12:10-12:15 Sensitivity of Physiotherapy-Based Clinical Tests in Detecting Gait and Balance Performance Following a 50 mL CSF Tap Test in Idiopathic Normal Pressure Hydrocephalus
Kardelen Akar
- 12:15-12:20 Evaluating Outcome of Shunt Insertion in Idiopathic Normal Pressure Hydrocephalus (iNPH) Patients within a Dedicated NPH Clinic
Afsana Afrin Nisa

12:20-12:35 **Discussion**

12:35-13:40 **Industry Sponsored Lunch Seminar** (CARAVELLE 1)

AUDITORIUM DE SAINT EXUPÉRY

13:40-15:30 **SESSION 29:
ADULT HYDROCEPHALUS**
Chairs: **Ben Elder & Gianpaolo Petrella**

Abstracts for this session are on pages 199 - 209

- 13:40-13:50 Differential Improvement in Patient-Reported Outcomes Measurement Information System (PROMIS) Domains after Ventriculoperitoneal Shunting (VPS) for Idiopathic Normal Pressure Hydrocephalus (iNPH)
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Romain Manet
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Jiho Lee
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Real-time Phase Contrast MRI of CSF flow in Patients with Hydrocephalus. Heart or Lung! Which is the Driver?
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Mapping Clinical Measures of CSF Responsiveness vs. Non-Responsiveness in Complex Normal Pressure Hydrocephalus using the Strategy of the Periodic Table of DTI Elements
Nicole Keong
- 13:50-13:55

Clinical Relevance of DESH Subtypes in Normal Pressure Hydrocephalus (Hakim's Syndrome): Implications for Therapeutic Outcomes
Juan Daniel Ramirez
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Association Between Cerebral Microbleeds and Idiopathic Normal Pressure Hydrocephalus
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Quantification of the Contribution of Metabolism-Derived Water to Cerebrospinal Fluid in Humans and Rats
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Danielle van Westen
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Is Sagittal T2 Flow Void MRI in Diagnosing Third Ventriculostomy Reliable?
Arianna Vignaroli
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Ventriculomegaly after Vestibular Schwannoma Treatment : Assessing Cerebral Hydrodynamics to Guide Hydrocephalus Management
Vincent Grandjean
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14:55-15:00	Association of Pre-Shunt MRI Metrics with Gait Outcomes after Shunt in Idiopathic Normal Pressure Hydrocephalus Rahul Kumar
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- 13:50-13:55 The impact of Alzheimer's and Vascular Dementia on Shunt Outcomes in Idiopathic Normal Pressure Hydrocephalus, a Systematic Review of 1.394 Patients
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Raphael Bertani

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16:05-16:15	Closing Address by the Hydrocephalus Society President Mats Tullberg
16:15-16:25	Hydrocephalus Society Presidency Handover Mats Tullberg, Giorgio Palandri
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DEEP LEARNING-BASED FRAMEWORK FOR AUTOMATED CSF SEGMENTATION AND DIFFERENTIATION BETWEEN IDIOPATHIC NORMAL - PRESSURE HYDROCEPHALUS AND ALZHEIMER'S DISEASE ON MRI

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INTRODUCTION: Ventriculomegaly, tightness in the high-convexity subarachnoid space, and Sylvian fissure dilation are imaging features collectively referred to as disproportionately enlarged subarachnoid space hydrocephalus (DESH), a hallmark of idiopathic normal-pressure hydrocephalus (INPH). In our previous study, we developed an automated three-dimensional volumetric method to quantify these cerebrospinal fluid (CSF) spaces using conventional neuroimaging techniques and the Talairach coordinate system. However, traditional neuroimaging pipelines are computationally intensive and time-consuming, limiting scalability for large-cohort studies. This study aimed (1) to develop a deep learning-based neuroimaging pipeline for automated and accurate quantification of CSF volumes in the lateral ventricles, high-convexity subarachnoid space, and Sylvian fissure region using T1-weighted MRI, and (2) to propose an automated method for distinguishing INPH from Alzheimer's disease (AD) based on these volumetric features.

METHODS: We analyzed 466 brain MRI scans from 385 patients with INPH, 259 with AD, and 82 healthy controls. An ensemble of two neural networks (nnU-Net and a 3D Vision Transformer) was trained on expert-annotated segmentations derived from conventional neuroimaging techniques to segment the target CSF spaces. Intracranial volume (ICV) was also measured and used to normalize CSF volumes (CSF/ICV ratios). These features were used to train a 3D convolutional neural network classifier to differentiate INPH from AD.

RESULTS: The deep learning-based segmentations achieved high accuracy, with mean Dice scores of 0.81–0.96 across regions and a median Hausdorff distance of 1 mm. The average segmentation time was 37.5 seconds per scan. The classifier distinguished INPH from AD with an area under the curve (AUC) of 0.99.

CONCLUSIONS: Our pipeline achieves accuracy comparable to conventional techniques, enabling highly reliable differentiation of INPH from AD. Its robust performance and efficiency support its potential for clinical deployment.

Patient Consent: The patient has provided their consent for the publication of this abstract.

DIGITAL TWIN INSIGHTS ON CEREBROSPINAL FLUID DYNAMICS AND DRUG PHARMACOKINETICS ACROSS THE HUMAN LIFESPAN, IN NONHUMAN PRIMATES, AND MINIPIGS

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INTRODUCTION: Digital analogs for model species (digital twins) are gaining attention as tools to deeply understand CSF biophysics in CNS diseases, therapeutic devices / interventions, and solute dispersion / drugs. Digital twins offer quantitative insights into allometric scaling and predict variability within study populations; factors that can impact pre-clinical and clinical study success. While digital twins are promising, models are limited by boundary conditions and validation. Here, we present a variety of digital twins with focus on interspecies scaling of CSF dynamics and intra-CSF drug pharmacokinetics.

METHODS: Digital-twin models across the human lifespan, cynomolgus NHP, and Göttingen minipig were constructed from non-invasive subject-specific anatomic and dynamic MR imaging protocols tailored for extraction of CSF system-wide boundary conditions. Computational fluid dynamics meshes were generated for each case with key physiologic parameters including CSF formation and fractionated efflux via arachnoid granulations, CNS tissue surface, nasal lymphatic, spinal nerve root sleeves, and deep cervical lymph nodes. Cardiac- and respiratory-induced CSF oscillations were integrated with neuraxial compliance using deforming mesh techniques. Model predictions were validated by construction and testing of bench-top model analogs for each species.

RESULTS: Quantitation of CSF geometry and axial distribution of CSF stroke volume, CSF peak velocities, and Reynolds number showed unique species and age-specific values. The intracranial-to-spinal CSF volume ratios were 1.0 (NHP 4 yr), 1.4 (minipig 9 week), 8.3 (2 yr human patient), 6.7 (9 yr human patient), and 2.2 (adult human), while brain-to-spinal cord CNS tissue volume ratios were 20, 16, 171, 166, and 62, respectively. Lumbar-puncture based drug pharmacokinetics had up to >100-fold differences across species for regional area under-the-curve (AUC). Agreement of digital twin predictions with bench-top testing was strong for all models.

CONCLUSIONS: Digital twin models of the CSF system offer detailed insights into CSF biophysics relevant in disease states and for solute dispersion.

IMPACT OF SYMPTOM DURATION ON BRAIN IMAGING FINDINGS IN SPONTANEOUS INTRACRANIAL HYPOTENSION

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INTRODUCTION: Spontaneous intracranial hypotension (SIH) is characterized by distinctive brain imaging findings. The Bern SIH score integrates the most important imaging features to aid diagnosis and standardize the radiological work-up. This study aimed to assess association between symptom duration and the Bern SIH Score.

METHODS: All consecutive patients evaluated for SIH at our department between January 2013 to January 2025 were screened. Those with a confirmed CSF leak were categorized into three groups based on the symptom duration: ≤ 10 , 11–52, and > 52 weeks. The evolution of the SIH score severity and the specific score items was analyzed.

RESULTS: In total, 210 SIH patients (mean $\pm$ SD age of 49 $\pm$ 13 years; 66% of females) were included. The median Bern SIH score at baseline was 7 (IQR 4 – 9). There was no association between the severity of Bern SIH score and either the type nor the spinal level of the CSF leak. When stratified by symptom duration, the median Bern SIH score showed a significant decline: 8 (IQR 6 – 9) in patients with symptom duration ≤ 10 weeks, 5 (IQR 3 – 9) in 11 – 52 weeks, and 4.5 (IQR 2.0 - 6.0) in > 52 weeks; $p < 0.001$. A gradual normalization of individual SIH score components - including dural enhancement, venous distention, subdural hygroma and supracellar cistern – was observed over time.

CONCLUSIONS: The Bern SIH score is typically high in the acute phase (within 10 weeks) but tends to decrease over time. Notably, almost one-third of SIH patients presenting more than one year after symptom onset may have a normal brain MRI. These results underscore the dynamic nature of SIH and highlight the importance of interpreting diagnostic tests - such as the Bern SIH score - within the temporal context of symptom duration and disease evolution.

IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: VALIDATION OF THE DESH SCORE IN THE CAPITAL REGION OF DENMARK

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INTRODUCTION: Previous research has shown that the Disproportionally Enlarged Subarachnoid-space Hydrocephalus (DESH) score may be a prognostic factor for shunt surgery response for idiopathic normal pressure hydrocephalus (iNPH) patients at 1-month follow-up after shunt surgery. The objective of the current study is to validate these findings in a patient population from a different neurosurgical center and with a longer follow-up period. Secondary, to assess whether the grading system is confounded by imaging modality.

METHODS: Preoperative baseline characteristics, magnetic resonance imaging (MRI) and/or computed tomography (CT) scans were retrospectively obtained in 127 shunt-operated iNPH patients. Evan's index, dilation of Sylvian fissures, tight high convexity, focal sulci, callosal angle, and a combination of these radiologic findings (DESH score) were compared according to patients' response to shunt treatment at a mean follow-up period of 7.4-months. In addition, the data were adjusted for whether grading was performed by MRI or CT.

RESULTS: Multivariate logistic regression, adjusted for age, sex, and imaging modality, demonstrated a significant association between the DESH score and subjective shunt response at follow-up (Odds Ratio 1.35, $p = 0.036$). Bivariate logistic regression revealed no significant difference in DESH score assessments between CT and MRI. Moreover, including or excluding imaging modality in the multivariate model did not meaningfully alter the regression coefficients.

CONCLUSIONS: In line with current literature, the DESH score serves as a prognostic marker for prediction of shunt response in iNPH patients, irrespective of whether MRI or CT was used to assess the score.

Patient Consent: This study was performed according to the Danish legislation as a quality assurance study after permission from the hospital administration. The need for explicit written consent was not required since the study was based on secondary use of retrospective data.

CEREBROSPINAL FLUID FLOW WITHIN VENTRICLES AND PERIVASCULAR SUBARACHNOID SPACE EVALUATED BY VELOCITY SELECTIVE SPIN LABELING MRI

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INTRODUCTION: The perivascular subarachnoid space (PVSAS) has recently been discovered, with impaired antegrade transport within the PVSAS in idiopathic normal pressure hydrocephalus. However, the current method requires highly invasive intrathecal tracer injections.¹ We propose a non-invasive velocity selective spin labeling (VSSL) MRI technique to visualize and assess CSF flow dynamics within the PVSAS and ventricular systems.

METHODS: 14 healthy volunteers (age: 39 ± 17 years) were scanned on a Philips MR Ingenia Elition 3T scanner. The VSSL pulse train² with a corresponding cut-off velocity of 0.29 cm/s was selected. The control modules used a velocity-compensated gradient configuration for a more balanced diffusion-weighting effect³. The VSSL signal displays a nearly linear relationship with the flow velocity. Images with three velocity-encoding directions (S-I: superior-inferior; A-P: anterior-posterior; L-R: left-right) were acquired. Then we calibrated the VSSL-derived velocity maps to actual flow velocity using PC-MRI.

RESULTS: With effective diffusion suppression and 3D acquisition, we successfully visualized CSF flow distribution in both the PVSAS and ventricles. The PVSAS system closely resembles prior findings from gadolinium-enhanced imaging¹. The normalized VSSL signal showed a strong linear correlation with average PC velocity across all directions, allowing us to derive velocity maps. The VSSL method successfully measured CSF flow in the PVSAS of major arteries, with an average flow velocity of 0.34 ± 0.12 cm/s and a weak orientation dependency. The flow velocity in the PVSAS of proximal arteries is higher than that of distal arteries. CSF flow in the ventricles was also measured.

CONCLUSIONS: This study successfully employed the VSSL MRI method to measure the CSF flow rate in the PVSAS of arteries and ventricles. It underscores the potential of VSSL MRI as a non-invasive tool for investigating CSF dynamics in both healthy and pathological conditions, offering new opportunities for diagnosing and monitoring hydrocephalus and related conditions.

Patient Consent: The patient has provided their consent for the publication of this abstract.

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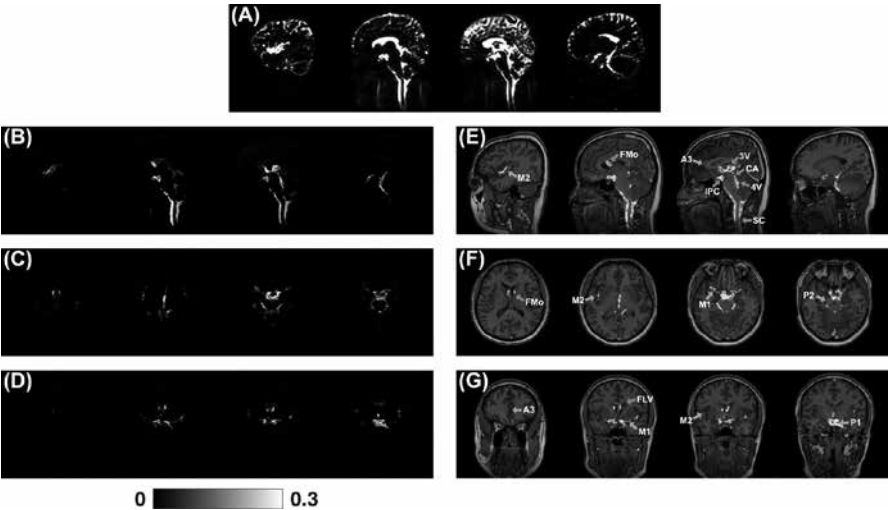


Figure 1. The M0 map (A) and normalized VSSL images (I_{sum}) in sagittal (B), axial (C), and coronal (D) views. VSSL image was overlaid with the MRA map and MPRAGE image in sagittal (E), axial (F), and coronal (G) views. The MRA map is shown in red, and the unnormalized VSSL signal is displayed using a jet colormap. The PVAS of arteries are indicated with yellow arrows, and other ROIs are labeled with green arrows.

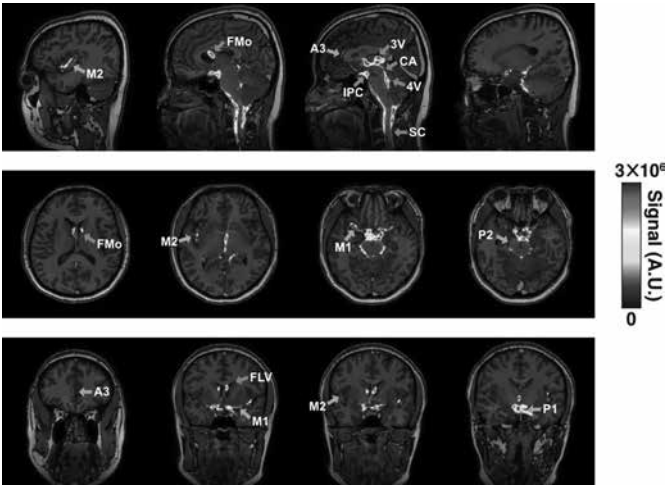


Figure 2. VSSL image was overlaid with the MRA map and MPRAGE image in sagittal, axial, and coronal views. The MRA map is shown in red, and the unnormalized VSSL signal is displayed using a jet colormap. The PVAS of arteries are indicated with yellow arrows, and other ROIs are labeled with green arrows.

PHASE-CONTRAST MRI ASSESSMENT OF VENOUS FLOW IN CHIARI SYNDROME

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INTRODUCTION: Intracranial venous drainage is a complex and variable system that remains poorly understood compared to the arterial system. It plays an active role in regulating intracranial compliance, particularly through the veins, whose flexible walls contrast with the rigidity of the dural venous sinuses anchored to the dura mater. Chiari syndrome (CS) is likely linked with intracranial compliance disturbance and neurofluids (CSF, arterial and venous blood) flow disturbance. Phase-Contrast MRI (PC-MRI) is currently the reference method for non-invasive evaluation of neurofluids circulation. This study aimed to analyze cerebral venous dynamics in CS patients and compare it with a control group.

METHODS: PC-MRI was performed on 13 adult patients with CS (28 ± 5 years) and 36 age-matched healthy controls (26 ± 4 years). Two PC-MRI planes were acquired: an intracranial plane to quantify venous flow in the superior sagittal sinus (SSS) and straight sinus (SS), as well as arterial inflow through the internal carotid and basilar arteries; and an extracranial plane aimed to measuring flow in the internal jugular veins, posterior venous circulation, internal carotid arteries, and vertebral arteries. The venous outflow was analyzed in relation to the arterial inflow to quantify the relative contribution of individual venous pathways and assess the extent of accessory drainage.

RESULTS: At the intracranial level, primary venous outflow (SSS+SS) was significantly greater in CS patients ($75 \pm 11\%$) compared to controls ($62 \pm 8\%$, $p=8 \times 10^{-4}$), while accessory drainage was significantly more utilized in controls ($p=8 \times 10^{-4}$). No significant difference was found in extracranial venous drainage between groups.

CONCLUSIONS: This study highlights changes of intracranial venous drainage patterns in patients with CS. These findings highlight the value of PC-MRI for neurofluids dynamic quantification and contribute to a better understanding of CS pathophysiology. Expanding the patient cohort would allow a more detailed assessment of extracranial drainage and strengthen these preliminary observations.

Patient Consent: The patient has provided their consent for the publication of this abstract.

PREDICTION OF RESPONSE TO VENTRICULOPERITONEAL SHUNT IN NPH WITH FRONTAL AND MOTOR TMS EVOKED POTENTIALS

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INTRODUCTION: NPH is an age-related condition of disturbed CSF dynamics, defined by a clinical triad of gait disturbance, urinary dysfunction, and cognitive decline, in the presence of hydrocephalus. While symptoms may improve with ventriculoperitoneal shunt (VPS), patient selection is based on an invasive procedure of drainage of a large volume of CSF (CSF tap-test, CTT) showing improvement of gait speed, a test that suffers from low sensitivity.

METHODS: Patients with possible idiopathic NPH underwent a Delphi TMS-EEG (transcranial magnetic stimulation) evaluation, before performing a CTT. Delphi is an accessible automated measurement of multifocal TMS-evoked potentials (TEPs). TEP was quantified by waveform adherence (WFA) is a composite numeric quantitative measure that reflects the normality of the TEP response. Patients were re-evaluated one year following VPS, using the clinical global impression of change scale (CGI-C) by a movement disorder specialist.

RESULTS: Eighteen out of 41 possible iNPH that were enrolled underwent VPS implantation [age 75.4 (± 4.3) years, 3 females, and MoCA: 19.4 ± 4.1] according to multidisciplinary team considerations, blinded to Delphi results. The rate of treatment success was 89.4% at around 6 months from VPS and dropped to 61% at 1 year or longer from VPS (CGI-C<4). Using a baseline Delphi TEP in response to right dorsolateral prefrontal cortex (rDLPFC) and the left primary motor cortex (M1L) discriminated NPH responders from non-responders: ROC-AUC=0.9 [95% CI: 0.76-1.0], P=0.006 with a sensitivity of 83.3% and specificity of 90.9% (Figure 1) and ROC-AUC=0.93 [95% CI: 0.82-1.0], p=0.002, sensitivity of 85.7% and, specificity of 90.9% (Figure 2), respectively, were both superior to prediction by CTT.

CONCLUSION: Probing the prefrontal and motor networks physiology with Delphi (TMS-EEG) and quantifying TEP WFA, provides a direct measurement of brain function and may be an alternative screening method for response to shunting in iNPH, which is safer, objective and more accurate than CTT.

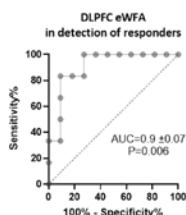


Figure 1- Area Under the Receiver Operating Characteristic (ROC) Curve of Delphi eWFA in discrimination of NPH responders to treatment with VPS

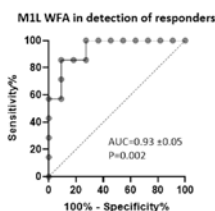


Figure 2- Area Under the Receiver Operating Characteristic (ROC) Curve of Delphi WFA in discriminating NPH responders to treatment with VPS from non-responders

EARLY SHUNT SURGERY IN PATIENTS WITH PROBABLE IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Shunt surgery is the standard treatment for idiopathic normal pressure hydrocephalus (iNPH), with the majority of patients experiencing postoperative improvement. Because of the risk of complications, a certain degree of symptoms is often required to be eligible for surgery. We hypothesized that early shunting in patients with mild symptoms is beneficial in the long-term and might reduce the condition's rate of deterioration.

METHODS: Patients were included from the Swedish Hydrocephalus quality registry. A simplified version of the Hellström iNPH-scale using only three ordinal scales (gait, balance and continence) was used for symptom evaluation. iNPH-score $\geq$ 85 was considered mild symptoms. Patients with mild symptoms (n=245) were matched with a ratio of 1:2 at baseline using propensity score matching based on sex, age, and comorbidities, with the registry mean (iNPH-score = 59 ± 10 , n=505). Postoperative outcomes were evaluated by healthcare professionals at 3 and 12 months, later outcomes at 2 and 5 years were based on patients' self-assessments.

RESULTS: Preoperative evaluation of patients with mild symptoms had a median iNPH-score of 93 (IQR 88–93) and the matched cohort 62 (IQR 58–67). Long-term follow-up patients with mild symptoms had a median iNPH score of 78 (2 years) and 71 (5 years), compared to 58 and 47 in the matched cohort. Those with mild preoperative symptoms showed less improvement on the iNPH scale at 3 months (median change 0 vs +13, $p < 0.001$), 12 months (0 vs +14, $p < 0.001$), and 2 years (−14 vs −5; $p = 0.001$). By 5 years, both groups had deteriorated in symptoms with no significant difference in score change (−19 vs −16; $p = 0.263$).

CONCLUSIONS: Contrary to our hypothesis, patients with mild symptoms did not demonstrate better long-term outcomes compared with patients with more pronounced symptoms. Early intervention does not appear to reduce long-term postoperative deterioration.

CORRELATION BETWEEN CAREGIVER BURDEN AND THE NORMAL PRESSURE HYDROCEPHALUS (HAKIM'S) TRIAD: A PATIENT-CAREGIVER DYAD ANALYSIS

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is a reversible cause of dementia, defined by a triad of gait disturbance, cognitive impairment, and urinary incontinence. While the clinical management of NPH has been extensively characterized, the impact on caregiver burden remains underexplored. This study aims to evaluate the relationship between caregiver burden and patient clinical, urinary, and cognitive domains, using a patient–caregiver dyad framework.

METHODS: A descriptive–correlational study was conducted at a specialized NPH center between 2018–2025. Post-ventriculoatrial shunt patients were assessed with standardized instruments: the Functional Independence Measure (FIM), International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF), Montreal Cognitive Assessment (MoCA), Mini-Mental State Examination (MMSE), and INECO Frontal Screening Test. Caregiver burden was evaluated using the Zarit Burden Interview (ZBI). Associations were analyzed using Spearman's correlation and multivariate models.

RESULTS: Caregiver burden (ZBI) was correlated with patient executive dysfunction, measured by the INECO test ($r=0.255$; $p=0.044$)—the only triad component showing a significant association. No significant correlations were found between ZBI scores and global cognition (MoCA/MMSE), functional dependence (FIM), or urinary incontinence (ICIQ-SF). Longitudinally, patients with NPH demonstrated statistically significant improvements over 12 months in executive function (INECO: median from 12.0 to 18.0, $p<0.001$), urinary incontinence (ICIQ-UI-SF: median from 11.0 to 1.5, $p<0.001$), and functional independence (FIM: median from 90.0 to 111.0, $p=0.007$). Although caregiver burden (ZBI) showed a median decrease from 48.0 to 40.0, this was not statistically significant ($p=0.089$), yet it may still reflect a clinically meaningful improvement.

CONCLUSIONS: In NPH, caregiver burden appears closely linked to patient executive dysfunction rather than physical or global cognitive decline, suggesting that the emotional and behavioral complexities of care play a critical role. These findings highlight the need for routine caregiver assessments and support within a dyad-centered model for NPH management.

EPIDEMIOLOGY OF iNPH IN KOREA: ANALYSIS OF PREVALENCE, MORTALITY, AND TREATMENT TRENDS

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INTRODUCTION: This study aims to estimate the incidence and prevalence of idiopathic normal pressure hydrocephalus (iNPH) in Korea, analyze the rates of shunt operations for iNPH, and compare mortality rates between patients who underwent shunt surgery and those who did not.

METHODS: We analyzed data from the Korean National Health Insurance claims database, including patients aged 60 years and older diagnosed with iNPH from January 2002 to December 2022. Incidence and prevalence rates were calculated using age-standardization, and Poisson regression was used to estimate incidence rates and assess temporal trends. Survival analysis was conducted using the Cox proportional hazards model to evaluate mortality differences based on shunt surgery status, applying a 1-year lag period

RESULTS: The incidence of iNPH showed a significant increasing trend, from 3.18 per million in 2002 to 27.08 per million in 2022 (P for trend < 0.001). By age group, the highest incidence was observed in individuals in their 80s. The average prevalence was 26.25 per 100,000 population. Among diagnosed patients, 27.9% underwent shunt surgery. Patients who received shunt surgery had a significantly lower mortality rate than those who did not (hazard ratio 0.520, 95% confidence interval 0.540–0.816).

CONCLUSIONS: This study provides the first epidemiological data on iNPH in Korea, highlighting its incidence, prevalence, and treatment patterns. However, as this study is based on administrative data, there is a possibility of underestimation of actual cases. Further research using complementary methodologies is needed to address this limitation and provide a more comprehensive understanding of iNPH in Korea.

PATIENT SYMPTOMATIC SELF-ASSESSMENT IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS; FLAWED OR FUTURE FRAMEWORK?

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INTRODUCTION: Postoperative follow-up of patients with idiopathic normal pressure hydrocephalus (iNPH) is often limited to months up to 1 year. The Swedish Hydrocephalus Quality Registry (SHQR) regularly sends postoperative follow-up letters (2-, 5-, 10 years etc.) with self-evaluations – a potential basis for research on the long-term effects of shunt surgery. The aim of this study was to investigate if patients' self-assessment of the ordinal iNPH scale was reliable and correlated with healthcare professionals' assessment.

METHODS: At Uppsala University hospital, the postoperative follow-up includes visits after 3 and 12 months with symptom assessment using the Swedish iNPH-scale. Patients with no missing responses, and a delayed 12-month follow-up which coincided with the SHQR 2-year follow-up letter (± 6 months) were included. Cognitive domains were absent from the follow-up letter and excluded from analysis. Self-assessed balance scale was a simplified version in order to void the use of a timer. In recent years, patients' best walking ability has been graded. However, patients' habitual walking was graded previously, causing inconsistencies in the registry's record of gait scale levels 4 through 6. In this paper, these gait scale levels were concatenated. The 3 ordinal scales for gait, balance, and continence were converted to their respective domain-score, creating the "ordinal iNPH scale" – a simplified version of the Swedish iNPH-scale.

RESULTS: Patients self-assessed the ordinal iNPH scale with good reliability ($ICC=0.779$, $p<0.001$). Calculating the iNPH outcome using the self-assessed score performed slightly better in terms of reliability ($ICC=0.809$, $p<0.001$). The self-assessment of the individual scales correlated moderately, Spearman's rho: Gait scale 0.644 ($p<0.001$), continence scale 0.633 ($p<0.001$), and balance scale 0.474 ($p=0.012$).

CONCLUSIONS: The patients' self-assessed ordinal iNPH scale showed good reliability compared with healthcare professionals' assessment. The scales performances were promising as a tool to assess long-term outcomes after shunt surgery in research studies.

COGNITIVE ASSESSMENT METHODS AND OUTCOMES FOLLOWING SHUNT SURGERY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (iNPH): A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: The core cognitive deficits in iNPH include processing speed, psychomotor speed, and executive functioning. The effectiveness of shunt surgery in alleviating iNPH cognitive symptoms is not well understood. A systematic review was conducted to synthesise the available evidence on cognitive assessment methods and outcomes following shunt surgery in iNPH patients.

METHODS: A systematic search of PubMed, Scopus, PsycINFO and Web of Science included peer-reviewed studies in English featuring adults with iNPH. Studies with extractable data for within-subject evaluations of cognition, before and after shunt surgery were included. Key descriptive data was extracted, and study quality was assessed. Random-effects meta-analyses were performed on pooled baseline and difference scores for the most frequently reported cognitive tests with comparable data.

RESULTS: A total of 1435 studies were identified and 155 met the inclusion criteria. Cognitive evaluation methods included subjective patient/carer reports, clinician reports, grading scales, brief screening tools and comprehensive neuropsychological batteries. Over 132 distinct cognitive tests were reported. Many studies used brief non-specific screening tools and 52.9% of studies did not measure any of the core iNPH cognitive deficits. Post-shunt cognitive improvement rates, follow-up times, and methods of defining improvement varied widely between studies. Meta-analyses revealed statistically significant improvements in eight tests following shunt surgery. Average mean differences for two tests achieved the clinically significant improvement threshold: Grooved Pegboard Test and Trail-Making Test-A.

CONCLUSIONS: There is considerable variability in assessment methods and the reported effectiveness of shunt surgery in alleviating iNPH cognitive symptoms. Many commonly used cognitive tests fail to capture the core domains affected in iNPH. When appropriate tests are used, there is evidence of clinically significant improvement in cognition post-surgery, beyond statistical significance alone. These findings highlight the need for standardised assessment tools which are tailored to detect iNPH-related cognitive deficits and feasible to apply in routine practice.

IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: INCIDENCE, PREVALENCE, & PROGRESSION IN A LARGE POPULATION-BASED COHORT OF OLDER ADULTS

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INTRODUCTION: Limited data exist on the population-based incidence of idiopathic normal pressure hydrocephalus (iNPH). We investigated iNPH incidence, prevalence, and progression over six years in a cohort of 70-year-olds using clinical assessments, MRI markers, and vascular risk factors (VRFs).

METHODS: This prospective population-based cohort study used data from the Gothenburg H70 studies, inviting 70-year-olds born in 1944 from Gothenburg, systematically selected by birth dates. Participants were examined in 2014–2016 and followed up in 2019–2022 (mean follow-up 5.8 years). Gait, balance, cognition, urinary continence, and VRFs were assessed clinically and by self-report. MRIs were evaluated for iNPH-specific markers, including z-Evans Index (z-EI), brain per ventricle ratio at the anterior (BVR_{AC}) and posterior commissure (BVR_{PC}), and callosal angle (CC-angle). iNPH diagnosis followed international guidelines¹. Individuals not diagnosed with iNPH were classified as asymptomatic iNPH (radiological iNPH criteria without symptoms), radiologic iNPH with isolated symptoms (radiological criteria with limited symptoms), or non-iNPH (no radiological criteria).

RESULTS: Baseline included 791 participants who underwent MRI; follow-up included 557 (467 participated at baseline, 90 first examined at follow-up). During follow-up, 13 developed iNPH (incidence 4.8 [95% CI 2.8, 8.3] per 1000 person-years), and 5 developed asymptomatic iNPH (incidence 1.9 [0.8, 4.5]). At follow-up, mean (SD) age was 77 (0.78), and the prevalence (95% CI) of possible iNPH was 2.9% (1.8–4.6), doubling from baseline, while the prevalence of asymptomatic iNPH was 2.3% (1.4–4.0). Strongest radiologic predictors were z-EI, BVR_{AC} , and CC-angle (AUC 0.90–0.93, $p < 0.001$). A higher BMI was associated with increased risk of developing iNPH. During follow-up, 43% of asymptomatic cases and 67% with radiologic iNPH and isolated symptoms progressed to iNPH.

CONCLUSIONS: iNPH incidence was 4.8 per 1000 person-years, with prevalence doubling over six years. Radiologic changes preceded symptoms and posed a high risk for iNPH, highlighting the need for monitoring and early intervention.

COGNITIVE-LINGUISTIC IMPROVEMENTS AFTER SHUNT SURGERY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: INSIGHTS FROM EYE-TRACKING DURING LEXICAL RETRIEVAL TASKS

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INTRODUCTION: Early detection of cognitive decline is essential for improving diagnosis and treatment outcomes in idiopathic normal pressure hydrocephalus (iNPH). However, traditional cognitive assessments often fail to capture the subcortical dysfunctions characteristic of iNPH. Lexical retrieval tasks combined with eye-tracking provide real-time analysis of lexical access and quantitative eye-gaze metrics, enabling a detailed evaluation of cognitive-linguistic function. This study aimed to characterize changes in eye movement patterns and lexical performance before and after shunt surgery in patients with iNPH.

METHODS: We analyzed data from 20 patients diagnosed with iNPH. Each participant completed a lexical retrieval task before and after surgery, allowing direct comparison of individual performance as their eye movements were recorded. Response time data were analyzed using the Wilcoxon signed-rank test, while differences in error type distribution and eye gaze metrics between pre- and post-surgery were assessed using repeated measures ANOVA.

RESULTS: Postoperative linguistic metrics demonstrated reduced response time (pre-op: 2797±1089ms, post-op: 2212±540ms). Error type analysis showed semantic errors as the most frequent type (pre-op: 43.98%, post-op: 46.00%), followed by mixed errors (pre-op: 29.69%, post-op: 24.74%) and TOT (Tip-of-the-Tongue) errors (pre-op: 12.74%, post-op: 19.64%). No statistically significant difference was found in the distribution of error types between pre- and postoperative assessments. Eye-tracking analysis revealed decreases in count measures (e.g., fixation count) and temporal measures (e.g., fixation duration) following shunt surgery.

CONCLUSIONS: Lexical retrieval tasks combined with eye-tracking quantified postoperative improvements in language processing and gaze efficiency in iNPH. This dynamic assessment provides real-time, objective evaluation of treatment effects, enabling objective monitoring of treatment efficacy.

BIOINSPIRED ANTI-FOULING CATHETER MATERIAL AND DESIGN

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INTRODUCTION: Current ventricular shunts for hydrocephalus face persistent issues with biofouling and occlusion due to suboptimal materials and designs. Here, we present a patented shunt platform combining a liquid-infused polydimethylsiloxane (iPDMS) material with a novel curved flange geometry designed for self-cleaning. This approach harnesses cerebrospinal fluid (CSF) flow to promote continuous debris removal through reduced bioadhesion forces and increased wall shear stress along the shunt surface.

METHODS: To evaluate bacterial resistance, we incubated *S. epidermidis* (10^5 CFU/mL) on iPDMS and SoC shunt materials, quantifying adhesion via crystal violet staining. Cellular adhesion of astrocytes, microglia, and choroid plexus cells was assessed through confocal imaging. Computational fluid dynamics simulations validated the self-cleaning performance of the curved flange design by modeling CSF flow and wall shear stress. In vivo biocompatibility was tested by implanting iPDMS and SoC materials into the right ventricle of C57BL/6 mice for 7-day and 5-month periods, followed by histological evaluation (H&E and special stains). Additionally, an infected mouse model challenged with *S. epidermidis* was used to assess bacterial adhesion on implanted materials via scanning electron microscopy.

RESULTS: iPDMS significantly reduced bacterial adhesion compared to SoC materials ($p < 0.001$), achieving a 90% reduction in bacterial and cellular adhesion forces. CFD simulations confirmed that the curved flange enhanced fluid-mediated debris removal and minimized occlusion risk by a 10x increase in wall shear stress. In vivo, iPDMS showed no significant tissue damage compared to SoC over both short- ($n=5$) and long-term ($n=3$) implantations. In the infection model, iPDMS exhibited substantially lower bacterial adhesion ($p < 0.0001$ vs. Integra). These results demonstrate that the combination of liquid-infused materials and curved geometries can synergistically enable self-cleaning and long-term anti-occlusion performance.

CONCLUSIONS: Our findings support iPDMS with a curved flange as a promising next-generation shunt platform to reduce infection and occlusion in hydrocephalus treatment.

COMPARISON OF GRAY MATTER ALTERATIONS BETWEEN NORMAL PRESSURE HYDROCEPHALUS AND ALZHEIMER'S DISEASE

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INTRODUCTION: Normal pressure hydrocephalus (NPH) and Alzheimer's disease (AD) both involve cognitive impairment and brain structural changes, yet their gray matter alteration patterns differ notably. This study aimed to identify these differences and their clinical implications.

METHODS: 42 NPH patients, 32 AD patients, and 30 age - matched healthy controls underwent 3.0T MRI. Voxel - based morphometry (VBM) and region - of - interest (ROI) analysis were employed to evaluate gray matter volume differences (FDR - corrected, $P < 0.05$). Cognitive function (MMSE, MoCA) and gait (Tinetti score) were assessed.

RESULTS: NPH exhibited bidirectional changes: the INPH patients had significantly reduced GM volumes in the bilateral hippocampus, bilateral calcarine gyrus, bilateral temporal gyrus, right caudate nucleus, and so on ($p < 0.05$). The significantly increased GM volumes in the bilateral precentral gyrus, right occipital. ($p < 0.05$). Compared with normal people, AD has extensive subcortical atrophy of gray matter, such as the hippocampus, medial temporal gyrus, parahippocampal gyrus, fusiform gyrus and temporal pole. NPH had a significantly larger right caudate nucleus ($P < 0.05$) compared to AD, while AD had more extensive atrophy of the bilateral hippocampus, bilateral temporal gyrus and other regions ($P < 0.05$) compared to NPH.

CONCLUSIONS: This study revealed distinct gray matter alteration patterns between NPH and AD. NPH showed bidirectional changes with reduced volumes in hippocampus, caudate, etc., and increased volumes in precentral and occipital regions. AD presented extensive subcortical atrophy across key temporal and limbic areas. Direct comparisons indicated a larger right caudate in NPH and more severe hippocampal - temporal atrophy in AD. These neuroimaging differences can aid differential diagnosis, enhance understanding of pathophysiology, and potentially guide targeted therapies. Future research should explore longitudinal changes and clinical correlations.

VENTRICULOSUBGALEAL SHUNTING MAY REDUCE SHUNT DEPENDENCY IN PRETERM POST-HEMORRHAGIC HYDROCEPHALUS: EVIDENCE FROM A SINGLE TERTIARY CENTER

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INTRODUCTION: Post-hemorrhagic hydrocephalus (PHH) is a prevalent complication in preterm neonates with high-grade intraventricular hemorrhage, often requiring permanent ventriculoperitoneal shunting (VPS). Temporary cerebrospinal fluid (CSF) diversion strategies include the Ommaya reservoir and ventriculosubgaleal shunting (VSGS). This study compares the effectiveness of these techniques in reducing the need for VPS within the first year of life.

METHODS: We performed a retrospective analysis of preterm neonates diagnosed with PHH and admitted to the neonatal intensive care unit of our institution between 2011 and 2023. All patients underwent temporary CSF diversion using either an Ommaya reservoir or a ventriculosubgaleal shunt. Collected data included perinatal clinical variables, type of diversion, rate of conversion to permanent shunting within the first year, and procedure-related complications.

RESULTS: Forty-six preterm neonates were included, with a mean gestational age of 28.13 ± 3.07 weeks. Half of the cohort were male (50%), and 19 infants (41.3%) had extremely low birth weight (<1000 g). There were no statistically significant differences in baseline characteristics between groups. Regarding the primary surgical intervention, the Ommaya reservoir was used in 30 patients (65.2%) and ventriculosubgaleal shunting in 16 patients (34.8%). Overall, 33 patients (71.7%) required subsequent ventriculoperitoneal shunting. The conversion rate was significantly lower in the ventriculosubgaleal group (50.0%) compared to the Ommaya group (83.3%, $p = 0.0168$). Complication rates were higher in the ventriculosubgaleal group (31.3% vs. 13.3%, $p = 0.1445$), although this difference was not statistically significant.

CONCLUSIONS: Primary placement of a ventriculosubgaleal shunt was associated with a significantly lower requirement for permanent CSF diversion, suggesting it may represent a promising initial surgical strategy for managing post-hemorrhagic hydrocephalus in preterm infants. Prospective studies are needed to confirm these findings and further assess both long-term outcomes and safety.

REAL-TIME SYMPTOM-ICP CORRELATION ENABLED BY LONG-TERM HOME MONITORING

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INTRODUCTION: Shunt failures are typically diagnosed reactively, relying on patients to present with symptoms. This is based on the understanding that abnormal intracranial pressure (ICP) contributes to symptom onset such as headache. However, the relationship between symptom onset, severity, and ICP remains poorly understood due to a lack of technology enabling long-term, concurrent symptom and pressure monitoring. This study explores this relationship using home-based telemetric ICP and symptom recordings.

METHODS: Patients undergoing shunt insertion or revision were implanted with a telemetric ICP sensor (Kitea Health). Using a handheld wand and mobile app, patients conducted regular ICP measurements from home while simultaneously reporting symptom presence and severity on a 0-10 scale at the time of each recording. Each patients' baseline symptom score, mean ICP, and pulse amplitude were defined as the median values recorded between weeks 3 and 4 post-surgery. Percentage changes from baseline were calculated for each recording and analysed over a three-month follow-up period. Associations between these changes and symptom severity were assessed using linear mixed-effects models.

RESULTS: To date, 12 patients have contributed over 1,500 paired ICP and symptom recordings. A significant association was found between pulse amplitude and overall symptom burden ($p < 0.001$), headache severity ($p < 0.001$), and nausea severity ($p < 0.001$). Symptom distribution varied by diagnostic group: among non-NPH patients ($n = 8$), the most reported symptoms were headache (60%), nausea (11%), and pulsatile tinnitus (12.3%). In contrast, NPH patients ($n = 4$) most reported headache (36%), urgency to urinate (23%), and forgetfulness (21%).

CONCLUSIONS: This study is the first to demonstrate a significant association between increases in pulse amplitude and real-time symptom severity in patients with hydrocephalus and CSF shunts. These findings support the potential utility of pulse amplitude monitoring via home-based telemetric ICP systems to enable proactive shunt management.

Patient Consent: The patients have provided their consent for the publication of this abstract.

DIAGNOSTIC PROCESS, MISDIAGNOSIS, AND BIAS IN SUSPECTED IDIOPATHIC INTRACRANIAL HYPERTENSION: A RETROSPECTIVE OBSERVATIONAL COHORT STUDY

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INTRODUCTION: Misdiagnosis of Idiopathic Intracranial Hypertension (IIH) is prevalent and potentially harmful. We evaluated the diagnostic process of IIH and the impact of implementing a National Guideline (NG) on IIH management to improve patient care.

METHOD: In this observational retrospective study we retrieved data on diagnostic investigations, duration, errors, and causes for suspecting IIH from patients referred to the Danish Headache Center by suspected new-onset IIH from Jan 2020 – Sept 2022. We compared outcomes by final diagnosis (true versus disproven IIH) and the period before and after implementation of the NG. Level of significance was Bonferroni-adjusted to $p < 0.002$.

RESULTS: Ninety-six patients were referred. We confirmed IIH in 27 (28%) and disproven IIH in 69 (72%) in whom final diagnoses were predominantly headache disorders (70%) and pseudo-papilledema (12%). True IIH was discovered by optic disc swelling ($n=25$, none detected by neurologists); neuroimaging indicating elevated intracranial pressure ($n=1$) or a typical clinical phenotype ($n=1$) aided little but often elicited IIH suspicion suggesting anchoring bias with premature closure. Misdiagnosis affected 11% ($n=11$). Diagnostic work-up was more comprehensive and faster in true IIH ($p < 0.001$). Mismanagement dropped by implementation of the NG (from 44% to 20%, $p=0.02$).

CONCLUSION: Optic disc swelling is the most predictive determinant of true IIH; neuroimaging and phenotype alone have poor diagnostic value and introduce bias. Fundus exam is urgent and decisive in suspected IIH and should guide diagnostic strategy to mitigate unnecessary investigations and preserve vision. A NG reduced diagnostic errors and optimized the diagnostic process.

REFINING TREATMENT PARADIGMS IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A PATIENT CENTRIC CLUSTER-BASED APPROACH TO SHUNT SELECTION

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INTRODUCTION: Idiopathic Normal Pressure Hydrocephalus (iNPH) is primarily treated through ventriculoperitoneal (VP) and lumboperitoneal (LP) shunting, yet shunt choice is largely dictated by surgeon preference rather than robust, evidence-based frameworks. Our previous meta-analysis demonstrated distinct symptomatic advantages between each shunt type dependent on symptom profiles. Building upon these findings, we now propose a refinement in approach: rather than seeking a universal recommendation for all patients, we aim to utilize patient-specific factors to define clinically meaningful patient clusters. From these clusters, we intend to derive a clear, actionable framework for shunt selection to enhance patient symptom alleviation.

METHODS: We propose a Bayesian modelling framework in which patient clustering and treatment effect estimation are jointly inferred. Each patient is assigned an unknown cluster membership parameter, with the Bayesian inference process simultaneously determining the optimal clustering structure and the corresponding treatment effects for each cluster. To validate the resulting clusters, we will retrospectively apply them to patients within existing randomized control trial datasets. Patients will be categorized based on whether the shunt treatment they received aligns with the shunt type predicted as optimal for their cluster. Comparative analysis of treatment outcomes between matched and mismatched groups will assess the predictive validity of the clustering framework.

RESULTS: Initial analysis has identified key clinically relevant patient-specific covariates. Based on these covariates, we anticipate that Bayesian clustering will delineate clinically relevant patient groups, each exhibiting differential symptom responsiveness to VP or LP shunting.

CONCLUSIONS: By implementing a Bayesian clustering framework that leverages patient-specific covariates, we will develop a robust, personalized decision-making tool for selecting optimal shunt type in iNPH treatment. This patient-centred approach has the potential to significantly improve clinical outcomes, moving beyond surgeon preference toward precise, evidence-driven care. Validation against retrospective trial data will further solidify its predictive accuracy and practical utility.

SQUISHY BRAIN: A POROELASTIC MATHEMATICAL MODEL OF THE BRAIN TISSUE TO STUDY PARENCHYMAL FLUID FLOW AND CLEARANCE

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INTRODUCTION: Unravelling the complex functioning of brain perfusion and waste clearance is essential to understand several neurodegenerative pathologies, among which hydrocephalus. It is known that the perivascular space (PVS) provides an efficient way for the delivery of cerebrospinal fluid (CSF) deep into the brain tissue (parenchyma). However, little is understood about how, from the delivery point in the PVS, the CSF flow pathway actually occurs, permeating the parenchyma and removing waste. This research is hence intended to implement a poroelastic model of the brain tissue able to capture the essential physics and its implications on the physiology of the system.

METHODS: We model the portion of the brain parenchyma sandwiched between a penetrating arteriole and a venule as a highly-deformable poroelastic medium, in which mechanical loads and fluid flow are strongly coupled. We then apply a mechanical forcing corresponding to arteriolar pulsations as experimentally observed in-vivo. We explore several parameters (such as, tissue properties and amplitudes and frequencies of the arterial pulsations), with a particular focus on their changes between different stages of wake and sleep.

RESULTS: We see that the specific arteriolar pulsations observed in each vigilance state (e.g., wake, REM and NREM sleep) lead to different poromechanical responses of the brain parenchyma, in terms of mechanical deformation, fluid-flow and solute transport. Specifically, fluid flow and solute transport are enhanced the most in sleep.

CONCLUSIONS: Solute transport in the brain is deeply impacted by the fluid flow, which in turns depends on the mechanical deformations experienced by the tissue. With this poromechanical model, several crucial questions could be addressed simultaneously, thus providing insights into the physics of brain perfusion and clearance. An improved understanding of the main poromechanical mechanisms in the brain tissue could support the interpretation of clinical observations and experiments.

TOWARD SMART SHUNTING: PREDICTING BODY POSITION USING ARTIFICIAL INTELLIGENCE IN PATIENTS UNDERGOING INTRACRANIAL PRESSURE MONITORING

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INTRODUCTION: It is well established in the literature that intracranial pressure (ICP) varies with body position. Currently, position-related ICP metrics rely on single measurements taken either in-clinic or during hospital admission, where patients are instructed to maintain set positions. The aim of this study was to develop an algorithm capable of accurately predicting patient body position using data from Inertial Measurement Units (IMUs).

METHODS: We fine-tuned a foundation model using data from 19 patients admitted for intracranial pressure (ICP) monitoring with various cerebrospinal fluid (CSF) dynamic disorders, representing approximately 80% of the total dataset. Patients wore three IMU sensors while maintaining several standardized positions. The model was then tested on its ability to predict patients' final body movements and validated on a held-out, unseen test set of 4 patients with randomized positions.

RESULTS: The foundation model achieved a prediction accuracy of 93.8% for identifying transition points and accurately classifying both the pre-existing and final body positions. When assessing individual predictions, the highest accuracy was observed for prediction of standing position (97.7%), followed by sitting (91.67%) and lying (88.21%).

CONCLUSIONS: This algorithm may enhance diagnostic and management strategies for patients with CSF dynamic disorders by providing continuous, position-specific ICP insights. It also holds promise for integration into smart shunt systems, enabling dynamic adjustment of shunt pressure and valve settings based on real-time body position.

A MODEL OF LOW-PRESSURE HYDROCEPHALUS AS WINDKESSEL IMPAIRMENT DUE TO LOW BRAIN ELASTANCE

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INTRODUCTION: Low pressure hydrocephalus (LPH) is a rare variant in which patients with shunts present with coma, bradycardia, enlarged ventricles, and markedly low intracranial pressure (ICP). Treatment includes prolonged external ventricular drainage with siphoning and neck wrapping with jugular vein compression. Patients remain dependent on shunt siphoning even after symptoms are resolved. The pathophysiology involves low brain elastance yet remains poorly understood. We propose that LPH is caused by windkessel impairment due to high compliance to cerebrospinal fluid (CSF) pulsations in the CSF pathways. Impedance to CSF pulsations is dependent on the elastance of the walls of the CSF spaces, and low elastance increases the impedance to CSF pulsatile energy and reduces the effectiveness of the cerebral windkessel system. We explored the pathophysiology of LPH using a circuit model of the cerebral windkessel system.

METHODS: We simulated low pressure hydrocephalus by increasing intracranial capacitance using a current divider model of the cerebral windkessel system with circuit values derived from published flow MRI imaging of normal individuals and hydrocephalic patients. We simulated physiological windkessel regulation with reduction of cerebral blood flow (CBF), bradycardia, adaptive ventriculomegaly and treatment by siphoning and neck wrapping.

RESULTS: Simulation reproduces the salient characteristics of LPH and reproduces its response to siphoning and neck wrapping. Simulations suggest that bradycardia and low cerebral blood flow are physiological responses to preserve windkessel function.

CONCLUSIONS: LPH is windkessel impairment due to low brain elastance caused by intracranial energy depletion from shunting. Siphoning and neck wrapping improve windkessel effectiveness. Bradycardia and coma due to low cerebral blood flow are the consequences of physiological windkessel tuning. Simulation of LPH as windkessel impairment caused by high brain compliance reproduces the characteristic features of the condition and provides a new understanding of this perplexing disorder.

CSF LIPID PROFILES DIFFER BETWEEN iNPH PATIENTS AND HEALTHY CONTROLS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a potentially reversible cause of dementia in the elderly, clinically defined by the triad of gait disturbance, urinary incontinence, and cognitive decline, along with radiological evidence of ventricular enlargement. Despite its clinical significance, iNPH remains underdiagnosed, with estimates suggesting that up to 80% of cases go unrecognized. Distinguishing iNPH from other neurodegenerative disorders remains a challenge, underscoring the need for reliable biomarkers to aid in diagnosis and treatment selection.

METHODS: In this exploratory study, cerebrospinal fluid (CSF) was collected from the lumbar compartment of 21 healthy controls and 19 patients with probable iNPH. An untargeted, mass spectrometry-based lipidomics approach was employed to comprehensively characterize and compare the complete CSF lipid profiles between groups.

RESULTS: A total of 244 lipids spanning 17 lipid classes were identified in the CSF samples. Notably, several lipid classes and individual lipid species were significantly reduced in patients with iNPH. In contrast, triacylglycerols were found to be elevated in CSF obtained from the iNPH group. These alterations in lipid composition suggest a possible distinct lipidomic signature associated with the disease.

CONCLUSIONS: Our study demonstrates that patients with iNPH exhibit a unique CSF lipidomic profile, characterized by specific reductions and elevations across multiple lipid classes. These findings highlight the potential of CSF lipidomics as a source of novel biomarkers that could support the clinical diagnosis of iNPH and aid in differentiating it from other neurodegenerative conditions.

VIDEO-OCULOGRAPHY: A DIAGNOSTIC TOOL FOR NORMAL PRESSURE HYDROCEPHALUS?

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a treatable cause of gait and balance impairment, cognitive decline, and urinary dysfunction in elderly patients, typically associated with enlarged brain ventricles. Despite the anatomical proximity of the ventricular system to brainstem and diencephalic oculomotor centers, oculomotor abnormalities in iNPH have not been systematically characterized.

METHODS: We performed a retrospective analysis of video-oculography (VOG) recordings from 22 patients diagnosed with iNPH between 2011 and 2023. We assessed horizontal and vertical prosaccades, smooth pursuit, antisaccades, and the number of square wave jerks. These data were compared with those from 44 age- and sex-matched healthy controls, as well as 22 elderly patients with gait disorders due to peripheral neuropathy, 22 patients with idiopathic Parkinson's disease, 22 with progressive supranuclear palsy, and 22 with Frontotemporal lobar degeneration.

RESULTS: Compared to healthy controls, patients with iNPH exhibited significantly higher antisaccade error rates ($p = 0.0001$) and hypometric vertical saccades ($p=0.003$). Saccade accuracy was correlated with iNPH severity scale scores ($p=0.03$). Although these oculomotor deficits were not specific to iNPH when compared with other neurodegenerative disorders, the overall oculomotor profile in iNPH differed from those observed in other conditions.

CONCLUSIONS: These findings highlight the potential utility of video-oculography as a diagnostic aid to increase confidence in diagnosing iNPH. Furthermore, prospective studies assessing oculomotor function before and after shunt derivation could offer deeper insights into the pathophysiology of oculomotor abnormalities in iNPH, and may help identify patients most likely to benefit from surgical intervention.

RATE OF SYMPTOM DETERIORATION PREDICTS POSTOPERATIVE OUTCOME IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The natural history of idiopathic normal pressure hydrocephalus (iNPH) is typically characterized by gradual symptom deterioration over time. Longer waiting times for shunt surgery have been associated with less favorable outcomes. However, clinical observations suggest that the rate of symptom progression is highly individual. We hypothesize that a faster rate of deterioration is associated with a more favorable postoperative outcome following shunt surgery.

METHODS: This is a prospective study with ongoing patient inclusion. In the pilot cohort, 35 patients were included and assessed clinically at three time points: baseline (at the time of the tap test), at admission for shunt surgery, and three months postoperatively. Gait was evaluated using a composite score based on the sum of time and number of steps required to complete the 10-meter walk test, the Timed Up and Go (TUG), and the 3-meter backward walking test. Changes in performance between baseline and admission, and between admission and postoperative follow-up, were calculated.

RESULTS: Complete data were available for 24 patients who were included in the statistical analysis. The median time from baseline to shunt surgery was 5.5 months, and the median follow-up time post-surgery was 3 months. Fourteen patients (58%) showed more than a 10% deterioration in gait performance prior to surgery, while seven patients (29%) improved during the waiting time. The median rate of deterioration was 3% per month. A significant correlation was found between preoperative deterioration and postoperative improvement (Spearman's $\rho = -0.60$, $p = 0.005$).

CONCLUSIONS: Consistent with previous reports, iNPH shows a gradual decline in symptoms over time. However, the rate of deterioration is highly individual and appears to correlate with the degree of postoperative improvement. This may reflect more and less active phases of the disease.

DTI-ALPS INDEX IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS BEFORE AND AFTER VENTRICULOPERITONEAL SHUNT SURGERY

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INTRODUCTION: Diffusion tensor imaging along the perivascular space (DTI-ALPS) is a non-invasive Magnetic Resonance Imaging (MRI) method for the evaluation of cerebral interstitial fluid (ISF) dynamics. The main aim of this study was to investigate whether the ALPS index would change after ventriculoperitoneal (VP) shunt surgery in idiopathic Normal Pressure Hydrocephalus (iNPH).

METHODS: Thirty-eight iNPH patients (Male:Female 21:17; median age 78,5 years) underwent a standardised clinical examination including Hellström's iNPH scale and MRI DTI pre- and postoperatively at three and twelve months respectively. Improvement of ≥ 5 points on the total iNPH scale postoperatively was considered a positive response to shunt surgery. The MRI data were evaluated using DTI-ALPS. After image preprocessing to mitigate crossing fibers' impact on the ALPS index regions of interest (ROIs) were annotated on modified fractional anisotropy maps. Longitudinal comparisons of the ALPS index were feasible only in the left hemisphere due to shunt artifact. Pre- and postoperative mean ALPS indices were compared using repeated measures analysis of variance while the Mann-Whitney U test was employed to compare the preoperative ALPS indices between the responder and non-responder groups.

RESULTS: Preliminarily the mean ALPS index in the left hemisphere was significantly increased postoperatively at three ($p = 0.002$) and twelve months ($p = 0.003$) compared to preoperative values. No significant difference was found between the mean ALPS index at three and twelve months postoperatively. Furthermore, the mean preoperative ALPS index did not significantly differ between responders ($n=31$) and non-responders ($n=7$).

CONCLUSIONS: The ALPS index was significantly higher after VP shunt surgery indicating an alteration in cerebral ISF dynamics postoperatively. Further analysis and larger studies are needed to better understand the role of ALPS-index in the context of iNPH.

REDUCING RISK IN THE MANAGEMENT OF NPH

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INTRODUCTION: Management of the syndrome of Normal Pressure Hydrocephalus was first described in 1965 by Hakim and colleagues in their seminal article. Over the following years due to improvements of the imaging technology and the surgical equipment, surgical treatment of this adult syndrome has become a common occurrence. Despite all the advances, however, the rate of complications linked to the treatment of NPH remains troubling.

METHODS AND RESULTS: The review of the literature reveals that the reported complications during the management of NPH are the consequence of several types of harmful errors. To start with diagnostic errors, we can mention wrong or delayed diagnosis of INPH or of complications secondary to its management (i.e. Subdural hematoma, infection, etc.), failure to employ indicated tests, use of outmoded tests or therapy, failure to act on results of monitoring or testing. Errors in treatment include performance of an inappropriate procedure or test, administration of the wrong dose of a medication, and providing inappropriate (not indicated) care. Errors of prevention include failure to provide prophylactic (antibiotic) treatment, inadequate monitoring or follow-up of a treatment, unrecognized hospital associated disability. Other errors include failure to communicate, equipment failure, other systemic failures. (Increasing) age adds another layer of complexity and renders caring for a person affected by INPH even more challenging that it would appear to a superficial observer.

CONCLUSIONS: Given the complexity of its management, it is very difficult for one person (the surgeon) to single-handedly manage INPH. Given all the co-morbidities and the possibility of many unexpected events that may jeopardize the outcome, safe management of INPH requires a proactive smoothly collaborating team that include physicians (neurologist, surgeon, geriatrician) and nurses.

HAKIM DISEASE DIAGNOSIS WITH PLASMA-BASED ALZHEIMER'S DETECTION

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INTRODUCTION: Hakim disease (idiopathic normal pressure hydrocephalus, iNPH) is an age-related condition causing gait disturbance, cognitive decline, and incontinence due to impaired cerebrospinal fluid (CSF) absorption. Shunt surgery improves patients' symptoms but prognosis is deteriorated by frequently comorbid Alzheimer's disease (AD), characterized by amyloid β ($A\beta$) accumulation. The pathophysiological mechanisms investigation of AD led to the discovery of various plasma biomarkers, such as tau protein phosphorylated at threonine 217 (pTau217) and 10-20 oligomer of $A\beta$ ($A\beta O^{10-20}$). The objective of this research was to develop blood-based biomarkers with application in iNPH diagnosis.

METHODS: This study explored plasma biomarkers - p-tau217 and $A\beta O^{10-20}$ for distinguishing iNPH from AD and healthy controls (HC). Pre-shunt patients with iNPH underwent testing using clinical methods: neuropsychological—iNPH Grading Scale, Mini-Mental State Examination, and Frontal Assessment Battery and laboratory - comprehensive biomarker analysis: CSF p181Tau, $A\beta 42$, $A\beta 40$, $A\beta O^{10-20}$, pTau217, and plasma $A\beta O^{10-20}$ and pTau217. Clinical scores were analyzed for correlations and associations with biomarker levels.

RESULTS: Plasma $A\beta O^{10-20}$ was elevated in iNPH, while p-tau217 was higher in AD. $A\beta O^{10-20}$ and p-tau217 distinguished among HC, iNPH, and AD groups. Significant differences were found between iNPH and iNPH with AD comorbidity. In pre-shunt iNPH patients, plasma and CSF pTau217 measurements were strongly correlated ($r = 0.779$). Post-surgery, CSF $A\beta O^{10-20}$ decreased significantly, but plasma levels remained unchanged.

CONCLUSIONS: This study establishes plasma $A\beta O^{10-20}$ and p-tau217 as minimally invasive biomarkers for distinguishing iNPH from AD and HC, independent of CSF values. These findings support the use of these plasma data in diagnosing iNPH and identifying concomitant AD pathology for improved treatment strategies.

Patient Consent: The patient has provided their consent for the publication of this abstract.

NON-INVASIVE TAP TEST ("PUMPING") TO REPLACE INVASIVE DIAGNOSTICS IN UNDERDRAINED SHUNTED NPH PATIENTS?

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INTRODUCTION: Suboptimal improvement or secondary deterioration is frequently observed in shunted NPH patients. The non-invasive tap test ("pumping") via the flushing reservoir of shunts may be an alternative to invasive potentially harmful diagnostic procedures for detecting underdrainage. The aim of this study is to demonstrate the efficacy and its potential to avoid more invasive diagnostic tests.

METHODS: A prospective study was conducted on 25 NPH patients shunted with a "Sprung-Reservoir" and a proGAV 2.0 in whom underdrainage was suspected. With 100 pumps approximately 20 ml of CSF were withdrawn from the ventricles. The immediate effects were evaluated through gait examinations after 10 minutes, and changes over a week were evaluated via an observation sheet provided to the patients and/or caregivers. Depending on the results with subsequent clinical decisions, the avoidance of invasive tests was calculated.

RESULTS: An improvement after 10 mins was observed in 11 patients; in 8 of these cases, the shunt valve was downregulated immediately. The remaining 17 patients were provided with observation sheets: 6 showed no improvement at all, 7 reported temporary improvement, and 4 experienced permanent improvement. Patients with temporary improvement were offered valve downregulation, while those with sustained improvement were advised to return in the event of new symptoms. Patients with no improvement were offered invasive tests for further clarification. Consequently, the pumping test allowed invasive test to be avoided in 19 cases (76%).

CONCLUSION: The pumping test proved to be effective, often providing rapid clinical feedback. The additional observation sheet helps monitor longer-term changes. More invasive and expensive can often be avoided, here in 76%. This non-invasive tap test should be considered as first line diagnostic procedure in cases of shunt failure – at least in NPH patients before pursuing invasive diagnostics. However, not all available flushing reservoirs are suitable for this "pumping-test".

OUTCOMES IN 481 PATIENTS WITH INPH SHUNT OPERATED WITH OR WITHOUT A PREVIOUS CEREBROSPINAL FLUID TAP TEST – A SINGLE CENTER LONGITUDINAL FOLLOW-UP STUDY

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INTRODUCTION: According to international guidelines, the diagnosis of iNPH is based on typical symptomatology, neuroimaging, and normal CSF opening pressure. Since many years, we select iNPH patients for shunting based on detailed assessment of clinical symptoms and MRI and add the cerebrospinal fluid tap test (CSF TT) to strengthen indication for surgery in cases where the diagnosis is considered uncertain. Here, we compared clinical characteristics and postoperative outcomes between iNPH patients shunted with or without a previous CSF TT.

METHODS: This longitudinal study included 481 consecutive iNPH patients (63% Male, mean age 76 ±6) diagnosed according to international guidelines at the Hydrocephalus Research Unit and subjected to shunt surgery. Clinical symptoms were assessed pre- and postoperatively (mean 7±5 months) using the Gothenburg Hellström iNPH scale and comprehensive gait and balance tests. Surgery outcomes were compared between iNPH TT (CSF TT, n=91) and iNPH NoTT (no CSF TT, n=390) groups.

RESULTS: iNPH TT patients had higher prevalence of comorbid neurological disorders than CSF NoTT (33.9 vs 9.9%, $p<0.001$) and performed better in baseline 10-meter walk, 3-meter backward walk and 6-minute walking test ($p=0.01-0.03$). Overall improvement on the iNPH scale was similar across groups (iNPH TT 7.0 (14.8) vs iNPH NoTT 11.8 (15.8): ($p=0.32$)). After adjusting for baseline factors and time to surgery iNPH NoTT showed better improvement in continence and Romberg's tandem stance eyes closed balance tests ($p=0.03$).

CONCLUSIONS: INPH patients can be selected for shunt surgery based on clinical symptoms and MRI without addition of the CSF TT with similar outcomes as patients selected based on a positive CSF TT. Patients who underwent CSF TT before shunt surgery more frequently presented with concurrent neurological disorders and experienced longer waiting time until the surgery.

GENETIC AND MOLECULAR DETERMINANTS OF THE HUMAN CSF-VENTRICULAR SYSTEM

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INTRODUCTION: Enlargement of the cerebrospinal fluid (CSF)-filled brain ventricles (ventriculomegaly) is a defining feature of congenital hydrocephalus (CH) and an underrecognized concomitant feature of neurodevelopmental disorders (NDD), including autism. The purpose of this study was to elucidate the genetic and molecular-mechanistic basis of human CH.

METHODS: We performed an integrated genomics analysis of 2,697 CH patient-parent (trio) exomes and 1,211,359 control developing human brain scRNA-seq transcriptomes. We validate lead CH gene PTEN in mice.

RESULTS: We show that pathogenic de novo variants underlie ~25% of CH cases and identify 35 genes reaching exome-wide significance, where mutations in PTEN are the most frequent monogenic cause of CH. Spatiotemporal scRNA-seq of the developing human brain maps CH genes to epochs critical for neurogenesis and cluster into three functional networks, 1) PI3K signaling, 2) BAF (SWI/SNF) chromatin remodeling, and 3) histone H3K4 complex. Mice harboring human CH-mutations in PTEN develop aqueductal stenosis due proliferation of Nkx2.1⁺ neural progenitors and increased CSF secretion as well as cortical network dysfunction and behavior abnormalities consistent with autism. Genetic deletion of Raptor or pharmacologic inhibition of mTORC1 (everolimus) corrects ventriculomegaly, rescues cortical network activity, and improves survival in PTEN mutant mice.

CONCLUSIONS: We perform the largest human genetics study of CH to date and identify a genetic basis (to single DNA base-pair resolution in select cases) for ~25% of cases. These results implicate potential nonsurgical treatments for CH, demonstrate a shared genetic and mechanistic basis of CH and NDDs, and help explain why NDDs may persist despite CSF diversion in select CH cases.

Patient Consent: The patient has provided their consent for the publication of this abstract.

T-CELL INFILTRATION IS ASSOCIATED WITH INCREASED REACTIVE ASTROCYTE AND PROINFLAMMATORY CYTOKINE ACTIVITY IN POST-HEMORRHAGIC HYDROCEPHALUS

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INTRODUCTION: Intraventricular hemorrhage (IVH), the most common neurological complication of prematurity, causes post-hemorrhagic hydrocephalus (PHH) with high morbidity and mortality. IVH/PHH has been associated with T-cell infiltration and gliosis in the periventricular regions including the periventricular white matter (PVWM). However, the role of T-cells in IVH/PHH pathogenesis remains to be elucidated.

METHODS: Four-day-old (P4) TCRb/d T-cell knockout (TCR KO) and wild-type (WT) mice received intraventricular injections of 5 µl lysed blood (PHH group) or artificial CSF (sham group). Seven days post-induction (P11), mice underwent magnetic resonance imaging (MRI) for ventricular volume quantification. Brains and blood were collected for histology, immunofluorescence, and flow cytometry.

RESULTS: T-cell deficiency significantly reduced ($p=0.04$) the number of astrocytes in the PVWM of PHH mice (18 ± 2.4 %) compared to WT PHH mice (26.4 ± 3.5 %). T-cell deficiency prevented gliosis in TCR KO PHH mice compared with TCR KO sham mice (16.3 ± 2.3 % GFAP+, $p=0.9$; 14.7 ± 2.2 % vimentin+ cells, $p>0.9$). Additionally, TCR KO PHH mice exhibited significant decreased ($p=0.01$) reactive astrocytosis (vimentin+ cells, 19.6 ± 1.5 % in WT PHH vs. 14.8 ± 0.3 % in TCR KO mice). Consistent with this, the levels of tumor necrosis factor alpha (TNFα), a well-known pro-inflammatory cytokine produced by astrocytes, did not significantly increase ($p=0.4$) when PHH was induced in TCR KO mice (5.2 ± 1.4 TCR KO sham vs. 7.4 ± 2 TCR KO PHH). Notably, T-cell deficiency did not impact the number of microglial cells in the PVWM ($p>0.9$), PHH-mediated ventricular enlargement ($p=0.06$), or ependymal disruption ($p>0.9$).

CONCLUSIONS: The results from this study implicate the relationship of T-cells, astrocyte function, and cytokine production in the pathophysiology of PHH. Further, these data support the notion of targeted immunotherapy in the treatment and prevention of PHH-related PVWM pathology.

AWARENESS, SCREENING AND HUMANITARIAN NEUROSURGERY AROUND THE INTERNATIONAL HYDROCEPHALUS DAY

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INTRODUCTION: Hydrocephalus represents 15.45% of pediatric hospital activity in Ivory Coast. Treatment is delayed with a consequent high morbidity, mortality, and kind of macrocephaly unknown in high-income countries. The main reason is the parents' lack of financial means and difficult access to care. It seems underestimated and poorly understood by populations and health personnel.

METHODS: We report on the results of the 2023 campaign, initiated by the Ivorian association for the fight against hydrocephalus Espérance'Hope and the Ivorian Society of Neurosurgery, in nine cities in Côte d'Ivoire.

RESULTS: The campaign totaled 19 days. The awareness raising brought together around 800 people, including health workers, pregnant women and women of childbearing age. It covered what you need to know about hydrocephalus, the importance of pre- and post-natal consultations, measuring head circumference, and prevention. Health workers have been trained on what to do when faced with hydrocephalus. A total of 285 consultations were carried out, including 55 children; among them 36 children presented 25 hydrocephalus or 69.44%, 10 spina bifida, 1 encephalocele, 1 holoprosencephaly. The average age was 32.75 months with extremes of 1 day and 16 years, with a sex ratio of 1.11. All the children have been operated on to date with satisfactory progress. The impact of these days was immediate with an increase in cases of hydrocephalus referred to our various services. Three campaigns of humanitarian surgery from December to March, allowing 34 children to be operated on.

CONCLUSIONS: Such a campaign makes it possible to circumvent the difficulties of treating hydrocephalus in low- and middle-income countries; but above all, the assessment must serve as a basis for advocacy in favor of improving care conditions. We note the important role of associations which should develop.

REDUCING CELLULAR ADHESION ON SHUNT CATHETERS USING ZWITTERIONIC SURFACE MODIFICATION: A BIOREACTOR-BASED STUDY

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INTRODUCTION: Given that the dominant cause of shunt malfunction is catheter obstruction by cells, numerous studies have explored the potential to reduce cellular attachment through the modification of catheter surface chemistry. Zwitterionic coatings, given strong hydrophilic properties and resistance to protein and cell attachment, are excellent candidates for further study.

METHODS: Commercial shunt catheters were compared with and without surface treatment using a zwitterionic coating. Polysulfobetaine (PSB), a zwitterionic polymer known for its antifouling properties, was used as a surface treatment for shunt catheters made from polydimethylsiloxane (PDMS). To covalently attach PSB to the PDMS surface, it was combined with perfluorophenylazide (PFPA), a photoreactive crosslinker that enables stable bonding upon UV activation. Experiments were conducted using a bioreactor developed in our lab, designed for testing shunt catheters. It uses a micropump to circulate media containing cells through a catheter in a closed loop system. Astrocytes were exposed to a flow rate of approximately 300 microliters per minute for 16 hours. After this period, the catheters were fixed, stained with 4',6-diamidino-2-phenylindole (DAPI), and immunolabeled for glial fibrillary acidic protein (GFAP) to visualize the cells attached to catheters.

RESULTS: The experiments revealed a clear difference in cell attachment between the commercial catheters and those surface-treated with a zwitterionic coating. The surface-treated catheters exhibited markedly reduced astrocyte adhesion compared to the untreated commercial catheters. Ongoing experiments are currently assessing the attachment of additional cell types, including microglia.

CONCLUSIONS: These results suggest that zwitterionic surface-treated catheters may offer a promising strategy to reduce cell attachment. Longer term studies with additional cell types, along with further testing to assess durability and performance, are needed to fully evaluate the coating's biological interactions and long-term performance under conditions that better mimic the in vivo environment.

MODELING CILIARY GENES IN XENOPUS UNCOVERS NOVEL MECHANISMS FOR CONGENITAL HYDROCEPHALUS

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INTRODUCTION: Congenital hydrocephalus (CH), characterized by the abnormal expansion of the brain ventricles, affects approximately 1 in 1000 births and remains one of the most debilitating childhood diseases with no medical treatments. To identify potential medical targets, we need to better understand the pathogenesis. Recent human genomic studies have identified multiple genes involved in cilia function, including cilia signaling (PTCH1), ciliogenesis (FOXJ1), and cilia motility (DNAI2) in patients with CH. However, our understanding of the role of cilia in hydrocephalus remains incomplete. To address the gap, we have coupled the genetically tractable *Xenopus* frog model with Optical Coherence Tomography (OCT) imaging, which enabled us to visualize in vivo cilia-driven cerebrospinal fluid circulation within the entire ventricular system during embryogenesis. We also demonstrated that tadpoles exclusively rely on ependymal cilia for bulk CSF circulation. By leveraging these unique advantages of *Xenopus*, we aim to understand the role of cilia in normal development and hydrocephalus.

METHODS: Using CRISPR/Cas9 system and morpholino oligos, we altered ciliary signaling and motility in *Xenopus*. We analyzed ventriculogenesis and CSF circulation using OCT imaging. Additionally, we examined the impact on neurodevelopment using in situ hybridization, immunofluorescence and RNAseq.

RESULTS: Our results showed that ependymal cilia in tadpoles set regional boundaries. When we knocked down cilia signaling (patch1 - hedgehog signaling) or cilia motility (c21orf59) both tadpoles developed aqueductal stenosis. Strikingly in both groups, we detected abnormal expansion of the diencephalic region and perturbed regional specification of neuronal identity in the developing brain.

CONCLUSIONS: *Xenopus* is a unique model system where ventricular development, cilia-driven CSF circulation, and CNS development can be analyzed throughout development in vivo, in a non-destructive, label-free fashion. This work provides new insights into the role of ependymal cilia and highlights the role of cilia in the specification of cell fate during neurodevelopment.

OPTIMIZATION OF HUMAN NEURAL STEM CELLS IN TRANSPARENT ANIONIC NANOFIBRILLAR HYDROGEL AS A MODEL FOR THE VENTRICULAR AND SUBVENTRICULAR ZONE

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INTRODUCTION: Recent research has suggested that a disruption of the ventricular zone (VZ) and subsequent maldevelopment of the subventricular zone (SVZ) may play a significant role in the development of pediatric hydrocephalus. Therefore, an understanding of these neurogenic zones are imperative for the investigation of this condition. However, experimental research is complex due to the unique characteristics of these zones, particularly the SVZ, which differs significantly between rodents and humans. Thus, the goal of this work is to recapitulate human-like VZ and SVZ in vitro to study their development under hydrocephalic conditions.

METHODS: To facilitate imaging and characterization of the cellular environment while providing a favorable environment for neural stem cell (NSC) proliferation, a negatively charged transparent hydrogel consisting of cellulose nanofibers and water (GrowDex-T) was selected. Human iPSC-derived NSCs were derived through Sendai virus reprogramming and grown in simultaneous 3D and 2D cultures, with a constant density of cells seeded within and on the biogel. After culture for 7 days, gels underwent immunolabeling for FoxJ1, GFAP, Vimentin, and Nestin, biomarkers of ependymal cells, astrocytes, and neural progenitor cells, respectively. DAPI was used for nuclear staining. Several factors were systematically tested, including cell density and hydrogel density, to determine the effect on NSCs' proliferation, maturation, and differentiation. We also determined whether the gel proved suitable for this application and subsequent imaging.

RESULTS: Moderate hydrogel density and dense cell seeding proved effective for the preservation of NSCs with a three-dimensional regionalization with differentiated ependymal cells forming at the periphery of the biogel—mimicking VZ maturation—and undifferentiated progenitor cells remaining in the inner regions, resembling the SVZ architecture.

CONCLUSIONS: These initial findings demonstrate the feasibility of recapitulating a human-like VZ-SVZ in vitro. Thus, the model provides a foundational platform for future studies of neurodevelopmental disorders, particularly acquired hydrocephalus.

ANALYSIS OF HYDROCEPHALUS CASES IN BRAZIL: PREVALENCE, MORTALITY, AND REGIONAL DIFFERENCES (2000–2023)

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INTRODUCTION: Hydrocephalus, a condition marked by cerebrospinal fluid accumulation causing ventricular dilation and elevated intracranial pressure, remains a significant cause of infant morbidity and mortality in Brazil when untreated.

METHODS: We conducted an ecological study using national birth data (SINASC, 2000-2023) to analyze hydrocephalus prevalence and mortality trends. Statistical analyses included linear regression, Pearson correlation, and ANOVA (GraphPad Prism 9).

RESULTS: Between 2000–2023, Brazil recorded 18,484 hydrocephalus cases (29.2% of nervous system malformations), with a prevalence of 2.65/10,000 live births. Analysis revealed a significant annual decline in prevalence ($r=-0.47$, $p=0.018$), with an average reduction of 11 cases/year (0.8%). Mortality data showed 6,501 infant deaths (35% mortality rate), decreasing by 10 deaths/year (1.98%). Age-stratified analysis demonstrated significant mortality differences ($p<0.0001$, $R^2=0.69$), with the post-neonatal period accounting for most deaths (54.3%), followed by early neonatal (30.4%) and late neonatal (15.2%) periods. While regional prevalence showed no significant variation ($p=0.39$), mortality rates differed markedly ($p<0.0001$), being highest in Central-West (27.4%) and North (26.5%) regions, and lowest in Southeast Brazil (13.7%).

CONCLUSIONS: The analysis suggests a decreasing trend, more pronounced in the post-pandemic period, which may be attributed to reduced notification efficiency during this period and a decline in the number of births. Furthermore, the data suggest inadequate treatment of this condition, as the mortality rate for children receiving proper treatment within three years is only about 10%, according to previous studies. These results emphasize the critical need for continuous monitoring and targeted interventions to reduce the incidence and mortality of congenital hydrocephalus, thereby significantly advancing neonatal health in Brazil

A STEREOTACTIC INJECTION METHOD TO ESTABLISH A CLINICALLY RELEVANT GERMINAL MATRIX HEMORRHAGE MURINE MODEL

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INTRODUCTION: Germinal matrix hemorrhage (GMH) and acquired posthemorrhagic hydrocephalus (PHH) remain the leading causes of premature infant morbidity and mortality. A GMH model that recapitulates both GMH-like tissue injury and hemorrhage via injection of clostridial collagenase into the ganglionic eminence (germinal matrix) has been previously established in rats. Given the goal of exploring pharmacologic interventions to mitigate the risk of acquired hydrocephalus using transgenic mouse lines, we sought to scale down this established rat model to mice.

METHODS: Wild type mouse neonates received stereotactic microinjections of clostridial collagenase into the germinal matrix to produce tissue injury and hemorrhage. Serial dilutions of clostridial collagenase and vehicle alone were delivered across four study groups to develop a collagenase dose-response curve. A fifth study group received intraventricular injections of whole blood to recapitulate intraventricular hemorrhage (IVH). Animals underwent 9.4T magnetic resonance imaging 14- and 28-days post-injection to analyze ventricular index and volumetric ventricular measurements. Animals were euthanized 28 days post-injection, and their brains were harvested for histologic analysis.

RESULTS: Our GMH/PHH model produced greater rates of ventriculomegaly in IVH and medium-dose (0.024 collagenase digestion units (CDU)) study groups compared to vehicle. Half-dose (0.012 CDU) collagenase groups did not produce greater rates of ventriculomegaly compared to vehicle. Double-dose (0.048 CDU) collagenase groups produced slightly greater rates of ventriculomegaly compared to vehicle but posed risk for ischemic stroke and cystic encephalomalacia. Histologic analyses confirmed tissue injury in the ganglionic eminence leading to GMH/PHH in our neonatal mouse model.

CONCLUSIONS: Our group developed a GMH/PHH neonatal mouse model with easily reproducible stereotactic microinjection coordinates. This model will serve as the foundation for future studies with transgenic mouse lines aimed at developing a more comprehensive understanding of the inflammatory response underlying acquired hydrocephalus development as well as support the preclinical study of potential therapeutic interventions.

PREDICTING ENDOSCOPIC THIRD VENTRICULOSTOMY WITH CHOROID PLEXUS CAUTERIZATION (ETV/CPC) OUTCOME IN INFANT HYDROCEPHALUS

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INTRODUCTION: Endoscopic third ventriculostomy with choroid plexus cauterization (ETV/CPC) is an effective alternative to shunts for treating infant hydrocephalus; however, ETV/CPC fails in about 40% of patients. Recently, the pre-operative frontal occipital horn ratio (FOHR) was found to be associated with ETV/CPC failure. Our study investigated whether quantitative measurement of pre-operative cerebrospinal fluid volume (CSFV) is superior to FOHR in predicting surgical outcome. We also developed an AI model for intracranial segmentation of T2 MRI scans of infant hydrocephalus.

METHODS: One-hundred and ninety-one patients undergoing ETV/CPC between 2008-2021 were included. Brain MRI taken within two weeks prior to the procedure were manually segmented into CSF, brain parenchyma, and background with z-scores adjusted for age and gender generated from normative growth curves of CSFV and brain parenchymal volume (BPV). The association between imaging variables and ETV/CPC outcome was assessed using Cox regression. These manually segmented images were used to train and validate a segmentation model using DenseNet and U-Net architectures with an attention regularizer. Performance was assessed using the Dice score.

RESULTS: Among 191 patients, 93 (48.7%) patients experienced ETV/CPC failure, among which 69 (36%) became shunt-dependent. In the univariate analysis, age at ETV/CPC, prior CSF diversion, FOHR, BPV, and CSFV z-score were significantly associated with ETV/CPC failure. The multivariable analysis confirmed that CSFV z-score ($p=0.01$) remained associated with shunt-dependence when adjusted for age and occurrence of prior CSF diversion. The AI segmentation model achieved an overall Dice score of 98.2% for CSF and 98.4% for brain parenchyma, demonstrating consistent performance across different hydrocephalus etiologies and effectively handling noise and artifacts.

CONCLUSIONS: This study first reported preoperative CSFV z-score as a novel risk factor for ETV/CPC failure and successfully developed a robust and accurate MRI segmentation model for infant hydrocephalus to make CSFV available to clinicians.

EXTERNAL HYDROCEPHALUS: A HIDDEN CAUSE OF ADDITIONAL MORBIDITY AFTER ANEURYSMAL SUBARACHNOID HAEMORRHAGE. A RETROSPECTIVE STUDY OF 89 ADULT PATIENTS

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INTRODUCTION: Subarachnoid hemorrhage (SAH) is a serious condition with potentially severe consequences. Acute "classical" hydrocephalus is a well-known secondary complication, easily diagnosed by a concomitant increase in intracranial pressure (ICP) and ventricle size. In contrast, external hydrocephalus (EH), which refers to an extra-axial cerebrospinal fluid (CSF) flow impairment with enlargement of the subarachnoid spaces (SAS) and a concomitant raised ICP but not necessarily with ventriculomegaly, is much more difficult to diagnose. It has been reported to worsen patients' prognosis but remains poorly studied. The aims of this study are (i) to describe EH in the adult population with aneurysmal SAH and (ii) to study the consequences of EH on short- and long-term prognosis.

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METHODS: Adult patients with aneurysmal subarachnoid hemorrhage were retrospectively included over 4 years. The occurrence of EH was assessed based on the evaluation of SAS on three or more sequential CT scans, each reviewed by two medical professionals. Neurological status, severity of SAH, complications of SAH, and short- and long-term (1-year GOS-E) outcomes were examined.

RESULTS: Among the 89 included patients, 48% developed EH. The median delay in the onset of EH was 7 days. EH was significantly associated with vasospasm ($p=0.034$) and chronic hydrocephalus ($p=0.035$). Patients with EH had a longer ICU stay (22 days versus 15 days, $p=0.025$) and more frequently received a permanent CSF diversion (42% versus 9%, $p=0.0006$). Among survivors, patients with EH had a higher rate of unfavorable 1-year outcomes, defined as a GOS-E ≤ 5 (48.6% in the EH group versus 32.1% in the non-EH group, $p=0.003$).

CONCLUSIONS: EH in adult patients remains poorly studied but is likely a frequent, unrecognized, and misdiagnosed condition following SAH, with a negative impact on patient prognosis. Further studies are necessary to enhance our understanding of pathophysiological mechanisms, diagnostic criteria, and optimal management of EH.

INTERIM RESULTS OF A RANDOMIZED, BLINDED PLACEBO-CONTROLLED TRIAL OF THE EFFICACY OF SHUNTING FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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BACKGROUND: Idiopathic normal pressure hydrocephalus (iNPH) is a disorder of gait impairment, urinary incontinence, cognitive impairment, and ventriculomegaly in individuals over age 60. The effectiveness of surgical treatment with cerebrospinal fluid (CSF) shunting has never been proven in a randomized study. Skepticism exists with regard to its efficacy, and concern for both over- or under-treatment.

OBJECTIVE: To assess the effectiveness of CSF shunting in iNPH 3 months after surgery in a multi-center randomized, blinded, placebo-controlled trial powered to detect a clinically significant group difference in the primary outcome measure of 0.2 meter/second change in gait velocity from baseline.

METHODS: Patients were selected for surgery according to the International iNPH Guidelines. The shunt valve used (Certas Plus with SiphonGuard; Integra LifeSciences) permits blinded, noninvasive adjustment to an open setting (Active group) or a closed setting ("virtual off"; Placebo group). In a delayed treatment design, following the 3-month assessments, all shunts were adjusted to an active setting while maintaining blinding. Patients and assessors were blinded to treatment assignment. Assessors were trained in gait and cognitive assessments. Quality control reviews were conducted. Secondary outcome measures included cognitive assessments (MoCA, SDMT), functional scales for bladder control, activities of daily living (ADLs), depression, quality of life, and complications.

RESULTS: Target enrollment (n=99) was completed in January 2025. The planned interim analysis included 74 participants (38 Active, 36 Placebo), mean age 75.0±5.4, 50% female. We will present results of the primary outcome (gait velocity) and secondary outcome measures 3 months after surgery, comparing Placebo vs. Active shunting.

CONCLUSION: This multicenter, randomized, blinded, placebo-controlled trial, which aimed to evaluate the effectiveness and safety of shunting in iNPH, has completed enrollment, and interim data will be presented. Assessments for 12-month outcomes are ongoing.

CEREBROSPINAL FLUID REDISTRIBUTION AFTER SHUNT PLACEMENT

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INTRODUCTION: Normal Pressure Hydrocephalus patients have an excess of cerebrospinal fluid in the intracranial cavity causing symptoms such as gait disturbance, incontinence and cognitive impairment. A shunt placement is the standard procedure to reduce the ventricular volume and alleviate the symptoms. Radiologically, the procedure is confirmed by assessment of the ventricle volume difference pre/post-operation. Little is known, however, of the redistribution of CSF throughout the intracranial cavity.

METHODS: A group of 50 NPH patients was enrolled in this prospective study. The patients provided their consent for the publication of this abstract. An MRI quantification sequence was used to measure the relaxation properties of the head, providing input data to quantify the amount of CSF and brain parenchyma for each voxel in the acquisition volume. SyMRI was used to map the intracranial volume, brain volume, total CSF volume, ventricular CSF volume and extra-axial CSF volume. Acquisition was performed prior and after shunt placement. The shunt artefact was corrected for, by addition of brain and CSF in the image void.

RESULTS: The mean ventricle volume reduction after placement of the shunt was 12.0 ml (-8.6%). Simultaneously, a reduction of extra-axial CSF of 26.7 ml (-9.5%) was observed. A high correlation was measured between ventricle CSF and total CSF volume reduction (slope 0.31, correlation coefficient 0.72). The shunt artefact was on average 28.9 ml, removing an estimated 7.9 ml of the observed total CSF.

CONCLUSIONS: Shunt placement results in a similar reduction in extra-axial CSF as ventricular CSF, making total CSF reduction a more sensitive measure than ventricular CSF reduction only for shunt assessment.

ARE ARACHNOID GRANULATIONS NECESSARY FOR CSF PHYSIOLOGY?

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INTRODUCTION: To clarify their role in cerebrospinal fluid physiology, we intend to show how the number, size, and distribution of arachnoid granulations change during the human lifespan.

METHODS: 3T magnetic resonance imaging was performed on 140 brains of patients of various ages (newborn, 2 years, 10 years, 20 years, 40 years, 60 years, and 80 years), all with normal cerebrospinal fluid findings. At each age, 10 male and 10 female subjects were analyzed. The size and position of arachnoid granulations were analyzed on T2 coronal and axial slices.

RESULTS: Our study shows that on magnetic resonance imaging, 85% of newborns and 2-year-old children do not have visible arachnoid granulations in the dural sinuses and skull bones. The percentage of subjects with arachnoid granulations increases significantly in older study groups. However, many individuals in different age groups still do not have arachnoid granulations in the dural sinuses. An interesting finding is that from age 60 onwards, arachnoid granulations were more numerous in the skull bones than in the dural sinuses.

CONCLUSIONS: The results suggest that the number, size and distribution of arachnoid granulations in dural sinuses and surrounding cranial bones change significantly throughout life. However, many subjects of different age groups with a completely normal CSF system do not have arachnoid granulations in the dural sinuses, which calls into question their role in CSF physiology.

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Patient Consent: The patients or their legal guardians have provided written consent for the publication of this abstract.

DIAGNOSTIC ACCURACY OF ARTIFICIAL INTELLIGENCE-BASED IMAGING FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a potentially reversible cause of dementia, gait disturbance, and urinary incontinence in older adults. Diagnosis remains challenging due to overlap with other neurodegenerative disorders and the absence of standardized imaging criteria. Artificial intelligence (AI) and radiomics offer promising solutions by automating brain morphometry and enhancing diagnostic precision. Therefore, we conducted a systematic review and meta-analysis to assess the diagnostic performance and clinical relevance of AI-based imaging methods in iNPH.

METHODS: Following PRISMA guidelines, we systematically searched PubMed, Embase, and Scopus. Eleven studies evaluating AI tools applied to MRI or CT data were included, encompassing 501 adult patients. Outcomes of interest were sensitivity, specificity, and area under the curve (AUC). Meta-analyses were performed using random-effects models, with subgroup analyses by imaging modality. Heterogeneity was evaluated using I^2 statistics, and publication bias was assessed with funnel plots. A bivariate Reitsma model and summary receiver operating characteristic (SROC) curve were generated.

RESULTS: Pooled sensitivity across seven studies was 95.3% [91.1–99.5%], with moderate heterogeneity ($I^2 = 72.9\%$). MRI sensitivity was 92.5% [86.8–98.1%], and CT sensitivity 99.5% [98.1–100%]. Overall specificity across six studies was 85.2% [74.1–96.3%], with high heterogeneity ($I^2 = 89.4\%$); MRI-based tools reached 91.2% [87.8–94.7%], while CT-based tools reached 57.1% [47.4–66.5%]. Combined AUC across nine studies was 94.4% [90.5–98.0%] with MRI-based tools achieving AUC 97.8% [95.8–99.8%] and CT-based tools AUC 89.9% [79.3–100%]. SROC analysis showed a summary sensitivity of 92%, false positive rate of 14%, and overall AUC of 94.9%. Funnel plots revealed no significant publication bias.

CONCLUSIONS: AI-based imaging demonstrates excellent diagnostic accuracy and holds potential to reduce misdiagnosis, improve patient selection for surgery, and accelerate treatment decisions in iNPH. Despite these promising results, prospective validation and standardized imaging protocols are essential to ensure consistent implementation in clinical practice.

VALIDATING POST-OPERATIVE TRANS-BURR HOLE ULTRASOUND TO MEASURE CEREBRAL VENTRICULAR SIZE IN HYDROCEPHALUS: COMPARISON OF ULTRASOUND TO COMPUTED TOMOGRAPHY

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INTRODUCTION: Hydrocephalus patients require chronic imaging to monitor ventricular size. Computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used. CT involves radiation exposure and MRI may be costly, less accessible, or contraindicated with metal implants. Ultrasound (US) offers an inexpensive, point-of-care (POC), radiation-free alternative. Sonolucent (US penetrable) burr hole implants can be used in ventricular shunt and endoscopic third ventriculostomy (ETV) procedures to allow for post-operative US. This study evaluates the accuracy of US compared to CT in measuring ventricular size.

METHODS: We identified all adult patients at a single institution who underwent placement of a right frontal sonolucent burr hole cover during ventricular shunt and ETV. Patients were included who had follow up US and CT imaging within 45 days of each other. Patients were excluded if there was an intervening procedure or shunt setting change between the compared modalities. US was performed transcutaneously through the burr hole implant to obtain a coronal view to the foramen of Monroe. Lateral ventricle size was measured using the ventricular index (distance from septum pellucidum to lateral frontal horn) in a blinded fashion. Measurements between modalities were compared using linear regression and Bland-Altman analysis.

RESULTS: A total of 78 paired imaging sets were analyzed. The mean ventricular index was 2.15 cm (SD 0.386) on US and 2.29 cm (SD 0.406) on CT. Linear regression revealed strong correlation between the two modalities ($R^2 = 0.82$, $p < 0.05$) for individual patients. Bland-Altman analysis showed a mean difference of 1.5mm, with US slightly underestimating ventricular size by this reliable factor.

CONCLUSIONS: Trans-burr hole US provides a highly correlated measurement of ventricular size compared to CT in post-operative hydrocephalus patients. There is a small predictable conversion factor of about 1.5mm, as US underestimates ventricular size slightly compared to CT.

DISTINCT WHITE MATTER CONNECTIVITY PROFILES IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS REVEALED BY QUANTITATIVE ANISOTROPY CONNECTOMETRY

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INTRODUCTION: Idiopathic Normal Pressure Hydrocephalus (iNPH) is characterized by gait disturbance, cognitive decline, and urinary incontinence. It often presents diagnostic challenges due to symptom overlap with other neurodegenerative disorders. Microstructural white matter alterations are implicated in iNPH pathophysiology. This study aimed to delineate specific patterns of altered brain connectivity in iNPH patients compared to controls with other cognitive disorders.

METHODS: Diffusion Tensor Imaging (DTI; $b=1000 \text{ s/mm}^2$, 15 directions) data from 33 subjects (including iNPH and controls [Alzheimer's Disease, PSP, Parkinsonisms]) were processed using DSI Studio. Q-space Diffeomorphic Reconstruction normalized the data to MNI space for high-resolution fiber tracking. Quantitative Anisotropy (QA) was calculated along the tracts. Connectometry analysis, utilizing partial Spearman correlation (controlled for age and sex), identified tracts where QA significantly correlated with group status. Rigorous statistical thresholds (T-score ≥ 2.5 , FDR ≤ 0.05 , 4000 permutations) were applied.

RESULTS: Connectometry revealed distinct, opposing QA patterns. iNPH patients exhibited significantly higher QA (FDR ≤ 0.05) in tracts associated with primary motor and sensory functions (precentral and postcentral gyri; cuneus). Conversely, controls showed significantly higher QA (indicating lower QA in iNPH patients) in tracts crucial for higher-order cognition, emotional regulation, and memory, including pathways connected to the anterior cingulate, orbitofrontal, entorhinal, and middle temporal cortices. This pattern highlights selective compromise of limbic and cognitive fiber integrity in iNPH.

CONCLUSIONS: Quantitative Anisotropy-based connectometry identified a distinct "connectivity signature" differentiating iNPH from other cognitive disorders. iNPH is characterized by the relative sparing of motor and sensory pathways alongside significant compromise of limbic, frontal, and temporal connections. These findings support connectometry as a promising tool for early iNPH characterization and offer insights into the anatomo-functional underpinnings of its clinical presentation.

Patient Consent: The patient has provided their consent for the publication of this abstract.

CDESH DECREASES AFTER SHUNTING AND CHANGES CORRELATE STRONGLY WITH MEASURES OF GAIT IMPROVEMENT

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INTRODUCTION: CDESH is a machine learning method measuring the presence of CSF space patterns consistent with DESH on structural MRI. We have previously shown the CDESH output is stable across time, modest imaging protocol changes, and cohorts. Scores are continuous with larger scores being indicative of a stronger DESH pattern. We take CDESH>1 as the cut-off for positivity when discrete classification is needed. Gait data was collected using a 10-meter pressure-sensitive walkway. Measured values included gait velocity, gait cadence, stride length, step width, gait stability ratio, and percentage of gait cycle spent in single leg support. We selected CDESH-positive patients, measured the change in CDESH scores approximately 30 days after shunt placement, and investigated the association of CDESH change with gait measures.

METHODS: Shunted patients with compatible imaging acquisitions and with gait assessment from the Mayo Clinic NPH Clinic were included. N=89 pre-shunt CDESH-positive individuals with gait assessments were identified. All available longitudinal data was included. We fit linear mixed effects models using CDESH score to predict the various gait metrics, allowing subject-specific intercepts.

RESULTS: CDESH scores in CDESH-positive patients decreased by an average of 2.4 (stdev 1.9) units at approximately 30 days post-surgery. Cadence was not associated with continuous CDESH score ($p=0.51$). Other gait metrics are ($p<10^{-7}$). The average velocity pre-shunt is 86cm/sec; velocity increased 4.3 (95% CI [2.9,5.6]) cm/sec/unit-CDESH post-shunt, for example. A plausible, hypothetical 2 CDESH-unit improvement from shunting would present a roughly 15% average increase in velocity. Similarly, step width is predicted to decrease roughly 10%, and the gait stability ratio to increase by roughly 22%.

CONCLUSIONS: In CDESH-positive patients, shunt, as expected, reduces CDESH abnormality. The CDESH and gait assessment values are significantly associated, excepting cadence. Typical gait measures increase 10-20% relative to baseline for a hypothetical 2 CDESH unit improvement from shunting.

Patient Consent: The patients provided consent for their data to be used for research.

INFLUENCE OF CSF SYSTEM EXPERIMENTAL BLOCKADE ON HYDROCEPHALUS DEVELOPMENT

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INTRODUCTION: New hypothesis regarding cerebrospinal fluid (CSF) physiology was tested according to which CSF pressure is not influenced by CSF secretion, unidirectional circulation and absorption. Obtained data implies that it is regulated mainly by different biophysical characteristics of cranial and spinal CSF space, which is in line with the laws of fluid mechanics.

METHODS: A new CSF system model consisting of the „cranial” part with unchangeable volume and „spinal” part with variable volume was constructed. Experiments were done on both the model and on anaesthetized cats and rabbits. CSF (or mock CSF) pressure and volume were measured in different body and model positions in control conditions as well as after producing cervical stenosis or aqueductal blockade in experimental animals.

RESULTS: According to obtained results, a negative (subatmospheric) intracranial pressure occurs in an upright position in both model and animals without CSF system impairment. This presumably enables stable blood brain perfusion in vertical position which is important for bipedal walking from an evolutionary point of view. Measured hydrostatic pressure gradients that exist throughout the craniospinal CSF system in all of the tested body positions are in opposition with the classical hypothesis of CSF physiology as they do not enable unidirectional CSF flow from the ventricles into the cortical and spinal subarachnoidal space. After craniospinal communication impairment, the pressure inside the ventricles becomes more positive in an upright position, possibly enabling hydrocephalus development in the long run.

CONCLUSIONS: The results of this research are in line with the new hypothesis of CSF physiology according to which osmotic and hydrostatic forces present at the brain and spinal cord capillary network are the main regulatory mechanisms of CSF pressure and volume.

INHIBITION OF TRPV4 AS A PHARMACOLOGICAL TREATMENT OF POSTHEMORRHAGIC HYDROCEPHALUS

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INTRODUCTION: Posthemorrhagic hydrocephalus (PHH) is a severe neurological condition characterized by cerebrospinal fluid (CSF) accumulation, ventricular enlargement, and elevated intracranial pressure following a brain hemorrhage. Due to the lack of efficient and specific pharmacological treatment options, current treatment is limited to surgical interventions, such as shunt insertion, which carry significant risks of complications and device failure.

METHODS: Using a well-established rodent model of PHH, we assessed ventricular volume via magnetic resonance imaging (MRI), measured brain water content, and determined CSF production through live imaging and radioisotope flux assays.

RESULTS: Pharmacological inhibition of the transient receptor potential vanilloid 4 (TRPV4) channel with GSK2798745, an orally bioavailable and selective inhibitor, significantly reduced ventricular enlargement, brain water content, and CSF secretion in rodents with PHH. These effects arose via modulation of the key transporters involved in CSF production; the $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ cotransporter and the Na^+/K^+ -ATPase. Importantly, therapeutic benefits were observed even when treatment was initiated within a clinically relevant timeframe after the hemorrhagic event.

CONCLUSIONS: Our findings suggest that TRPV4 inhibition represents a potential pharmacological approach to managing PHH, offering a non-surgical strategy to reduce CSF accumulation and mitigate hydrocephalus formation. This approach could help decrease reliance on invasive neurosurgical procedures and improve patient outcomes.

BRAIN PATHOLOGY IN THE MODEL MICE OF CHRONIC HYDROCEPHALUS CONCOMITANT WITH ALZHEIMER'S DISEASE

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INTRODUCTION: We previously reported that DNAH14 knockout (DNAH14^{-/-}) mice exhibit features of chronic hydrocephalus due to ciliary dysfunction. In that study, DNAH14^{-/-} mice demonstrated delayed molecular clearance from ventricular cerebrospinal fluid (CSF), followed by inflammation in the hippocampus. These findings led us to hypothesize that ciliary dysfunction results in the accumulation of toxic waste molecules in the brain—a possibility that remains to be fully evaluated. However, a limitation of our previous approach was the use of methodologies involving surgical intervention to assess molecular clearance. To address this limitation, we generated a new mouse model by crossing DNAH14^{-/-} mice with an Alzheimer's disease (AD) model (APP^{NL-G-F/NL-G-F} mice), creating a “combined model” that represents chronic hydrocephalus with concomitant AD pathology. In this study, we evaluated the behavioral, electrophysiological, and pathological features of the combined model.

METHODS: For behavioral assessments, we performed the Y-maze (YM) test and the Morris water maze (MWM) test on 16- and 24-week-old mice. Electrophysiological activity was analyzed using a multi-electrode array (MEA) on hippocampal slices obtained from 32-week-old mice. For pathological assessment, immunohistochemistry targeting amyloid β (A β) was conducted on brain tissues from 8-week-old mice.

RESULTS: Behavioral tests (YM and MWM) revealed a significant impairment in spatial memory in the combined model compared to AD model mice at 24 weeks of age ($p < 0.05$, both tests). MEA recordings showed decreased field excitatory postsynaptic potentials in the hippocampus of the combined mice. Immunohistochemistry revealed a significant increase in A β deposition in both cortex and hippocampus of the combined model ($p < 0.001$ for both regions).

CONCLUSIONS: This study demonstrates that ciliary dysfunction exacerbates AD-related pathology and A β deposition without the interference of surgical intervention. These findings suggest that impaired ciliary motility disrupts brain clearance mechanisms, contributing to neurodegeneration.

SHUNT-RELATED CSF OVERDRAINAGE - A MULTICENTER CONSENSUS DEFINITION

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INTRODUCTION: Overdrainage of the cerebrospinal fluid (CSF) is a known complication of shunt-based hydrocephalus treatment. The concept of CSF overdrainage has evolved alongside advancements in shunt technology and hydrocephalus management. A systematic literature review identified 22 definitions of CSF overdrainage, highlighting the lack of a universally accepted definition. To address this ambiguity, we conducted a multi-center consensus study to establish a clinically relevant definition of CSF overdrainage that can guide future research and clinical decision-making.

METHODS: A Delphi consensus process was conducted with 19 neurosurgeons and neuroscientists specializing in hydrocephalus from centers in Africa, Europe, India, and USA. Participants had at least ten years of clinical experience and/or significant publications in the field. The previous literature review identified 32 clinical and radiological manifestations of CSF overdrainage, which

were evaluated by the consensus-panel. The process included multiple rounds of structured questionnaires and virtual discussions. Consensus was achieved if a manifestation gained more than 70% support throughout the process. Last, through iterative refinement the definitions were established.

RESULTS: The panel agreed that CSF overdrainage presents differently in various patient populations and should be defined by cardinal symptoms rather than additional less frequent symptoms. Three age-dependent definitions were established for pediatric patients: infants (age <1 year), children with a growing skull (age 1-7 years), and children with a fixed skull (age >7 years). A separate definition was formulated for adults (age ≥ 18 years). Across all age groups, CSF overdrainage was characterized by posture-related symptoms, primarily headache (or in infants/younger children; irritability consistent with headache), relieved in supine position, and radiological findings such as ventricular collapse (age <18 years) and non-traumatic subdural collections (all age groups).

CONCLUSION: These consensus-based definitions provide a standardized framework for future research and clinical practice in hydrocephalus management, addressing the longstanding variability in diagnosis and treatment of CSF overdrainage.

ALTERATION OF NEUROINFLAMMATION AND INTRACRANIAL MICROBIOME WITH ANTIBIOTIC IMPREGNATED CATHETERS

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INTRODUCTION: Ventricular catheter obstruction is a leading cause of shunt failure. While different catheter materials are used clinically, their impact on obstruction mechanisms remains unclear. The recent discovery of intracranial 16S rRNA introduces a potential microbiome-related modulator of neuroinflammation. This study investigated the neuroinflammatory and microbiome responses to commonly used catheter materials using MRI and 16S analysis.

METHODS: Twenty-nine female C57BL/6 mice were divided into four groups: control (n=6), sham surgery (n=6), plain silicone catheter (PS, n=6), and antibiotic impregnated silicone catheter (AIS, n=6). The rest five were used for MRI. Catheters were implanted in both the parietal cortex and peritoneal cavity. MRI was performed at 1, 4, 8, and 16 weeks on five mice on an 11.7 Tesla Bruker Biospec MRI system, using T2-weighted, FLAIR, and SWI sequences following ferumoxytol injection. Brain and cecum samples were collected at 7 and 28 days for microbiome analysis. Host reads were removed using Kraken2 with a GRM39 mouse genome database. Reads were processed via DADA2 and QIIME 2; diversity metrics and differential abundance (LEfSe) were assessed in R. PICRUSt2 was used for functional inference.

RESULTS: Peri-implantation edema was similar across implant groups and resolved by week 4. MRI revealed reduced macrophage activity in the AIS group after week 4. 16S profiling showed a treatment-specific shift: AIS mice had increased anti-inflammatory taxa (e.g., Lachnospiraceae, Akkermansia), while PS and sham groups were enriched in pro-inflammatory taxa (e.g., Gammaproteobacteria, Flavobacteriia). Functional prediction suggested decreased LPS and increased SCFA pathways in the AIS group, aligning with imaging data.

CONCLUSIONS: Catheter material influences neuroinflammation and intracranial microbiota. AIS implantation yielded reduced inflammatory activity and a microbiome profile consistent

CSF PROTEOMICS IN SPONTANEOUS INTRACRANIAL HYPOTENSION: A METABOLIC DISEASE?

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INTRODUCTION: Spinal CSF leaks affect CSF dynamics, but sparse knowledge about metabolic change exists. Currently, one of the main diagnostic modalities for confirming a CSF leak is myelography, although it is effective, it involves radiation exposure and sometimes fails to confirm the diagnosis. There is a need for CSF markers of SIH to improve the understanding, diagnosis, and management of patients with CSF spinal leaks.

METHODS: This cohort study was conducted in a large SIH referral center and involved CSF samples from patients with a confirmed spinal CSF leak and a control group. Samples underwent label-free proteome analysis, High-Performance Liquid Chromatography (HPLC) on a MARS column, and processing using the Single-Pot Solid-Phase-enhanced Sample Preparation (SP3) bead protocol, measured on a Q Exactive mass spectrometer. Statistical analysis was performed using the Limma software, with a focus on pairwise comparisons to identify differentially expressed proteins.

RESULTS: The study included 18 participants (9 SIH and 9 controls). A total of 919 proteins were identified and quantified. Applying stringent criteria—adjusted p-value <0.05 and a log2 fold change ≥ 0.58 or ≤ -0.58 —51 proteins showed significant alteration in SIH patients. We were able to identify specific patterns of change, providing insight into four main findings in SIH: Neomembranes, persistent CSF leak, metabolic changes, and oxidative stress. The alteration in the proteomic landscape of SIH subjects suggests that SIH may be associated with a metabolic disturbance.

CONCLUSION: SIH frequently causes limiting and disabling symptoms persisting even after surgical or endovascular management. Our study presents the first promising results of a comprehensive metabolic disturbance in SIH patients, indicating a discernible proteomic profile unique to these patients and paving the way for the development of proteomic biomarkers and a radiation-free diagnostic modality.

EFFECT OF ANESTHESIA AND BLOOD OXYGENATION ON RODENT CSF SECRETION

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INTRODUCTION: Hydrocephalus occurs following dysregulation of the cerebrospinal fluid (CSF) homeostasis, which may arise as a consequence of decreased CSF drainage but can also be caused by CSF hypersecretion. To address the latter in rodent models, it is crucial to understand the effect of blood oxygenation and anesthesia on CSF secretion in the animal model.

METHODS: Adult male rats were exposed to different conventional anesthesia protocols with varying levels of oxygen delivered via a nose mask, with subsequent arterial blood quantification. The CSF secretion rate was determined with the ventriculo-cisternal perfusion assay in rats with or without mechanically ventilation, and as a function of employed ketamine re-administrations.

RESULTS: Midazolam-containing anesthesia protocols reduced blood oxygenation compared to the standard xylazine-ketamine anesthesia. Hypoxia conditions, such as those obtained in experiments performed without mechanical ventilation, did not affect the CSF secretion rates. In contrast the CSF secretion decreased as a function of ketamine redosing, with the highest CSF secretion rate observed in awake and freely moving rats.

CONCLUSIONS: Anesthesia reduces the CSF secretion rates in rats, although apparently not as a direct function of anesthesia-induced disturbances of the blood oxygen saturation, which varies between different anesthesia protocols.

AQUAPORIN 1 IS NOT REQUIRED FOR CSF SECRETION AND BRAIN FLUID HOMEOSTASIS IN MICE

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INTRODUCTION: Disturbances in the brain fluid balance can lead to life-threatening elevation in intracranial pressure (ICP), which represents a vast clinical challenge. Targeted and efficient pharmaceutical therapy of elevated ICP is not currently available, as the molecular mechanisms governing cerebrospinal fluid (CSF) secretion are partly unresolved.

METHODS: To resolve the quantitative contribution of aquaporin 1 (AQP1) to CSF dynamics, we employed mice with genetic knockout of AQP1 and mice with viral-dependent choroid plexus-specific knockdown of AQP1 for in vivo determinations of CSF dynamics.

RESULTS: Mice with systemic and embryonic AQP1 deficiency displayed undisturbed CSF secretion rates, brain water content, ventricular volume, and ICP, as did mice with choroid plexus-specific virally-induced knockdown of AQP1 in adulthood.

CONCLUSIONS: AQP1 is not required for choroid plexus-dependent CSF secretion and thus brain fluid homeostasis, and therefore does not represent a potential target for pharmacological treatment of ventriculomegaly and elevated intracranial pressure.

ROLE OF THE CHOROID PLEXUS IN AMYLOID-B CLEARANCE IN PTPN20 KNOCKOUT MICE

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) shares several pathological features with Alzheimer's disease (AD), including impaired clearance of amyloid- β (A β). We previously identified Protein Tyrosine Phosphatase Non-Receptor Type 20 (PTPN20) as a candidate gene for congenital hydrocephalus in H-Tx rats and demonstrated that Ptpn20 deficiency induces hydrocephalus-like changes and promotes early A β deposition in an AD mouse model. This study aimed to elucidate the role of PTPN20 in choroid plexus-mediated A β clearance and the development of AD-like pathology.

METHODS: PTPN20 expression in the choroid plexus of wild-type (WT) mice was evaluated at multiple ages using quantitative real-time PCR. Choroid plexus tissues were harvested from PTPN20 knockout (PTPN20-KO), APP knock-in (APP^{NL-G-F/NL-G-F}; APP-KI), and APP-KI $\times$ PTPN20-KO mice at 8 and 16 weeks of age. Immunofluorescence staining for F-actin, RhoA, ZO-1, and A β was conducted to assess cytoskeletal architecture, tight junction integrity, and A β accumulation. Ultrastructural alterations were analyzed by transmission electron microscopy. Additionally, transcriptomic profiling by microarray was performed at 4 and 10 weeks, with validation of differentially expressed genes by quantitative PCR.

RESULTS: In WT mice, PTPN20 expression in the choroid plexus progressively declined with age. PTPN20-KO mice exhibited significantly reduced F-actin staining at the basal membrane of epithelial cells. APP-KI $\times$ PTPN20-KO mice demonstrated accelerated A β accumulation on the ventricular surface, within intercellular spaces, and throughout the stroma. Electron microscopy revealed pronounced epithelial atrophy, disruption of tight junctions, and widening of intercellular spaces, along with decreased ZO-1 expression. Gene expression analyses confirmed significant downregulation of LRP1 and Slc13a3, both implicated in A β transport and clearance.

CONCLUSIONS: These findings suggest that PTPN20 is critical for maintaining the structural and functional integrity of the choroid plexus epithelium. Loss of PTPN20 impairs CSF-mediated A β clearance and may represent a novel therapeutic target for Alzheimer's disease.

EXPLORING THE ROLE OF LATERAL VENTRICLE GEOMETRIC FEATURES IN DETECTING EXTRACELLULAR DEPOSITION OF AMYLOID-B PEPTIDES IN PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) can lead to dementia, gait disturbances, and urinary incontinence, impairing quality of life. While shunt surgery can alleviate these symptoms, comorbid Alzheimer's disease (AD) may negate benefits, necessitating accurate AD diagnosis for predicting shunt surgery outcomes. While existing research has emphasized cerebrospinal fluid (CSF) biomarkers and positron emission tomography, our study employed a novel approach using brain biopsy-verified amyloid-beta (A β) pathology and leveraging geometric features from magnetic resonance imaging (MRI) to differentiate A β -positive from A β -negative cases.

METHODS: We studied 144 patients (68 A β positive and 76 A β negative) from the Kuopio NPH registry, with inclusion criteria requiring a brain biopsy and preoperative anatomical MRI. We performed volumetric brain segmentations using cNeuro software on T1-MRI images, followed by the generation of 3D lateral ventricle meshes and geometric feature extraction. The LogisticNet model was employed for classification and evaluated through repeated nested cross-validation (10 rounds with five inner and five outer folds). Feature importance was assessed based on the frequency of features included in the model.

RESULTS: LogisticNet achieved an AUC of 0.648 (± 0.079) in predicting A β pathology, with the Surface Area to Volume Ratio (SAVR) as the top predictor. The use of SAVR alone yielded an AUC of 0.665. However, when tested on a subset of 83 patients with available CSF biomarkers, the SAVR AUC decreased to 0.615, whereas the p-tau/A β ratio reached 0.712. Combining SAVR with the p-tau/A β ratio resulted in an AUC of 0.700 (± 0.085), indicating no improvement.

CONCLUSIONS: SAVR demonstrated moderate discrimination between A β -positive and A β -negative iNPH patients yet proved less accurate than CSF biomarkers. A β -positive cases had higher SAVR values, indicating notable lateral ventricle morphological differences compared to A β -negative cases. While SAVR lacked sufficient standalone discrimination, its differentiation, quantitative and non-invasive nature make a strong case for further investigation.

NORMAL PRESSURE HYDROCEPHALUS: THE ROLE OF EMERGENCY SERVICES AND PRIMARY CARE IN ITS EARLY DIAGNOSIS

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is one of the potentially reversible causes of dementia due to its surgical treatment. Early diagnosis is essential to reverse the symptoms, improving patients' prognosis. Their main entry into the health system is the Emergency Department and Health Centers, thus they are the critical link in the diagnostic process.

METHODS: A descriptive study has been carried out to evaluate the degree of knowledge about NPH in Primary Care (represented by five Health Centers) and Emergencies in our region through an initial survey. This was about basic concepts of hydrocephalus and how many times they have diagnosed NPH throughout their professional career. After that, refresher sessions on this pathology and its management were given to include it as possible differential diagnosis. These sessions were assessed through a second survey with a Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"). All the answers were adjusted by assigning a numerical value to be able to analyze them.

RESULTS: A total of 61 surveys were obtained (27 from the Emergency Department and 34 from the Health Center), which 87% were consultants and 7%, residents. The concept of hydrocephalus was known by 77% and its types by 22%. The 50% were able to name the characteristic triad of NPH. The 60% suspected the pathology less than 10 times throughout their professional career. There was high level of satisfaction after the sessions: all the assistants considered them useful, 78% rated five points and 22%, four.

CONCLUSIONS: Doctor's level of knowledge about NPH was not satisfactory for diagnosing the disease. However, it is necessary to carry out the study on a larger scale to infer the results in the total census of doctors and to evaluate the impact of the formative sessions on the referral of patients with NPH.

EVALUATING THE ADDITIVE PROPERTIES OF DIFFERENTIAL PRESSURE VALVES IN A NOVEL BENCHTOP SHUNT MODEL

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INTRODUCTION: Cerebrospinal fluid (CSF) over-drainage is an unintended consequence of CSF shunting for the treatment of hydrocephalus. Two shunt valves may be applied in series to better control drainage. In this study, we tested whether the opening pressures (OP) of two valves placed in series—Codman Hakim® ball valve (HBV) and the Miethke M.blue® adjustable gravitational valve (AGV)—can be treated as being additive using a novel in-vitro benchtop model.

METHODS: Six dual-valve circuits were tested in triplicate for different combinations of HBV and AGV settings adding up to a summed OP of either 20 or 40 cmH₂O. This “theoretical” sum was based on the addition of the nominal OP settings provided by the manufacturer. Kruskal-Wallis tests and linear mixed-effect models were employed to analyze the flow rates for HBV-AGV settings with the same theoretical OP.

RESULTS: Kruskal-Wallis analysis demonstrated that HBV-AGV settings for each circuit, at a theoretical OP of 20 and 40 cmH₂O, showed statistically significant differences in flow rate. In subsequent linear mixed-effects models, accounting for experimental conditions such as day of run, duration of run, and circuit, as HBV OP was increased and composed a larger fraction of the theoretical OP, the flow rate decreased (effect size: -1.567×10^{-3} mL/min, standard error: 1.663×10^{-4} mL/min, $p < 2 \times 10^{-16}$ at 20 cmH₂O, and effect size: -3.735×10^{-3} mL/min, standard error: 1.475×10^{-4} mL/min, $p < 2 \times 10^{-16}$ at 40 cmH₂O respectively).

CONCLUSIONS: An analysis of the flow data demonstrated statistically significant differences between combinations of HBV-AGV settings adding up to the same theoretical OP. When adjusting OPs of Hakim® and M.blue® valves placed in series, clinicians should be aware that the assumption that HBV-AGV settings with the same summed theoretical OP behave alike may lead to varying drainage patterns in patients.

BRAIN TISSUE MIMICKING HYDROGEL FOR BENCHTOP INVESTIGATION OF HYDROCEPHALUS MECHANISMS

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INTRODUCTION: Hydrocephalus results in approximately 2.6 billion dollars of financial strain on the healthcare system each year in the United States. The underlying pathomechanism of hydrocephalus is poorly understood, but further investigation is limited due to the ethical and logistical challenges posed by working with ex vivo brain tissue. This presents an opportunity for benchtop models that recreate the native brain environment for the investigation of hydrocephalus mechanisms. Here, a novel hydrogel formulation that mimics the viscoelasticity of native brain tissue with fine-tunable elastic and viscous parameters is presented as brain tissue phantom for such investigations.

METHODS: Glycosaminoglycans (GAGs) native to brain tissue – hyaluronic acid (HA) and chondroitin sulfate (CS) – were selected as the base biopolymers. These biopolymers were methacrylated and crosslinked using LAP photoinitiator under violet light to develop a non-cytotoxic hydrogel that mimics the frequency dependent behavior seen in native brain tissue. Weight volume percentage of CS was varied (1%, 2%, 4%) with 1% HA for each hydrogel, and 1%/1% gels were used for astrocyte encapsulation as initial proof-of-concept for cell viability. Resultant hydrogels were compared to in-house quantifications of polyvinyl-alcohol (PVA)-pytagel, gelatin methacrylate (GelMA), and unfixed excised post-mortem porcine brain tissue.

RESULTS: Storage and loss moduli for HA-CS hydrogels were of the same order of magnitude ($\sim 10^3$ KPa) as those reported in the literature for native brain tissue, with similar viscoelastic behavior between 0.1 - 10 Hz. Initial live/dead cell assays of encapsulated astrocyte-laden hydrogels showed that this formulation could successfully support cell life throughout the 3D gel construct.

CONCLUSIONS: These results indicate that a HA-CS hydrogel can replicate the viscoelastic behavior of native brain tissue and can support 3D astrocyte cell cultures. This hydrogel provides a novel brain tissue mimic that will allow for further benchtop investigations of the complex hydrocephalus pathology.

POSTOPERATIVE DELIRIUM FOLLOWING CSF SHUNT SURGERY FOR NORMAL PRESSURE HYDROCEPHALUS: A 5-YEAR RETROSPECTIVE ANALYSIS OF 326 PATIENTS

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INTRODUCTION: Delirium is a frequent postoperative complication in older neurosurgical patients and is closely associated with cognitive impairment and systemic stress. This study examines the incidence, causative factors, and cognitive outcomes of postoperative delirium (POD) in patients undergoing ventriculo-peritoneal (VP) or ventriculo-atrial (VA) shunt placement for Normal Pressure Hydrocephalus (NPH).

METHODS: Retrospective review of 326 elective primary VP or VA shunt procedures for NPH between January 2021 and January 2025. Delirium episodes were classified as acute (in-hospital), or delayed onset (readmission). Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA) or Mini-Mental State Examination (MMSE). Data collected included anaesthetic regimen, sedation depth, ASA score, clinical outcome, discharge delays and age. Co-morbid dementia diagnoses before and after surgery were analysed.

RESULTS: POD occurred in 43 patients (13.2%): 31 acute, 12 delayed onset. 24/43 had pre-operative moderate-to-severe cognitive impairment. Nine patients had a known diagnosis of dementia, while 13 received a new diagnosis post-operatively. Identified triggers included urinary retention (n=6), chest infection (n=5), urinary tract infection (n=4), over-drainage (n=3), hyponatremia (n=2) and single instances of hypoglycaemia, seizures, NSTEMI, acute kidney injury, intracranial haemorrhage, and autistic shutdown. Sixteen cases had no identifiable cause, likely stress-related. Among affected patients, 10 were ASA4 and 33 ASA3. ASA 4 was associated with an increased risk of delirium. Anaesthetic drug protocols were consistent, but depth of anaesthesia may influence risk and is the subject of ongoing analysis. Acute delirium was associated with prolonged hospital stay (1 vs 11-days $p<0.01$). Eight patients had persistent cognitive decline.

CONCLUSIONS: POD after shunt surgery for NPH is multifactorial and strongly associated with cognitive vulnerability. Both pre-existing and occult dementia play key roles. Although anaesthetic delivery was largely consistent, the technique itself may influence outcomes and warrants further study. Higher ASA scores and older age were also associated with increased POD risk.

GAIT OUTCOMES OF WHEELCHAIR DEPENDENT PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS FOLLOWING SHUNT PLACEMENT

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is characterized by gait deterioration, which may result in wheelchair-dependence. However, data on ambulatory recovery following ventriculoperitoneal shunt (VPS) placement in this subgroup are limited. This study aims to evaluate improvements in ambulatory ability after VPS placement among iNPH patients who were wheelchair-dependent at baseline.

METHODS: Patients treated with VPS for iNPH by the senior author between February 2019 and August 2024 were included. All patients were wheelchair-dependent prior to surgery, had a minimum of 6 months of postoperative follow-up, and had available detailed motion analysis both preoperatively and postoperatively.

RESULTS: We included 59 patients (median age 75.7 years [IQR 72.4–79.6]; 34.5% female), of whom 49 patients (84.5%) successfully became wheelchair-independent. At last follow-up (median 12.4 months [IQR 9.3–13.8]), 15 patients (25.9%) ambulated without assistive devices, 12 (20.7%) used a cane, and 22 (37.9%) used a walker. Patients who remained wheelchair-dependent were shorter (median 1.6 vs 1.7m, $p=0.05$), had a wider step width (18.9 vs 14.4 cm, $p=0.03$), and higher stability ratio (7.4 vs 2.7 steps/min, $p=0.04$). No significant differences in baseline gait velocity or stride length were observed. At last follow-up, patients achieving wheelchair-independence demonstrated significantly better gait performance, including higher velocity (0.65 vs 0.28 m/s, $p=0.01$), longer stride length (85.1 vs 43.0 cm, $p=0.01$), and improved stability ratio (1.9 vs 3.0 steps/min, $p=0.01$). Univariate regression analysis identified that wider baseline step width (OR 0.21, $p=0.02$) and higher baseline stability ratio (OR 0.22, $p=0.03$) were significantly associated with decreased odds of achieving wheelchair-independence.

CONCLUSIONS: In wheelchair-dependent iNPH patients, VPS placement resulted in high rates of functional recovery. Wider preoperative step width and higher stability ratio were predictive of persistent wheelchair dependence and may serve as valuable prognostic markers of patients with a low likelihood of significant improvement following VPS placement.

Patient Consent: The patient has provided their consent for the publication of this abstract.

QUANTITATIVE GAIT ANALYSIS USING A DEEP LEARNING-BASED APPLICATION REVEALS DISTINCT UPPER AND LOWER LIMB MOVEMENT PATTERNS IN HAKIM'S AND PARKINSON'S DISEASE

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INTRODUCTION: Pathological gait, such as shuffling, short-stepped, wide-based, or spastic gait, in patients with Hakim's disease (HD, iNPH), Parkinson's disease (PD), and cervical myelopathy (CM), has been evaluated subjectively and inconsistently among clinicians. To provide a quantitative assessment, we developed a smartphone-based application, the Three-Dimensional Pose Tracker for Gait Test (TDPT-GT), which estimates 3D relative coordinates of 24 body key points using deep learning without requiring physical markers.

METHODS: In this study, 1491 circular walking measurements (1-m diameter circle) were obtained from 122 patients with HD, 12 with PD, 93 with CM, and 200 healthy controls. Two-dimensional body axis projections were calculated from estimated 3D coordinates to assess joint motion. The ranges of angle of hip, knee, shoulder, and elbow joints, along with 75% tolerance ellipses for key points, were analyzed.

RESULTS: The angle ranges of hip and knee joints on the sagittal plane decreased in the healthy elderly > CM > PD > HD, while those of the shoulder and elbow followed healthy > CM > HD > PD. The outward displacement of the lower limbs on the axial plane increased in the healthy elderly < CM < PD < HD, whereas that of the upper limbs decreased. The strongest correlation was found between the hip and elbow joint angle ranges on the sagittal plane. The correlation between upper and lower limb movements was weaker in pathological gait than in healthy controls.

CONCLUSIONS: This study suggests that our application can quantitatively distinguish gait patterns among three pathological groups. In particular, distinct differences in upper and lower limb movement patterns were identified between patients with Hakim's disease and Parkinson's disease.

BIOMARKERS OF NEURODEGENERATION: COMPARISON BETWEEN iNPH, LOVA, AND OTHER NEURODEGENERATIVE DISEASES

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) and Long-standing Overt Ventriculomegaly in Adults (LOVA) are chronic adult-onset hydrocephalus forms. LOVA is typically considered a congenital, obstructive condition characterized by macrocephaly and marked ventriculomegaly, whereas iNPH may involve neurodegeneration and frequently overlaps clinically with other neurodegenerative disorders. Cerebrospinal fluid (CSF) biomarkers could aid in differential diagnosis, but no definitive CSF profile has been established for iNPH, and data for LOVA are lacking. Our study aims to analyze CSF neurodegeneration biomarkers in iNPH and LOVA patients, and compare them with profiles from other neurodegenerative diseases

METHODS: We analyzed CSF samples from patients with idiopathic Normal Pressure Hydrocephalus (iNPH, n=97), Long-standing Overt Ventriculomegaly in Adults (LOVA, n=20), Parkinson's disease (PD, n=26), Alzheimer's disease (AD, n=27), vascular dementia (VD, n=21), and frontotemporal dementia (FTD, n=18). Concentrations of total tau (T-tau), phosphorylated tau (p-tau), amyloid-beta 40 (A β 40), and amyloid-beta 42 (A β 42) were measured, and the A β 42/A β 40 ratio was calculated. Statistical comparisons were conducted using the Kruskal-Wallis H test followed by Dunn's post-hoc analysis with Bonferroni correction.

RESULTS: LOVA patients showed significantly lower T-tau and p-tau levels than those with AD, iNPH, VD, and FTD (p<0.05). AD patients exhibited significantly higher T-tau and p-tau than iNPH, LOVA, and PD (p<0.05). A β 40 levels were similar between LOVA and iNPH but significantly lower in LOVA compared to PD, AD, VD, and FTD (p<0.05). iNPH also showed lower A β 40 than AD and PD (p<0.05). The A β 42/A β 40 ratio was significantly reduced only in the AD group.

CONCLUSIONS: CSF biomarker profiles differ between iNPH and LOVA and show distinctive patterns compared to other neurodegenerative diseases. These findings may contribute to improved differential diagnosis, prognostic assessment, and surgical decision-making in the future.

HYPONATREMIA IN PAEDIATRIC PATIENTS UNDER 2 YEARS WITH NON-TUMOUR HYDROCEPHALUS SEEN AT THE KENYATTA NATIONAL HOSPITAL

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INTRODUCTION: Hydrocephalus is a prevalent neurological condition in pediatric populations, often leading to cognitive impairment and developmental delays. Hyponatremia is an electrolyte disturbance that can exacerbate neurological outcomes and can lead to severe complications, such as cerebral edema and seizures. Despite its clinical significance, there is limited data on the prevalence and severity of hyponatremia in children with hydrocephalus, particularly in resource-limited settings. This study aimed to determine the incidence of hyponatremia in children under 2 years with non-tumour hydrocephalus at Kenyatta National Hospital (KNH).

METHODS: A hospital-based prospective cohort study was conducted at KNH among 40 pediatric patients diagnosed with non-tumor hydrocephalus. Clinical assessments, serum sodium, serum and urine osmolality, urine sodium, and radiological parameters (Evans Index) were recorded. The type and severity of hyponatremia were classified based on standard biochemical criteria. Data was analyzed using SPSS, with Pearson correlations and Kruskal-Wallis tests applied where appropriate.

RESULTS: True hyponatremia (serum sodium <135 mmol/L with low osmolality) was found in 70% of participants. Of these, 25% had mild, 22.5% moderate, and 22.5% severe hyponatremia. The Evans Index showed a significant inverse correlation with serum sodium levels ($r = -0.472$, $p = 0.002$), while head circumference Z-scores did not. Euvolemic hyponatremia and SIADH were the most common subtypes. Following ventriculoperitoneal shunting (VPS) in 34 patients, mean serum sodium improved by 8.6 mmol/L, although 50% remained hyponatremic post-operatively.

CONCLUSION: Hyponatremia is a highly prevalent and clinically significant condition in pediatric patients with non-tumor hydrocephalus at KNH. Radiological ventricular dilation, as reflected by the Evans Index, correlates with hyponatremia severity. While surgical CSF diversion improves sodium balance in many cases, persistent hyponatremia remains common, necessitating continued biochemical monitoring and targeted management strategies.

Patient Consent: The patient has provided their consent for the publication of this abstract.

FEASIBILITY AND SAFETY OF THE NON-INVASIVE TAP TEST ("PUMPING-TEST") IN SHUNTED NPH-PATIENTS

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INTRODUCTION: The non-invasive tap ("pumping") test via the flushing reservoir of hydrocephalus shunts presents a potential alternative to invasive procedures such as infusion studies, shunt punctures etc. to detect shunt malfunction or underdrainage. The aim of this study is to demonstrate the safety and feasibility of the pumping test.

METHODS: A prospective study was conducted on 25 NPH patients shunted with a "Sprung-Reservoir" and a proGAV 2.0 with suspected underdrainage. The Sprung reservoir is a burr hole reservoir with an anti-reflux valve, the volume of the reservoir is 0,2 ml. With 100 pumps approximately 20 ml of CSF are withdrawn from the ventricles. Side effects were monitored for 15 min as well as clinical changes in gait.

RESULTS: The test was feasible in all patients. It was well tolerated without side effects or discomfort in 21 patients, with temporary headaches in 1 case and dizziness lasting less than 5 min in 3 cases. A clinical improvement within 10 mins was observed in 11 patients, and in 8 of these the valve was down-regulated in the same visit. In 14 patients no immediate change was seen, and these patients along with 3 from the previous group were given an observation sheet to document their gait changes over the next 7 days.

CONCLUSION: The pumping test via the Sprung reservoir proved to be a feasible, safe and effective tool for assessing shunt function, often providing rapid clinical feedback. Not all, but many of the available shunts allow a "pumping - test", however the mechanics must be understood by the examiner. The test can help to reduce the need for more invasive, potentially harmful, and expensive diagnostic procedures. It should be considered in cases of suspected suboptimal shunt performance or secondary clinical deterioration before performing invasive diagnostics.

HOME ICP MONITORING – A NEW PARADIGM FOR MANAGEMENT OF PATIENTS WITH HYDROCEPHALUS

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INTRODUCTION: Intracranial pressure (ICP) is typically measured in controlled hospital environments. However, shunt failure in hydrocephalus patients remain unpredictable, and the ability to monitor ICP remotely over the long term is considered a major unmet clinical need. A novel telemetric ICP system (Kitea Health) has been approved for first-in-human studies in New Zealand. This study reports the safety outcomes.

METHODS: Adults and children undergoing cerebrospinal fluid (CSF) shunt insertion or revision at Auckland City Hospital, New Zealand were eligible for inclusion. The Kitea sensor was implanted intraparenchymally, parallel to the ventricular catheter, at the time of shunt insertion or revision surgery. Participants were monitored under standard clinical follow-up over a three-month period.

RESULTS: Twelve participants (10 adults, 2 paediatric) were recruited, including 4 with normal pressure hydrocephalus, 4 with idiopathic intracranial hypertension, 2 with non-communicating hydrocephalus, 1 with communicating hydrocephalus, and 1 with an unknown etiology. No sensor-related adverse events were reported. All devices remained functional, and ICP readings were stable over time. Participants continued regular ICP recordings beyond three months, with the longest follow-up reaching 14 months without complication.

CONCLUSIONS: This study demonstrates that the Kitea telemetric ICP sensor is a safe and reliable tool for long-term monitoring in patients with hydrocephalus and a CSF shunt. These early findings support its potential integration into routine care to enable remote, home-based ICP monitoring.

Patient Consent: The patients have provided their consent for the publication of this abstract.

HOW LOW CAN WE GO? THE OPTIMAL INITIAL OPENING PRESSURE SETTING FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Although setting a low initial opening pressure in a programmable valve with a gravitational unit seems to be the gold-standard treatment for idiopathic normal pressure hydrocephalus (iNPH) patients, there are no studies in the literature describing the optimal initial low-pressure setting. Here, we sought to describe the optimal initial opening pressure setting for idiopathic normal pressure hydrocephalus in terms of both efficacy and safety.

METHODS: Patients with probable iNPH underwent shunt surgery with a programmable valve with a gravitational unit, using either an opening pressure of 3 cm H₂O or 6.5 cm H₂O, and were prospectively followed for one year. Clinical improvement and complications were recorded.

RESULTS: 19 patients with an opening pressure of 3 cm H₂O and 37 patients with an opening pressure of 6.5 cm H₂O were analyzed. There was no significant difference between the groups. A significant improvement in the iNPH Japanese scale score was observed one year following shunt placement in both the 3.0 cmH₂O ($p = 0.001$) and 6.5 cmH₂O groups ($p < 0.001$), but there was no statistical difference between groups ($p = 0.708$). 2 patients (10.5%) had subdural effusions that required surgery in the 3 cmH₂O group and none in the 6.5 cm H₂O group ($p = 0.043$).

CONCLUSIONS: Patients with iNPH treated with a programmable valve with an initial opening pressure of 6.5 cm H₂O showed the same clinical improvement as those treated with an initial opening pressure of 3 cm H₂O, but with fewer overdrainage complications.

Patient Consent: The patient has provided their consent for the publication of this abstract.

THE TEXTBOOKS WERE RIGHT - THE INTRACRANIAL PRESSURE-VOLUME RELATIONSHIP HOLDS UP IN LONG-TERM, AT-HOME ICP MONITORING OF HYDROCEPHALUS

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INTRODUCTION: The relationship between intracranial pressure (ICP) and pulse amplitude is often used as an index of intracranial compliance in clinical and research settings. However, it has not been investigated using long-term, home-based ICP recordings in patients with hydrocephalus and a CSF shunt. This study is the first to examine pressure-volume dynamics using telemetric ICP data collected at home from a heterogeneous hydrocephalus cohort.

METHODS: Twelve patients undergoing CSF shunt insertion or revision were implanted with a telemetric ICP sensor (Kitea Health). Patients or caregivers recorded 13-second ICP waveform measurements at home using a handheld wand. Mean ICP and pulse amplitude were extracted for each session. Amplitude was calculated using frequency domain analysis to isolate the dominant cardiac frequency. Each measurement was plotted as amplitude versus mean ICP and colour-coded by aetiology group and symptom presence.

RESULTS: A total of over 1,500 ICP measurements were collected from 12 patients, including 4 with normal pressure hydrocephalus, 4 with idiopathic intracranial hypertension, 2 with non-communicating hydrocephalus, 1 with communicating hydrocephalus, and 1 with an unknown aetiology. When plotted collectively, pulse amplitude increased with rising mean ICP in a pattern consistent with the expected intracranial pressure-volume curve. Visual inspection suggested possible differences in distribution by aetiology and symptom status, though no statistical comparisons were performed.

CONCLUSIONS: This study demonstrates the feasibility of plotting pulse amplitude-mean ICP relationships using long-term, home-based recordings in patients with hydrocephalus. These findings support future research into the potential of telemetric ICP data to characterise individual pressure-volume dynamics and identify clinically meaningful patterns across hydrocephalus aetiologies and symptom status.

Patient Consent: The patients have provided their consent for the publication of this abstract.

A LINK BETWEEN RADIOLOGICAL FEATURES AND INTRACRANIAL PRESSURE WAVEFORM COMPONENTS IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Previous studies have suggested that increased cardiac-related intracranial pulsations and vasogenic slow wave activity may contribute to ventricular enlargement in normal pressure hydrocephalus (NPH). This study examined the relationship between radiological markers of NPH and intracranial pressure (ICP) waveform components, along with compliance-related indices from overnight ICP monitoring.

METHODS: We retrospectively studied 121 patients with suspected NPH who underwent computerized overnight ICP monitoring. Three distinct ICP waveform components were analyzed: heartbeat-related ICP pulse wave amplitude (AMP), amplitude of respiration-induced ICP waves (RESP), and power of slow vasogenic waves (SLOW). In addition, compliance-related metrics—including the cerebrospinal compensatory reserve index (RAP) and the ICP pulse shape index (PSI)—were calculated from these high-resolution ICP recordings. Radiological assessments included the Evans Index (EI) and the Disproportionately Enlarged Subarachnoid Space Hydrocephalus (DESH) score from CT scans. Associations were assessed using Spearman's rank correlation (R_s), with significance set at $p < 0.05$. Ethical approval was obtained (ISLHD/LNR/2020-083); informed consent was waived due to the retrospective design and use of routinely collected data.

RESULTS: SLOW and RESP were significantly associated with DESH ($R_s = 0.34$, $p < 0.0002$; $R_s = 0.26$, $p < 0.004$, respectively) but not with EI. In turn RAP showed a positive association with EI ($R_s = 0.22$, $p < 0.02$) but not with DESH. No significant associations were found between DESH or EI and AMP or PSI.

CONCLUSIONS: ICP slow and respiratory wave activity—but not cardiac-related pulse components—were associated with DESH in NPH. Compliance-related indices were not associated with DESH; however, RAP showed an association with ventricular enlargement.

UPRIGHT CEREBRAL VENOUS PRESSURE AND ITS IMPLICATIONS FOR GLYMPHATIC DRIVING FORCES AND SULCAL NARROWING IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The glymphatic system has been identified as a critical mechanism for interstitial fluid clearance in the brain. It is presumed to rely on pressure gradients to drive fluid exchange, but the exact nature of these forces, especially under upright physiological conditions, remains uncertain. Disruptions in glymphatic flow have been implicated in pathological conditions, including normal pressure hydrocephalus (NPH) and brain structural changes observed in astronauts after prolonged spaceflight. This study aims to investigate the static driving pressure of the glymphatic system by analyzing upright intracranial venous pressure and proposing a mechanism linked to sulcal narrowing.

METHODS: Twenty-one NPH patients were studied. Intracranial venous pressure in the upright sitting position was estimated using compliance curve analysis adapted from Ohmura et al. Simultaneous intracranial pressure (ICP) measurements were recorded under shunt-off and shunt-on conditions. The pressure gradient between the brain parenchyma (assumed equivalent to venous pressure) and cerebrospinal fluid (CSF) was calculated, correcting for the vertical distance between the pressure sensor and the external auditory canal. Healthy upright CSF pressure was estimated using vertebral-level zero-pressure site data from Magnaes et al.

RESULTS: The mean upright intracranial venous pressure was -0.78 ± 2.46 mmHg. ICP during shunt-off was $+1.47 \pm 13.59$ mmHg, and -10.96 ± 7.13 mmHg during shunt-on. The brain-to-CSF pressure gradient was -2.45 ± 4.16 mmHg (shunt-off) and $+9.73 \pm 7.74$ mmHg (shunt-on). Estimated upright CSF pressure in healthy individuals was -4.11 ± 3.27 mmHg, indicating a physiological glymphatic perfusion pressure of approximately $+3.3$ mmHg.

CONCLUSIONS: A small static pressure gradient from brain to CSF in the upright position may be sufficient to drive glymphatic flow. Disruption of this gradient may contribute to sulcal narrowing in NPH and spaceflight. Shunt surgery may restore this gradient and improve interstitial clearance.

Patient Consent: Written informed consent was obtained from all patients for the use and publication of anonymized data in this study.

A STUDY ON OPTIMAL VALVE PRESSURE AFTER VENTRICULOATRIAL SHUNT IN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: In normal pressure hydrocephalus (NPH), selecting the optimal shunt pressure is considered important, and a quick reference table (QRT) serves as a indicator for VP shunts. However, no such indicator exists for ventriculoatrial shunts (VAS). In this study, we retrospectively evaluated the postoperative pressure settings in cases where VAS were performed and investigated the optimal pressure for VAS.

METHODS: Among NPH patients aged 60 years or older who underwent VAS, we investigated postoperative valve pressure changes and modified Rankin scale (mRS) and iNPH grading scale (iNPHGS) after valve pressure changes in 54 cases in whom preoperative height and weight were recorded and SPVA-140 was used for the shunt valve.

RESULTS: The mean age at surgery was 78.0 ± 6.1 years, and preoperative height, weight, BMI, and ICP were 154.6 ± 9.4 cm, 53.4 ± 9.8 kg, 22.3 ± 3.1 , and 125.0 ± 33.9 mmH₂O, respectively. The median preoperative mRS and iNPHGS scores were 3 (IQR: 2–3) and 6 (IQR: 4.75–8), respectively. The postoperative follow-up period was 3.3 years (IQR: 2.0–6.1), and the mRS and iNPHGS scores at the time of maximum symptom improvement were 2 (IQR: 1–2) and 3 (IQR: 1–4), respectively. The initial shunt valve pressure was 140 cmH₂O in 87% of cases and 110 cmH₂O in 13% of cases. The optimal pressure, at the time of maximum symptom improvement, was 10 cmH₂O (IQR: 10–40). No correlations were observed between preoperative height, weight, BMI, ICP, and optimal pressure ($p = 0.59$, $p = 0.52$, $p = 0.27$, $p = 0.21$, respectively).

CONCLUSIONS: The optimal pressure for VAS differs from that for VP shunts, and it is suggested that the most effective pressure is likely to be set at a very low level of 10–40 cmH₂O.

Patient Consent: The patient has provided their consent for the publication of this abstract.

NECESSITY OF THE TAP TEST IN PATIENTS WITH DESH: VALIDATION OF THE JAPANESE TREATMENT GUIDELINES

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INTRODUCTION: Tap tests are widely used to predict the efficacy and thus determine the indication of shunt surgery in idiopathic normal pressure hydrocephalus (iNPH). The Japanese iNPH guidelines suggest that patients with imaging features of disproportionately enlarged subarachnoid space hydrocephalus (DESH) may proceed to shunt surgery without tap tests. At our institution, however, we provide tap tests for all the patients with suspected iNPH regardless of DESH findings. This study aimed to evaluate the validity of this guideline recommendation.

METHODS: We retrospectively analyzed patients with suspected iNPH (based on clinical symptoms, history, and radiographical findings) with modified Rankin Scale scores of 0–3, between May 2020 and December 2024. DESH was defined by tight high-convexities and enlarged Sylvian fissures. Tap test results were considered positive if the gait improved within 7 days. Patients were classified into four groups according to the presence or absence of DESH (DESH(+/-)) and the tap test result (tap(+/-)). We calculated the sensitivity and specificity of DESH in predicting tap test positivity, and odds ratios (ORs) for postoperative gait improvement at 1 and 3 months of the DESH(+)/tap(–) group compared to the tap(+) group.

RESULTS: Among the 268 included patients (mean age 79.4 (SD 5.8), median TUG 17.5 sec (IQR 13.8–25.9)), 12 (4.5%) were DESH(–)/tap(–), 90 (34.0%) were DESH(–)/tap(+), 14 (5.3%) were DESH(+)/tap(–), and 149 (56.2%) were DESH(+)/tap(+). Sensitivity and specificity of DESH for tap(+) were 62.3% and 46.2%, respectively. Gait improvement in the DESH(+)/tap(–) group was significantly less common compared to the tap(+) group (41.7% vs 78.4%, crude OR (95%CI): 0.20 (0.06–0.65) at 1 month; crude OR 0.14 (0.03–0.55) at 3 months).

CONCLUSION: Tap tests remain essential for determining surgical indication in suspected iNPH, even among patients with radiographical features of DESH.

Patient Consent: The patients have provided their consent for the publication of this abstract

FROM MRI IMAGING TO INFUSION: INVESTIGATING THE ROLE OF CONVEXITY TIGHTNESS IN CSF CIRCULATION IMPAIRMENT

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INTRODUCTION: Two key biomarkers—resistance to CSF outflow (Rout) and disproportionately enlarged subarachnoid space hydrocephalus (DESH)—are associated with diagnosis and prognosis in NPH. While Rout is derived from invasive testing, DESH is quantifiable on MRI. This study investigates whether tightness over three physiologically interesting regions of the high convexities, related to DESH and expected CSF outflow pathways, correlates with increased Rout, potentially offering a pathophysiological explanation for NPH signs and symptoms.

METHODS: From a retrospective cohort of patients evaluated for shunt surgery, those with complete preoperative infusion tests and 3D T1-weighted MRI scans were included. Rout was calculated from lumbar infusion tests, and the CSF volume of the high convexities was segmented using a semi-automated method in MATLAB. We selected three key anatomical areas: the medial high convexities (near arachnoid granulations), the motor cortex territory for lower limbs, and part of the high convexity SAS.

RESULTS: 264 patients with ventriculomegaly were analysed. Rout was 12.5 ± 8.4 mmHg/(mL/min), with medial high convexity volumes [mL] of 15.9 ± 8.1 , SAS high convexity volumes of 6.7 ± 3.3 and lower limb territory volumes 10.4 ± 5.2 . There was no correlation between high convexity volume and Rout for any of the volumes investigated ($-0.2 < R < 0.2$ and $p < 0.2$ for all). For Rout ≥ 12 (N=170) and ≥ 15 (N=71) R was -0.17 to 0.13 , $p > 0.1$.

CONCLUSIONS: With our present neuroanatomical correlations, it appears there is no link between Rout and high convexity volumes. No link to tightness over the arachnoid granulations argues against obstruction of CSF reabsorption by upward brain shift. Additionally, tightness over the medial motor cortex and at the high convexity SAS do not seem to be contributing to increased Rout, denoting compensation through alternative circulatory routes.

STABILITY ANALYSIS OF INTRACRANIAL PRESSURE

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INTRODUCTION: The arterial pulse is an energy pump, and the cranium is a frequency-sensitive energy filter. Normally, pulsatile energy flows from the arterial pulse through cerebrospinal fluid to the veins, safeguarding smooth capillary perfusion and aiding venous blood flow. This is the cerebral windkessel system. Intracranial pressure (ICP) is intracranial pressure energy density, so when the windkessel energy filter is impaired and energy accumulates in the cranium, ICP rises. The accumulation of intracranial energy is a form of dynamic instability, and ICP can be stable or unstable according to Bounded-Input Bounded-Output (B.I.B.O.) stability criteria. We test B.I.B.O. stability with Z-transform analysis under normal conditions and with increased ICP in a canine model.

METHODS: We anesthetized 12 dogs and recorded arterial blood pressure (ABP) and ICP simultaneously. We increased ICP by injecting saline into the subarachnoid space and analyzed the frequency response of the cranium using the z-transform with ABP as input and ICP as output, both at normal and high ICP levels.

RESULTS: According to B.I.B.O. criteria, all 12 dogs had stable intracranial dynamics at normal ICP. Early in ICP elevation, all dogs showed transient B.I.B.O. instability at DC frequency due to increased intracranial mass from the saline bolus.

CONCLUSIONS: B.I.B.O. instability leads to elevated ICP due to energy buildup in the brain, causing tissue damage, swelling, and herniation. The z-transform identifies and measures the causes of instability, such as new mass lesions, edema, or hydrocephalus, and can predict the rate and severity of ICP instability. It also offers real-time analysis of the effectiveness of therapies for elevated ICP. The measurement of B.I.B.O. instability offers a method for predicting elevated ICP and may offer insights into the cause of elevated ICP and the effectiveness of its treatment.

SPONTANEOUS INTRACRANIAL HYPOTENSION (SIH) AFFECTS ALL AGES AND BODY TYPES: RESULTS FROM 397 PATIENTS

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INTRODUCTION: Spontaneous intracranial hypotension (SIH) is identified with increasing frequency in recent years. Traditionally, SIH has often been stereotyped as a very rare condition affecting young, slender, tall, females perpetuating the assumption of connective tissue disorders. This study aimed to describe basic demographic and imaging findings in patients with SIH and to explore patterns related to the underlying CSF leak type.

METHODS: We conducted a retrospective analysis of patients with confirmed spontaneous spinal CSF leaks diagnosed at our tertiary CSF Center between 2018 and 2024. Data on Age, sex, BMI, leak type, and Bern score were collected.

RESULTS: A total of 397 patients were included (61% female, age 48.4 ± 14.5 years (range 11 – 89 years), BMI 24.8 ± 4.6 kg/m²). The Bern Score was 4.9 ± 2.9 . Leak types were distributed as follows: ventral leaks (56.2%), lateral leaks (18.9%), CSF-venous fistulas (20.7%), and sacral leaks (4.3%). Leaks were found across the levels C5/C6 to L2/3 with a predominance of ventral leaks in the upper thoracic spine (T1/2 - T3/4; 42.2%), whereas lateral leaks and CSF-venous fistulas were most common in the lower thoracic spine (T8/9 - T11/12; 49.3% and 46.3%, respectively). Patients with CSF-venous fistulas were significantly older (60.4 ± 16.0 years) than those with ventral and lateral leaks (47.3 ± 12.3 years, 40.4 ± 10.4 years; $p < 0.001$, respectively). Unlike the female predominance seen in lateral leaks (74.7% female) and ventral leaks (59.3% female), sex distribution among CSF-venous fistula cases was balanced (50% female).

CONCLUSIONS: This large SIH cohort reflects a demographically broad population, extending to the upper range of normal BMI. SIH predominantly affects individuals in their working years, highlighting its potential socioeconomic burden if left untreated. Notably, CSF-venous fistulas affect older and more male patient- challenging long-held assumptions about the typical SIH patient profile.

DRAIN – DOUBLE-BLIND RANDOMIZED ACETAZOLAMIDE TRIAL IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: There is currently no pharmacological treatment available for patients with idiopathic normal pressure hydrocephalus (iNPH). This study aimed to evaluate whether the carbonic anhydrase inhibitor acetazolamide improves gait function in patients with iNPH.

METHODS: This was a double-blind, randomized, placebo-controlled trial conducted at a single center. A total of 50 patients were enrolled, with 25 randomized to receive placebo and 25 to receive acetazolamide. The median treatment duration was 112.5 days, with a median dosage of 1.8 capsules per day (250 mg per capsule in the active treatment group). Median treatment compliance was 98.6%. The primary outcome was change in gait function before and after treatment, assessed using a composite score combining time and step count from the 10-meter walk test, timed up-and-go test, and 3-meter backward walk test.

RESULTS: Participant inclusion was completed in November 2024, and unblinding is scheduled for spring 2025. Results for the primary outcome will be presented at the Hydrocephalus 2025 conference.

CONCLUSIONS: The findings from this study may provide a foundation for future, larger-scale trials investigating pharmacological treatment options for iNPH.

ADVANCING HYDROCEPHALUS PATIENT EDUCATION AND SUPPORT: IMPLEMENTING AND ASSESSING IMPROVEMENTS IN A VIRTUAL NORMAL PRESSURE HYDROCEPHALUS SUPPORT GROUP

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INTRODUCTION: The clinical stigmata of Normal Pressure Hydrocephalus (NPH) includes gait, cognitive, and urinary issues. Despite these potential barriers to participation in support groups, we previously demonstrated active engagement and educational benefits for in-person and virtual physician-led NPH support groups. This study shows that introduction of novel educational engagement features helps to create a more engaging and sustainable virtual model.

METHODS: Monthly virtual meetings were held 7/2023-5/2025 for NPH patients and their friends/families. The meeting format included: introduction (10 minutes), presentation (15 minutes), discussion/audience questions (30 minutes), and poll questions (5 minutes) about educational and emotional benefits. New features added included peer-led sessions, real-time translation into any Zoom-supported language, and physician presentations from non-neurosurgery but NPH related specialties.

RESULTS: We hosted 20 virtual sessions attended by 1,119 participants. Participants rated knowledge gained, self-efficacy, and satisfaction between 4.27 and 4.66 on a 5-point scale—well above the favorable cutoff of 3, confirming strong positive impact. Key impact metrics improved: average attendance rose from 31 to 55 participants per session, audience engagement grew from 23 to 36 questions per meeting, and international reach expanded from 12 to 124 non-U.S. participants. Attendance peaked during our joint session with Hydrocephalus Canada, whereas the greatest volume of questions arose in the interactive polling meetings, where participants had pre-submitted questions for discussion.

CONCLUSIONS: A virtual platform enhanced with peer leadership, multilingual translation, and multidisciplinary presentations sustained high satisfaction/engagement, and amplified knowledge, sense of community, and global reach. Participants valued these meetings for education gained, camaraderie through shared experiences, and the chance to help and advocate for others with NPH. Because the format involves straightforward infrastructure and accommodates multiple languages, it offers a practical template for support-and-education programs across other neurological disorders—especially where geography, mobility, or specialist access are limiting factors.

THE BRAIN IN SPACE: MRI QUANTIFICATION OF STRUCTURAL CHANGES TO THE CEREBROSPINAL FLUID, BRAIN AND EYE IN ASTRONAUTS

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INTRODUCTION: Keeping astronauts healthy is challenging due to the many deleterious impacts of long-duration spaceflight on human health and performance. Spaceflight associated neuro-ocular syndrome (SANS), a pathology documented in several astronauts, could permanently alter the eye and brain shape and function. At present, there is no clear understanding of causative or preventative factors for SANS. Here, we investigate a variety of MR-based structural CNS variables in astronauts to help identify potential factors underlying SANS pathophysiology.

METHODS: T1 and T2 MRI were collected before and after spaceflight from 26 astronauts (~6 mo spaceflight) and 10 control participants not exposed to spaceflight. Whole brain (WB), gray matter (GM), white matter (WM), extra-axial cerebrospinal fluid (eaCSF) and optic globe segmentations were used to quantify pre- to post-flight center-of-mass structural shift within the skull and volumetric changes. Custom algorithms were developed and applied to semi-automatically quantify posterior optic globe flattening, optic nerve and nerve sheath cross-sectional area and tortuosity.

RESULTS: In astronauts, we found significant change from baseline for the following parameters: WB volume $15063 \pm 19710 \text{ mm}^3$, WB superior shift $0.75 \pm 0.47 \text{ mm}$, eaCSF volume $-3280 \pm 11462 \text{ mm}^3$, eaCSF superior shift $-2.3 \pm 1.32 \text{ mm}$, ventricle volume $2210 \pm 1745 \text{ mm}^3$, optic globe anterior shift $0.82 \pm 0.51 \text{ mm}$, and optic globe flattening of $8.7 \pm 10.8 \text{ mm}^3$. None of these changes were observed in controls at a 1 yr follow-up. In astronauts, there was a positive association between superior brain shift and anterior eye shift ($r^2=0.25$, $p=0.0062$), but not anterior eye shift and optic globe flattening ($r^2=-0.023$, $p=0.51$). Optic globe flattening lacked correlation with superior brain shift.

CONCLUSIONS: Methods were developed and applied to quantify intracranial and ocular structural changes in astronauts and tested for consistency in controls. These methods can be applied in future space missions and terrestrial disease states.

Patient Consent: This is an IRB approved study and all participants have provided their consent for the publication of data included in this abstract.

CSFSIM: A SIMULATION FRAMEWORK FOR CEREBROSPINAL FLUID DYNAMICS AND HYDROCEPHALUS SHUNT SYSTEMS

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INTRODUCTION: Modeling and analysis of the cerebrospinal fluid (CSF) dynamics play a vital role in understanding the underlying processes that drive CSF disorders and are essential for the development of hydrocephalus shunt systems. While many CSF models have been developed over the last decades, their accessibility remains limited as implementations are rarely published and the mathematical details are often not sufficiently described.

METHODS: To facilitate independent validation, replication, and systematic comparison of CSF dynamics models, we developed a unified and open-source simulation framework that incorporates a variety of the most prominent lumped-parameter models. The framework enables the creation of a patient-specific simulator through the automated estimation of model parameters from physiological measurements and personalized cerebrovascular forcing generators. Furthermore, shunt systems with adjustable physical properties and control strategies can be integrated for closed-loop simulations.

RESULTS: To evaluate the framework, two case studies were conducted using previously published in vivo data from an ovine research model of CSF dynamics. First, the parameters of the Marmarou (1978) model were estimated using measurements of intracranial pressure (ICP) and CSF infusions. The resulting model was subsequently used to study the influence of different shunt designs on ICP. Second, the Ursino (1988) model and a cardiovascular forcing generator were fitted using measurements of ICP and arterial blood pressure. The resulting model was subsequently used to study the effect of potential changes in CSF outflow resistance on CSF and blood pressures, as well as autoregulatory activity.

CONCLUSIONS: The framework's ability to accurately estimate the parameters of CSF models may provide clinicians with deeper insights into a patient's pathophysiology, enabling more personalized treatment decisions for hydrocephalus. Additionally, a standardized simulation framework can support the development of new CSF models for fundamental research on CSF disorders and the design of smart shunt systems for improved therapy outcomes.

CODE: <https://gitlab.ethz.ch/ics/csfsim>

NEW CE-AUTHORIZED NON-INVASIVE ADJUSTABLE CSF FLOW DEVICE WITH A REAL OFF FUNCTION FOR THE TREATMENT OF COMPLEX HYDROCEPHALUS

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INTRODUCTION: The purpose of an implantable shunt is to achieve physiological pressure values (ICP) by controlling an artificial outflow from the CSF-System into another body cavity. The resulting ICP is regulated by the opening pressure of the valve and resistance of the shunt, but also by the volume outflow over time after valve opening. While the function of adjustable and gravitational valves is fairly understood, the additional effect of the CSF flow velocity has only scarcely been discussed. In this context, we present a novel implantable adjustable flow restrictor as additional contribution to the treatment of hydrocephalus.

METHODS: Based on the well-established technology of adjustable valves, the newly developed M.flow offers the option of adjusting the length of a constricted channel within the implant resulting in true flow regulation. The CSF outflow rate is defined by the effective length of the constricted channel.

RESULTS: The M.flow is a CE-marked implantable device for CSF-flow adjustment. Its intended use is to combine it with other valve types. In vitro studies have shown that the flow rate can be adjusted precisely and reliably. When a constant pressure gradient acts on the device, the amount of CSF flow over time is setting dependent. This is achieved by varying the positioning of a magnetically adjustable rotor that may bypass the channel or increases its flow length. In addition, the rotor position at its highest position may also reliably close the channel for possible shunt weaning.

CONCLUSIONS: M.flow represents a promising solution for difficult hydrocephalus cases and offers a new and innovative control of CSF outflow in patients, which may be particularly important for patients with low intracranial compliance. The device is currently being implanted in European clinics as part of a controlled pioneering phase and will promote the exchange of knowledge and further clinical experience.

ENDOSCOPIC VENTRICULAR LAVAGE VERSUS CONVENTIONAL EXTERNAL DRAINAGE IN SPONTANEOUS INTRAVENTRICULAR HAEMORRHAGE: MATCHED-COHORT EVIDENCE OF SUPERIOR CLOT CLEARANCE AND OUTCOMES

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INTRODUCTION: Spontaneous intraventricular haemorrhage (IVH) carries a $\approx 50\%$ mortality and is traditionally managed with external ventricular drainage (EVD), yet catheter occlusion, prolonged intensive-care stay and chronic hydrocephalus limit its effectiveness. Neuroendoscopic ventricular lavage permits direct clot evacuation and CSF pathway restoration. We compared lavage + EVD with EVD alone in matched adults with spontaneous IVH.

METHODS: In this single-centre retrospective cohort-matched study (2018 – 2024), 23 consecutive lavage patients were matched 1:1 to 23 EVD controls for age, admission Glasgow Coma Scale and modified Graeb score. The primary endpoint was shift in 90-day modified Rankin Scale (mRS). Secondary endpoints were radiological clot clearance, EVD time, ICU length-of-stay and ventriculoperitoneal shunt (VPS) implantation rate

RESULTS: Baseline characteristics were comparable. Endoscopically treated patients achieved 66.7% greater clot clearance (mean $\Delta mGraeb = 13 \pm 5.8$) and halved catheter duration (3 ± 2.5 days vs 7 ± 5.7 days, $p < 0.001$). ICU stay was reduced three-fold (8 ± 5.4 days vs 25 ± 19.3 days, $p = 0.002$). VPS was required in 13% of ENDO versus 26% of EVD patients ($p = 0.03$). Ordinal logistic regression demonstrated an independent shift toward better functional outcome with lavage group (adjusted common OR = 2.9); median 90-day mRS improved from 5 to 3 ($p = 0.005$).

CONCLUSIONS: Neuroendoscopic ventricular lavage combined with EVD provides superior radiological clearance, shorter catheter and ICU requirements, lower shunt dependence and significantly better early functional recovery than EVD alone in spontaneous IVH. These findings support endoscopic treatment as a valuable adjunct to standard drainage and warrant confirmation in prospective multicentre trials.

MANAGEMENT OF CHRONIC SUBDURAL HEMATOMA IN SPONTANEOUS INTRACRANIAL HYPOTENSION

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INTRODUCTION: There is no established algorithm for the management of chronic subdural hematoma (cSDH) caused by spinal CSF leaks in spontaneous intracranial hypotension (SIH). This study analyses characteristics of cSDH in SIH and aims to establish a practical management algorithm.

METHODS: This retrospective cohort study included all patients with spinal CSF leak closure from April 2018 to April 2024. Demographics, leak type, treatment modalities, as well as cSDH characteristics, prevalence, and risk factors were analyzed.

RESULTS: Among 272 SIH patients, 85 (31%) concomitantly had cSDH, predominantly bilateral (88%). Hematoma width ranged from 2 to 30mm. CSDH prevalence was highest in CSF-venous fistulas (43%), followed by ventral (31%) and lateral leaks (22%). Male sex (OR=4; $p<0.001$) and age >70 years (OR=6; $p=0.008$) were significant risk factors. Surgical evacuation was performed in 23 patients, with symptoms attributable to cSDH in 17/23 patients. The biggest cSDH without surgical treatment was 20mm. No neurological deterioration occurred during diagnostics or treatment of CSF leaks. After leak closure, no cSDH, regardless of initial size or previous treatment, required additional treatment, and no recurrence occurred in the 3-month follow-up.

CONCLUSION: Primary localization and treatment of the spinal leak is safe in asymptomatic patients and cSDH width ≤ 10 mm ("leak first" strategy). Immediate evacuation of the cSDH is mandatory in symptomatic patients ("subdural first" strategy). Spinal surgery might be considered a causal treatment for cSDH in SIH that goes beyond a purely conservative approach. Prospective validation of these findings is needed.

QUANTITATIVE ANALYSIS OF NEUROFLUID DYNAMICS IN CHIARI SYNDROME: TOWARD A BETTER UNDERSTANDING OF SYMPTOM GENESIS

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INTRODUCTION: Chiari Syndrome (CS) is defined by ptosis of cerebellar tonsils below the McRae's line and can be associated with symptoms or not. No morphological feature predicts symptom development. Alterations in neurofluid dynamics during cardiac cycle (CC) have been observed in CS. CSF flow is passively driven by intracranial arteriovenous volume changes occurring throughout CC. Phase-contrast MRI (pcMRI) is the only non-invasive method to evaluate these dynamics across CC. Under physiological conditions, CSF compensates for intracranial vascular volume changes. Due to the increased resistance to CSF flow at the foramen magnum (FM) from tonsillar descent, analyzing CSF dynamics is crucial. This study aims to compare CSF dynamic responses to arteriovenous volume fluctuations in symptomatic and asymptomatic patients.

METHODS: 93 CS patients were retrospectively included (68 symptomatic, 25 asymptomatic). All patients underwent pcMRI to quantify the CSF stroke volume at three key levels: the prepontine cisterns (SVppc) represent intracranial subarachnoid spaces, the FM (SVfm), and the C2–C3 level (SVcerv) (represent subarachnoid extracranial spaces). Intracranial arteriovenous stroke volume (intracranial vascular volume change) (SVvasc) was also measured. The study focused on analyzing correlations between CSF stroke volume and SVvasc.

RESULTS: In symptomatic CS group, significant correlations were observed between SVppc and SVvasc ($\rho=0.5$, $p<0.001$), SVfm and SVvasc ($\rho=0.32$, $p=0.03$), and SVcerv and SVvasc ($\rho=0.58$, $p<0.001$). No significant correlations were found in asymptomatic CS group.

CONCLUSIONS: CSF compensates for intracranial vascular stress occurring during CC. Asymptomatic patients show no correlation between CSF and vascular dynamics, suggesting other compensatory mechanisms may be in place to offset the altered CSF flow at the FM. Symptomatic patients display a direct correlation indicating possible dysfunction or exhaustion of these alternative mechanisms. Differences in neurofluid dynamics exist between symptomatic and asymptomatic patients. Investigating these alterations may help clarify the pathophysiological origin of symptoms and enhance treatment strategies.

Patient Consent: The patient has provided their consent for the publication of this abstract.

DIAGNOSTIC ACCURACY OF SHUNTOGRAPHY IN SUSPECTED CEREBROSPINAL FLUID SHUNT MALFUNCTION: A SAFE AND EFFECTIVE NON-INVASIVE IMAGING MODALITY

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INTRODUCTION: Permanent cerebrospinal fluid (CSF) diversion procedures are widely used for managing hydrocephalus and raised intracranial pressure. Shunt malfunction is a common and serious complication, yet diagnosis often relies on clinical signs and conventional imaging, which may be inconclusive. Shuntography (shuntogram) is a minimally invasive, fluoroscopy-guided technique involving iodinated contrast injection into the shunt reservoir to directly visualize cerebrospinal fluid (CSF) flow and assess shunt integrity, including proximal and distal components.

METHODS: We retrospectively reviewed adult patients who underwent shuntography for suspected shunt malfunction over an 18-month period at the National Hospital for Neurology and Neurosurgery. Data collected included demographics, underlying CSF pathology, shunt type, shuntogram findings, clinical management, and correlation with intraoperative results when available.

RESULTS: Fifty-six patients (22 males [40%], 34 females [60%]) were included. The most common etiologies were congenital hydrocephalus (n=17), normal pressure hydrocephalus (n=9), tumour-related hydrocephalus (n=7), Chiari malformation (n=6), idiopathic intracranial hypertension (n=6), post-subarachnoid haemorrhage (n=3), post-infectious (n=1), and others (n=7). Most had VP shunts (n=40); others had ventriculoatrial (n=5) or ventriculothecal (n=4) shunts. No contrast- or procedure-related complications were reported. Shuntograms were normal in 28 patients (50%) and abnormal in 28 (50%). Among normal studies, 12 underwent valve setting adjustments, 2 had revisions, and 14 required no intervention. Abnormal findings included proximal obstruction (n=9), distal obstruction (n=6), tube fracture (n=4), valve dysfunction (n=3), slow distal flow (n=3), shunt-bowel fistula (n=1), functional obstruction (n=1), and displaced thecal catheter (n=1). Twenty-five patients underwent revision surgery, with complete concordance between imaging and intraoperative findings. One patient was shunt-independent, one had ICP monitoring, and one is awaiting elective revision.

CONCLUSIONS: Shuntography is a safe, accurate, and non-invasive diagnostic adjunct in evaluating suspected shunt malfunction, with excellent operative correlation and no procedural complications.

Patient Consent: The patient has provided their consent for the publication of this abstract.

ASSESSING INTRACRANIAL FLUID DYNAMICS USING FUNDOSCOPY

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INTRODUCTION: Fundoscopy allows direct, noninvasive visualization of retinal vessels, offering a unique window into cerebral hemodynamics due to shared anatomical and physiological pathways between the eye and brain. Changes in intracranial pressure (ICP) and brain compliance may impair venous outflow, leading to retinal venular dilation and a reduction in the arteriole-to-venule (A/V) ratio. While current invasive methods for ICP monitoring are accurate, they are limited by risk and accessibility. This thesis investigates whether the A/V ratio, obtained through automated retinal imaging, can serve as a surrogate marker of ICP and compliance in both acute and chronic neurological conditions, including iNPH.

METHODS: Fundoscopy videos were collected from three populations: anesthetized pigs with controlled ICP changes, sedated patients in the neurointensive care unit, and patients undergoing diagnostic work-up for iNPH. Retinal vessels were segmented and classified using AI-assisted image analysis. Arteriolar and venular diameters were measured to calculate the A/V ratio, enabling the investigation of its correlation with intracranial pressure and compliance across experimental, acute, and chronic clinical settings.

RESULTS: In pigs, a strong inverse correlation between A/V ratio and ICP was observed (slope: -0.0027 [95%-CI: $-0.0039347 - (-0.0014121)$], $p < 0.001$). In NICU patients, relative ICP changes could be detected when ICP exceeded 15 mmHg (slope: -0.0659 , 95%-CI: $[-0.0665; -0.0653]$, $p < 0.001$), but absolute ICP could not be estimated. In the iNPH cohort, A/V ratio was significantly lower in iNPH patients compared to controls ($p = 0.02$), despite similar mean ICP ($p = 0.8$), suggesting the A/V ratio may reflect impaired compliance rather than static pressure.

CONCLUSIONS: The A/V ratio reflects relative changes in ICP and may serve as a noninvasive marker of brain compliance. It shows potential for screening and monitoring in both acute and chronic neurological conditions.

COGNITIVE REASONING IN ADULT VENTRICULOPERITONEAL (VP) SHUNT SURGERY: A HUMAN FACTORS PILOT STUDY

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INTRODUCTION: Ventriculoperitoneal (VP) shunt surgery is an index neurosurgical procedure learned early on in neurosurgical training. Whilst relatively straightforward, shunt surgery is associated with a high rate of complications and early revision surgery, the risk of which is related to surgeon experience. This study aimed to qualitatively explore the underlying differences in approach between experienced and inexperienced neurosurgeons. We aim to deconstruct the procedural reasoning, anticipatory reasoning, and adaptive thinking between consultants and trainees performing adult VP shunt surgery.

METHODS: Fourteen neurosurgeons were recruited from the UK, US, and Canada (n=6 Experts (>15 years since start of neurosurgery residency); n=8 Non-experts (≤15 years neurosurgery experience)). Participants were interviewed using a structured, concurrent think-aloud (TA) protocol and were asked to narrate their approach to a standardized adult VP shunt case. Transcripts were inductively analyzed to elucidate the steps, the order they were carried out in (procedural knowledge) and their explanations and decision-making process.

RESULTS: All participants successfully narrated core procedural steps. However, cognitive differences were discovered. Experts had a richer descriptive narrative of the procedure, they consistently verbalized the rationale behind each step, how they were carrying it out, and why they chose this approach over alternative approaches. Non-experts narrated procedures in a linear, step-by-step manner, often without providing explanation or foresight. Experts anticipated a range of risks and even fallback planning, while non-experts relied more on reactive reasoning.

CONCLUSIONS: Surgeons with more experience demonstrated a higher capacity to anticipate and prepare for potential complications. They were able to think beyond the core steps of the procedure. This may underpin the higher rates of complications associated with less experience. The findings highlight the need for training models that cultivate cognitive reasoning, a deeper understanding of the surgical procedure and proactive risk anticipation alongside the technical skills to carry out the procedure.

VALVE-AGNOSTIC CRANIAL IMPLANT IN NORMAL PRESSURE HYDROCEPHALUS VENTRICULOPERITONEAL SHUNTING: A CASE SERIES

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is commonly treated with ventriculoperitoneal shunting, though shunt revisions remain a frequent complication. The Valve-Agnostic Cranial Implant (VACI, "InvisiShunt®" Longeviti, Inc.), is designed to countersink ventriculo-peritoneal shunt valves, in order to reduce dehiscence and the need for revision. These were first implanted in 2019 and offer a low-profile alternative to traditional subgaleal shunt placement. However, only one prior clinical trial report of its use exists to-date (n=25). This case series of twenty-five patients seeks to add to the existing literature on VACI efficacy in NPH patients.

METHODS: Twenty-five patients diagnosed with NPH underwent implantation of the VACI (InvisiShunt®), at a mean age of 80 ± 10.1 years. This case series was conducted at Hoag Medical Center, Newport Beach, CA, USA, from November 2022 to March 2023. Follow-up ranged from 12 to 28 months. Patient demographics, comorbidities, preoperative symptoms, surgical details, postoperative outcomes, and complications were collected and analyzed.

RESULTS: No intraoperative complications occurred. Six patients demonstrated either altered mental status, abdominal pain, or generalized weakness, unrelated to the implant. There were no infections reported within the 30-day post-operative period and up to 28 months follow-up. There were no incidences of valve dehiscence. Patients underwent an average of 2.3 ± 1.4 reprogramming events. Post-operative outcomes included improvements in gait disturbance (n=18; 72.0%) and urinary incontinence (n=9; 36.0%), and cognitive disturbances (n=8; 32%).

CONCLUSIONS: Our findings support the potential of VACI as a viable and safe low-profile alternative to traditional subgaleal shunt valve placement for NPH treatment, with no increase in morbidity. Further research with extended follow-up is needed to confirm these preliminary results and evaluate long-term efficacy.

MANAGEMENT OF SHUNTED HYDROCEPHALUS DURING TRANSITION FROM CHILDHOOD TO ADULTHOOD: IS ROUTINE CLINIC REVIEW REQUIRED?

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INTRODUCTION: There is debate about the management of shunted paediatric patients once they transition to adult care. The period of transition is a major source of worry and concern for patients and their parents. Within this cohort, there will be children who experience recurrent shunt malfunctions necessitating multiple revisions, as well as children with long-standing shunt systems that may be non-functional at the time of referral. Because of this variable natural history there is no consensus guideline on their outpatient follow-up. We hypothesise that the incidence of shunt-related problems in patients with long-term indwelling shunts is low, and if a shunt malfunction does occur it requires acute intervention; and therefore suggest that regular routine follow-up for these patients is not required.

METHODS: Single-centre retrospective review of all children transitioned from paediatric to adult neurosurgical services between 2011-2024. Inclusion criteria included: presence of a CSF shunt; adult follow-up duration >1 year. Exclusion criteria included: incomplete documentation, followed up at an outside hospital. The following data were collected: presence and nature of childhood shunt revision, need for adult shunt revision, evidence of radiological shunt disconnection, number of clinic appointments and length of follow-up in adult services.

RESULTS: 127 children with CSF shunts were included in the study. The mean period from time of transition to data collection was 4.5 years. 6.3% (n=8) of children required an adult shunt revision, of whom 6 had required previous childhood shunt revisions. Of those who received shunt imaging in adulthood, 20.9% (24/115) had radiological evidence of shunt fracture or mechanical failure, of whom the majority were asymptomatic and did not require shunt revision.

CONCLUSIONS: Most children transitioned to adulthood do not require adult shunt revisions. We question the benefit of regular review for these patients, and advocate for patient-initiated follow-up if concerns arise.

Patient Consent: Not applicable

ASSESSING COGNITIVE CHANGE IN INPH USING THE SOUND SYMBOLIC WORDS TEXTURE RECOGNITION TEST (SSWTRT)

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INTRODUCTION: In our previous study, we developed the Sound Symbolic Words Texture Recognition Test (SSWTRT) to assess cognitive dysfunction in patients with idiopathic normal pressure hydrocephalus (iNPH) by analyzing texture recognition through sound symbolic words. The SSWTRT involves patients selecting sound symbolic words to describe the texture of a close-up images of various object surfaces. This study aimed to evaluate the effectiveness of the SSWTRT in detecting cognitive changes following shunt surgery.

METHODS: Eighteen consecutive patients (mean age = 78.0, SD = 5.6; male = 8) diagnosed with iNPH according to the Japanese iNPH Guidelines were recruited at Juntendo University Hospital between October 2023 and September 2024. All participants underwent shunt surgery. The SSWTRT was administered twice: before and between 3 and 12 months after surgery. Cognitive function was also assessed using the MMSE, Frontal Assessment Battery (FAB), and EU-iNPH Grading Scale.

RESULTS: Spearman's correlation analysis revealed a positive correlation between improvements in MMSE and SSWTRT scores ($p = 0.48$, $p = 0.04$). Improvement was calculated by taking the difference between pre- and post-operative scores. No other neuropsychological measures from the EU-iNPH Grading Scale showed significant correlations with changes in SSWTRT scores.

CONCLUSIONS: Despite the small sample size, the SSWTRT showed potential as a tool for detecting post-surgical cognitive changes in iNPH. It is quick to administer, self-explanatory, and does not rely on fixed correct answers, which helps reduce the pressure on patients during testing, allowing repeated assessments more feasible. The SSWTRT can be a unique and practical tool to be administered alongside the traditional neuropsychological assessment in clinical settings. Future studies with larger samples are needed to validate the diagnostic sensitivity.

Patient Consent: The patient has provided their consent for the publication of this abstract.

IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS DIFFUSION IMAGING ABNORMALITIES IN RELATION TO A BIOMECHANICAL MODEL OF VENTRICULAR EXPANSION

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a cause of dementia resulting from ventricular expansion which can produce diffusion tensor imaging abnormalities. Accurate diagnosis remains challenging. Clinical and radiological features overlap with other conditions, including Alzheimer's disease (AD). Identifying reliable non-invasive biomarkers can inform treatment selection, including shunting.

METHODS: We performed voxel-wise analysis of diffusion metrics in iNPH (N=22), AD (N=28), traumatic brain injury (N=23) and healthy controls (N=30). We correlated diffusion abnormalities with symptoms of urinary incontinence, gait, and cognitive deficits. We employed a Finite-element biomechanical model of hydrocephalus to study the effect of stretching and compression caused by ventricular expansion on diffusion properties. FE approaches subdivide the brain into smaller "elements", to model how these respond to mechanical forces deforming from normal to iNPH brain, and producing voxel-wise strain maps.

RESULTS: Relative to all comparison groups, iNPH showed elevated and reduced fractional anisotropy (FA) in different sections of the corticospinal tract and corona radiata. Increase and reduced FA correlated with incontinence, while only elevated FA correlated with the degree of working memory impairments. The biomechanical model revealed that different locations of these tracts experienced specific compression and stretching forces (Figure1). Compression corresponded to reduced FA resulting from raised axial diffusivity (AxD) and radial diffusivity (RD). Stretching along the tracts' main axis corresponded to increased AxD with little change in RD, therefore increasing FA. Conversely, the highest stretch was in the corpus callosum, which was associated with the biggest increase in AxD and RD, leading to FA reduction. Corpus callosum's DTI abnormalities correlated with processing speed deficits.

CONCLUSIONS: We identified iNPH diffusion abnormalities in specific white matter tracts/sections which deviate from typical axonal damage patterns and correlate with symptoms. Biomechanical modelling of ventricular expansion can explain the diffusion changes seen in affected tracts, which may serve as iNPH biomarkers.

EARLY CRANIOPLASTY AS A RISK FACTOR FOR POST-TRAUMATIC HYDROCEPHALUS

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INTRODUCTION: Decompressive craniectomy (DC) is often a necessary procedure in many cases of traumatic brain injury (TBI). Unfortunately, it is associated with high rates of post-traumatic hydrocephalus (PTH), complicating the recovery of TBI patients. We looked to assess modifiable factors of the craniectomy procedure that may predispose to PTH.

METHODS: All admissions (n= 2865) to Neurotrauma at The Royal London between 2019-2024 were searched for inclusion into the study. A total of 73 patients who had undergone DC remained after exclusion and had their demographic, clinical, radiological and post-operative factors recorded for analysis. The main outcome of the study was the development of PTH, defined by the need for permanent shunt.

RESULTS: 27.4% of patients in our DC cohort developed PTH. Bifrontal DC ($p = 0.006$), early cranioplasty ($p < 0.001$), and new intraventricular haemorrhage after DC ($p < 0.001$) were significantly associated with PTH. After multivariable regression analysis, only early cranioplasty was a significant risk factor for the need of ventriculoperitoneal shunt (VPS).

CONCLUSION: Early cranioplasty (<90days) may increase the likelihood of requirement of VPS for post-traumatic hydrocephalus (OR 6.390, 95% CI 1.6-25.1).

ENDOSCOPIC THIRD VENTRICULOSTOMY VERSUS VENTRICULOPERITONEAL SHUNT FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A SYSTEMATIC REVIEW AND UPDATED META-ANALYSIS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a chronic neurological condition frequently managed surgically. While ventriculoperitoneal shunting (VPS) has been the conventional surgical intervention, endoscopic third ventriculostomy (ETV) has emerged as a potential alternative. This systematic review and updated meta-analysis was undertaken to rigorously assess the comparative safety and efficacy of these two surgical modalities.

METHODS: A comprehensive systematic search was conducted across PubMed, EMBASE, Scopus, Cochrane Library, and Web of Science databases up to April 2025. Randomized and observational studies comparing ETV with VPS for the treatment of iNPH were included. Pooled risk ratios (RRs) and corresponding 95% confidence intervals (CIs) for the outcomes of mortality, complications, infections, intracranial hemorrhage, and subdural hematoma were calculated using random-effects models.

RESULTS: Four studies totalizing 13,862 patients (VPS: 13,059; ETV: 803), met the inclusion criteria. The analysis revealed a statistically significant increase in the risk of overall complications associated with ETV compared to VPS (RR 1.42; 95% CI 1.09-1.84; $I^2 = 11.6\%$). Although point estimates suggested a potentially elevated risk of mortality (RR 2.87; 95% CI 0.60-13.80; $I^2 = 90.6\%$), intracranial hemorrhage (RR 2.09; 95% CI 0.22-19.39; $I^2 = 69\%$), and infections (RR 2.23; 95% CI 0.17-29.08; $I^2 = 69.5\%$) in the ETV group, these findings did not reach statistical significance and exhibited substantial heterogeneity. The incidence of subdural hematoma was comparable between the two surgical approaches (RR 0.77; 95% CI 0.36-1.65; $I^2 = 0\%$).

CONCLUSIONS: ETV was associated with a significantly higher risk of overall complications compared to VPS for iNPH. While non-significant trends suggested increased risks of mortality, hemorrhage, and infections with ETV (albeit with considerable uncertainty), subdural hematoma incidence was similar.

APPLICATION OF MACHINE LEARNING-BASED CLUSTERING TO IDENTIFY CLINICAL SUBGROUPS AND TREATMENT OUTCOMES IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The variability in treatment outcomes of Normal Pressure Hydrocephalus (NPH) poses significant challenges for its diagnosis and management. This study aimed to utilize artificial intelligence techniques, specifically unsupervised machine learning clustering, to identify meaningful clinical subgroups and outcome trajectories following ventriculoperitoneal (VP) shunt insertion.

METHODS: Four clustering methods were tested to characterize 185 patients who underwent VP shunt surgery for NPH, using retrospectively collected data. Clustering was based on a combination of demographic, radiological, and clinical variables.

RESULTS: Ward's hierarchical agglomerative clustering provided the optimal model fit, identifying four clearly defined subgroups. Individuals with suspected NPH typically aligned with one of the following profiles: **Marked Ventriculomegaly with Fewer Comorbidities:** These patients showed a strong overall response to shunting across all symptom domains, although they required more frequent shunt adjustments. **High Vascular Burden on Imaging with Gait and Cognitive Impairment:** These patients presented primarily with gait disturbance and cognitive impairment, with a lower incidence of urinary symptoms. They reached their optimal shunt setting in a shorter time frame but exhibited a shorter duration of response. **DESH-Negative Males with Syncope or Presyncopal Symptoms:** These patients had low vascular burden on imaging and a higher prevalence of syncope or presyncopal symptoms. Following shunt insertion, they experienced moderate improvements, primarily in gait. **DESH-Positive Patients with a Hyper-Acute Callosal Angle:** This group required fewer shunt adjustments and demonstrated significant improvements in gait and cognitive function, with the longest duration of therapeutic effect.

CONCLUSIONS: Unsupervised machine learning applied to clinical and radiological data successfully identified meaningful patient subtypes. Clustering may serve as a valuable tool to improve patient stratification and guide more tailored management strategies.

RESEARCH PRIORITIES FOR IMPROVING COGNITIVE AND NEUROPSYCHOLOGICAL OUTCOMES IN HYDROCEPHALUS

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INTRODUCTION: Many advances in surgical interventions have helped substantially improve the survival rates and quality of life of those affected by hydrocephalus, however there continues to be great gaps in our understanding of the neuropsychological challenges of this heterogeneous condition across the lifespan.

METHODS: To address these gaps, the Hydrocephalus Association and Rudi Schulte Research Institute convened a research workshop entitled, "Improving Cognitive and Psychological Outcomes in Hydrocephalus" bringing together top academics in the fields of hydrocephalus, cognition, and neuropsychology, and individuals with hydrocephalus. The goal was to evaluate the existing evidence and the identify key areas for future research aimed at improving cognitive function, functional status, and quality of life for those living with hydrocephalus. These areas included cognitive and neuropsychological assessments, everyday functioning in both children and adults with hydrocephalus, biomarkers of cognitive function, animal models of hydrocephalus, and the longitudinal effects of hydrocephalus treatment.

RESULTS: Consensus discussions identified four key priority areas in need of further research: (1) neuropsychological phenotypes, (2) treatment-focused research considerations, (3) translational pre-clinical tools, and (4) establishing paths for longitudinal care.

CONCLUSIONS: This publication is a result of the group's collaborative efforts and aims to inspire and guide scientific and clinical research toward these identified priorities. This work aims to ultimately enhance the lives of individuals with hydrocephalus and their families.

DUAL-APPROACH SURFACE ENGINEERING OF VENTRICULAR CATHETERS TO REDUCE CELLULAR OCCLUSION IN THE TREATMENT OF HYDROCEPHALUS

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INTRODUCTION: Proximal catheter occlusion remains a major cause of shunt failure in hydrocephalus treatment. To address this, we evaluated two catheter surface modification strategies: a zwitterionic anti-fouling coating, and a combination of zwitterionic coating with an additional web-spun fiber layer designed to physically block cellular infiltration into catheter drainage holes.

METHODS: Silicone catheters were modified using a zwitterionic silane-based surface treatment involving plasma activation, silanization, and zwitterion grafting. A subset of catheters was further layered with a web-spun polymer mesh fabricated by electrospinning. Human astrocytes were cultured on both modified and unmodified catheters. We analyzed 4 zwitterionic-coated catheters, 4 zwitterionic-coated catheters with web-spun mesh, and 4 unmodified control catheters. Cellular attachment was assessed by immunostaining for glial fibrillary acidic protein (GFAP) and 4',6-diamidino-2-phenylindole (DAPI), followed by quantitative imaging analysis. Cerebrospinal fluid (CSF) flow performance was also evaluated to ensure functional compatibility.

RESULTS: Preliminary data shows that the zwitterionic coating significantly reduced astrocyte attachment compared to unmodified catheters (mean cell density: ~ 0 vs. 8.5 ± 2.7 cells/mm²). The modified catheters with the additional web-spun layer also demonstrated reduced overall cellular attachment relative to controls (3.7 ± 1.5 cells/mm²) and effectively prevented astrocyte penetration into drainage holes. Flow testing confirmed that both modified catheter types maintained fluid dynamics comparable to unmodified catheters.

CONCLUSIONS: Zwitterionic surface modification effectively minimized astrocyte adhesion on ventricular catheters. The addition of a web-spun layer protected the drainage holes by physically limiting cellular access. Notably, the web structure appeared to block cellular penetration, and pore sizes smaller than 5 μ m are expected to be critical for maintaining the barrier function. These surface engineering strategies show strong potential to improve the long-term durability of ventricular shunt systems in the treatment of hydrocephalus.

PROXIMAL HOLE DISOCCLUSION VIA RETROGRADE FLUSHING: IN VITRO EVALUATION

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INTRODUCTION: Pediatric ventriculoperitoneal shunt (VPS) placement is associated with significant risk of ventricular catheter occlusion, which requires emergency revision surgery and contributes to increased morbidity. Malfunction rates for VPS reach as high as 40% within the first year of placement, particularly among patients with posthemorrhagic hydrocephalus, who experience high rates of ventricular catheter blockage. Because most cerebrospinal fluid flows in through the catheter's proximal apertures, they are vulnerable to clogging by cellular debris and protein deposits. This study evaluates the viability of a retrograde flushing device to disocclude ventricular shunt blockages and determines the direction of the resulting fluid flow – proximal or distal – within the shunt.

METHODS: The ReFlow device was connected to a ventricular catheter whose tip positioned inside a 3D printed ventricular phantom model. A syringe pump and pressure sensor were connected directly to the ventricular phantom model. Ventricular catheter tips were packed with finely ground coffee to create partial or complete occlusions of the fenestration holes. Patency was evaluated visually and by measuring pressure before and after flushing.

RESULTS: In partially obstructed catheters, a stepwise increase in intracatheter pressure was observed after each activation of the ReFlow device, suggesting gradual clearance of debris. Visual inspection confirmed that disocclusion was limited to the most proximal holes of the ventricular catheter. In contrast, completely obstructed catheters showed no significant pressure change following multiple flush attempts. A strong and rapid flushing pulse was able to produce a retrograde flow volume of 0.35ml. In addition, a portion of the fluid also traveled distally along the peritoneal catheter.

CONCLUSIONS: Our study demonstrates that the ReFlow system can dislodge obstructions at the proximal holes of a partially obstructed ventricular catheter. This simple bedside maneuver offers a promising, non-operative strategy to rescue shunt failure and may reduce emergency revision surgeries.

CHANGE IN OPTIC NERVE SHEATH DIAMETER AND CEREBROSPINAL FLUID SHUNT FAILURE IN CHILDREN

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INTRODUCTION: Ocular point-of-care-ultrasound (POCUS) is a portable, radiation-free, inexpensive technique for obtaining optic nerve sheath diameter (ONSD) measurements with excellent interrater reliability. While age-based normal ranges for ONSD exist, the upper limits of these ranges have failed to reliably identify cerebrospinal fluid (CSF) shunt malfunctions. Our study assessed if a change in ONSD (Δ ONSD), relative to a prior asymptomatic baseline measurement, could more reliably identify shunt malfunctions in symptomatic pediatric patients.

METHODS: An institutional research ethics board approved single-center prospective cohort study was conducted at a tertiary-care children's hospital from 1/2018 to 3/2022. CSF shunt dependent patients aged 0 -18 years without comorbid ocular pathology underwent baseline POCUS measurements of ONSD in clinic when asymptomatic. Repeat POCUS measurements were obtained when patients presented to hospital with shunt malfunction symptoms. All measurements were acquired in the transverse plane using a 5-14 MHz high frequency linear probe placed over an occlusive dressing covered closed eyelid of a supine patient (head of bed: 30 degrees).

RESULTS: Seventy-six pairs of POCUS measurements were analyzed from 58 patients with a mean age of 6.6 (4.7) years. Δ ONSD in patients with shunt malfunction was 0.89 (0.66) versus 0.16 (0.40) in patients without ($p=0.0012$). The odds of shunt failure were 1.4 times greater for every 0.1mm increase in Δ ONSD. Assuming 15% of consultations represent true shunt malfunctions, a cutoff of $\geq +0.4$ mm Δ ONSD yields a sensitivity of 0.93, specificity of 0.73, PPV of 0.43, and NPV of 0.98.

CONCLUSIONS: An increase in ONSD ≥ 0.4 mm from asymptomatic baseline is strongly associated with CSF shunt malfunction in symptomatic pediatric patients. While further multi-site research is warranted to validate generalizability, we feel that POCUS measurements of ONSD can serve as a valuable tool for patient triage and may ultimately reduce the number of brain imaging studies obtained for this patient population.

Patient Consent: The patients have provided their consent for the publication of this abstract.

LONG-TERM CLINICAL OUTCOMES OF THE FLOW VENTRICULAR CATHETER FOR HYDROCEPHALUS: A FOLLOW-UP STUDY

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INTRODUCTION: Previously, we studied the flow in ventricular catheters under steady and pulsatile boundary conditions using computational fluid dynamics (CFD) in catheter designs with homogeneous flow patterns. One prototype was chosen after a validation study for a clinical test. We tested the effectiveness of the Flow ventricular catheter in a prospective, multi-centre, comparative study in 2018.

METHODS: A clinical trial was approved and initiated in selected hospitals from three continents. Three hospitals included pediatric patients, one hospital included mixed adult-pediatric cases, and adult-only patients were from two hospitals. The trial enrolled patients with overt hydrocephalus undergoing initial ventriculoperitoneal shunt placement or revision.

RESULTS: A total of 86 hydrocephalic patients were included, with 58 pediatric cases (age range: 5-14 years, mean = 7.1 years) and 28 adult cases (age range: 18-86 years, mean = 67.5 years). The Flow catheter demonstrated significantly lower proximal obstruction rates than regular ventricular catheters over a mean follow-up of six years. No obstructions occurred in the Flow group (0/40, 0%), while the regular catheter group had seven cases (7/43, 16.28%) ($p = 0.0127$). This difference was more pronounced in pediatric patients, where five obstructions were observed in the regular catheter group (5/26, 19.2%) compared to none in the Flow group (0/30, $p = 0.0172$). Five of the seven obstructions occurred in children aged 10 years or younger, mainly in occipital placements, with rates slightly higher in Grade II (21.43%) than in Grade I (17.39%) according to Schaumann and Thomale classification. No obstructions were seen in frontal placements for either catheter, and infection rates were similar (Flow: 3.3%, Regular: 3.8%).

CONCLUSIONS: The Flow catheter, representing the next generation of ventricular catheters with a homogeneous flow pattern, can be inserted safely in hydrocephalic patients of all types. This comparative study still showed possible obstruction-free functionality.

DIAGNOSTIC UTILITY AND CLINICAL CORRELATES OF AUTOMATED MRI INDICES IN NORMAL PRESSURE HYDROCEPHALUS (NPH)

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INTRODUCTION: Diagnostic consideration of NPH commonly follows qualitative interpretation of brain images, which has wide inter-individual variability. Diagnosing NPH may be improved with automated quantitation of MRI indices differentiating NPH, normal controls (NC), and Alzheimer disease (AD). Correlation with clinical measures such as balance impairment, resistance to CSF outflow and subjective capacity would add to validity and utility of such indices.

METHODS: Participants were patients from our NPH clinic selected for shunting (n=26), and age-matched individuals from the Alzheimer's Disease Neuroimaging Database (ADNI) diagnosed as NC (n=101) or early AD (n=26). Volumetric brain MRIs were processed using FreeSurfer to quantify indices: volumes/widths/depths of sulci; interhemispheric distance at the vertex; sylvian fissure width; and volumes of ventricles, CSF spaces, cerebral cortex, hippocampus, deep brain nuclei. Group indices were analyzed via ANOVA with post-hoc Scheffe, and Receiver Operator Curves. Diagnostic indices were correlated with miniBEST total, CSF outflow resistance, and patient-reported capacity.

RESULTS: Lower interhemispheric distance at the vertex and volume of central sulci best distinguished groups (NPH < AD and NC at p<.001). Area under the curve (AUC) for all 4 comparisons ranged from 0.86 to 0.95. Suggested cutoff for these indices are 0.1 cm and 3.1 mls respectively. Lateral and third ventricle volumes were higher in NPH than NC and AD (p< .001) though AUCs were smaller (0.76 to 0.87). Sylvian Width was larger in NPH (3.05 cm) than NC (1.17 cm, p<.001 and AUC 0.8) but overlapping with AD (2.3 cm). (Lower) central sulcus volume was the only MRI index that linearly correlates with a prespecified clinical measures, i.e. (worse) miniBEST (p=0.025).

CONCLUSIONS: Automated measures of interhemispheric distance at the vertex and central sulcus volume were the most promising NPH markers, as both were substantially smaller in NPH as compared to with age matched NC and AD patients.

COMPARISON OF INFUSION-DERIVED AND PHYSIOLOGICAL CRANIOSPINAL COMPLIANCE IN CHRONIC HYDROCEPHALUS PATIENTS

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INTRODUCTION: Compliance is simply defined as the ratio of volume change (ΔV) to pressure change (ΔP). Nevertheless, measuring craniospinal compliance remains challenging, as the system behaves differently depending on the temporal context. During prolonged infusion tests, the craniospinal system is stressed artificially, whereas during a single cardiac cycle (CC), it operates under dynamic physiological conditions. Additionally, the ΔV introduced during infusion is not comparable in magnitude or nature to the physiological ΔV resulting from the interplay between cerebral blood and CSF flows. This study aims to propose and compare two methodologies for estimating compliance under distinct conditions.

METHODS: Twenty-nine patients (74 ± 6 years) with chronic hydrocephalus (CH) who showed improvement after shunting underwent phase-contrast MRI and infusion test before surgery. Using the intracranial pressure (ICP) signal, infusion-derived compliance (C_{inf}) was calculated by dividing the injected volume (ΔV_{inf}), measured between the start of infusion and the onset of the pressure plateau, by the corresponding pressure change (ΔP_{inf}), defined as the difference between mean plateau and baseline ICP values. Cerebral blood and CSF flows acquired from PC-MRI were used to compute the intracranial volume change over one cardiac cycle (ΔV_{cc}), while ΔP_{cc} was derived from the amplitude of an average ICP pulse extracted from baseline ICP recordings prior to infusion. Physiological compliance (C_{physio}) was then computed as $\Delta V_{\text{cc}} / \Delta P_{\text{cc}}$.

RESULTS: Infusion-derived compliance ($C_{\text{infus}} = 0.92 \pm 0.57$ mL/mmHg) was significantly higher than physiological compliance ($C_{\text{physio}} = 0.16 \pm 0.11$ mL/mmHg; $p < 0.001$). No significant correlation was found between the two measures ($R = 0.27$; $p = 0.15$).

CONCLUSIONS: These results show that the compliances are different, not significantly correlated and then complementary, reflecting the different craniospinal compartment's ability to respond to different volume stress conditions. Moreover, we believe that craniospinal compliance is not just a number, but a complex function that depends on time, volume, and pressure exerted on the system.

Patient Consent: The patient has provided their consent for the publication of this abstract.

VOLUMES AND VELOCITIES: META-ANALYSIS OF PC-MRI STUDIES IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Phase contrast magnetic resonance imaging (PC-MRI) represents an opportunity to non-invasively investigate cerebral spinal fluid (CSF) flow in patients with idiopathic normal pressure hydrocephalus (iNPH). Studies in recent years have explored the diagnostic and prognostic value of PC-MRI derived parameters. This review aims to identify all PC-MRI studies of iNPH published since 2010, synthesise a review based on collated results, and analyse specific flow parameters identified in the selected studies.

METHODS: Our protocol was prospectively registered on PROSPERO [CRD42020180826]. We systematically searched four databases: Pubmed, Web of Science, Ovid, and Cochrane library to identify all eligible studies. Quality assessment was performed using a modified Newcastle–Ottawa Scale. Systematic review was conducted according to Prisma guidelines. A random-effects model was used to perform meta-analysis on the available flow parameters.

RESULTS: Eighteen records were identified for inclusion. Five studies were eligible for meta-analysis, representing 107 iNPH patients and 82 controls. CSF flow parameters available for analysis were stroke volume and peak velocity. Both were significantly higher than controls ($p = 0.0007$ and $p = 0.0045$ respectively) according to our random-effects analysis, consistent with a model of hyper-dynamic CSF in iNPH. Our systematic review revealed average stroke volumes in iNPH ranging from 43uL to over 200uL. Peak velocity values ranged from 5.9 cm/s to 12.8 cm/s.

CONCLUSIONS: Significant increases in stroke volume and peak velocity values in iNPH patients suggest a place for PC-MRI as supplementary evidence in the diagnostic work-up of iNPH. Although shunting reduces aqueductal stroke volume and peak velocity, the ability of pre-shunt values to reliably predict treatment response remains complicated. We suggest that it may be more appropriate to consider a range of values that reflect varying probabilities of shunt success. We recommend that future studies should prioritise standardising PC-MRI protocols, and before then PC-MRI findings should be considered supportive rather than determinative.

CAN SEMI-AUTOMATED BRAIN MORPHOMETRICS DISTINGUISH BETWEEN ASYMPTOMATIC AND SYMPTOMATIC TYPE I CHIARI MALFORMATION, AND AGE AND GENDER MATCHED CONTROLS?

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INTRODUCTION: Chiari malformation Type 1 (CMI) is a neurological disorder of the hindbrain often characterized by descent of the cerebellar tonsils below the foramen magnum (FM). Common symptoms include posterior pain in the head and neck, poor balance, and impaired cognitive function. Symptoms of CMI have been attributed to crowding of structures at the FM, resulting in altered CSF hydrodynamics and dysmorphism of the osseous confines of the posterior cranial fossa (PCF). We hypothesized that morphometric measurements of the related structures in symptomatic CMI patients would be different from healthy controls and asymptomatic CMI patients.

METHODS: Twenty-six parameters including lengths, angles, areas, and ratios were semi-automatically measured from mid-sagittal T1-MPRAGE MRI using Morphpro and CerePro2D software (MATLAB-2023a, MathWorks, Natick, MA). Symptomatic, Asymptomatic, and age/gender matched Control subjects were recruited with n=20 in each cohort. Principal component analysis (PCA), Silhouette Clustering to interpret and validate consistency within clusters of data, and t-test between cohorts with family-wise error correction were used to identify relevant parameters.

RESULTS: Average tonsillar position below the FM was 10.17 ± 5.32 , 5.52 ± 5.76 , and 0.04 ± 0.14 mm in the Symptomatic, Asymptomatic, and Control groups, respectively. Silhouette Clustering identified two optimum clusters. PCA revealed six PCs >1 out of which five had area under the curve (AUC) >0.9 and six more between 0.8 and 0.9. These parameters were, Cerebellum/PCF Height Ratio, Tonsil Area, Tonsillar Position, Cerebellum Height, Area Ratio, Total Cerebellum Area, Anterior CSF Area in PCF, Anterior CSF Characteristic Width, Posterior CSF Area, Area Ratio Excluding Brainstem, and Cerebellum Area in PCF. The t-test revealed 10 and 15 parameters significantly different ($p < 0.05$) when Asymptomatic and Symptomatic patients were compared to Controls, respectively.

CONCLUSIONS: Although a continuum can be observed between cohorts, Controls can clearly be distinguished from the patient groups, while Asymptomatic parameters remained indistinguishable from Symptomatic.

CARDIAC FREQUENCY BY ITSELF CAN CHANGE CSF DYNAMICS IN THE BRAIN COMPARTMENTS. A NEW REALISTIC 2D NUMERICAL MODEL INVESTIGATION

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INTRODUCTION: We know for decade that CSF oscillates between tree compartments: the ventricles (VEN) the intra Cranial Subarachnoid Spaces (Cranial_SS) and the spinal Subarachnoid Spaces (Spinal_SS) to balance intracranial blood volume change during cardiac cycle. We also know that CSF oscillations amplitudes and phases increase or decrease in hydrocephalus patients. But reasons of ventricle dilation in hydrocephalus remain unclear. Aim of our work was to investigate how cardiac frequency impact CSF dynamics in the ventricles.

METHODS: Based on finite element, Navier stokes equations and fluid-structure interaction we developed a numerical 2D model to simulate CSF flow interactions between Spinal_SS, Cranial_SS and VEN. We adapted a 2D mesh model based on morphological MRI (brain tissues, ventricles, aqueduct, spinal canal, subarachnoid spaces). Young module of the brain tissue was $10000 \text{ g.cm}^{-1}.s^{-2}$. We simulated INPUT as $\text{Spinal\_SS}(t) = \text{Ampli} \cdot \sin(f \cdot 2\pi t)$ with f as cardiac frequency, and two OUTPUT waveforms: one in the middle of the Aqueduct for the VEN(t) and one 1 cm above the foramen Magnum for the Cranial_SS(t). We repeated the simulation with different f from 30 Beats per minute to 150 but keeping constant the volume displaced in the cranium as 1ml. We measured how volume displaced (%) between VEN and Cranial_SS during cardiac cycle and their phase shift (radian) with INPUT.

RESULTS: For all the frequencies the input volume was mainly directed through the Cranial_SS (mean= $80\% \pm 15\%$; minimum= 60% ; maximum= 95%) and complementary in the VEN (mean= $20\% \pm 15\%$; minimum= 5% ; maximum= 40%).

Cranial_SS output presented small phase shift (radian) ((mean= 0 ± 0.1 ; minimum= -0.22 ; maximum= 0.31).

VEN output presented non negligible phase shift (radian) (mean= 0.5 ± 1 ; minimum= -1.85 ; maximum= 1.19) it was only positive before 60 BPM.

CONCLUSIONS: Numerical 2D model with fluid-structure interaction can test non-invasively complex physiological situations.

Cardiac frequency alone can modify CSF dynamics in the ventricles.

Next step is to investigate coupling of cardiac and breathing frequencies.

THE UTILITY OF PHASE-CONTRAST MRI AND ICP MONITORING IN CHIARI I MALFORMATIONS: A SYSTEMATIC REVIEW

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INTRODUCTION: Chiari I Malformation (CMI) is associated with complex cerebrospinal fluid (CSF) dynamics and heterogeneous clinical presentation. Conventional imaging criteria often fall short in guiding management. Phase-contrast MRI (PC-MRI) and intracranial pressure (ICP) monitoring are increasingly investigated for their role in assessing CSF flow and intracranial compliance. This systematic review evaluates their clinical utility in patients with CMI.

METHODS: A systematic search of MEDLINE, EMBASE, Scopus, Web of Science, and Cochrane Library (1994–2021) was performed in accordance with PRISMA guidelines (PROSPERO: CRD42022373516). After screening 1883 studies, 23 met inclusion criteria: 18 on PC-MRI (n=590) and 5 on ICP monitoring (n=93). Data were extracted on CSF flow parameters (e.g., peak velocity, stroke volume, intracranial volume change [ICVC]), ICP-derived measures (e.g., mean wave amplitude [MWA], RAP index), and surgical outcomes.

RESULTS: Fifteen of 18 PC-MRI studies (83.3%) demonstrated associations between CSF flow parameters and clinical or surgical outcomes. Peak velocity (22%), CSF flow rate (27.7%), and ICVC (5.5%) were the most frequently investigated metrics. All five ICP monitoring studies reported clinical utility, with MWA and RAP (a measure of compensatory reserve) identifying reduced intracranial compliance in symptomatic patients. The review also found physiological convergence between PC-MRI-derived pulse pressure gradients and invasively measured MWA.

CONCLUSIONS: PC-MRI and ICP monitoring provide complementary insights into CSF physiology in CMI. While PC-MRI enables non-invasive flow assessment, ICP monitoring quantifies compensatory reserve and compliance. Their overlapping targets and observed clinical value support their integration into multimodal evaluation protocols. Further prospective studies are needed to validate combined use and inform surgical decision-making.

AGE-RELATED CHANGES IN VENOUS DRAINAGE IN ADULTS WITH CHIARI SYNDROME ASSESSED BY PHASE-CONTRAST MRI

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INTRODUCTION: Chiari syndrome (CS) is radiologically defined by a descent of the cerebellar tonsils of at least 5 mm below McRae's line. CS is linked with intracranial compliance disturbance and neurofluids (CSF, arterial and venous blood) disturbance. Age-related changes in vascular compliance and flow distribution may influence venous drainage patterns in this population. Phase-Contrast MRI (PC-MRI) allows non-invasive assessment of cerebral flow dynamics. The aim of our study was to investigate whether age has an impact on cerebral venous drainage in CS patients.

METHODS: 41 patients with CS underwent PC-MRI using two acquisition planes. An intracranial plane was used to quantify flow in the internal carotid arteries, basilar trunk, superior sagittal sinus, and straight sinus. An extracranial plane assessed flow in the internal carotid arteries, vertebral arteries, internal jugular veins, and posterior accessory veins. Patients were divided into two age groups: <40 years and ≥40 years. The relative contribution of each vein (jugular veins, epidural veins, posterior veins of the neck) to the overall cerebral venous drainage was calculated based on the quantified arterial inflow on each plane, and compared between age groups. We calculated the proportion of accessory drainage.

RESULTS: No significant differences were observed in intracranial venous sinus drainage between age groups. However, in the extracranial region, patients aged 40 and above (N=23) showed a significantly greater contribution of the internal jugular veins ($p=0.01$), whereas younger patients under 40 (N=18) exhibited a significantly higher use of posterior accessory venous drainage ($p=0.05$).

CONCLUSIONS: Our findings suggest an age-related shift in extracranial venous drainage patterns in patients with CS. This observation raises new questions about the physiological adaptation of venous drainage with aging in CS population.

Patient Consent: The patient has provided their consent for the publication of this abstract.

STUDY PROTOCOL: A RANDOMIZED CLINICAL TRIAL ON NON-INVASIVE EVALUATION OF SHUNT OBSTRUCTION IN ADULT HYDROCEPHALUS AT TWO HYDROCEPHALUS RESEARCH CENTERS IN SWEDEN

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INTRODUCTION: Seven out of ten patients with normal pressure hydrocephalus (NPH) respond to shunt treatment, while non-responders may experience shunt malfunction. Shunt obstruction is the most common reason for malfunction, with a reported rate of 23.2% of diagnosed shunt failures. Current methods for diagnostic evaluation of shunt patency are mainly invasive. MRI volumetry is non-invasive and has recently been evaluated for assessing shunt function.

METHODS: The objective of this double-blinded dual center (Gothenburg & Linköping) RCT is to evaluate shunt obstruction using MRI volumetry (n=60, 30 per arm of intervention versus controls), and to explore the following questions 1) whether volumetric assessment of MRI could successfully detect shunt obstruction at an early stage, 2) whether symptom burden dynamics are connected to changes in lateral ventricle or supratentorial subarachnoid space volumes, and 3) whether levels of blood biomarkers GFAP, NFL, Tau and S-100B correlate to dynamics of clinical symptoms and whether their dynamics can be used to identify shunt obstruction. Shunt valve setting is adjusted to performance setting 8 (Virtual Off, i.e. shunt obstruction) in the interventional group 3 months post shunting and reset to original (open) setting after 7 days. Clinical assessments of gait, cognitive and urinary function and biomarkers are collected pre- and 3 months postoperatively and lastly 7 days after intervention. This RCT is registered at Clinicaltrials.gov, ID: Dnr2024-01568-01 on February 2nd, 2025. Enrollment has not yet started.

RESULTS: Ventricular volumes will be analyzed for changes over time and across groups of patients with closed versus open shunts. The clinical response will be explored through correlation analysis between MRI volumetry and symptom burden evaluation, in addition to analysis of the relationship between blood biomarkers and symptom dynamics.

CONCLUSIONS: This study may demonstrate the potential of MRI volumetry as a non-invasive method for diagnosing shunt obstruction.

BRIDGING GAPS IN GERIATRIC NEUROSURGERY: A PUBLIC AND PROFESSIONAL PERSPECTIVE ON NORMAL PRESSURE HYDROCEPHALUS IN BRAZIL

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INTRODUCTION: Geriatric patients present distinct clinical and surgical challenges, especially in the context of chronic conditions such as Normal Pressure Hydrocephalus (NPH). Despite its treatable nature, NPH remains underdiagnosed, and there is no dedicated neurosurgical subspecialty for elderly care in Brazil. This study aimed to assess public and healthcare professional perceptions regarding the creation of a Geriatric Neurosurgery subspecialty, using NPH as a reference condition.

METHODS: A 21-item questionnaire was distributed to two populations: general public (n=149) and healthcare professionals or students (n=110). Items covered awareness of neurosurgery and NPH, confidence in geriatric neurosurgical care, access to treatment, and support for a dedicated subspecialty. Descriptive statistics and chi-squared tests were used for group comparisons.

RESULTS: Awareness of NPH was significantly higher among professionals (69.2%) than in the general public (20.1%) ($p<0.0001$). Recognition of the classic NPH triad (gait disturbance, cognitive decline, urinary incontinence) was also significantly greater among professionals (65.8% vs. 14.1%; $p<0.0001$). A majority of professionals (76.9%) and public respondents (61.7%) perceived current access to NPH treatment as inadequate ($p=0.018$). Notably, 91.9% of the general public and 89.7% of professionals supported the creation of a geriatric neurosurgical subspecialty. Among professionals, only 13.1% reported the existence of geriatric-specific neurosurgical protocols in their institutions, and 73% considered their training insufficient or only partially adequate for elderly neurosurgical care. Furthermore, 34.2% failed to identify NPH in a clinical case scenario. Additionally, 50.4% stated that elderly patients are treated the same as younger adults.

CONCLUSIONS: Significant gaps in knowledge, training, and institutional preparedness regarding NPH and geriatric neurosurgical care were identified. Both the general public and professionals overwhelmingly support the establishment of a Geriatric Neurosurgery subspecialty. These findings suggest a strong demand for structured specialization and highlight the need for policy initiatives focused on elderly neurosurgical patients.

ROLE OF MULTIDISCIPLINARY APPROACH IN THE DIAGNOSIS AND THERAPY OF NORMAL PRESSURE HYDROCEPHALUS: A SINGLE CENTER EXPERIENCE

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INTRODUCTION: Normal Pressure Hydrocephalus (NPH) shares features with neurodegenerative diseases, making diagnosis challenging. A multidisciplinary approach combining clinical, neuroimaging, cognitive, and biomarker data can help identify patients likely to respond to CSF drainage.

METHODS: Patients suspected of NPH were assessed by a team including neurologists, neurosurgeons, radiologists, geriatricians, and neuropsychologists. Those with probable NPH underwent a TAP test. Gait, cognition, and urinary symptoms were evaluated before and five days after lumbar puncture using MoCA, simple reaction times (sRT), Go-No-Go reaction time, 4-Stage Balance Test (4SBT), 4-Meter Gait Speed (4MGS), Timed Up and Go (TUG), and the ICIQ-SF. CSF biomarkers (Tau, p-Tau, A β -42, A β -40) were analyzed. Responders were defined based on clinical improvement.

RESULTS: Over 24 months, 139 patients were screened; 61 underwent TAP test, and 43 were classified as responders. At baseline, no significant differences were found between responders and non-responders. After CSF drainage, responders showed a significant 10% improvement in MoCA scores ($p = 0.002$) and a trend towards better sRT ($p = 0.06$), while non-responders showed MoCA decline ($p = 0.002$). No significant differences were found in TUG, 4SBT, or ICIQ-SF ($p = 0.6, 0.8, 0.5$), though a trend toward improvement was observed. 39 patients received a ventriculoperitoneal shunt (VPS), and 4 underwent serial lumbar punctures..

CONCLUSIONS: A multidisciplinary approach improves NPH recognition and assessment. TAP responders showed significant cognitive gains, suggesting partial reversibility of symptoms. While gait and urinary outcomes did not reach statistical significance, clinical trends were encouraging. Integrating cognitive, motor, and biomarker data is crucial to identify candidates likely to benefit from CSF drainage.

Patient Consent: The patient has provided their consent for the publication of this abstract.

CORRELATION BETWEEN CEREBROSPINAL FLUID TAU BIOMARKERS AND CSF TAP TEST RESPONSIVENESS IN iNPH PATIENTS

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INTRODUCTION: The idiopathic normal pressure hydrocephalus (iNPH) is a type of neurodegenerative disorder of gait impairment, dementia and incontinence. Here we investigate the correlation between lumbar cerebrospinal fluid (CSF) biomarkers and the CSF tap test (CSF-TT) responsiveness in patients with iNPH.

METHODS: A total of 163 iNPH patients were prospectively enrolled and subjected to CSF-TT. The CSF levels of A β 42, phosphorylated tau 181 (P-tau181) and total tau (T-tau) were analyzed. CSF-TT was carried out in accordance with the relevant guidelines and disciplines. In more detail, the 3 main characteristics (gait, cognition and bladder) of iNPH were assessed in all patients on the day before CSF-TT scheduled (pre-CSF-TT). In the current study, we validated this finding via a much larger number of subjects, and more critically, demonstrated that dividing the CSF-TT responders into 3 subgroups help identify the pathophysiological changes of the disease. We also used quantitative diagnostic examinations including MMSE, TUG and 10MWT rather than subjective questionnaires to evaluate the CSF-TT responsiveness.

RESULTS: The number of people in the gait improvement group is 64, the cognitive improvement group is 16, the gait+cognitive improvement group is 19, and the negative group is 64. P-tau181 and T-tau levels were significantly lower in the CSF-TT responders compared to the non-responders ($P = 0.032$ and $P = 0.028$ respectively). The lower levels of CSF P-tau181 were discovered in the CSF-TT responders with the improvement of gait + cognition or cognition only compared to the non-responders ($P = 0.026$ and $P = 0.036$ respectively). The ROC curve analyses revealed that P-tau181 has the highest capability in differentiating CSF-TT responders and non-responders ($AUC = 0.72$), while the P-tau181/A β 42, T-tau/A β 42 ratios and T-tau level also have the AUC higher than 0.70.

CONCLUSIONS: Lower levels of CSF P-tau181 correlated with a positive response to CSF-TT in gait+cognition and cognition improvement subgroups compared with non-responders. The CSF tau biomarkers show a significantly negative correlation with the responsiveness to CSF-TT.

Patient Consent: The patient has provided their consent for the publication of this abstract.

CEREBRAL BLOOD AND CSF FLOW DYNAMICS IN HEALTHY ELDERLY SUBJECTS AND CHRONIC HYDROCEPHALUS PATIENTS

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INTRODUCTION: The interaction between cerebral blood flow and CSF circulation during the cardiac cycle is essential to understanding key pathophysiological mechanisms in chronic hydrocephalus (CH). This study aimed to characterize CSF and blood flow and volume dynamics in shunt-responsive CH patients compared to healthy elderly volunteers (HEV).

METHODS: Twenty-nine CH patients who showed clinical improvement after shunting (74±6 years) and twenty HEV (72±7 years) underwent phase-contrast MRI. In the CH group, imaging was performed prior to surgery. CSF flow oscillations and volume changes were measured at the C2–C3 spinal level. Cerebral arterial and venous flows, were assessed intracranially—before the circle of Willis and through the venous sinuses—to reconstruct arteriovenous (AV) flows and calculate volume changes during cardiac cycle. A custom MATLAB script was used to extract amplitude and temporal key points from the flow waveforms for each group. The delays between arterial inflow and CSF and venous outflows were estimated using the midpoint of the steepest slope during systole, instead of the conventional peak-to-peak approach.

RESULTS: Arterial, venous and CSF flow curve morphologies were preserved across groups. However, amplitude and mean arterial flow were significantly lower in CH (516±145 mL/min and 440±112 mL/min) compared to HEV (686±137 mL/min and 610±113 mL/min; $p<0.001$). AV flow delay was significantly shorter in CH (45±13 ms) than in HEV (69±17 ms; $p<0.001$), along with a reduced AV stroke volume (0.77±0.30 mL vs. 1.13±0.21 mL; $p<0.001$), whereas CSF parameters showed no significant differences.

CONCLUSIONS: The shorter AV delay observed in CH patients may reflect reduced intracranial compliance, leading to a more rapid venous outflow response to arterial input. Consequently, less intracranial blood volume increase during cardiac cycle. Although AV amplitude is decreased in CH, CSF oscillations remain unchanged, potentially compensating for the reduced compliance to maintain ICP stability.

Patient Consent: The patient has provided their consent for the publication of this abstract.

A MINIMALLY INVASIVE APPROACH FOR DISCONNECTION OF CEREBROSPINAL FLUID VENOUS FISTULA

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INTRODUCTION: Surgical disconnection is an effective treatment for spinal cerebrospinal fluid venous fistula (CVF). Conventional surgical techniques involve a midline laminectomy approach.

METHODS: We describe the largest UK series of surgical management of CVF and the development of a novel, minimally invasive approach for disconnection of CVF.

RESULTS: 27 patients underwent surgical management of CVF over a 4-year period. The most recent 21 patients were treated with this novel minimally invasive approach. The most common presenting symptom was an orthostatic headache. Myelography was performed for identification and confirmation of location of CVF. We describe (with intra-operative imaging and videos) the development of a minimally invasive tubular, paramedian, extrafacetal surgical approach to disconnect the CVF. This disconnection includes nerve root preservation when the dural integrity is maintained. There was a median duration of 10.5 months of clinical follow up (IQR 12.9). Twenty (95%) patients had improvement in their headache symptoms at follow up. Fourteen (67%) had complete resolution, six (29%) had partial improvement and one (4%) no change in their headache symptoms. There was a median of 8 months post operative MRI head imaging follow up (IQR 8). All patients showed radiographic improvement in SIH features on follow up MRI head with a significant reduction in SIH score on post-operative MRI scans (mean reduction 6.2, 95% CI 4-7.5, $p < 0.01$). There were two cases of rebound intracranial hypertension which resolved with a short course of acetazolamide and there were no surgical complications.

CONCLUSIONS: Here we have described the development of a novel, effective and safe minimally invasive approach for disconnection of CVF. This approach mitigates the possible complications of a midline laminectomy approach by reducing exposure of the thecal sac and preserving the facet joint. The minimally invasive technique potentially allows the surgery to be performed as a day case procedure.

WAS FORAMEN MAGNUM DECOMPRESSION SURGERY INAPPROPRIATELY PERFORMED IN PATIENTS WITH SPONTANEOUS INTRACRANIAL HYPOTENSION?

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INTRODUCTION: Spontaneous intracranial hypotension (SIH) is an increasingly recognised pathology with associated radiological features only described less than ten years ago. The classical orthostatic headache of SIH can attenuate over time with a subsequent change in headache phenotype. This in conjunction with the commonly seen radiological finding of cerebellar ectopia in SIH, leads to the potential misdiagnosis of SIH as Chiari 1 malformation (CM-1). Subsequent treatment targeted to treat CM-1 including foramen magnum decompression (FMD) surgery may lead to delays in adequate treatment and complications of untreated SIH including siderosis and frontotemporal brain sagging syndrome. We assessed the frequency of pre-operative radiological features of SIH in patients who have undergone FMD surgery.

METHODS: Retrospective single-centre case series including patients who have had FMD surgery for CM-1 at the National Hospital for Neurology and Neurosurgery between the years 2010 and 2025. Clinical and radiological data was collected. Pre-operative MRI scans were used to identify whether radiological features of SIH were present prior to FMD surgery, with calculation of SIH score.

RESULTS: A total of 108 patients were included. 81.5% were females with median age of 36 (range 17-70) at time of surgery. Mean SIH score was 2.41 (SD, +/- 1.73), with only 1 (0.9%) patient showing high suspicion radiological features for SIH. One patient was subsequently diagnosed with a cerebrospinal fluid-venous fistula post-FMD. There were no significant differences in symptomatology between low/high SIH scores.

CONCLUSIONS: Our study shows that the cohort of patients selected for FMD surgery reassuringly tend not to have pre-operative radiological features of SIH and the rate of misdiagnosis in this cohort is low. However, prior to selecting patients for FMD the possibility of SIH should be considered. A high index of suspicion for SIH is needed when reviewing previous patients who have had FMD with refractory symptoms.

ORTHOSTATIC HEADACHE: TREATMENT RESPONSE STRATIFIED BY SPINAL IMAGING FINDINGS

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INTRODUCTION: Up to 20% of patients with spontaneous intracranial hypotension (SIH) have normal brain magnetic resonance imaging (MRI). The presence of spinal meningeal diverticula increases the likelihood of detecting a cerebrospinal fluid (CSF) leak on myelography. Among patients with orthostatic headache and a normal brain MRI, a CSF leak is identified in 20% of those with meningeal diverticula, whereas none of the patients without diverticula are found to have a leak. In this study we compared how patients with clinically, but not radiographically, suspected SIH responded to epidural blood patching, stratified by the presence or absence of meningeal diverticula.

METHODS: Data was extracted from the medical records of patients presenting to Mayo Clinic Florida between 2020 and 2024 with orthostatic headaches but no signs of SIH on brain and spine MRI. Patients with spinal meningeal diverticula were compared to patients with no spinal meningeal diverticula.

RESULTS: Fifty-one patients were included, of whom 30 had meningeal diverticula and 21 did not. Patients in both groups received at least one epidural patch. Patients with meningeal diverticula had a mean number of epidural patches of 3 (SD 1.7), while patients with no meningeal diverticula had a mean number of 2 (SD 1.3) epidural patches ($p=0.02$). Overall, 10 (33.3%) patients with meningeal diverticula and 11 (52.4%) with no meningeal diverticula experienced resolution of headache after the treatment but this was not statistically significant.

CONCLUSIONS: Although patients with meningeal diverticula had a greater number of patches than patients with no meningeal diverticula, there was no significant difference in resolution of orthostatic headache following treatment. While patients with orthostatic headache and negative brain MRI are typically not found to have a spinal CSF leak, they may still respond to epidural blood patching as successfully as patients who do have spinal meningeal diverticula.

SOCIOECONOMIC EFFECT OF SURGICAL TREATMENT OF SPINAL CSF LEAKS IN SPONTANEOUS INTRACRANIAL HYPOTENSION

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INTRODUCTION: As Spontaneous Intracranial Hypotension (SIH) classically affects younger patients without comorbidities, socioeconomic effects are likely. This study investigates the impact of SIH on the ability to work and the effect of surgical treatment.

METHODS: This monocentric retrospective study evaluated all patients ≤ 65 years who underwent surgery for spinal CSF leaks between April 2018 and September 2024 regarding their ability to work using a customized questionnaire. Results from the onset of symptoms were compared with those 3 months after surgery and at the time of the survey. A cost-effectiveness study was conducted.

RESULTS: Of 278 eligible patients, 219 (79 %) responded, and 210 patients were included. Median age was 45.5 years (IQR 36-53, range 20-65), and 62% were female. Median symptom duration before surgery was 168 days (IQR 86-513). Before the start of symptoms, 173/210 (82.5%) patients worked at 100%, 34/210 (16.2%) had a voluntary reduction of working hours, and three were unemployed. After symptom onset, most patients (128/210, 61%) were unable to work, 19/210 had to reduce their work to 20-50%, and 18/210 to 50-80%. Only 10/210 worked at full capacity, with an additional 35/210 patients with full capacity under adaptation. Three months postoperatively, there was a significant improvement, with 54/210 (26%) unable to work, 19% experiencing work reduction, and 115/210 (55%) working at full capacity (33 with adaptations). At the last follow-up, only 9% were unable to work, 18% had reduced work capacity, and 136/210 (65%) were working at full capacity (26 with adaptations). Within the follow-up period, 19 patients retired as a sequela of SIH or independently of it.

CONCLUSION: SIH frequently causes incapacity for work, which is highly socio-economically relevant. In most cases, surgical treatment can restore the ability to work; however, 10% of patients remain unable to work. The cost-effectiveness study revealed a clear benefit of treating patients early.

SPINAL CSF LEAK VOLUMETRY IN SIH PATIENTS BEFORE AND AFTER TREATMENT

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INTRODUCTION: Spontaneous intracranial hypotension (SIH) is a disabling condition caused by cerebrospinal fluid (CSF) leakage at the spinal level, leading to reduced CSF volume and orthostatic headaches. While intracranial CSF volumetry has been well-studied in SIH, spinal CSF volumetric data remain limited.

METHODS: In this retrospective, single-center study, 28 SIH patients with myelographically confirmed spinal CSF leaks underwent pre- and post-treatment brain and spine MRI with 3D T2-weighted sequences. Volumetric segmentation of the intrathecal compartment excluded epidural fluid. A control group of 10 patients without SIH-like symptoms was included. CSF volume changes were compared across leak types (ventral/lateral dural tears vs. CSF–venous fistulas) and with controls. This study evaluates spinal CSF volume before and after confirmed CSF leak closure in SIH patients, using semi-automated MRI-based volumetry, and compares findings with a control group.

RESULTS: Following successful leak closure, spinal CSF volume increased significantly from 88.3 ± 17.5 mL to 100.1 ± 17.6 mL ($p < 0.001$). This increase was observed in both type 1/2 leaks (+15%) and type 3 leaks (+5%). Post-treatment CSF volumes were also significantly higher than in controls (99.1 ± 17.0 mL vs. 86.7 ± 13.6 mL, $p = 0.043$), though pre-treatment values did not differ. Spinal cord volume remained stable, confirming segmentation reliability.

CONCLUSIONS: Spinal CSF volumetry demonstrates significant volume increases following leak closure in SIH patients and may serve as a quantitative biomarker for treatment response, particularly in cases without typical imaging findings such as CSF–venous fistulas. These results support the utility of spinal volumetry in the diagnosis and monitoring of SIH and warrant further investigation with larger, prospective cohorts.

Patient Consent: The patient has provided their consent for the publication of this abstract.

LOCATING SPINAL LEAKS IN SPONTANEOUS INTRACRANIAL HYPOTENSION: HOW MANY DYNAMIC MYELOGRAPHIES DOES IT TAKE?

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INTRODUCTION: Localizing a cerebrospinal-fluid (CSF) leak in spontaneous intracranial hypotension (SIH) patients is of utmost importance, when pursuing a targeted therapy. The study aimed to evaluate the accuracy of dynamic myelography techniques in localizing spinal CSF leaks.

METHODS: SIH patients with a spinal longitudinal extradural CSF collection (SLEC) investigated at our department from January 2013 to February 2025 were screened. All included patients underwent a dynamic myelography work-up to localize the level CSF leak using conventional dynamic myelography (CDM), and/or dynamic computed tomography myelography (DCTM).

RESULTS: In total, 198 SLEC positive SIH patients (mean age: 50 ± 12 years; 67% female, 133/198) were included. In total, 147 patients had a ventral (74%), 49 patients had lateral (25 %), and two patients had a primary dorsal (1 %) leak. The spinal CSF leak was localized with the first, second, third or fourth dynamic myelography in 97 (49%), 70 (35%), 16 (8%), 11 patients (6%), respectively. The median number myelography exams (CDM + DCTM) per patient to localize a CSF leak was 2 (IQR 1-2; range 1-8); 1 (IQR 1-2; range 1-5) for ventral, 2 (IQR 1-2; range 1-6) for lateral and 6 (IQR 5-7; range 4-8) for dorsal leaks. In total, 160 patients (81%) were referred for microsurgical closure. The dural leak was identified intraoperatively on the indicated vertebral level in 153 patients (96%), in 2 patients (1.3%) spontaneous sealing occurred, in 5 patients (3%) wrong level surgery occurred.

CONCLUSIONS: Dynamic myelography exams accurately and reliably localize spinal CSF leaks in SIH patients with SLEC. In about half of the patients, the level of the leak can be localized with the first CDM. In case of a repeat dynamic myelography the technique and patient positioning can be adopted according to the results of the previous exam.

Patient Consent: The patient has provided their consent for the publication of this abstract.

EVALUATION OF FINGER FUNCTION IN INPH: A COMPARATIVE CUEING STUDY

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BACKGROUND: In idiopathic normal pressure hydrocephalus (iNPH), finger motor dysfunction is commonly observed. We have previously reported that external auditory cueing around 2 Hz is useful for detecting upper limb impairments in iNPH. However, internal rhythm generation may also be impaired, and the optimal assessment method for evaluating both external cue responsiveness and internal rhythmic capacity has yet to be established.

OBJECTIVE: To investigate whether external or internal cueing more effectively evaluates finger motor function in patients with definite iNPH.

METHODS: Ten patients with definite iNPH (mean age: 76.4 ± 4.6 years) performed a finger-tapping task under two conditions: (1) external cueing (EC; auditory cueing at 2 Hz), (2) internal cueing (IC; self-generated rhythm at 2 Hz following initial auditory presentation). Finger tapping of the index finger and thumb was recorded using a magnetic sensing device at four points; prior to the tap test (T-T), 24 and 48 hours after the T-T, and after shunt surgery. M-Amplitude was defined as the mean of maximum amplitude and CI-Velocity as the peak velocity of the closing movement. Evaluation metrics included M-Amplitude, CI-Velocity, frequency, and their coefficients of variation (CVs). Repeated measures ANOVA was used for analysis.

RESULTS: Under the EC condition, both of M-Amplitude ($F(2,18) = 6.87, p = 0.0061$) and CI-Velocity ($F(2,18) = 4.99, p = 0.0188$) significantly increased at 48 hours after the T-T and after shunt surgery compared to baseline. In contrast, no such improvements were found under the IC condition. Furthermore, CI-Velocity was significantly higher with EC compared to IC at 48 hours after the T-T and after shunt surgery ($p = 0.03$).

CONCLUSIONS: External auditory cueing at 2 Hz is a sensitive method for assessing finger motor function in iNPH and effectively captures functional improvements following intervention.

Patient Consent: The patient provided consent for the publication of this abstract.

INVESTIGATION OF COEXISTING DISPROPORTIONATELY ENLARGED SUBARACHNOID SPACE HYDROCEPHALUS (DESH) ON IMAGING IN CASES OF DEMENTIA WITH LEWY BODIES (DLB)

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INTRODUCTION: To know the coexisting cerebrospinal fluid circulation disorders in cases of Lewy body dementia (DLB)

METHODS: Thirty cases diagnosed with DLB according to the 2015 MDS diagnostic criteria were retrospectively reviewed, who were treated at the Department of Psychiatry, Yamagata University School of Medicine between March 2013 and September 2022. Information was obtained about age, symptoms including tremor, rigidity, bradykinesia, gait disturbance, and instability, disease duration, and the L-DOPA therapy. Cranial MRI or CT scans assessed the Evans index, tight high convexity (THC), and disproportionately enlarged subarachnoid space hydrocephalus (DESH). ECD-SPECT was used to assess the areas with reduced cerebral blood flow (CBF) and the Kapparah sign. Striatal uptake on DaT scan and cardiac uptake on MIBG myocardial scintigraphy were checked. Ethical approval was obtained from the ethics committee (Yamagata Uni.) with informed consent by opt-out.

RESULTS: The mean age at the head MRI or CT examination was 77.8 ± 6.4 (SD) years, and 25 cases had concomitant motor symptoms. Among the cases with DESH on head imaging, 3 cases were classified as MRI-supported possible iNPH; the initial symptoms were depression and delusions in 1 case, falls and visual hallucinations in 1 case, and depression and visual hallucinations in 1 case, with the duration until the onset of motor symptoms being 0, 4, and 10 years, respectively. They all showed postural instability, L-DOPA administration, and no posterior-CBF reduction. DaT scan was positive in 2 cases, and MIBG was positive in 3 cases. Additionally, 4 cases (13.3%) had THC alone; among these, 2 cases had relatively prominent motor symptoms.

CONCLUSIONS: In 7/30 (23.3%) of DLB cases, brain imaging revealed findings suggestive of THC or DESH. In DLB cases, in addition to the management of psychiatric symptoms, evaluation of THC and DESH may imply the comorbidity.

B-WAVES IN NONINVASIVE CAPACITANCE SIGNAL CORRELATE WITH B-WAVES IN ICP IN RECORDINGS OF 51 PATIENTS

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INTRODUCTION: B-wave analysis in overnight intracranial pressure (ICP) recordings has historically served as a valuable diagnostic tool for normal pressure hydrocephalus (NPH). Stronger and more frequently occurring B-waves are indicative of reduced craniospinal compliance and are predictors of response to cerebrospinal fluid shunting. Here, we have explored a novel approach to detect B-wave equivalents in a noninvasively acquired signal, termed W, related to the electrical capacitance of the head.

METHODS: In a prospective study, a cohort of 51 patients with suspected NPH or spontaneous intracranial hypotension underwent infusion testing as part of the standard diagnostic workup. W was acquired using two isolated electrodes placed on the patient's scalp and a device that acts, together with the patient's head, as a resonator circuit. Invasively acquired ICP was recorded simultaneously with W. B-waves were detected in both signals using template matching in the time domain.

RESULTS: Strong correlation was observed between B-wave durations in ICP and W ($R^2 = 0.9$, $p < 0.001$). Moderate correlation was found between B-wave amplitudes ($R^2 = 0.5$, $p < 0.001$). The lower correlation of B-wave amplitudes is potentially caused by differences in the biophysical nature of the signals: W is an indirect measure of intracranial volume composition, whereas ICP is a pressure. W is linked to ICP by the nonlinear craniospinal pressure-volume relation, which varies between patients.

CONCLUSIONS: Under the premise that more frequent occurrence of B-waves is indicative of impaired craniospinal compliance, our results suggest that analysis of W could be used in the triage of patients suspected with pathologies characterized by impaired craniospinal compliance. We gratefully acknowledge partial funding by Swiss National Science Foundation, project 205321_182683 and through a Margarete-von-Wrangell Fellowship from Ministry of Research, Baden-Württemberg, Germany.

The patients have provided written consent for participation in the study and for publication of this abstract.

LAPAROSCOPIC PEEL-AWAY SHEATH TECHNIQUE VERSUS MINI-OPEN LAPAROTOMY FOR LUMBEROPERITONEAL SHUNT IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A PROSPECTIVE COMPARATIVE COHORT STUDY

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is commonly treated with lumbaroperitoneal shunt (LPS), yet traditional mini-open laparotomy (MOL-LPS) poses challenges in obese patients. This study evaluates a novel laparoscopic peel-away sheath technique (LPSPA-LPS) against MOL-LPS, focusing on efficacy, safety, and procedural efficiency.

METHODS: In this prospective comparative cohort study at Huadong Hospital (July 2020–April 2024), 104 iNPH patients were allocated to MOL-LPS (n=59) or LPSPA-LPS (n=45). Inclusion criteria included age ≥ 60 years, probable iNPH diagnosis, and standardized LPS protocol. Primary outcome was ≥ 1 -point improvement on the modified Rankin Scale (mRS) at 12 months. Secondary outcomes included symptom resolution (iNPH Grading Scale), operative metrics, hospitalization length, and complications. Statistical analyses included t-tests, Wilcoxon tests, and chi-square tests.

RESULTS: The cohort exhibited a mean Evans index (EI) of 0.34 ± 0.03 and mean cerebrospinal fluid opening pressure (OP) of 14.3 ± 2.3 cmH₂O, with a mean age of 74 years (range: 61–93). MOL-LPS group (cases 1–59) and LPSPA-LPS group (cases 60–104) exhibited no significant differences in baseline demographics, comorbidities, or disease severity. Functional improvement (mRS ≥ 1 -point) did not differ significantly (82.2% vs. 69.5%, $p=0.14$). LPSPA-LPS reduced total operative time (48.0 ± 10.3 vs. 68.8 ± 18.8 min, $p<0.001$), blood loss (9.1 ± 2.3 vs. 14.9 ± 4.1 mL, $p<0.001$), and hospitalization (6.2 ± 2.0 vs. 8.3 ± 1.8 days, $p<0.001$). Subgroup analysis revealed significant mRS improvement in overweight/obese patients (91.7% vs. 63.0%, $p=0.016$). Complication rates were comparable, but LPSPA-LPS eliminated abdominal morbidity (0% vs. 5.1%, $p=0.256$). Technical proficiency improved over time, with later LPSPA-LPS cases showing 20% shorter operative time ($p<0.001$).

CONCLUSIONS: LPSPA-LPS achieves functional outcomes equivalent to MOL-LPS while optimizing procedural efficiency and postoperative recovery, particularly in obese patients. Its minimally invasive design, reduced hospitalization, and adaptability underscore its utility in high-BMI or frail iNPH populations. Further multicenter validation is needed to confirm long-term benefits.

WEARABLE, NON-INVASIVE SPOT CHECK MEASUREMENTS OF SHUNT FLOW VIA THERMAL ANISOTROPY: DEVICE ADVANCEMENTS FOR IMPROVING DEPTH OF MEASUREMENT

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INTRODUCTION: Wearable sensors based on spatiotemporal measurements of thermal flow have recently been rendered into wireless, soft bandage-like devices for noninvasively assessing ventriculoperitoneal shunt flow. Ongoing clinical trials have led to new understanding of device optimization related to widely varying anatomy in shunted patients, including device design advancements to improve the ability to detect flow in deeper shunts. Here we present data from >150 shunted subjects using an updated device design, as well as underlying physical principles driving technical advancement.

METHODS: 146 subjects with ventriculoperitoneal shunts were enrolled for one or more spot-check measurements (approximately 10-minutes each) of shunt flow, as well as ultrasound measurements of shunt depth. Similar measurements were conducted on synthetic shunt phantom systems of varying depths and simulated anatomy.

RESULTS: Synthetic shunt phantom data reveals reliable signal-to-noise levels to shunt depths deeper than 6 millimeters in simple anatomical simulations. Data from shunted subjects, accounting for noise levels related to motion and more complex anatomy, suggests reliable measurements to a shunt depth of 5-6 millimeters.

CONCLUSIONS: New engineering designs support a significantly improved signal-to-noise, particularly in deeper shunts, of wearable, non-invasive thermal-anisotropy based measurements of CSF shunt flow.

SHUNT FLOW THROUGHOUT DAILY LIFE: DATA FROM THE FIRST USE OF CONTINUOUSLY WORN CEREBROSPINAL FLUID SHUNT FLOW MONITORS ON 25 SHUNTED HYDROCEPHALUS SUBJECTS OVER 30-DAY PERIODS

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INTRODUCTION: Hydrocephalus shunt management is informed by sparse snapshots in time (clinical visits, imaging, symptoms), but what if we could understand the dynamics of shunt flow longitudinally during an individual's activities of daily living? Recent developments in wireless, wearable thermal flow sensing provide new possibilities in noninvasive CSF flow monitoring and are compatible with existing implanted shunts with no additional surgery. The longitudinal tracking of shunt flow outside of clinical settings, via continuous wear throughout daily life, is an important potential application of the technology. Here, we present results from the first iteration of such a device.

METHODS: 25 shunted hydrocephalus subjects without suspicion of shunt malfunction (age 6-60, 15 female 10 male) were provided an Extended Wear Shunt Monitor system for home-use. An additional cohort of subjects without an implanted shunt were asked to follow the same procedures. Devices recorded flow-related signals, motion, and orientation during wear. Subjects were asked to obtain at least 40 hours of data across a 30-day period. Flow signals were analyzed relative to posture, activity, time of day, reported symptoms, across days and between shunt and non-shunt groups.

RESULTS: 1,605 hours of use were recorded across all shunted subjects, resulting in 1,852 individual flow measurement datasets. An additional 758 datasets were collected from subjects without a shunt. Flow signal magnitudes were significantly different ($p < 0.01$) between shunted subjects during waking hours or standing posture compared to sleeping hours, supine posture, and non-shunted subjects and between periods of reported symptoms. Flow signals vary significantly within single days and over the 30-day period between shunted subjects.

CONCLUSIONS: The data in this study indicate the potential to understand patient-specific relationships between shunt flow and activity, time of day, and symptoms with a non-invasive, low profile, continuous wearable.

BEYOND MONITORING AT REST: REAL-LIFE INSIGHTS INTO ICP DYNAMICS

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INTRODUCTION: Conventional intracranial pressure (ICP) monitoring is typically performed when the patient is at rest. This limits its clinical relevance, as ICP behavior in the context of everyday activity may provide crucial information for diagnosis and treatment. To address this, a next-generation mobile telemetric ICP monitor was enhanced with sensors for body position and activity, and an interface for well-being input. This research explores the potential of the system to provide contextual ICP interpretation in real-world conditions.

METHODS: Two complementary studies were conducted. First, in a validation study, 10 participants performed tasks (e.g., lying, standing, walking) over periods of 3 minutes to evaluate the integrated body position and activity sensors. Second, in a case study, the system recorded ICP, pulse amplitude, body position, and activity during these tasks, followed by a 1.5-hour unguided phase of everyday activity.

RESULTS: The next-generation mobile telemetric ICP monitor reliably distinguished body positions and activity levels in all participants of the validation study. The case study showed a drop of mean ICP of 17.7 cmH₂O when transitioning from lying to standing, while walking increased the mean pulse amplitude by 8.5 cmH₂O compared to standing. To support interpretation of the unguided phase, two visual tools were developed: (1) a color-coded actigraph showing body position, activity, and well-being over time and (2) a plot of ICP versus pulse amplitude, using the same color scheme for intuitive interpretation of patterns in relation to body position, activity, and well-being.

CONCLUSIONS: Integrating body position, activity, and well-being provides valuable context for interpreting ICP in everyday settings. This approach enables a more meaningful assessment of ICP during daily life and can support smart shunt development. The visual tools developed support interpretation of ICP data in real-live conditions.

HIGHER HARMONIC CENTROID IN HYDROCEPHALUS: EARLY INSIGHTS FROM TELEMETRIC INTRACRANIAL PRESSURE MONITORING

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INTRODUCTION: Telemetric intracranial pressure (ICP) monitoring enables longitudinal assessment of brain compliance in patients with hydrocephalus. Recent advances allow long-term home ICP recording at sampling rates suitable for frequency-domain analysis, with shifts in the higher harmonic centroid (HHC) potentially reflecting changes in waveform complexity and compensatory reserve. This exploratory study examines how HHC varies with mean ICP and pulse amplitude, to evaluate whether spectral dynamics reflect suspected compliance changes in patients with intermittent episodes of abnormally high mean ICP and pulse amplitude.

METHODS: Patients with hydrocephalus were implanted with a fully implantable telemetric ICP sensor (50Hz sampling rate, Kitea Health) during shunt insertion or revision. Regular 13-second ICP waveforms were recorded at home using a handheld wand and mobile app over three months. Mean ICP, amplitude, and HHC were extracted from every measurement. Exploratory correlation analysis was performed in a cohort of 12 patients, with particular focus on three patients who demonstrated abnormal ICP profiles, including one NPH patient whose programmable shunt valve was adjusted to its highest setting due to clinical indications during the study.

RESULTS: Three patients reported symptoms during periods that included intermittent significant elevations of mean ICP above their baselines and pulse amplitudes exceeding 5 mmHg. They consequently showed significant negative correlations between mean ICP and HHC, as well as between pulse amplitude and HHC, from their recordings during the study (Pearson, $p < 0.01$). Among the remaining nine patients, who exhibited normal ICP profiles without significant symptom fluctuations, no consistent correlation pattern was observed across the group.

CONCLUSIONS: Long-term telemetric monitoring of HHC may offer a tool to track changes in brain compliance and shunt functional status. Whether a negative correlation for HHC reflects impending shunt malfunction or impaired compliance status regardless of a working shunt remains to be clarified through further longitudinal studies.

Patient Consent: The patient has provided their consent for the publication of this abstract.

PREDICTIVE VALUE OF RISK ANALYSIS INDEX AND MODIFIED FRAILTY INDEX FOR GAIT OUTCOMES FOLLOWING SHUNT SURGERY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) predominantly affects elderly patients, who are commonly frail with multiple comorbidities. Here we evaluated the ability of the Modified Frailty Index (mFI-5) and Risk Analysis Index (RAI) to predict changes in gait parameters following shunt surgery.

METHODS: Patients who underwent shunt placement for iNPH by the senior author between November 2018 and May 2024 were included. Records were queried for demographics, baseline and post shunt gait parameters, and medical comorbidities, which were quantified with mFI5 and RAI. Generalized mixed models were constructed to predict postoperative gait outcomes.

RESULTS: We included 242 patients (median age 75.4 years [72.2–80.0]; 34.7% female), with a median of four gait assessments per patient over a median follow-up period of 13.7 months. Median baseline scores were 1 [1–2] for mFI-5 and 14 [7–22] for RAI. Baseline gait parameters were as follows: gait velocity 0.58m/s [0.38–0.78], stability ratio 2.1steps/min [1.65–3.02], step width 12.7cm [12.7–17.1], and stride length 73.6cm [53.8–93.3]. At last follow-up, the median changes in gait parameters were: 0.17m/s for gait velocity ($p < 0.001$), 16.3cm for stride length ($p < 0.001$), -0.21steps/min for stability ratio ($p < 0.001$), and -1.5cm in step width ($p < 0.001$). After adjustment for age, sex, and BMI, mFI-5 was more predictive of changes in gait velocity ($\beta = -0.07\text{m/point}$, $p < 0.001$) and stride length ($\beta = -0.78\text{cm/point}$, $p < 0.01$) compared to RAI ($\beta = -0.04\text{m/point}$ for gait velocity, $p < 0.001$; $\beta = -0.40\text{cm/point}$ for stride length, $p = 0.02$). However, neither mFI-5 nor RAI significantly predicted changes in stability ratio or step width.

CONCLUSIONS: In iNPH patients undergoing shunting, frailty was associated with changes in gait outcomes. Higher frailty scores were predictive of less improvement in gait velocity and stride length, with mFI-5 demonstrating stronger predictive ability compared to RAI.

Patient Consent: The patient has provided their consent for the publication of this abstract.

IMPACT OF VOLUME INPUT FREQUENCY ON CRANIOSPINAL COMPLIANCE: A SPECTRAL APPROACH

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INTRODUCTION: Craniospinal compliance (CC) is a mechanism that characterizes the ability of the cerebrospinal space to compensate increases in volume without disproportionate increases in intracranial pressure (ICP). However, the ICP signal comprises distinct components of different frequencies, such as vasogenic (B-waves) and cardiac-induced pulsations. Hence, in this study we aimed to assess if the frequency of volume input influences CC estimates in normal pressure hydrocephalus (NPH).

METHODS: Retrospective analysis was performed in a group of 92 NPH patients who underwent computerized infusion studies. CC was calculated as the change in volume (dV) over change in pressure (dP), where V is cerebral arterial blood volume (CaBV) estimated from transcranial Doppler measurements of cerebral blood flow velocity and P is ICP measured via lumbar puncture. CC was calculated using spectral analysis at two different frequencies corresponding to the slow vasogenic and cardiac component, respectively. CC estimates were compared across frequencies and between the baseline and plateau phase of infusion.

RESULTS: CC estimates significantly decreased with mean ICP increase induced by the plateau phase of the infusion test ($p < 0.001$). However, the two CC estimates were significantly different across frequencies ($p < 0.001$) and only moderately correlated with each other ($r = 0.63$ at baseline). CC was higher when calculated for vasogenic B-waves and lower when calculated for the cardiac-induced pulsations.

CONCLUSIONS: Both CC estimates calculated based on naturally occurring fluctuations in blood volume at two distinct ICP frequencies reflect diminished CC associated with volume addition and mean ICP increase during the infusion test. This supports the feasibility of using non-invasive CaBV estimation to calculate CC. However, the magnitude of changes in response to the volume stimulus varies across frequencies, suggesting different underlying physiological mechanisms, particularly in the slower end of the frequency spectrum where vasogenic B-waves occur.

IS ICP REALLY NORMAL IN NPH? - FIRST INSIGHTS FROM HOME-BASED TELEMETRIC MONITORING

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INTRODUCTION: The term “normal pressure” in normal pressure hydrocephalus (NPH) is a misnomer. While mean intracranial pressure (ICP) may fall under a conventional range, invasive ICP monitoring studies have demonstrated abnormal cerebrospinal fluid dynamics in these patients. However, most of these studies have been limited to short-term monitoring in the supine position within hospital settings. This study presents the first use of long-term, home-based ICP monitoring in ambulatory patients with NPH using a fully implantable telemetric device following shunt insertion.

METHODS: Four patients with NPH were implanted with a wireless intraparenchymal telemetric ICP sensor (Kitea Health) at the time of shunt surgery. Patients or caregivers recorded 13-second ICP waveform measurements at home using a handheld wand. Mean ICP and pulse amplitude were extracted from each recording, alongside body position and symptom scores, over a six-month period.

RESULTS: All patients tolerated the device without complications and maintained high adherence to regular measurements. Each patient received a Codman-Certas-valve set to 5 at the time of surgery. ICP values varied by body position, with median ICP readings of -7 mmHg supine, -16 mmHg sitting, and -16 mmHg standing. In one patient, the shunt was temporarily turned “off” during the study period due to clinical indications. This was followed by a sustained increase in both mean ICP and pulse amplitude, coinciding with worsening gait. The remaining patients demonstrated stable ICP trends postoperatively.

CONCLUSIONS: This is the first report of long-term telemetric ICP monitoring in patients with NPH measured in the home environment, providing insight into posture-related ICP variability in a home environment. The Kitea-ICP-system was safe, well tolerated, and provided objective physiological data to inform assessment of shunt function and demonstrate shunt reliance in a patient. These findings highlight the potential of telemetric ICP monitoring to support individualised, remote care in NPH patients.

Patient Consent: The patients have provided their consent for the publication of this abstract.

FEASIBILITY OF PATIENT-LED HOME ICP MONITORING

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INTRODUCTION: Remote intracranial pressure (ICP) monitoring has the potential to reduce hospital burden and enable earlier detection of shunt malfunction in patients with hydrocephalus. However, its clinical utility depends on patient engagement and consistent data acquisition in home-based settings. This study reports adherence and measurement patterns, including body position and time of day preferences, from patient-led home ICP monitoring using a fully implantable telemetric sensor.

METHODS: Twelve participants with hydrocephalus were implanted with a telemetric ICP sensor (Kitea Health) during cerebrospinal fluid shunt insertion or revision surgery. Patients or caregivers were instructed to perform 13-second ICP waveform measurements at home using a handheld wand (daily for the first two weeks, then at least every two days thereafter). Body position (supine, sitting, standing) and time of day (morning, afternoon, evening, night) were recorded for each session. Data were collected over a three-month period.

RESULTS: All participants successfully recorded ICP measurements from home. Adherence was 75% in Week 1 and 45% in Week 2. From Week 3 onward, weekly adherence ranged from 56% to 82%. Most measurements were performed in the morning (6:00 am to 12:00 pm, 41%) and 72% were taken in the sitting position. Mean ICP values differed significantly by body position ($p < 0.001$, linear mixed model): supine (5.7 mmHg), sitting (-5.3 mmHg), and standing (-7.0 mmHg). Among sitting measurements, ICP was significantly higher in the evening compared to the morning ($p < 0.05$).

CONCLUSIONS: Long-term telemetric ICP monitoring is feasible, with participants demonstrating sustained engagement over time. The Kitea ICP System enabled meaningful trend analysis and revealed clear posture and time dependent ICP patterns.

Patient Consent: The patients have provided their consent for the publication of this abstract.

EFFECT OF A STRUCTURED EXERCISE PROGRAM ON CENTER OF MASS VARIABLES DURING WALKING IN INDIVIDUALS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A PRELIMINARY STUDY

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INTRODUCTION: Idiopathic Normal Pressure Hydrocephalus (iNPH) is a neurodegenerative disorder characterized by gait and balance disturbances. Therapeutic approaches, including exercise programs, are essential for enhancing gait performance in individuals with iNPH. This study aimed to evaluate the effects of a structured exercise program on the Center of Mass (CoM) displacement, total path length, and velocity during walking in individuals with iNPH.

METHODS: The intervention consisted of a personalized exercise program aimed at improving balance, strength, and mobility. Sessions were conducted three times per week, each lasting one hour, over a 4-week period. Gait data were collected pre- and post-intervention using Xsens Inertial Measurement Unit (IMU) sensors. The Center of Mass (CoM) displacement, total path length, and velocity (mean and peak) in the mediolateral (ML), anteroposterior (AP), and vertical (VT) directions were analyzed over three gait cycles in the middle section of the walkway. The Wilcoxon signed-rank test was employed to determine differences between pre- and post-intervention measurements, with statistical significance set at $p < 0.05$.

RESULTS: Six individuals with iNPH participated in the study, comprising four males and two females. The average participant characteristics were as follows: age 77 ± 7.2 years, weight 63.9 ± 9.3 kg, height 1.62 ± 0.1 m, and body mass index (BMI) 24.4 ± 3.5 kg/m². Post-intervention analysis revealed significant improvements in CoM displacement, total path length, and mean velocity in the ML direction ($p < 0.05$), indicating enhanced gait performance following the exercise program.

CONCLUSIONS: The structured exercise program significantly improved kinematic variables, including CoM displacement, total path length, and velocity, in individuals with iNPH. These findings suggest that exercise-based interventions can effectively enhance gait performance in this population. Future studies with larger sample sizes and extended follow-up periods are recommended to further validate these results.

HANDWRITING ANALYSIS IN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS: A STUDY ON 18 PATIENTS

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INTRODUCTION: This project explores the clinical use of graphology as a complementary tool to identify functional alterations associated with normal pressure hydrocephalus (iNPH). It highlights the potential of clinical graphology as a non-invasive method for monitoring and assessing the functional conditions of patients with iNPH, offering an innovative approach in the field of clinical neurology. The study's aim is to demonstrate how the graphological analysis of patients' handwriting, before and after surgery, can be used as a possible indicator of patients' motor and cognitive conditions, also for making differential diagnosis with Parkinson's and/or Alzheimer's patients.

METHODS: 18 patients diagnosed with normal pressure hydrocephalus were analyzed using the Morettian Graphological Method. Of these, 2 cases were not analyzable due to the lack of complete data, while 16 cases were subjected to an in-depth analysis of the handwriting. The investigation focused on comparing the changes in the patients' handwriting before and after the intervention, with particular attention to the quality of the graphomotor tract. Various aspects were observed and evaluated, including the ability to organize space, graphomotor movement, graphic cohesion, pressure, size of the letters, arrangement and alignment on the line.

RESULTS: Among the 16 cases analyzed:

- In 10 cases (62.5%) an improvement in handwriting was observed;
- In 3 cases (18.75%) the handwriting remained unchanged.
- In 1 case (6.25%) there was a worsening of handwriting.

The results of the study reveal that patients with iNPH show constant distinctive characteristics. The graphomotor characteristics decreased significantly in the patients who underwent surgery.

CONCLUSIONS: This preliminary analysis suggests that writing is a useful tool for monitoring the clinical evolution of patients with iNPH. The improvement is a recovery of fine motor and cognitive functions; however, further research with a larger sample is needed to confirm these results and investigate more detailed correlations.

PRE- AND POST-SHUNT EVALUATION OF AUDITORY SIGNS IN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is characterized by gait disturbance, cognitive impairment, and urinary incontinence, primarily affecting older adults. While improvements in neurological symptoms and quality of life after shunting are well-documented, the postoperative effects on otologic function remain underexplored. This study aimed to evaluate these changes following ventriculoatrial shunt (VAS) surgery in patients with NPH.

METHODS: A prospective, descriptive study was conducted on NPH patients who underwent VAS between July, 2018, and August, 2021, at our institution. Inclusion criteria comprised patients over 18 years of age diagnosed with NPH, who were otologically assessed preoperatively and 3-6 months postoperatively. The audiologic test battery to assess auditory and speech processing functions included pure-tone audiometry (0.25-8 kHz), speech testing, and auditory brainstem responses (ABR). Descriptive statistics and comparisons of central tendency and dispersion were calculated.

RESULTS: 13 patients were included (23.08% female, median age 75 years [IQR: 66-81 years]). Speech testing showed improvement in most patients, with a median threshold reduction of 5dB. A reduction in variability on pure-tone audiometry and ABR latencies I, III, and V was observed after VAS, suggesting stabilized auditory pathway conduction. Speech testing improvement indicates a better ability to identify, recognize, discriminate, remember, understand, and repeat speech at lower decibels, likewise a positive change in auditory pathway activation and hearing sensitivity.

CONCLUSIONS: The disease burden of otologic alterations in NPH may be underrecognized but potentially reversible after VAS. Improved speech discrimination and reduced variability in ABR latencies and audiometric thresholds suggest enhanced auditory processing postoperatively. Since speech testing evaluates various aspects of cognitive function, it may be a valuable tool for understanding the progression of executive function in NPH patients. These results underscore the need for incorporating otolaryngology tests into pre- and post-shunting evaluations. Further research in larger patient cohorts is warranted to validate these preliminary findings.

BEYOND THE CARDIAC PULSE WAVES: GAIT-RELATED OSCILLATIONS IN INTRACRANIAL PRESSURE PROFILES

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INTRODUCTION: Intracranial pressure (ICP) monitoring is an important tool in hydrocephalus care. While cardiac-related ICP waves are well understood, the impact of physical activity remains unclear. This study explores how physical activity, particularly walking and stair climbing, alters ICP amplitude and waveform.

METHODS: A mobile next-generation telemetric ICP monitor was used, enhanced with sensors for body position and activity. The subject performed predefined activities (e.g., lying, standing, walking, stairs) over periods of 3 minutes and a 1.5-hour unguided phase of everyday activity while the ICP was continuously recorded. Frequency-domain analysis was used to identify activity-related signal components. The measurements were also simulated in a model patient within a laboratory setting.

RESULTS: The ICP waveform during walking and stair climbing showed mean pulse amplitudes of up to 23.3 cmH₂O. It also revealed a cardiac pulse and a second component matching step cadence, confirmed by spectral analysis. This pattern was also observed in the model patient. This suggests that gait influences ICP dynamics and led to a refinement of the classical ICP-volume model. By incorporating an activity-related component, the model illustrates how step-induced accelerations cause periodic displacement of CSF and/or brain tissue in the cranio-caudal direction, which may result in corresponding rhythmic changes in ICP.

CONCLUSIONS: Physical activity effects the ICP waveform and may represent a physiological driver of CSF flow. The refined model may improve ICP interpretation in real-world settings. Further clinical validation will help translate these findings into practice. Our results highlight the diagnostic potential of next-generation telemetric ICP monitors, capturing ICP dynamics along with activity, body position, and well-being data.

ESTABLISHING A STANDARD PROTOCOL FOR M.SCIO ICP MONITORING: LEARNING POINTS FROM EXTERNALIZED SHUNT SYSTEMS

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INTRODUCTION: The Miethke M.scio telesensor is a non-invasive intracranial pressure (ICP) monitoring device increasingly used to assess of cerebrospinal fluid (CSF) dynamics. However, posture-dependant variability in ICP readings risks misinterpretation, particularly when measurements are taken in isolation. In this study, we present findings from externalized ventriculo-peritoneal shunt systems to inform a standardized approach to M.scio measurements.

METHODS: We measured mean ICP, amplitude, and waveform of the externalized ventriculo-peritoneal shunt system. The study assessed ICP and CSF drainage in relation to patient position and drain height. The shunt was initially clamped, and readings taken in both supine and sitting positions. It was then unclamped, and measurements repeated across six configurations—three in sitting and three in lying.

RESULTS: With the shunt clamped, both supine and sitting positions showed preserved pulsatility. After unclamping in the sitting position with the drain 20 cm above the zygoma, there was no CSF drainage but an intact waveform. When moved to abdominal level, drainage began, but soon after, pulsatility was lost and ICP dropped, halting further outflow. In the supine position, with the drain 20 cm above the abdomen, a small volume drained and pulsatility was preserved. However, lowering the drain to abdominal level again led to pulsatility loss and slower drainage. After drainage cessation, no pulsatility or additional outflow was observed. These findings suggest remaining in any single position for an extended period may cause temporary ventricular collapse, resulting in waveform loss and cessation of CSF drainage.

CONCLUSIONS: These findings underscore the need for a standardized protocol when using M.scio sensors in clinical settings. We recommend initiating ICP measurements in the supine position and capturing data across multiple postures at standardised time points to account for physiological changes such as posture-induced ventricular collapse. Such an approach may enhance diagnostic accuracy and support better-informed shunt management decisions.

NEUROSURGICAL MANAGEMENT OF IDIOPATHIC INTRACRANIAL HYPERTENSION (IIH): PRELIMINARY INSIGHTS FROM THE EUROPEAN ASSOCIATION OF NEUROSURGICAL SOCIETIES GUIDELINES

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INTRODUCTION: Neurosurgical management of idiopathic intracranial hypertension (IIH) is usually indicated for vision-threatening papilloedema, but comparative evidence guiding optimal intervention - between cerebrospinal fluid (CSF) shunting, optic nerve sheath fenestration (ONSF), and dural venous sinus stenting (DVSS) – remains limited. As part of the upcoming European Association of Neurosurgical Societies (EANS) guidelines on neurosurgical and interventional management of IIH, we conducted a systematic review to evaluate the efficacy and safety of these modalities in adults with IIH.

METHODS: We searched MEDLINE/PubMed, EMBASE, Scopus, and Cochrane Library for RCTs, non-randomized trials and cohort/case-series (N > 10) in adults (≥ 18 y) with IIH undergoing CSF diversion, DVSS or ONSF (secondary/pediatric excluded). Two reviewers screened, extracted data and assessed bias (RoB 2/NIH). Primary outcome was surgical failure; secondary outcomes included visual, headache, QoL, cost-effectiveness and technical/complication metrics.

RESULTS: We included 115 studies, encompassing 21,934 patients (mean age 33.3 years; mean BMI 34.8 kg/m²; male:female ratio 1:9.4) with a mean pre-operative CSF opening pressure of 48.7 cmH₂O. Interventions included 17,485 CSF shunting operations, 3,052 DVSS, and 1,054 ONSF procedures. CSF diversion rapidly relieved headache and resolved papilledema but had high revision and failure rates. DVSS consistently resolved papilloedema and headaches with the lowest retreatment rates. ONSF effectively arrested visual decline and reversed papilledema, with few serious complications and low failure rates. Cost-effectiveness data were limited.

CONCLUSIONS: The treatment of IIH should be tailored to individual patient profiles. DVSS offers a strong balance of symptom relief and durability. CSF shunting delivers rapid results but with higher failure. ONSF is particularly effective for visual preservation. A randomized trial is needed to provide high quality evidence.

Patient Consent: The patient has provided their consent for the publication of this abstract.

IMPACT OF DISTAL CATHETER TIP PLACEMENT ON VENTRICULOPERITONEAL SHUNT DYNAMICS

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INTRODUCTION: Ventriculoperitoneal (VP) shunts are standard therapy for hydrocephalus. Drainage rate depends on the differential pressure acting on the shunt valve. Suboptimal catheter placement may cause under- or over-drainage, leading to clinical complications. While research has mainly focused on intracranial pressure (ICP), variability across abdominal compartments and posture effects on shunt drainage remains underexplored.

METHODS: We investigated how distal catheter tip placement and posture could influence the differential pressure acting on a virtual VP shunt using physiological pressure recordings from six acute ovine trials. Our data include simultaneous measurements of ICP and intra-abdominal pressure (IAP_x) in four compartments (x = [cranial, caudal, dorsal, ventral]), with the animal prone and tilt angle θ set at 0°, +13° (head over body) and -13° (body over head) with respect to horizontal. Differential pressure is defined as $P_{diff,x} = ICP - IAP_x + P_{hyd}$, where P_{hyd} is the hydrostatic pressure acting on the shunt, depending on θ and on the relative positioning of the two catheter tips.

RESULTS: Across six animals, mean differential pressure ranged from -3.27 ± 16.49 to 14.47 ± 8.87 mmHg at 0°, from 9.83 ± 11.71 to 18.04 ± 9.17 mmHg at +13° tilt, and from -3.46 ± 23.92 to 13.80 ± 16.32 mmHg at -13° tilt (Fig. 1).

CONCLUSIONS: The presented results demonstrate how distal catheter tip placement influences differential pressure in VP shunts by combining compartment-specific IAP and posture-dependent hydrostatic effects. As differential pressure drives CSF drainage, these findings, while derived from an ovine model, still raise concern that distal catheter tip placement could affect CSF drainage rate in humans.

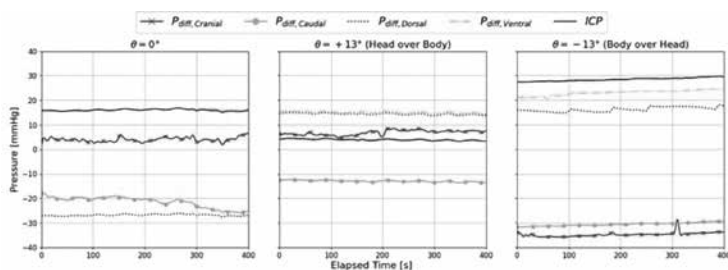


Fig. 1. Exemplary differential pressures results for a virtual ventriculoperitoneal shunt for different distal catheter tip locations and postures, shown alongside ICP. Signals are from a single animal, low-pass filtered at 0.1 Hz. $P_{diff,x}$: differential pressure relative to the abdominal compartment (x = [cranial, caudal, dorsal, ventral]), ICP: intracranial pressure

WHAT HAPPENS TO THE BRAIN AFTER A CSF TAP-TEST?

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INTRODUCTION: Patients with Normal Pressure Hydrocephalus (NPH) have an excess of cerebrospinal fluid in the intracranial cavity causing symptoms such as gait disturbance, incontinence and cognitive impairment. A CSF tap-test, where 40 ml of CSF is removed via a lumbar puncture, can be performed to aid in the selection of shunt candidates. Previous studies have shown small to moderate reductions in the ventricle size after the drainage. Little is known, however, about the changes in characteristics of the brain parenchyma. Functional changes in tissue status may hold more information related to symptoms and treatment response.

METHODS: Twenty-three patients with idiopathic NPH were enrolled in this prospective study. The patients provided their consent for the publication of this abstract. An MRI quantification sequence was used to measure the relaxation properties of all intracranial structures. The acquisition was performed twice at baseline, followed by a CSF tap-test. The acquisition was repeated at 1, 4, and 24 hours after the tap-test. SyMRI was used to measure ventricle, total CSF and brain volumes as well as the R1 and R2 relaxation rates and proton density PD.

RESULTS: The mean CSF volume reduction after the tap-test was 14.9 ml (4.4%), 1.7 ml (0.5%) and 4.1 ml (1.2%) and the mean ventricle volume reduction was 5.7 ml (4.1%), 3.1 ml (2.2%) and 2.2 ml (1.6%) at 1, 4 and 24 hours, respectively. Mean brain R1 relaxation reduced with 0.67, 0.01 and 0.09%, mean brain R2 relaxation reduced with 0.41, 0.09 and 0.02% and mean proton density increased with 0.41, 0.11 and 0.14% at 1, 4 and 24 hours, respectively. No gradient in relaxation as a function of distance from lateral ventricles was observed.

CONCLUSIONS: Sudden removal of CSF from the intracranial cavity causes the brain parenchyma to absorb more liquid, uniformly distributed over the entire brain.

INVESTIGATING THE UTILITY OF ICP MONITORING IN CHIARI I MALFORMATION: INSIGHTS FROM A LONG-TERM OBSERVATIONAL STUDY

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INTRODUCTION: Chiari I Malformation (CMI) remains a complex neurosurgical condition, with significant heterogeneity in clinical presentation and cerebrospinal fluid (CSF) dynamics. While radiological imaging is central to diagnosis, it often lacks physiological granularity. This study evaluates the utility of dynamic intracranial pressure (ICP) monitoring, focusing on the compensatory reserve index (RAP), in influencing surgical decision-making.

METHODS: Between 1996 and 2019, 432 radiologically confirmed CMI patients were identified. A carefully selected sub-cohort underwent overnight intraparenchymal ICP monitoring via the ICM+ platform. Patients with prior CSF-diverting procedures were excluded. Mean ICP and RAP were analysed alongside clinical decisions and post-operative outcomes, with the Chicago Chiari Outcome Scale (CCOS) used for structured follow-up assessment.

RESULTS: Although mean ICP ranged within normal limits (3.4–12.7 mmHg; mean 6.46 ± 3.32 mmHg), several patients exhibited impaired compensatory reserve ($RAP > 0.5$), indicating reduced intracranial compliance. Among these, 67% underwent CSF diversion or foramen magnum decompression based on RAP trends. On follow-up, 72% of those treated achieved favourable outcomes ($CCOS \geq 13$), suggesting a clinically meaningful relationship between RAP-guided decision-making and post-operative recovery.

CONCLUSIONS: This single-centre, long-term study highlights the potential of RAP as a physiologically sensitive parameter in the pre-operative evaluation of CMI. RAP identified occult dysfunction in patients with normal ICP and imaging, offering added value in complex or ambiguous cases. These findings support the integration of ICP-derived parameters into clinical workflows and underscore the need for prospective multicentre validation to inform future guidelines.

PHYSICAL THERAPY-EVALUATED SHUNT TAPS IN THE MANAGEMENT OF INCOMPLETE RESPONSE AND RELAPSE IN SHUNTED IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Despite initial improvements with shunting in idiopathic Normal Pressure Hydrocephalus (NPH), many patients exhibit incomplete response or delayed symptom recurrence. Increasing cerebrospinal fluid (CSF) drainage by reprogramming/exchanging the shunt valve to a lower opening pressure may improve symptoms in these instances, but overdrainage can cause subdural hematoma. We developed the Physical Therapy-Evaluated Shunt Tap (PEST) test to predict potential benefit of a lower valve opening pressure, which may be particularly useful in patients at high risk for complications of overdrainage (e.g., anticoagulation). Here, we evaluate the safety and efficacy of this test.

METHODS: We included all shunted iNPH patients who underwent PEST testing at our institution over a 5-year period. PEST involved percutaneous shunt tap with removal of 20cc of CSF, preceded and followed by standardized physical therapy (PT) assessments: Timed Up and Go, 10-meter walk, 2-minute walk, 30 second sit-to-stand, and balance testing. Short-term (within 3 days) subjective (patient-reported) response to the tap was recorded. Safety outcomes included infection within 90 days and subdural hematoma within 30 days. Correlation of PEST results was evaluated with Chi-square.

RESULTS: 108 PEST tests were performed on 85 patients. No infections or subdural hematomas occurred. 45 patients were ultimately trialed at a lower valve pressure. 57% percent of these patients were symptomatically improved on follow up. A combination of positive subjective (patient-reported) response and objective gait and balance response to PEST was correlated with eventual symptomatic improvement with a lower valve pressure setting ($p=0.015$). Subjective response alone was 96% sensitive but only 32% specific. Specificity improved to 63% when both subjective and objective response were combined.

CONCLUSIONS: PEST is a safe and informative tool to guide valve pressure setting management in shunted iNPH patients. While subjective response alone is sensitive to predict eventual improvement, adding objective gait and balance testing improves specificity.

CHALLENGES IN NEUROPSYCHOLOGICAL IMPROVEMENT AFTER SHUNT SURGERY FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: We sought to analyze cognitive performance and depressive symptoms of Idiopathic Normal Pressure Hydrocephalus (iNPH) patients three months after the shunt surgery.

METHODS: iNPH patients underwent a complex neuropsychological assessment prior to the shunt surgery and three months after. Additionally, we compared the post-surgical cognitive performance of iNPH patients to age, sex and education matched group of healthy controls to see whether the iNPH patients reached the performance level of the normal population.

RESULTS: Out of the 126 patients for suspected iNPH 33 patients met all the inclusion criteria. Additionally, we used 71 healthy controls. For the analysis of cognitive performance change after shunt surgery we found significant improvement in tests covering Verbal Memory ($p = .033$, $p = .043$ and $p = .007$) and Psychomotor Pace ($p = .003$). We found mixed results for tests covering Executive functions ($p = .89$, $p = .07$, $p = .002$). We found no improvement for tests covering Non-Verbal Memory ($p = .1$, $p = .297$), Language ($p = .916$, $p = .498$) and Visuo-spatial Abilities ($p = .483$). We also found improvement in depressive symptoms ($p = .02$). For the analysis of the 3 months after surgery iNPH patients cognitive performance and control group cognitive performance we found all neuropsychological tests to significantly differ ($p < .001$).

CONCLUSIONS: Shunt surgery appears to have a positive effect on the neuropsychological performance of patients with iNPH. However, the improvement is limited. We observed improvements in the Verbal Memory and Psychomotor Pace domains, while results for Executive Functions were mixed—suggesting a positive effect on patients' ability to plan but no effect on their ability to shift. Interestingly, depressive symptoms followed a similar pattern to cognitive functioning before and after surgery. We found that shunt surgery significantly alleviated depressive symptoms. Although overall performance improves three months after surgery, it still does not reach the level of healthy individuals.

Patient Consent: The patient has provided their consent for the publication of this abstract.

IMPLEMENTING A CLINICAL PATHWAY FOR NORMAL PRESSURE HYDROCEPHALUS (NPH) : A STANDARDIZED APPROACH FOR THE CARE OF NPH PATIENTS UNDERGOING VENTRICULOPERITONEAL SHUNT INSERTION

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INTRODUCTION: Clinical pathways are standardized, evidence-based care plans designed to optimize patient outcomes and resource utilization. This study presents the 10 year experience with the development, implementation, and evaluation of a clinical pathway for managing Normal Pressure Hydrocephalus (NPH) through ventriculoperitoneal (VP) shunt insertion.

METHODS: In 2015, a multidisciplinary team began developing the clinical pathway for NPH patients undergoing VP shunt placement. The pathway went live in 2016 and covers care from the decision for surgery through discharge. It integrates evidence-based guidelines and standardized order sets within the electronic medical record (EMR). The pathway is reviewed every 2-3 years to ensure compliance with best practices. Annual variance reports track key metrics, including cost per encounter, order set compliance, length of stay (LOS), and outlier analysis. LOS is calculated using benchmarks such as the geometric mean LOS for the diagnosis-related group (DRG) and historical institutional data. Patients are classified as outliers if their LOS exceeds twice the defined pathway length, or if their admission is urgent/emergent.

RESULTS: The NPH clinical pathway optimizes care for elective VP shunt placements while remaining flexible for urgent/emergent cases. From 2016 to 2024, 126 patients followed the clinical pathway: 4 in DRG 31, 33 in DRG 32, and 89 in DRG 33. Excluding outliers, the weighted average LOS was 3.16 days for DRG 31, 1.86 days for DRG 32, and 1.28 days for DRG 33. Order set utilization improved steadily, reaching 83% in FY24. Standardized preoperative assessment and management of comorbidities contributed to LOS performance remaining within GMLOS benchmarks.

CONCLUSIONS: The NPH clinical pathway has enabled consistent care delivery, improved LOS outcomes, and supported ongoing quality monitoring. Future enhancements include real-time compliance tracking and expanded variance reporting. This model demonstrates the value of structured clinical pathways in improving patient outcomes and resource utilization in neurosurgical practice.

THE ECONOMIC IMPACT OF UNDERDIAGNOSIS IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a pathology consisting of an increase in the size of the ventricular cavities of the brain, without an increase in cerebrospinal fluid pressure on lumbar puncture. It is characterized by the Hakim-Adams triad of symptoms, consisting of progressive cognitive decline, urinary incontinence and gait disorders. It is a condition typical of old age: its prevalence is estimated at around 1.3% in patients over 65 years of age, a figure however burdened by the important problem of underdiagnosis. In fact, normal pressure hydrocephalus, despite being a fundamental element to consider in the differential diagnosis of neurodegenerative diseases, remains too often unrecognized in the non-specialist medical field. This consideration has an important economic implication for the patient, for the relatives and for the National Health System.

METHODS: Using the prevalence data obtained by Anderson and Costant, we estimated the minimum and maximum number of patients affected by normal pressure hydrocephalus in each individual region and throughout the national territory (Italy) and in economic terms, calculated the savings, that would be obtained if the pathology were adequately recognized and treated.

RESULTS: in Italy, it's estimated that the number of patients affected by iNPH is between 114961-611436 people, with a relative economic saving between 6,731,477,554 and 35,802,217,133 euros.

CONCLUSIONS: Our study shows that an adequate knowledge of pathology and treatment would allow a significant economic saving for the patient and for the National Health System.

IDENTIFYING SECONDARY HYDROCEPHALUS IN POST-INTENSIVE CARE PATIENTS: AN INFUSION STUDY APPROACH

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INTRODUCTION: Secondary normal pressure hydrocephalus (sNPH) following traumatic brain injury (TBI) or subarachnoid hemorrhage (SAH) is a common complication that can negatively impact neurological outcomes. sNPH is classically treated with CSF shunting, but many patients do not improve after surgery. Diagnosing sNPH is challenging, especially in post-intensive care rehabilitation units (PICRU: specialized units for initiating rehabilitation after an ICU stay for brain injury), where neurological examination is limited. The lumbar infusion test (LIT) helps differentiate sNPH from cerebral atrophy. This study describes the epidemiology and risk factors of sNPH in PICRU.

METHODS: A retrospective study was performed at the University Hospitals of Saint-Etienne and Lyon, including patients with clinical and radiologic signs of sNPH (ventriculomegaly) who were evaluated with a LIT. Rout > 12 was considered in favor of sNPH.

RESULTS: Between 2019 and 2022, 168 patients (53.8 ± 16.7 years) were admitted to the PICRU after severe TBI or SAH. sNPH was suspected in 36 patients (21.4%). LIT was performed at least two months after the initial brain insult and confirmed the diagnosis of sNPH in 17 patients (47.2%). The presence of SAH (whether traumatic or aneurysmal) in the acute phase was a risk factor (OR 1.51; 95% CI [1.02-2.22]). Patients with a duration of external CSF drainage greater than 10 days also showed a significant association (OR 1.87; 95% CI [1.05-3.33]) with sNPH. In the traumatic subgroup, there was a relation between traumatic SAH and sNPH ($p=0.009$). In the SAH subgroup, there was a relationship with vasospasm ($p=0.043$).

CONCLUSIONS: This study demonstrates a high prevalence of sNPH among patients with severe brain insults. Combining current clinical and radiologic criteria and the LIT may improve patients' selection for CSF shunting. Further prospective studies are needed to confirm the positive impact of LIT on patients' outcomes.

BENCHTOP INVESTIGATION OF TISSUE PULL-IN OF SHUNT CATHETERS IN HYDROCEPHALUS

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INTRODUCTION: Over 85% of hydrocephalus patients will experience shunt catheter failure within 10 years. These revisions represent not only a large financial burden to the patient, but a significant decrease in quality of life as well. Catheter failure is one of the primary causes for revisions. The mechanism that underpins catheter failure is not well understood, but ex-plant catheters indicate that brain parenchyma is often “pulled-in” to the catheter creating an array of papillae on the tissue surface. To better understand the conditions that result in these papillae, a benchtop apparatus that aims to recreate these conditions is proposed here.

METHODS: A previously validated oscillatory pump was used in combination with a custom in-house built vacuum chamber bioreactor that allowed for the controlled contact between unfixed excised post-mortem porcine brain tissue and standard commercial catheters. This contact can result in a “pull-in” of the brain tissue that aims to replicate the in-vivo conditions that may result in tissue pull-in. This apparatus allows for the controlled manipulation of fluid velocity, volumetric flowrates, perfusion pressure, and bulk-flow for experimental purposes.

RESULTS: The presented benchtop apparatus was successfully able to recreate tissue pull-in. The porcine tissue was notably pulled into the catheter as observed by an endoscope and the flow parameters that resulted in this recorded.

CONCLUSIONS: These initial images of benchtop tissue pull-in provide insight into the fluid dynamic mechanisms under which tissue pull-in occurs. These results are some of the first that reliably recreate this poorly understood but essential phenomena in hydrocephalus catheter failure. This method opens the door to further investigation into the underlying mechanisms at play such as pressure gradients, material properties, and eventually cellular response to these strain conditions.

A MATERIAL-MEDIATED DECREASE IN NEUROLOGICAL CELL ADHESION TO HYDROCEPHALUS SHUNT CATHETERS

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INTRODUCTION: Cellular and tissue adhesion to ventricular catheters (VCs) in hydrocephalus shunting contributes to VC obstruction. In-vitro and in-vivo studies show that silicone-based VCs are conducive to neurological cell adhesion and proliferation. A newly developed Endexo® surface modifying macromolecule (SMM) polymer additive is blended into the bulk silicone of antibiotic impregnated (AI) VCs. The Endexo SMM's fluorinated end groups significantly alter the surface chemistry, reducing biomaterial adhesion. This novel material is compared to unmodified control AI VCs in an in-vitro flow-based bioreactor model of shunt flow.

METHODS: The Test VCs have rifampin, clindamycin, and Endexo SMM polymer additive blended into the silicone. The Control VCs are equivalently sized, commercially available, silicone AI VCs with rifampin and clindamycin. A flow-based co-culture method first seeds human microglia and astrocytes to the tip of the VCs in a bioreactor. The cell-laden VC is connected to a peristaltic pump that provides cell media at a physiologically relevant flow rate (0.25 ml/min) with weekly media changes. One Control and one Test VC are connected to the same reservoir of media to give a matched pair for comparison. After 4 weeks, the bioreactor is carefully disassembled, the cells attached to the VCs are fixed, the VCs are longitudinally cross-sectioned, stained, and imaged via fluorescent confocal microscopy to quantify percent surface coverage.

RESULTS: The Test VCs showed a significant decrease in cell adhesion compared to the Control VCs. Across 17 paired replicates, Test VCs showed a 96.1% decrease in neurological cell surface coverage vs. Control VCs (Range 88.3% – 99.8%, StDev = 6.0%; p-value <0.001).

CONCLUSIONS: The antibiotic impregnated ventricular catheters with the Endexo SMM significantly reduced microglia and astrocyte cell surface area coverage in vitro compared to commercially available antibiotic impregnated ventricular catheters.

VENTRICULAR AND CHOROID PLEXUS VOLUME CHANGES IN ALZHEIMER'S AND NON-ALZHEIMER'S DEMENTIAS: IMPLICATIONS FOR SHARED PATHOLOGICAL FEATURES AND CEREBROSPINAL FLUID DYNAMICS

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INTRODUCTION: Ventricular and choroid plexus enlargement is a common neuroimaging feature in Alzheimer's disease (AD) and has been associated with cognitive decline. However, whether these changes are specific to AD or reflect general dementia-related pathology remains unclear.

METHODS: This retrospective study included 662 participants (healthy controls [HC]: 191; AD: 327; nonAD: 144) enrolled between January 2022 and December 2024. AD patients were clinically diagnosed and biomarker-confirmed as A+, while nonAD patients (FTD, VAD, Clin-AD/Bio-nonAD, NPH, DLB, PDD) were confirmed as A-. Neuroimaging measures (3D-MRI) included CSF spaces, choroid plexus volume, and ventricle volumes (lateral, inferior lateral, third, fourth). We used multiple linear regression to analyze the differences in ventricular and choroid plexus volumes across diagnostic groups. Associations with CSF biomarkers (A β 42/40, pTau181, tTau) were analyzed in a subgroup (AD: 208; nonAD: 91) undergoing Lumipulse testing.

RESULTS: Both AD and nonAD dementia groups showed significantly enlarged ventricular and choroid plexus volumes compared to HC, except for the fourth ventricle in AD. Similarly, ventricular and choroid plexus volumes (excluding the fourth ventricle) correlated with higher CDR scores. In AD, all ventricular and choroid plexus volumes, including the fourth ventricle, were associated with CSF biomarkers, while no such associations were found in nonAD. Compared to nonAD dementia, AD patients showed reduced fourth ventricle volumes ($\beta=-0.352$, $p_{\text{adj}}=0.006$) after adjusting for age, sex and CDR scores. Stratified analyses showed FTD patients exhibited the most pronounced ventricular enlargement, while VAD patients uniquely had fourth ventricle enlargement. Clin-AD/Bio-nonAD patients had smaller CSF spaces and inferior lateral ventricles.

CONCLUSIONS: Ventricular and choroid plexus enlargement appears to be a shared feature across dementias, rather than AD-specific. Reduced fourth ventricle volumes in AD relative to nonAD suggest distinct cerebrospinal fluid dynamics. Correlations with CSF biomarkers highlight the potential utility of neuroimaging markers for tracking disease progression.

Patient Consent: The patient has provided their consent for the publication of this abstract.

INVESTIGATING CHOROID PLEXUS ORGANOGENESIS USING AN ORGANOID MODEL

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INTRODUCTION: Organoids serve as a powerful tool for in vitro modeling of human organ development and disease, offering three-dimensional, tractable systems. In 2022, the first commercialized choroid plexus organoid (ChPO) kit was released, providing a novel platform for hydrocephalus research. However, the developmental trajectory and maturation of ChPOs remain poorly understood. This study aims to characterize ChPO formation and maturation over time and compare it with human choroid plexus (ChP) development.

METHODS: ChPOs were generated using a commercial kit, following the manufacturer's protocol. Organoids were harvested on days 22, 32, 42, 52, and 62 for immunofluorescence staining. Markers of interest included transthyretin, aquaporin-1 (AQP1), claudin-1, forkhead box protein J1 (FOXJ1), paired box protein 6, t-box transcription factor 2, and glucose transporter type 1 (GLUT1).

RESULTS: Immunofluorescence analysis revealed that early-stage ChPOs exhibited pseudostratified epithelial architecture at the embryoid periphery, with bipolar AQP1 expression. As cysts grew larger, AQP1 became restricted to the basal surface of the cyst wall not in contact with the media and both AQP1 and GLUT1 expressions diminished from the media-tissue interface. FOXJ1 expression was predominantly localized to the media-facing surface of the cysts.

CONCLUSIONS: Initial bipolar AQP1 expression suggests early bidirectional cerebrospinal fluid transport. The subsequent loss of AQP1 and GLUT1 from the media-tissue interface combined with FOXJ1 enrichment, indicates a transition from ChP identity towards a simple, ependymal-like epithelium. Ongoing investigation seeks to explore the differences found between ChPOs and human ChP. With further functional validation and cellular characterization, ChPOs may serve as a valuable model for investigating hydrocephalus pathophysiology.

CHANGES IN CHOROID PLEXUS MACROPHAGES ACROSS NEONATAL DEVELOPMENT IN A GENETIC MODEL OF HYDROCEPHALUS

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INTRODUCTION: Kohlmer's epiplexus macrophages (CP^{epi} MΦ) are a subpopulation of non-parenchymal, border-associated macrophages in the central nervous system (CNS). CP^{epi} MΦ reside on the apical surface of the choroid plexus (CP) and are spatially and transcriptionally distinct from other populations of non-parenchymal macrophages in the CNS, such as CP stromal macrophages (CP^{stroma} MΦ). These cells have been shown to respond to inflammatory diseases. Their proximity to the CP establishes the hypothesis that they play a role in the pathogenesis of hydrocephalus. This study aims to assess the longitudinal changes in the CP^{epi} MΦ and CP^{stroma} MΦ cell populations, collectively referred to here as choroid plexus macrophages (CPMΦ), in a rat model of genetic neonatal hydrocephalus. In this model, homozygous mutant animals present with mild hydrocephalus at birth, which progresses quickly and severely. These animals generally do not survive beyond postnatal day P20.

METHODS: Common markers of macrophages/microglia are used for multi-label immunohistochemistry and confocal microscopy, alongside 3-dimensional reconstruction analysis to investigate cell counts and morphological changes in CPMΦ between wildtype and hydrocephalic mutant rat pups at P5, P10, and P15.

RESULTS: There is an increase in CPMΦ cell counts in hydrocephalic animals at P10 and P15 compared to wildtype. This difference increases with postnatal age. Mean fluorescent intensity measurements as well as morphological analysis substantiate these findings.

CONCLUSIONS: These data indicate that CPMΦ show phenotypical differences between hydrocephalic and healthy development at early postnatal time points. Future studies will investigate CPMΦ in different animal models of hydrocephalus as well as the impact of drugs that treat hydrocephalus on CPMΦ.

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DIFFERENTIAL IMPROVEMENT IN PATIENT-REPORTED OUTCOMES MEASUREMENT INFORMATION SYSTEM (PROMIS) DOMAINS AFTER VENTRICULOPERITONEAL SHUNTING (VPS) FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (iNPH)

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INTRODUCTION: Patient-reported outcomes measurement information system (PROMIS) is a widely utilized tool to overview various functional domains of health. We describe longitudinal changes in various PROMIS domains after ventriculoperitoneal shunting (VPS) for patients with idiopathic normal pressure hydrocephalus (iNPH).

METHODS: Patients with “probable” iNPH who underwent VPS from December 2017 to January 2025 and had completed pre- and post-operative PROMIS questionnaires were retrospectively reviewed. PROMIS computerized adaptive testing (CAT) domains including anxiety, depression, fatigue, sleep disturbance, pain interference, social ability, and physical function were assessed and tabulated. Generalized additive mixed models (GAMM) were utilized to assess longitudinal changes in each domain while controlling for variable follow-up time and patient-specific repeated measures.

RESULTS: A total of 174 patients with 464 PROMIS assessments (median 3 per patient) were included with median follow-up time of 5.9 months (IQR 2.4-12.0). Pre-operative scores for physical function (median 34), sleep disturbance (median 49), and social ability (median 44) were significantly lower compared to other domains (Tukey-adjusted $p < 0.05$). Short-term improvements within 6 months were noted in all domains, except pain interference and sleep disturbance, with median absolute change ranging from 2-4 points (BH-adjusted $p < 0.05$). GAMM modeling disclosed significant longitudinal improvements at 3, 6, and 12 months for physical function, social ability, and fatigue scores while anxiety scores demonstrated improvement that plateaued at 6 months (Tukey-adjusted $p < 0.05$). No significant changes were noted in longitudinal pain interference, depression, or sleep disturbance domain scores.

CONCLUSIONS: Longitudinal PROMIS assessments in iNPH patients undergoing VPS discloses differential temporal trends in improvement across various functional domains. Improvements in physical function, social ability, and anxiety are noted shortly after VPS while improvements in fatigue occur over a more protracted time course. Further refinement of patient-reported outcomes specific to iNPH will be useful in characterizing functional improvement.

IS SHUNTING WORTHWHILE FOR BEDRIDDEN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS ?

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INTRODUCTION: If left untreated, Normal Pressure Hydrocephalus (NPH) follows a progressively course that ultimately leads to a bedridden status. It is unclear whether delayed treatment can still improve this condition. This study aims to evaluate the clinical benefit of shunt surgery in NPH patients who have reached a bedridden status.

METHODS: This retrospective cohort study included NPH-related bedridden adult patients (age > 18 years) who underwent shunt surgery between January 2020 and January 2025. The Clinical Frailty Scale (CFS), an index of patients' overall physiological and functional reserve, was used as the primary outcome measure. All enrolled patients had a preoperative CFS score of 7 (bedridden). Patients lost to follow-up were considered failures (CFS = 7).

RESULTS: During the 4-year study period, 563 patients underwent shunt surgery. Of these patients, 41 (7%) underwent surgery for NPH-related bedridden status, of which 26 (63%) had idiopathic NPH. At the first postoperative assessment (mean: 2.9 months; SD: 0.7), 2 patients were lost and 28 (68%) showed a reduction in CFS score (median improvement: 1, IQR: 1, $p < 0.001$). At the last postoperative assessment (mean: 20.4 months; SD: 15.5), 13 patients were lost and 18 (44%) still showed improvement in CFS (median change: 0, IQR: 0, $p < 0.001$). Multivariate regression analysis showed that the best predictors of surgical success were the absence of CSF dynamics exploration (because of obvious diagnosis) ($p = 0.012$) and younger age ($p = 0.015$), but not the duration of gait impairment ($p = 0.76$).

CONCLUSIONS: Our results suggest that shunt surgery may be effective even in patients with long-standing and extremely severe gait and balance impairments due to NPH, especially in clear-cut cases (no CSF perfusion test required) and in younger patients. This should prevent the systematic rejection of shunt surgery in these apparently desperate cases.

DEVELOPMENT OF A NON-INVASIVE MULTIMODAL SYSTEM FOR NPH MONITORING THROUGH SPEECH, GAZE, GAIT, AND HEARING PARAMETERS

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INTRODUCTION: South Korea is experiencing rapid population aging, with dementia prevalence projected to reach 16.1% among elderly by 2050. Normal Pressure Hydrocephalus (NPH) accounts for approximately 10% of dementia cases and is potentially curable through surgical intervention, unlike Alzheimer's and vascular dementia. However, NPH remains underdiagnosed due to lack of awareness, diagnostic tools, and specialized personnel, leading to missed treatment opportunities.

METHODS: We developed a multimodal data collection system incorporating four non-invasive parameters: speech, eye-tracking (gaze), hearing, and gait analysis. These parameters align with the clinical symptoms of NPH (cognitive decline, gait disturbance, and urinary incontinence). The system utilizes a specialized application that captures and analyzes these parameters simultaneously, facilitating comprehensive NPH symptom monitoring. The study established global research collaborations with institutions in Japan and Thailand, focusing on pre- and post-surgical NPH patient assessment.

RESULTS: Our preliminary work yielded a functional multimodal data collection platform integrating speech recognition APIs, eye tracking metrics (fixation, saccade patterns), hearing threshold assessment, and gait analysis tools. Ethics approval was obtained (IRB), and the system successfully captured multimodal data from both healthy controls and NPH patients, enabling comparative analysis for distinctive NPH indicators.

CONCLUSION: This all-in-one digital medical device enables real-time monitoring of NPH symptoms through non-invasive speech, gaze, gait, and hearing assessments. The system shows promise for early detection of NPH, potentially improving surgical outcomes through timely intervention. Further development will focus on identifying definitive multimodal indicators specific to NPH and quantifying post-surgical improvements.

CEREBRAL PSEUDOATROPHY IN NORMAL PRESSURE HYDROCEPHALUS (HAKIM'S SYNDROME): CLINICAL AND VOLUMETRIC CHANGES FOLLOWING SHUNTING

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is characterized by gait disturbances, cognitive decline, and urinary incontinence. Postoperative MRI studies have shown volumetric changes, including reductions in lateral ventricle cerebrospinal fluid (CSF) volume, and a decrease in total CSF volume, white matter, gray matter, and total brain parenchyma. The relationship between these changes and the clinical improvement following shunting. This study aims to evaluate pre- and postoperative MRI volumetric changes and their association with clinical outcomes in NPH patients.

METHODS: A retrospective cohort study was conducted on NPH patients who underwent shunt surgery at our institution (2016–2024). Pre- and postoperative MRI scans were analyzed for volumetric changes. Cognitive function, urinary incontinence, and gait were evaluated pre- and postoperatively. Statistical analysis included the Wilcoxon signed-rank test, paired t-test, Mann–Whitney U test, and chi-square test, with odds ratios and 95% confidence intervals.

RESULTS: 32 patients (68.7% male, mean age 79 years) were included. A significant reduction in CSF volume ($p=0.03$), a significant increase in total brain parenchyma volume ($p=0.024$), and a significant decrease in CSF in the lateral ventricle ($p=0.001$) were observed. Increased brain parenchyma was associated with improvements in urinary incontinence ($p=0.021$) and cognitive function ($p=0.012$). Increased brain parenchyma and white matter, and decreased total CSF volume and CSF in the lateral ventricle were associated with higher odds of cognitive improvement (OR 2.400, 95% CI 1.229–4.688; OR 4.000, 95% CI 1.501–10.658; OR 1.750, 95% CI 1.112–2.755; respectively). Decreased CSF was also associated with higher odds of improved gait (OR 1.400, 95% CI 1.005–1.950).

CONCLUSIONS: Postoperative changes in brain volume, including increased parenchyma and reduced CSF, are associated with significant clinical improvements in cognitive function, urinary incontinence, and gait. These changes may represent reversible brain atrophy (pseudotrophy) that improves following shunting.

TARGETED CSF METABOLOMICS SUGGESTS POTENTIAL DIAGNOSTIC BIOMARKERS FOR IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The pathophysiological mechanisms of idiopathic normal pressure hydrocephalus (iNPH) remain largely unknown. In this study, we investigated whether the levels of a broad set of metabolites in cerebrospinal fluid (CSF) differ between patients with iNPH, neurodegenerative disorders, and healthy controls, aiming to identify new objective diagnostic markers.

METHODS: Lumbar CSF was collected from patients at a single center, distributed among the following diagnostic groups: iNPH (n = 120), healthy controls (n = 44), Alzheimer's disease (AD) (n = 72), mild cognitive impairment due to AD (ADMCI) (n = 24), stable MCI (n = 48), and frontotemporal dementia (FTD) (n = 8). The abundance of targeted metabolites was analyzed using liquid chromatography coupled to high-resolution mass spectrometry (LC-HRMS). Linear regression models were used to identify metabolites with significant differences in mean levels between the groups, adjusting for age and sex. The false discovery rate (FDR) was set at 5% to control for multiple testing.

RESULTS: Out of 219 metabolites analyzed, 61 were found at relevant levels in samples from iNPH patients and healthy controls. These 61 metabolites were subsequently analyzed across the neurodegenerative disorder groups, and 25 metabolites were found to differ significantly ($q < 0.05$) between the groups. Of these, eight metabolites were specifically different between iNPH and the other groups. These metabolites included the amino acids threonine, histidine, tyrosin and tryptophan, as well as isobutyrylcarnitine, citric acid, and dehydroascorbic acid.

CONCLUSIONS: The eight selected metabolites may have diagnostic potential in the evaluation of patients with iNPH, helping to differentiate this condition from other neurodegenerative disorders.

CSF BIOMARKERS ARE RELATED TO SYMPTOMATOLOGY AND OUTCOME IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS – THE GOTHENBURG POINT-CSF STUDY

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INTRODUCTION: In this prospective longitudinal follow-up study, we used a range of CSF biomarkers to explore the neurochemical fingerprints of idiopathic normal pressure hydrocephalus (iNPH) and to identify biomarkers for prediction of outcome.

METHODS: Study of 135 consecutive iNPH patients (mean age 73.8 (SD 6.6), 66% males) diagnosed according to Guidelines, shunt operated and followed up after median 5.4 months. Symptoms and outcomes were scored on the Gothenburg iNPH scale. Pre- and postoperative lumbar CSF were analyzed for amyloid proteins A β 40, A β 42, A β 40/ A β 42 ratio; soluble amyloid precursor proteins (sAPP α and sAPP β), total and phosphorylated tau (T-tau, P-tau), neurofilament light (NFL), YKL-40, MCP1, neurogranin and GAP-43.

RESULTS: Total iNPH scale score increased from mean 53.8 (SD 17.8) preoperatively to 66.2 (SD 18.2) postoperatively, mean improvement 12.4 points (95% CI, 10.6–14.2; $p < .001$). Substantial postoperative changes in several CSF biomarker concentrations were observed, the largest increase for GAP43 (fold change, 2.92; 95% CI, 2.59–3.29) followed by tau (fold change, 2.29; 95% CI, 2.05–2.55), AMY40 (fold change, 1.93; 95% CI, 1.79–2.07), and AMY42 (fold change, 1.76; 95% CI, 1.61–1.93) ($p < .001$). Changes in several biomarkers were significantly associated with clinical improvement. In adjusted analyses, positive correlations were observed between changes in AMY40 ($r = 0.26$; $p = .016$), AMY42 ($r = 0.25$; $p = .011$), YKL40 ($r = 0.22$; $p = .038$), and GAP43 ($r = 0.22$; $p = .032$) and the change in iNPH total scale score. Lower baseline MCP1 levels were associated with greater clinical improvement. (partial $r = -0.22$; 95% CI, -0.38 to -0.04 ; $p = .015$). Higher baseline MCP-1 levels were associated with worse odds for improvement (adjusted OR, 0.44; 95% CI, 0.24–0.83; $p = .011$; AUC of 0.67 (95% CI, 0.57–0.77).

CONCLUSIONS: Postoperative clinical improvement in iNPH is associated with increase in biomarkers related to amyloid metabolism and synaptic function. Lower preoperative concentrations of MCP-1, a cytokine involved in monocyte recruitment, may serve as a predictive marker for favorable surgical outcomes.

Patient Consent: The patient has provided their consent for the publication of this abstract.

AK9 MUTATIONS AND NORMAL PRESSURE HYDROCEPHALUS: VALIDATING GENETIC EVIDENCE FROM A CASE-CONTROL STUDY

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INTRODUCTION: Previous studies support normal pressure hydrocephalus (NPH) as a syndrome driven by several pathophysiological pathways, including gene expression impairing ependymal ciliary function. A recent report identified mutations in AK9 (adenylate kinase 9) in 9.6% of NPH patients and validated gene effect using a knockout mice model resulting in gait disorder, impaired balance and communicating hydrocephalus. This study aimed to validate the prevalence of AK9 variants in an independent NPH cohort.

METHODS: We conducted a case-control study examining NPH patients and healthy controls. DNA samples were analyzed for AK9 variants. Associations of risk for NPH with common AK9 variants and gene-burden measures for rare AK9 variants were evaluated using logistic regression models adjusted for age and sex.

RESULTS: We compared 85 non-Hispanic White patients diagnosed with NPH (33% female, median age 77 years [range: 48-92]) to controls (n=534, 44% female, median age 66 years [range: 55-96]). We identified 34 different AK9 variants across cases and controls : 3 common with minor allele frequencies (MAF) >0.5% and 31 rare (MAF <0.5%). Common variants did not associate with NPH (rs150078049 [OR=0.45; 0.02-2.68], rs559724447 [OR=1.22; 0.17-5.68], rs186606173 [OR=0.99; 0.05-6.73]). Gene-burden analysis revealed a trend toward association between the presence of minor allele of any rare AK9 variant (MAF <0.5%) and NPH (10.6% vs. 5.4% in healthy controls, OR=2.17; 0.88-5.04). The presence of any AK9 variant, regardless of frequency, was not associated with increased risk for NPH (OR=1.37; 0.64-2.77).

CONCLUSIONS: Our findings suggest rare AK9 variants may contribute to NPH pathogenesis, supporting previous observations. Although statistical significance was not reached, likely due to sample size limitations, similar prevalence of rare AK9 variants in our cohort supports the potential role of impaired ependymal ciliary function in NPH development. Further studies with larger cohorts are needed to elucidate the contribution of AK9 mutations to NPH pathophysiology.

TRANSCRANIAL DOPPLER DURING CSF INFUSION TEST

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INTRODUCTION: Hydrocephalus diagnosis and management rely on access to the intrathecal space to monitor CSF pressure, perform infusion tests, and drain CSF. Whilst access to CSF has been obtained, additional monitoring can be performed, providing unique insights into cerebral fluid dynamics. This study explores the added value of Transcranial Doppler (TCD) and arterial blood pressure (ABP) monitoring during infusion testing, aiming to enhance the interpretation of CSF dynamics through non-invasive cerebral hemodynamics.

METHODS: A cohort of 65 NPH patients underwent computerised lumbar CSF infusion testing, with TCD monitoring of cerebral blood flow velocity (FV) in the middle cerebral artery, with plethysmography recording ABP. Waves of ICP, ABP and FV were recorded for further analysis. Dynamic autoregulation was assessed using the Mx index, calculated as the correlation between slow waves in CPP and FV. Global autoregulation was assessed with the Pressure Reactivity Index (PRx) as the correlation between slow waves of ABP and ICP.

RESULTS: During infusion, slow waves of ICP increased in amplitude and were synchronised with ABP and FV slow waves. Coherence function between ICP and TCD signals, peaked within the frequency range from 0.005 to 0.05 Hz. Rises in FV preceded rises of ICP, indicating vasogenic origin of ICP fluctuations. During a recorded plateau wave (single case), TCD signal showed specific widening of distance between systolic and diastolic FV (increased pulsatility). Autoregulation, as indicated regionally by Mx, slightly declined during infusion and was worse in patients with lower resistance to CSF outflow (Rout) or ischaemic lesions in MRI. PRx was unchanged during infusion and similarly to Mx, indicated worse autoregulation in patients with low Rout.

CONCLUSIONS: TCD provides valuable insights during CSF infusion testing by detecting slow ICP waves and evaluating cerebral autoregulation, without substantial increase of clinical time once a needle is inserted into the spinal canal. These findings support the integration of TCD into routine pressure monitoring for improved diagnostic accuracy in hydrocephalus.

VARIABILITY OF CEREBRAL VENOUS DRAINAGE IN PATIENTS WITH CHRONIC HYDROCEPHALUS: A PHASE-CONTRAST MRI STUDY

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INTRODUCTION: Intracranial venous drainage is complex, variable, and less understood than the arterial system. It plays a key role in intracranial compliance, particularly through the veins, which have flexible walls, unlike the venous sinuses that are encased in dura-mater. Chronic hydrocephalus (CH) is characterized by increased ventricular volume, necessitating compensation within the intracranial space. Phase-Contrast MRI (PC-MRI) is currently the unique technique for quantifying cerebral circulation of neurofluids (CSF, arterial and venous blood) non-invasively. The aim of this study is to investigate the impact of CH on cerebral venous dynamics.

METHODS: Venous drainage was analyzed in 29 adult CH patients clinically improved after shunt and 36 healthy controls using PC-MRI. Two planes were acquired: an intracranial plane crossing the superior sagittal sinus (SSS) and the straight sinus (SS) for venous measurements, as well as the internal carotid and basilar arteries for arterial inflow. An extracranial plane to quantify flow in the internal jugular veins, posterior circulation, vertebral arteries, and internal carotids. Venous flow was compared to arterial inflow to determine the relative contribution of each venous pathway to the overall cerebral venous drainage and to calculate the proportion of accessory drainage.

RESULTS: At the intracranial level, the main venous outflow (SSS+SS) accounted for $72 \pm 13\%$ in CH patients versus $62 \pm 8\%$ in controls ($p = 2 \times 10^{-4}$), while accessory drainage was significantly more prominent in controls ($p = 8 \times 10^{-4}$). At the extracranial level, main drainage with internal jugular veins represented $86 \pm 16\%$ of total venous outflow in CH patients, compared to $66 \pm 18\%$ in controls ($p = 1 \times 10^{-6}$).

CONCLUSIONS: We identified significant differences in cerebral venous drainage in patients with CH, both intracranially and extracranially. These patients appear to rely predominantly on main venous pathways. We hypothesize that this predominance is due to greater flexibility of the accessory veins, which may be more easily compressed when intraventricular volume increases.

Patient Consent: The patient has provided their consent for the publication of this abstract.

BEYOND IDIOPATHIC: SECONDARY NORMAL PRESSURE HYDROCEPHALUS (sNPH) – ETIOLOGICAL PATTERNS AND SURGICAL OUTCOMES

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INTRODUCTION: Secondary normal pressure hydrocephalus (sNPH) accounts for nearly 50% of NPH cases, following identifiable neurological insults including subarachnoid hemorrhage (SAH), traumatic brain injury (TBI), intracranial tumors, or central nervous system (CNS) infections. Despite its prevalence, sNPH remains undercharacterized in the literature. This study aims to delineate the etiological patterns and surgical outcomes in patients with sNPH.

METHODS: A retrospective analysis (2018–2024) was performed comparing idiopathic to sNPH (prior neurological insult). Univariate, bivariate, and multivariate analysis were performed. Associations between sNPH, surgery, complications, and reinterventions were explored (χ^2 , Fisher, and Mann–Whitney U tests). Two logistic regression models evaluated predictors of sNPH (1) and surgery (2) using Firth's correction when separation bias was suspected.

RESULTS: Among 198 patients (mean age 79.0 years; 63.1% male), 56 (28.3%) had documented sNPH, primarily due to stroke (17.2%) and traumatic brain injury (TBI; 7.1%). Notable comorbidities included hypertension (67.2%) and smoking (45.5%). Surgery was performed in 47.5% (n=94), of which 35.1% had a history of secondary insult. sNPH patients had faster symptom progression, with shorter gait disturbance duration ($p=0.018$). Surgical intervention was more likely in patients with prior TBI (OR=4.46; $p=0.016$) or overall sNPH (OR $\approx$ 1.9; $p=0.042$). sNPH patients had rates of postoperative complications of 30.3%, and reintervention of 21.2%. Hypertension (OR=2.15; $p=0.044$) and shorter gait symptom duration (OR=0.98; $p=0.018$) predicted sNPH, with modest model performance (Pseudo $R^2\approx 0.076$).

CONCLUSIONS: sNPH is a different subtype of NPH, accounting for more than a quarter of cases, primarily associated with stroke and TBI. Patients with sNPH exhibited more rapid symptom progression and surgical likelihood, with TBI emerging as an independent predictor. Heightened clinical awareness of sNPH is needed to inform timely diagnosis and surgical decision-making.

SPEED MATTERS: MAXIMAL 10M WALKING TEST IS SUPERIOR TO NORMAL PACE IN PREDICTING GAIT RECOVERY FOLLOWING VENTRICULOPERITONEAL SHUNT INSERTION IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: In patients with suspected Idiopathic Normal Pressure Hydrocephalus (iNPH), the 10-meter walking test (10 MWT) is a widely used instrument to evaluate gait performance following cerebrospinal fluid (CSF) drainage – guiding treatment decisions regarding ventriculoperitoneal (VP) shunt insertion. However, current literature and guidelines do not specify whether normal or maximal 10 MWT offers better prognostic value for sustained gait improvement following definitive CSF diversion.

METHODS: A retrospective longitudinal cohort study of iNPH patients treated at a single tertiary neurosurgical centre between 2013 and 2023 was conducted. Patients underwent a standardised 10 MWT at normal and maximal speeds before and after 72-hour extended lumbar drainage trial (ELDT), and at multiple timepoints following VP shunt insertion. Linear mixed-effects models assessed whether early gait response (post-ELDT) predicted long-term functional gains (post VP shunt insertion). Postoperative assessments were performed immediately after surgery (n=10/12 maximal/normal speed), after 6-months (n=63/75), 1-year (n=63/67), 2-years (n=44/46), 3-years (n=20/25), 5-years (n=14/13) and 8-years (n=9/5) [total n=106/119].

RESULTS: In maximal speed tests, early improvement after ELDT significantly predicted long-term gait improvement ($\beta = 1.31$, $p < 0.001$) with consistent gains over time ($\beta = 0.997$, $p = 0.004$). In contrast, normal speed tests showed a weaker, non-significant association ($\beta = 0.46$, $p = 0.077$) and no improvement over time ($p = 0.152$). Model comparisons showed maximal speed tests had a better fit (AIC = 1489.3 vs 2122.3, BIC = 1509.7 vs 2143.4) and lower variability (RSD = 5.36 vs 11.51; RISD = 4.63 vs 17.74).

CONCLUSIONS: Maximal speed 10 MWT provide superior predictive value for long-term gait improvement in iNPH patients post CSF diversion, underscoring the importance of task demand in revealing latent gait dysfunction and recovery potential. These findings support greater incorporation of maximal effort gait assessments in preoperative evaluations to enhance prognostication and guide individualised treatment planning.



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HYDROCEPHALUS IN LEPTOMENINGEAL METASTASIS MAY LACK TYPICAL IMAGING FEATURES OF NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The radiological characteristics of hydrocephalus in patients with leptomeningeal metastasis (LM) remain poorly defined. This study aimed to evaluate whether LM-associated hydrocephalus (LM-H) presents typical imaging features of normal pressure hydrocephalus (NPH), including Evans' index (EI) ≥ 0.3 , callosal angle (CA) $\leq 90^\circ$, periventricular lucency (PVL), and disproportionately enlarged subarachnoid space hydrocephalus (DESH).

METHODS: Radiologic parameters were assessed per the 2021 Japanese NPH guidelines. LM was classified as confirmed (positive CSF cytology or biopsy), probable (clinical and neuroradiological evidence), or possible (clinical or radiological evidence alone) based on 2023 EANO-ESMO criteria. LM-H was defined as hydrocephalus with clinical symptoms and either typical radiologic features or a positive lumbar tap test. Statistical analysis was performed using SPSS v25, with significance set at $p < 0.05$.

RESULTS: From 2019 to 2024, sixty-eight lung cancer patients with LM-H were included (confirmed: 27; probable: 28; possible: 13). Mean age was 61.3 years. Rates of radiologic features were as follows: EI ≥ 0.3 (51.5%), CA $\leq 90^\circ$ (48.5%), PVL (79.4%), and DESH (27.3%). Confirmed LM patients were significantly younger than probable or possible LM groups ($p < 0.001$). No significant group differences were observed in EI, CA, or PVL ($p = 0.95$, 0.44 , and 0.41 , respectively). However, DESH was significantly more frequent in the possible group (100%) than in confirmed (19.2%) and probable (22.2%) groups ($p = 0.05$). Following shunt surgery, 89.6% of patients experienced symptomatic improvement within one month.

CONCLUSIONS: Absence of typical hydrocephalus features (EI < 0.3 , CA $> 90^\circ$, no PVL or DESH) should not preclude the diagnosis of LM-H. In clinically suspected cases, a lumbar tap test is warranted regardless of imaging findings.

NO CORRELATION BETWEEN FUNCTIONAL DOPAMINERGIC IMAGING, IRON LOAD AND CSF OUTFLOW RESISTANCE IN SUSPECTED IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) lies at the intersection of CSF dynamics and neurodegeneration. Functional imaging techniques such as DaTScan and iron-sensitive MRI (R2* mapping) are increasingly used to assess overlapping degenerative mechanisms. However, their relationship with cerebrospinal fluid outflow resistance (Rout) remains unclear. This study aimed to determine whether dopaminergic function and brain iron load correlate with Rout in patients evaluated for iNPH.

METHODS: We retrospectively analyzed 70 patients with ventriculomegaly and suspected iNPH who underwent a standardized workup including MMSE, UPDRS, MRI volumetry, DaTScan, R2* mapping of the substantia nigra, and lumbar infusion testing for Rout measurement. Based on clinical consensus and follow-up, 29 patients were shunted (DVP+), and 41 were not (DVP-). Correlation analyses between Rout and functional imaging markers (striatal uptake, asymmetry index, R2*) were performed across the full cohort and within subgroups.

RESULTS: In the full cohort, no significant correlation was found between Rout and DaTScan uptake ($r = 0.06$, $p = 0.58$), asymmetry index ($r = 0.03$, $p = 0.71$), or R2* values ($r = 0.07$, $p = 0.61$). Among DVP+ patients (mean Rout = 15.2 ± 4.1), there was no association with DaTScan ($r = 0.09$) or R2* ($r = 0.13$). Similar absence of correlation was observed in the DVP- group (mean Rout = 8.3 ± 3.6 ; DaTScan: $r = 0.04$; R2*: $r = 0.08$). No significant differences in functional imaging values were found between groups.

CONCLUSIONS: Functional dopaminergic imaging and brain iron content show no relationship with CSF outflow resistance in iNPH. These findings support the use of multimodal assessment rather than relying on single imaging biomarkers

TRANSMISSION OF PULSATILITY ACROSS THE LEVEL OF THE FORAMEN MAGNUM IN CHIARI SYNDROME: ALTERATION OF MOBILE COMPLIANCE?

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INTRODUCTION: Chiari Syndrome (CS) is radiologically defined by the ptosis of cerebellar tonsils below the McRae's line. This downward displacement results in a reduced cross-sectional area of subarachnoid spaces, leading to increased resistance to CSF circulation at this level. During a cardiac cycle (CC), the arterial blood inflow is not immediately compensated by venous outflow, causing transient changes in intracranial vascular volume. CSF oscillations through the foramen magnum (FM) play a crucial role in compensating for these vascular volume changes during CC. This mobile compliance may be impaired in patients with CS. The objective of this study is to investigate the transmission of CSF pulsatility across the foramen magnum throughout the CC.

METHODS: 92 patients with CS were retrospectively included. Each underwent phase-contrast MRI (pcMRI) to measure CSF stroke volume at three key anatomical location: the prepontine cisterns (SVppc), representing intracranial subarachnoid spaces; the foramen magnum (SVfm); and the cervical subarachnoid space at the C2C3 level (SVcerv), corresponding to the extracranial subarachnoid compartment. The pulsatility of the brainstem and cerebellar tonsils was also evaluated using the stroke volume of the neuraxis at the foramen magnum (SVnevrax).

RESULTS: There is statistically significant positive correlation between SVcpp and SVfm (Spearman's rho: 0.68, $p < 0.001$), between SVcpp and SVcerv (rho: 0.62, $p < 0.001$), and between SVfm and SVcerv ($p < 0.001$). Using Wilcoxon test, SVcerv is significantly higher than both SVppc and SVfm ($p < 0.001$), and SVfm significantly higher than VOppc ($p < 0.001$). VOfm+nevrax is statistically higher than every measured SV ($p < 0.001$).

CONCLUSIONS: Despite a reduced CSF flow cross-sectional area at the FM in CS, transmission of CSF pulsatility from the intracranial to the extracranial subarachnoid spaces remains functionally preserved. Neuraxial pulsatility at the foramen magnum appears to compensate for the altered CSF oscillations, contributing to intracranial compliance.

DIAGNOSTIC ACCURACY OF THERMAL TRANSCUTANEOUS FLOW COMPARED WITH RADIONUCLIDE SHUNT PATENCY STUDY TO DETECT SHUNT OBSTRUCTION IN ADULTS WITH HYDROCEPHALUS- A CROSS SECTIONAL ANALYTIC STUDY

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INTRODUCTION: Increased recognition of hydrocephalus in an aging population and technological improvements has resulted in an increase in diagnosis and treatment, however; shunt malfunction remains a significant concern and evaluation for patency often involves invasive procedures, such as radionuclide shunt patency studies (SPS). The objective was to compare the diagnostic accuracy of thermal transcutaneous flow (TTF) to SPS.

METHODS: 30 patients with hydrocephalus were evaluated prospectively. Eligible for inclusion were consecutive adults 18 years old and older with a ventriculoperitoneal shunt and suspected shunt malfunction in a tertiary care center. The most frequent etiology of hydrocephalus was idiopathic normal pressure hydrocephalus followed by congenital hydrocephalus and acquired hydrocephalus. Patients underwent TTF before and after SPS in a single visit. Because CSF flow is known to be intermittent combining results of 2 tests with flow confirmed (FC) in either test was accepted as confirmation of CSF flow. TTF confirmation with the manufacturer's threshold of 0.20-degree Celsius decrease in temperature were compared to interpretation of SPS. Results of the 0.20 degree C threshold were also evaluated with a threshold of 0.15 degree C for comparison. Receiver operating curve analysis was used and summarized as Area Under the Curve and diagnostic accuracy measures were assessed.

RESULTS: Using a threshold of 0.2 Celsius the AUC is 0.8 Sensitivity 89% Specificity 70% PPV 85% NPV 78% Accuracy 83% .Using a threshold of 0.15 Celsius the AUC is 0.8 Sensitivity 85% Specificity 50% PPV 77 NPV 71% Accuracy 76%

CONCLUSIONS: Using a TTF threshold of 0.2 with a diagnostic accuracy of 83% TTF demonstrates utility as a noninvasive, point of care, inexpensive screening tool to evaluate shunt patency. While neither TTF nor SPS assesses adequate flow TTF compares favorably to SPS to assess shunt patency.

CONTINUOUS TELEMETRIC INTRACRANIAL PRESSURE MEASUREMENT (ctICPM) ASSESSING THE EFFECT OF DIFFERENT BODY POSITIONS, ACTIVITY, TIME AND SHUNT VALVE ADJUSTMENT

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INTRODUCTION: Non-invasive intracranial pressure (ICP) measurements using a telemetric sensor can help to objectify patients' symptoms, further elucidate pathophysiologies and be used to optimize valve settings. However, continuous telemetric ICP measurements (ctICPM) along with body position and activity are hampered by limited technical options. In this prospective study, using a novel reader unit prototype for the M. Scio, ctICPM assessing the effect of different body positions and activity were performed to evaluate the correlation of ICP, body position, activity and time.

METHODS: A standardized protocol (lying, sitting, standing, walking, climbing stairs, valsalva) was established. ctICPM was performed for up to 45min. In a subset of patients, after the initial measurement, valve settings were changed and a second ctICPM was performed. An ICP analysis software (ICPicture, Miethke, Germany) was used for evaluation of the data. Informed consent was obtained from all patients.

RESULTS: The patient group consisted of 5 patients (median age: 43.8+/-12.8y; 60%female). Underlying pathologies were idiopathic intracranial hypertension (n=2), 1 aqueductal stenosis, 1 complex shunt course after neonatal ICH and 1 post SAH hydrocephalus. ctICPM showed robust continuous recording values in all patients. ctICPM clearly demonstrated a significant direct ICP response in all patients changing from lying to sitting as well as lying to standing position, while no differences in the AMP was found. No relevant differences in mean ICP or AMP between sitting or standing position were detected. Overall highest AMP values were found during activity. Most interestingly, in all hydrocephalus pathologies, increasing the shunt valve setting resulted in significant ICP changes within 20min.

CONCLUSIONS: Our study of ctICPM showed robust measurements and revealed direct effects of body position, activity as well as valve changes on ICP and AMP. ctICPM provides new opportunities to obtain objective data to develop a better understanding and optimize treatment strategies.

PURE ENDOSCOPIC CYSTO VENTRICULOSTOMY FOR ARACHNOID AND GLIOEPENDYMAL CYSTS: TECHNICAL ASPECTS IN A COHORT SERIES WITH LONG FOLLOW UP

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INTRODUCTION: Arachnoid and glioblastoma cysts are pathological entities that can manifest with variable neurological symptoms depending on their location and size; many are asymptomatic, and observation should be warranted. Traditionally, surgical management has included open microsurgical approaches and cyst-peritoneal shunting. In this study, we present our 10-year experience in treating symptomatic lesions solely through a pure cerebral endoscopic approach, focusing on establishing direct communication between the cyst and the ventricular system.

METHODS: We retrospectively analyzed the data of 20 symptomatic patients (7 pediatric and 13 adults) affected by cerebral arachnoid cysts (n=15) and glioblastoma cysts (n=5) treated at our center over a 10-year period. In all cases, a pure cerebral endoscopic approach was utilized to create one or more communicating fenestrations between the cyst cavity and the adjacent ventricular system. We evaluated demographic data, pre-operative clinical presentation (80% headache, 20% seizures or cognitive deficits), pre-operative cyst location and size, details of the endoscopic technique, intra- and post-operative complications, and long-term clinical and radiological outcomes.

RESULTS: In all 20 patients successfully treated, effective communication between the cyst and the ventricular system was achieved. Radiological cyst volume control was observed in 100% of patients at follow-up. Notably, an 80% reduction in cyst size was observed. Clinically, improvement of pre-operative symptoms was observed in all treated patients. No major complications directly related to the endoscopic procedure occurred.

CONCLUSIONS: Our 10-year experience with 20 cases demonstrates that a minimally invasive pure endoscopic approach is an effective and safe strategy for treatment of symptomatic cerebral arachnoid and glioblastoma cysts. The creation of communication with the ventricular system results in cyst volume control and significant clinical improvement in all patients. These findings underscore the crucial role of endoscopy as the sole treatment modality in this specific patient population, avoiding the need for open approaches or shunting.

FLUID DYNAMICS MODEL OF THE CEREBRAL VENTRICLE SYSTEM

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INTRODUCTION: Hydrocephalus is a neurological condition characterized by an excessive buildup of cerebrospinal fluid (CSF) in the brain. Current treatments, such as ventriculoperitoneal shunts, divert excess CSF from the brain but often face complications. While previous shunt designs were targeting the improved fluid flow and reduced occlusion, they often lacked the precision needed for real-world applications, primarily due to simplified simulation models. Here, we introduce BrainFlow, a computational model that integrates detailed anatomical and physiological features to simulate CSF dynamics in the presence of shunt implants.

METHODS: BrainFlow incorporates patient-specific medical imaging data, pulsatile flow to mimic cardiac cycles, adjustable parameters for various hydrocephalus conditions, and a biomolecule tracking feature to evaluate the long-term risk of shunt occlusion due to flow-mediated biomolecular transport.

RESULTS: We validated BrainFlow against 4D MRI flow data and clinically reported values for velocity and wall shear stress. Through our comprehensive simulations, we uncovered four key findings: 1) the majority of biomolecules enter the shunt through the proximal holes, confirming previous studies and highlighting the vulnerability of previous designs with equal-sized holes to non-uniform flow; 2) bacterial and cellular adhesion was primarily observed between inlets with equal flow rates, especially at interstitial material locations, leading to biomolecular buildup and increasing the risk of complications; 3) stagnation zones and vortex formations are formed near the shunt tip and within the third ventricle; and 4) biomolecules frequently collided with and adhered to the tissue lining of the ventricle, especially when the shunt was placed close to the tissue.

CONCLUSIONS: Our work lays the groundwork for development of next-generation shunts tailored to individual patient anatomy and pathology, ultimately aiming to improve outcomes for patients with hydrocephalus by reducing the rate of shunt failure through informed, patient-specific design strategies.

WIRELESS MONITORING OF CSF FLOW RATE, PRESSURE, AND DEVICE PATENCY FOR TIMELY DIAGNOSIS OF HYDROCEPHALUS SHUNT FAILURE

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INTRODUCTION: Hydrocephalus, a chronic disease, characterized by buildup of excess cerebrospinal fluid (CSF) in the brain's ventricles, rapidly leads to severe brain damage, if left untreated or due to treatment (shunt) failure. Unfortunately, shunts fail at extremely high rates, followed by lengthy and oftentimes inconclusive diagnostic testing. To address this need, Senseer is developing the MultiSense Hydrocephalus Shunt System, including a) a flow, pressure, and patency sensor module that is connected in-line with commercial shunts, b) a programmer for wireless implant powering and data acquisition, and c) the Senseer cloud for data management and setting of alerts, enabling timely intervention. Currently, Senseer is focused on translational product development, including validation of wireless power transfer, development of patency measurement procedures, and evaluation of prototype mechanical designs.

METHODS: Wireless power transfer at ~2 MHz was demonstrated using Litz wire wound into various primary and secondary coil shapes and breadboard-scale circuit components. An oscilloscope was used to evaluate transfer efficiency. Patency measurement procedures were performed using a Gamry potentiostat, a MEMS sensor die, a platinum mesh counter electrode, phosphate buffered saline (PBS), ventricular catheters, plastic tubing, and Luer lock valves, nozzles, and tubing. Experiments were performed on the benchtop and in ex vivo pig heads. Mechanical device prototypes were built using 3D printing and commonly available materials.

RESULTS: Wireless power was successfully transferred using various coil designs, power levels, ranges, and angles. These data will inform design decisions. Patency experiments confirmed that impedance measurement between MEMS sensors in-line with the ventricular catheter and a large counter electrode beneath the scalp is possible. Impedance increased when ventricular catheter holes were gradually blocked.

CONCLUSIONS: We believe this paradigm shift in the care of patients can significantly mitigate risk of permanent brain damage, thus improving the lives of thousands of patients that are affected by hydrocephalus.

LUMBOPERITONEAL SHUNT IS COMPARABLE TO VENTRICULOPERITONEAL SHUNT FOR THE TREATMENT OF IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: While ventriculoperitoneal shunt (VPS) has long been established as a standard treatment for idiopathic normal pressure hydrocephalus (iNPH), the evidence regarding the efficacy and safety of lumboperitoneal shunt (LPS) has been limited. This study compared the outcomes of LPS and VPS at our institution and also examined the impact of perioperative continuation of antithrombotic agents, presence of low back pain, or spinal canal stenosis on the outcomes of LPS.

METHODS: We retrospectively reviewed iNPH patients with a preoperative modified Rankin Scale score of 0–3 who underwent VPS or LPS between May 2020 and December 2024. Gait improvement at 1, 3, and 6 months postoperatively was compared between LPS and VPS groups using crude and adjusted odds ratios (ORs). Incidence of device-related complications, chronic subdural hematoma (CSDH), intracerebral hemorrhage (ICH), seizure, and death were also assessed between the groups. We further analyzed the impact of low back pain, spinal stenosis, and continued antithrombotic use on gait improvement and complications.

RESULTS: Among 250 patients, 197 underwent LPS (78.8%) and 53 underwent VPS (21.2%). Age and baseline gait function were similar between groups. At 1, 3, and 6 months, gait improvement rates in LPS vs. VPS were 74.1% vs. 82.9% (OR 0.59, 95% CI 0.24–1.43), 75.2% vs. 71.1% (OR 1.23, 95% CI 0.56–2.71), and 71.9% vs. 75.7% (OR 0.82, 95% CI 0.36–1.90), respectively. Device-related complications occurred in 7 cases (3.6%) in the LPS group and 2 cases (3.8%) in the VPS group ($p = 0.94$). The incidence of CSDH, ICH, seizure, and death did not demonstrate a statistically significant difference between the groups. No statistically significant differences were found in outcomes based on spinal stenosis, back pain, or antithrombotic therapy continuation.

CONCLUSION: LPS appears to be a comparable and reasonable alternative to VPS for the treatment of iNPH.

PREDICTIVE ACCURACY OF A CLINICAL MODEL FOR PATHOGENIC GENE CARRIAGE IN PUMCH DEMENTIA PATIENTS WITH A POSITIVE FAMILY HISTORY

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INTRODUCTION: Family history and clinical features, particularly age at onset (AAO), are critical for identifying pathogenic genes in dementia. Given concerns about disease inheritance and limited whole-exome sequencing cohorts, we aimed to develop and validate a clinical model for detecting pathogenic/likely pathogenic (P/LP) gene variants in dementia patients with a positive family history.

METHODS: We enrolled 601 Chinese dementia patients with a family history at PUMCH, comprising a retrospective derivation cohort (n = 476, January 2014–June 2022) and an external validation cohort (n = 125, July 2022–August 2024). Predictors included AAO, APOE ε4 status, and family history details (number of affected relatives, parental disease status, and early-onset cases). Model performance was evaluated using AUC and calibration (Hosmer-Lemeshow test, calibration plots).

RESULTS: In the derivation cohort (median AAO 66 years, IQR 58–73; 41.2% males), 10.3% harbored P/LP variants. Multivariate analysis showed that early-onset family history (OR = 2.61, p = 0.0096), AAO <55 years (OR = 2.56, p = 0.0098), >2 affected relatives (OR = 3.32, p = 0.0039), and parental disease status (OR = 4.72, p = 0.015) increased P/LP detection, while APOE ε4 carriage was protective (OR = 0.36, p = 0.0041). The model achieved AUCs of 0.784 (95% CI, 0.705–0.864) and 0.776 (95% CI, 0.701–0.853) when AAO was modeled continuously and dichotomized, respectively. In the validation cohort, AUCs were 0.781 (95% CI, 0.647–0.914) and 0.770 (95% CI, 0.626–0.916), with adequate calibration (Hosmer-Lemeshow p > 0.05).

CONCLUSIONS: The clinical model demonstrated robust discrimination for identifying P/LP gene carriers among dementia patients with a positive family history, supporting its potential to guide genetic testing in clinical practice. Further evaluation, including decision curve analysis, is warranted.

LACK OF CORRELATION BETWEEN FUNCTIONAL IMAGING AND BRAIN VOLUMETRY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A MULTIMODAL DIAGNOSTIC STUDY

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is defined by gait and cognitive impairment associated with ventriculomegaly. While structural MRI markers such as the Evans index and callosal angle are frequently used for diagnosis, functional imaging (e.g., DaTScan, iron-sensitive MRI) has been proposed to improve diagnostic accuracy. This study assessed whether these modalities correlate with each other and with clinical outcomes.

METHODS: We retrospectively studied 70 patients with suspected iNPH between 2016 and 2022, divided into shunted (DVP+, n = 29) and non-shunted (DVP-, n = 41) groups. All patients underwent neurocognitive evaluation (MMSE, UPDRS), structural MRI (Evans index, callosal angle, white matter lesions), DaTScan (striatal binding ratio, asymmetry index), and R2* MRI targeting the substantia nigra to quantify iron content within the substantia nigra's iron-rich subregion. Correlations were analyzed within and across subgroups.

RESULTS: In the DVP+ group, no significant correlation was found between striatal DaTScan uptake and Evans index ($r = 0.09$, $p = 0.64$), callosal angle ($r = -0.10$, $p = 0.59$), or MMSE ($r = -0.11$, $p = 0.56$). Similarly, R2* values did not correlate with ventricular size ($r = 0.13$, $p = 0.47$) or cognitive performance ($r = -0.07$, $p = 0.72$). In the DVP- group, results were comparable: DaTScan uptake vs. Evans index ($r = 0.06$, $p = 0.73$); R2* vs. Evans index ($r = 0.08$, $p = 0.65$); no correlation with callosal angle or MMSE in either case. No functional marker significantly predicted surgical durable response (at least 3 years).

CONCLUSION: Functional imaging (DaTScan, R2*) did not correlate with volumetric MRI or cognitive scores in either shunted or non-shunted patients. These findings suggest a dissociation between functional and structural alterations in iNPH, reinforcing the need for integrative diagnostic approaches.

TREATMENT-RESPONSIVE CHANGES IN POSITIONAL CEREBRAL COMPLIANCE IN PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS DEMONSTRATED BY NON-INVASIVE MONITORING

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) may affect 700,000 patients in the United States alone, causing progressive gait, cognitive, and urinary symptoms. CSF diversion relieves these symptoms in some patients, but diagnosis is confounded by clinical features that overlap with other common conditions. Furthermore, changes in CSF fluid dynamics in iNPH are still unclear, and biomarkers of improvement and optimization after CSF diversion are lacking. We sought to evaluate cerebral compliance in iNPH patients before and after shunt surgery.

METHODS: Fifteen patients with iNPH and four control subjects agreed to participate in this IRB approved study. They were evaluated with non-invasive intracranial compliance monitoring within three months before and after shunt surgery, for 5-minutes supine and with the head of bed at 30°. Compliance was measured as P2/P1 ratio by the BrainforCare proprietary algorithm and visually checked and corrected by three authors. P2/P1 was normalized by dividing the ratio in sitting position by supine position. ANOVA and Student's two-tailed T test were used to compare pre-operative and post-operative ratios.

RESULTS: The patients' average age was 76, and average opening pressure at shunt surgery was 13. Compliance ratio in the sitting position normalized to supine was significantly lower after surgery ($P=0.03$). Before surgery, P2/P1 while sitting trended lower in the laying position versus sitting position (mean 1.15 and 1.26 respectively). After surgery, mean P2/P1 sitting was 1.27 and laying down 1.26. Within three months of shunt surgery, 93% reported improvement in their gait, 60% in cognition and 53% in urinary symptoms.

CONCLUSIONS: Patients with iNPH may have position-dependent changes in their cerebrospinal fluid dynamics, which are buffered by CSF diversion. Positional changes in compliance may be used as an adjunct evaluation for response to CSF diversion trials or shunt setting changes, although further studies must demonstrate statistical correlation with symptomatic improvement.

SPACING SHUNT VALVES IN SERIES: A NOVEL STRATEGY TO MITIGATE SIPHON-INDUCED OVERDRAINAGE

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INTRODUCTION: Overdrainage of cerebrospinal fluid (CSF), typically secondary to siphoning effect, remains a common complication in patients with cerebrospinal fluid shunt-dependent hydrocephalus despite modern advances in the surgical armamentarium like gravitational valves, anti-siphon devices, and programmable shunts. Acute and chronic sequelae, ranging from subdural hematomas to slit-ventricle syndrome, continue to impact patient outcomes. Clinical observations by the senior author suggested that increased spacing between two shunt valves in series appears to offer more protection against overdrainage. In this study, we aimed to examine how variable spacing of valves in series affected differential pressure across the dual-valve system and whether strategic valve spacing could potentially mitigate shunt overdrainage complications.

METHODS: An in vitro experimental model incorporated two identical gravitational valves arranged vertically in series. Two distinct shunt configurations were tested, both identical in total catheter length but differing with respect to inter-valve distance: a short interval of 2 cm and a long interval of 38 cm. Artificial CSF was delivered at a constant flow rate of 330 $\mu\text{L}/\text{min}$ using a syringe pump. Differential pressure across the system was measured using a precise sensor connected at points immediately proximal to the first valve and distal to the second valve.

RESULTS: In the short-interval configuration, the mean differential pressure gradient was approximately 67 mmHg. However, when valves are spaced further apart in the long-interval configuration, the mean differential pressure decreased to 46 mmHg, indicating decreased pressure "pulling" the fluid distally through the system.

CONCLUSIONS: Our study demonstrates that increasing the distance between valves arranged in series reduces the differential pressure within the shunt system. This suggests that widely spaced valves in series could mitigate shunt overdrainage secondary to the siphoning effect. These findings offer a potential alternative approach for managing patients with intractable CSF overdrainage, particularly in low-resource settings.

MRI EVIDENCE OF CHOROID PLEXUS ENLARGEMENT IN POST-HEMORRHAGIC PEDIATRIC HYDROCEPHALUS

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INTRODUCTION: In recent years, choroid plexus (ChP) cerebrospinal fluid (CSF) hyperproduction associated with acute inflammatory processes has been proposed as a crucial etiological mechanism in the onset of acquired hydrocephalus secondary to central nervous system infections or intraventricular hemorrhage (IVH). However, this mechanism does not explain why patients continue to require surgical treatments following resolution of the acute inflammatory. Our group has proposed that pathological enlargement of the choroid plexus may contribute to persistent CSF hyperproduction and the ongoing need for long-term hydrocephalus management.

METHODS: To evaluate the size of the ChP, MRI scans were selected from 30 perinatal patients diagnosed with hydrocephalus due to intracranial hemorrhages, as well as from control subjects. The maximum diameter of the ChP was measured using Synapse software in axial sections posterior to the foramen of Monro, within the body of the lateral ventricle, and in parasagittal sections at the atrium.. Additionally, 15 tissue samples from autopsy studies of patients with similar conditions were examined histologically to validate the imaging data.

RESULTS: Preliminary results indicate that patients with IVH who develop hydrocephalus exhibit larger ChP sizes compared to those who did not develop hydrocephalus and non-IVH control subjects.

CONCLUSIONS: Our preliminary findings suggest that ChP enlargement may play a role in the etiology of pediatric acquired hydrocephalus and could serve as a potential biomarker for predicting the need for shunt implantation. Further studies with larger cohorts are necessary to confirm these results and to elucidate the pathophysiologic mechanisms underlying ChP enlargement.

DETERMINING THE UTILITY OF BASELINE GAIT AND COGNITIVE ASSESSMENTS IN THE DECISION FOR TRIAL OF CSF DRAINAGE IN SUSPECTED NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: In our centre the decision to proceed with a trial of CSF diversion for NPH is multidisciplinary and influenced by clinical assessment, radiological features and patient wishes. We aim to investigate the utility of gait and neuropsychological assessments in that decision making process.

METHODS: Retrospective observational study of demographic, gait and neuropsychological assessment data from patients reviewed in the diagnostic NPH clinic. The cohort was dichotomized into those offered trial of CSF drainage and those discharged. Statistical comparisons were made between the cohorts.

RESULTS: Between January 2019 and November 2024, 259 patients were evaluated in the initial multidisciplinary NPH clinic. Of these, 155 were offered CSF drainage, 99 were discharged, and five were excluded from analysis. Patients selected for CSF drainage were slightly younger (mean difference: 1.99 years, $p=0.0045$) but no significant differences in other baseline characteristics were identified. Gait velocity was slower in those offered CSF drainage compared to those discharged (mean gait velocity: 0.59m/s vs 0.66m/s, $p=0.0203$). However, both cohorts had reduced gait velocity relative to age and sex-matched normative values (48.1% and 39.3% respectively). In the 10-meter dual task test, greater gait velocity slowing was observed in the CSF drainage cohort (mean 0.13m/sec vs 0.11m/sec), though this was not statistically significant ($t=0.7603$, $p=0.45$). No significant difference was found in the 360-degree turn ($p=0.063$). Patient selected for CSF drainage performed worse on the Trail-Making Task (B) compared to those discharged (median: 185s (IQR 100) vs 115.9s (IQR 34.9), $p=0.0003$). No significant differences were observed in phonemic fluency, semantic fluency, or Trail-Making Task (A).

CONCLUSION: In our cohort, gait velocity and performance on the Trail-Making Task (B) correlated with global assessment and decision for trial of CSF drainage. The utility of other assessments is less clear, and these findings continue to guide the evolution of our assessment pathway.

UTILITY OF BLOOD BIOMARKERS IN PREDICTION OF POST-OPERATIVE OUTCOMES IN PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a reversible cause of dementia among elderly patients that may present with abnormal blood biomarkers. This study aimed to evaluate the role of baseline blood biomarkers in predicting post-shunt outcomes in patients with iNPH.

METHODS: All patients who underwent shunt placement for iNPH by the senior author at a single tertiary care center between December 2017 and January 2025 were retrospectively reviewed. Data were collected on patient demographics, baseline laboratory values (albumin, hemoglobin, and white blood cell counts), and postoperative outcomes, including length of stay (LOS), discharge disposition, and shunt-related complications such as subdural fluid collections (SDC) and shunt revisions.

RESULTS: A total of 394 patients were included (median age 75.3 years [71.4–79.6]; 37.1% female). Baseline laboratory median values were as follows: albumin 4.3g/dL [4.1–4.9], hemoglobin 13.7g/dL [12.5–14.9], WBC $7.0 \times 10^3/\mu\text{L}$ [5.8–8.6], and neutrophil-to-lymphocyte ratio (NLR) 2.8 [2.0–3.9]. Postoperatively 366 patients (92.9%) discharged home. Complications occurred in 62 patients, including tract hemorrhage in 10 (2.5%), intraventricular hemorrhage in 9 (2.3%), SDC in 43 (10.9%). 22 (5.7%) patients required shunt revisions. Logistic regression demonstrated higher hemoglobin levels were significantly associated with increased odds of home discharge (OR=1.40, $p < 0.01$) and decreased odds of developing SDC (OR=0.81, $p = 0.04$). Additionally, NLR was associated with an increased risk of shunt revision (OR=1.18, $p = 0.01$).

CONCLUSIONS: Blood biomarkers may help predict postoperative outcomes in patients with iNPH undergoing ventriculoperitoneal shunting. Anemia was associated with increased odds of non-home discharge and subdural fluid collection, while a higher neutrophil-to-lymphocyte ratio, a marker of systemic inflammation, was associated with an increased risk of shunt revision. Further validation of these findings through multi-institutional studies is warranted.

EVALUATING THE EFFECT OF THE TAP TEST ON COGNITIVE TEST SCORES IN SUSPECTED IDIOPATHIC NPH

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INTRODUCTION: Idiopathic Normal Pressure Hydrocephalus (iNPH) is associated with cognitive impairment, yet a lack of consensus remains on the optimal cognitive tests to aid the diagnosis and best predict those that may benefit from CSF diversion. The aim of this study was to evaluate the efficacy of the cognitive battery used pre- and post-tap test (TT) in the diagnostic assessment of iNPH.

METHODS: Observational study of patients undergoing CSF TT between 2021 and 2024 with prospective data collection. Assessment of cognition was undertaken pre- and post-TT. The cohort was dichotomised into those that were offered a shunt or not.

RESULTS: Ninety patients undergoing a CSF-TT were included in the analysis, with 52 being offered a shunt and 38 not being offered a shunt. No significant differences were noted between the cohorts in their baseline demographic characteristics and cognitive test scores. For those offered a shunt, significant improvements ($p < 0.05$) were observed in WMS-III mental control (+2), RBANS story immediate recall (+2), 9-peg right hand (-1s) and left hand (-1.42s). For those not offered a shunt, Trail Making Task A improved (-8.58 seconds, $p = < 0.05$). RBANS semantic fluency demonstrated statistically significant improvement for both cohorts (+4 vs +2). Trail Making Task B did not demonstrate significant improvement for either cohort (-28.18s vs +5.01s). No statistically significant differences in score improvements were identified between cohorts in any cognitive tests.

CONCLUSIONS: Improvements in cognitive test scores post-TT were observed in both patient groups and no significant difference was found between these groups. Larger sample sizes may be required to better discriminate between groups and highlight which cognitive tests are most likely to influence decision making.

QUANTIFYING CHANGES IN MEASURES OF GAIT FOLLOWING TAP TEST TO VALIDATE CLINICAL DECISION MAKING FOR SHUNT SURGERY IN SUSPECTED IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The use of a tap-test (TT) and quantitative gait analysis is an established investigation in suspected NPH. Defining “responders” and predicting shunt responsiveness remains challenging. We aim to quantify improvement in gait parameters in our cohort undergoing a TT, dichotomized according to whether they were offered a shunt or not.

METHODS: Observational study of patients undergoing CSF TT between 2021 and 2024 with prospective data collection. Assessment of gait (Tinetti test, 10m walking tests, 360-degree turn) was undertaken immediately prior to and after a CSF TT. These assessments were used as part of a multidisciplinary decision to offer patients a shunt.

RESULTS: Of ninety-eight patients who underwent TT, 52 were offered a shunt whilst 46 were not. There were no significant differences in baseline demographic or measures of gait between groups. A greater improvement in mean gait velocity was noted in the shunt group post-TT ($0.11 \pm 0.18\text{m/s}$ vs $0.05 \pm 0.13\text{m/s}$), although the difference between groups was not significant ($p=0.093$). Increase in dual task gait velocity was also greater in the shunt group ($0.1 \pm 0.19\text{m/s}$ vs $0.03 \pm 0.1\text{m/s}$) and the difference between groups was significant ($p=0.008$). Improvements were seen in Tinetti scores post-TT for both groups. The median improvement was greater for those offered a shunt and the difference between the groups was significant (Gait: +4 vs +2, $p=0.01$; Balance: +3 vs +0, $p=0.01$; Total: +6 vs +3, $p=0.016$). No significant change in dual task cost and 360 degree turn post-TT was noted between the cohorts.

CONCLUSIONS: Improvements in measures of gait and balance were seen in both groups of patients following TT. Although greater improvements in gait velocity were seen in the patients offered a shunt, the change in Tinetti score may better differentiate our two cohorts and help validate clinical decision making.

HIERARCHICAL BAYESIAN MODELING IMPROVES SHUNTING OUTCOME PREDICTION IN NPH PATIENTS

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INTRODUCTION: Cerebrospinal fluid (CSF) infusion testing aids normal pressure hydrocephalus (NPH) diagnosis and shunt response prognostication. However, current decision-making relies on simplified resistance to CSF outflow (Rcsf) thresholds that show limited predictive power. This study evaluates hierarchical Bayesian modeling that leverages full probabilistic distributions of CSF dynamics parameters to predict post-shunting improvement.

METHODS: We analyzed intracranial pressure (ICP) measurements from computerized infusion studies from 202 NPH patients (mean age 70.9 years) including 82 males (40.6%) and 94 patients with idiopathic etiology (46.5%) who underwent shunt surgery. Post-shunting outcomes were classified as permanent improvement in 126 patients (62.4%), temporary improvement in 31 patients (15.3%), or no improvement/worsening in 45 patients (22.3%). These outcomes were dichotomized as permanent improvement (1) or temporary/no improvement (0). We developed three Bayesian models: classical Marmarou model (parameters: Rcsf, elasticity coefficient (E), reference pressure (P0) equal to sagittal sinus pressure (Pss)), extended model with P0 and Pss optimized independently, and Pss-optimized model (with P0 derived from pulse amplitude/ICP intercept). Our approach optimizes CSF parameters as probability distributions rather than fixed values. Measurement uncertainty is further accounted for through a hierarchical framework that incorporates these parameters with demographic factors to predict outcomes. We compared performance against the traditional Rcsf threshold of 13 mmHg/mL/min).

RESULTS: All Bayesian models significantly outperformed traditional threshold approaches. Agreement between models and traditional approach was limited (31-47% overlap). The sagittal sinus pressure-optimized model performed best, achieving 95% sensitivity (threshold model: 70%), 94% negative predictive value (30%), 83% accuracy (41%), 71% specificity (13%), 76% positive predictive value (44%), 0.86 Area Under Receiver Operating Characteristic Curve, and 0.84 F1 score (54%) at optimal probability threshold.

CONCLUSIONS: Hierarchical Bayesian modeling of CSF dynamics provides substantially improved predictive power for shunting outcomes compared to traditional thresholds, potentially reducing unnecessary procedures while improving patient selection for shunting.

IS DAVSON'S EQUATION RELIABLE IN HYDROCEPHALUS? A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Davson's equation models intracranial pressure (ICP) as a function of cerebrospinal fluid (CSF) production rate (I_p), resistance to outflow (R_{out}), and sagittal sinus pressure. We assume both I_p and R_{out} are independent of ICP. Despite its routine clinical application in hydrocephalus, the validity of this equation in hydrocephalus has not been systematically assessed. We aimed to evaluate the relationship between ICP, I_p and R_{out} in patients with hydrocephalus to test the assumptions underpinning Davson's model.

METHODS: We performed a systematic review and meta-analysis of experimental studies reporting I_p , R_{out} , and/or ICP in hydrocephalus. Databases searched included MEDLINE and Embase up to February 12, 2024. Individual measurements were extracted from figures or tables and analysed using linear regression and mixed-effects models. We compared directly measured I_p with values derived from Davson's equation using corresponding ICP and R_{out} values.

RESULTS: Data from 16 studies on 124 patients with hydrocephalus were included. Across these cases, I_p was approximately constant and did not correlate with ICP ($r = 0.063$, $p = 0.873$), supporting the assumption of independence. A significant positive correlation between ICP and R_{out} was found ($r = 0.490$, $p < 0.001$). When comparing measured I_p to I_p estimated via Davson's equation, there was no significant difference ($p = 0.154$), indicating that the equation provides reliable estimates of I_p in hydrocephalus.

CONCLUSIONS: Our findings support the validity of Davson's equation in hydrocephalus, with measured and estimated CSF production rates aligning closely, and ICP shown to increase with the resistance to CSF outflow. These results confirm that Davson's equation remains a reliable tool for characterising CSF circulation in hydrocephalus.

ADJUSTING THE UNKNOWN: INTRACRANIAL PRESSURE AND CLINICAL OUTCOMES IN IDIOPATHIC INTRACRANIAL HYPERTENSION USING NON-INVASIVE TELEMETRIC MONITORING

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INTRODUCTION: Idiopathic Intracranial Hypertension (IIH) poses a clinical dilemma due to its difficulty in symptoms. Surgical insertion of the Miethke Sensor Reservoir (MScio) in shunt series allows for telemetric monitoring of intracranial pressure (ICP). We investigated MScio-derived ICP in IIH and how adjustable valve settings affect ICP and clinical outcomes.

METHODS: A retrospective case series was performed of IIH patients identified to have had shunt insertion with the Miethke Sensor Reservoir in series with adjustable valves between August 2023 and February 2025. Valve settings were categorised as high-, intermediate-, or low-pressure. Each observation included MScio ICP recording at sitting, standing and supine positions. Clinical outcome including symptomatic improvement and complication was assessed. Symptom trajectories were categorised and comparative analysis was performed between patient datasets.

RESULTS: No significant differences in ICP values were observed across high, intermediate, and low valve settings in any position. In the sitting position, mean ICP were 8.2 ± 3.5 mmHg (high), 8.5 ± 3.3 mmHg (intermediate), and 8.1 ± 3.7 mmHg (low), with all pairwise comparisons yielding p -values > 0.05 . Similar results were found in the standing (high: 5.9 ± 3.1 mmHg, intermediate: 6.2 ± 3.4 mmHg, low: 6.0 ± 3.2 mmHg) and supine positions (high: 10.5 ± 4.0 mmHg, intermediate: 10.2 ± 3.8 mmHg, low: 10.6 ± 4.2 mmHg), with no significant differences. Of 231 valve observations, 41.6% showed no change, 38.5% worsened, and 19.9% improved. 15% of patients experienced clinical complications.

CONCLUSIONS: IIH appears physiologically distinct within hydrocephalus, with MScio metrics showing deviation from classic shunt-responsive patterns. Valve setting did not statistically influence ICP across all positions. A standardised approach to CSF diversion in IIH may be essential to improve symptom resolution and reduce complication rate.

Patient Consent: The patient has provided their consent for the publication of this abstract.

TELEMETRIC INTRACRANIAL PRESSURE MONITORS: CURRENT STATUS AND FUTURE TRENDS – A SYSTEMATIC REVIEW

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INTRODUCTION: Intensive development of telemetric intracranial pressure (ICP) monitors has continued since 1967. The expected benefits of such systems are obvious: lower infection risk and no restrictions on patient mobility. However, challenges such as low long-term stability and device lifetime have limited their clinical use in neurosurgical care. Today, several systems are available or in advanced development.

METHODS: A systematic literature research was conducted using PubMed and manufacturer data to identify the technical specifications, regulatory status, and clinical performance of ICP monitors from Raumedic, Branchpoint, Kitea, and Miethke. The data were transferred into a matrix, enabling structured technical and clinical comparison. Systems were evaluated for strengths, weaknesses, and emerging trends.

RESULTS: The reviewed telemetric ICP monitors differed significantly in measurement duration, connectivity, long-term stability, and other characteristics. Strengths include: Raumedic's system is suited for long-term recordings during daily activity. Branchpoint's monitor offers Bluetooth connectivity to an external monitor. Kitea's system (under development) includes a smartphone interface, potentially enabling advanced data analysis. Miethke's device provides high long-term stability with minimal drift and long device lifetime. No available system meets all clinical requirements. A notable trend is the integration of contextual information, such as patient well-being, body position, and physical activity alongside ICP.

CONCLUSIONS: Studies demonstrate the clinical value and cost-saving potential of telemetric ICP monitors, offering advantages over conventional sensors. However, continued interdisciplinary collaboration is essential for developing next-generation systems. These may improve diagnostic accuracy and support treatment decisions by linking ICP data with contextual patient information.

SURGICAL FINDINGS IN CHRONIC POST DURAL PUNCTURE HEADACHE SYNDROME

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INTRODUCTION: Post-dural puncture headache (PDPH) has been considered benign and responsive to epidural blood patch (EBP). A minority of patients will have persistent and limiting symptoms even after repeated EBP. The alleged dural injury created by a lumbar puncture (LP) or by an unintended dural puncture (UDP) is increasingly recognised as a possible cause. The characteristics and nature of the leaks, as well as their anatomical properties remain unknown. We aimed to describe the microsurgical findings encountered in cPDPH.

METHODS: This cohort study was conducted using data from a prospectively maintained database between April 2018 and August 2024 at a large CSF leak referral centre, involving patients who met the modified ICHD, 3rd edition criteria for acute PDPH and persisting clinical symptoms. Patients treated surgically for PDPH were included. Anatomic and intraoperative data were extracted from operative notes and supplemented with surgical video and imaging data.

RESULTS: Forty-one patients were included for a total of 49 surgeries, and 79 levels were explored. The average latency between onset of symptoms and surgery was 932 +/- 2040 days. We were able to identify pathological findings in the majority of cases. As predominant anatomical features, we identified translucent sticky neomenbranes and red neovascularised neomenbranes in 93.8%, arachnoid blebs and posterior dural defects in 62%, as well as an anterior transdural penetrating dural defect (10%). Prominent anatomic features were clustered into six main categories among different types of cPDPH leaks.

CONCLUSION: Surgery revealed pathological changes induced by intended or unintended lumbar puncture in patients with cPDPH. Our findings were categorized into distinct patterns, including arachnoid blebs, sticky neomenbranes, and neovascularised neomenbranes. These structural changes may play a significant role in the pathophysiology of cPDPH and its resistance to treatment. Recognition and further research on these chronic anatomical changes may be paramount for diagnosing and treating patients with cPDPH.

INFLUENCE OF CSF VOLUME CHANGES AND BODY POSITION ON CRANIAL AND SPINAL CSF PRESSURE IN PATIENTS WITH INPH

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INTRODUCTION: The regulation of cerebrospinal fluid (CSF) pressure within the craniospinal system remains poorly understood. This study evaluated the influence of body position and CSF volume on intracranial and spinal CSF pressure in patients with idiopathic normal-pressure hydrocephalus (iNPH).

METHODS: Nineteen patients with iNPH were examined. CSF volume in the cranial space was assessed using volumetric technique (volBrain), while spinal CSF volume was measured via semi-automatic segmentation. CSF pressure was recorded in cranial and lumbar subarachnoid spaces in both horizontal and head-up tilt (15°) positions. The impact of CSF volume reduction via lumbar puncture (15 ml) was analyzed. Twelve of the 19 patients showed a positive clinical response to extended external lumbar drainage and subsequently underwent shunt surgery.

RESULTS: The average cranial CSF volume was approximately 300 ml, while spinal CSF volume averaged 114 ml. A 15 ml reduction in CSF volume resulted in an average CSF pressure drop of 8.5 cm H₂O, indicating a strong correlation between spinal CSF volume and overall pressure. In the horizontal position, CSF pressure was uniform along the craniospinal axis at the same hydrostatic level. When tilted 15°, cranial pressure decreased while spinal pressure increased, consistent with hydrostatic gradients. Importantly, patients who responded to CSF drainage had significantly higher spinal CSF volumes (120.5 ± 14.9 ml) compared to non-responders (103.1 ± 27.4 ml).

CONCLUSIONS: This study confirms that CSF pressure follows hydrostatic principles (the observed pressure difference in the cranium and spinal space corresponds exactly to the hydrostatic difference) and is not primarily regulated by secretion or absorption, which is in accordance with new understandings of CSF physiology and pathophysiology. Results suggest that spinal CSF volume could be a predictive marker in the preoperative evaluation of iNPH patients, with implications for clinical decision-making and individualized treatment planning.

APPLICATION OF LUMBOPERITONEAL SHUNTING IN THE TREATMENT OF COMPLEX CRANIAL WOUND HEALING DISORDERS

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INTRODUCTION: The treatment of complex cranial wound healing disorders (WHD) along with implant-related infections after neurosurgical procedures represents a major challenge in neurosurgery and is often associated with the need for implant removal or exchange, long term antimicrobial therapy and prolonged in hospital treatment. Complications are often associated with cerebrospinal fluid (CSF) circulation disorders. In these cases moving the shunt implant from the head to the lumbar spine appears as a valuable salvage strategy. Here we applied a lumboperitoneal shunt system (LPS) as a rescue approach in the treatment of complex cranial wound conditions.

METHODS: Thirteen consecutive patients, who underwent LPS implantation within the treatment of complex WHD between June 2023 and April 2025 were retrospectively analyzed. Data encompassing demographics, surgical specifics, complications and outcomes were collected and evaluated.

RESULTS: The median age of the cohort was 51.8+/-17.9 years, with a f/m ratio of 6:7. Underlying pathologies were: persisting CSF fistula after tumor surgery (n=6), WHD after craniectomy with shunt dependency (n=4), shunt treatment for meningeosis carcinomatosa (n=2) and WHD after a ventricluoperitoneal shunt for iNPH (n=1). Within a median follow up of 9.14+/-7.9months LPS survival was 92.3% as only one LPS had to be explanted due to CSF infection. No overdrainage requiring surgery was found. The presence of an adjustable valve and a gravitational unit was particularly important for craniectomized patients to adjust the pressure settings.

CONCLUSIONS: In our study LPS demonstrated high implant survival and no overdrainage requiring surgical intervention. We demonstrate promising results for LPS as a rescue approach in the treatment of complex WHD. Especially in shunt dependent craniectomized patients an adjustable valve system is indispensable to adjust the shunt settings. LPS should be considered as a valuable option in patients with complex WHD. Our results need to be confirmed in larger studies.

EXPANDING HAKIM'S TRIAD: SHUNTING ENHANCES UPPER-LIMBS FUNCTION IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS – THE PRO HYDRO STUDY

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is traditionally characterized by Hakim's triad—gait disturbance, cognitive decline, and urinary incontinence. While shunting reliably improves gait and balance, its impact on upper-limb motor-executive functions has not been fully elucidated.

METHODS: In this prospective observational Pro Hydro study (2023–2025), 44 consecutive iNPH patients (mean age 76.1 ± 4.4 years; 21 female) underwent comprehensive neuro-motor assessments before and after VAS. Upper-limb executive function was evaluated by the Luria Motor Sequence Test and selected subdomains of the Unified Parkinson's Disease Rating Scale (UPDRS) Part III—finger tapping, hand opening/closing, and pronosupination. Gait and global function were assessed using the Tinetti Performance-Oriented Mobility Assessment, Gait Status Scale (GSS), Japanese iNPH Grading Scale (JSINPH), modified Rankin Scale (mRS), and the standardized iNPH scale. Pre- to postoperative changes were analyzed by paired Student's t-tests ($\alpha = 0.05$).

RESULTS: Slightly pathological features were observed in preoperative upper-limb executive function. Following VAS treatment, patients demonstrated statistically significant improvements in upper-limb executive performance. Luria test scores increased by 0.36 points for the non-dominant hand from a baseline of 1.8 ($p < 0.05$). UPDRS Part III subdomains improved by 0.40 (right) and 0.56 (left) in finger tapping, 0.28 (right) and 0.33 (left) in hand opening/closing, and 0.29 in left pronosupination (all $p < 0.05$). All changes were statistically significant ($p < 0.05$), with baseline values of 1.3, 1.6, 1.0, 1.0, and 1.07, respectively. Concurrently, Tinetti scores decreased by 3.2 points, confirming gait enhancement.

CONCLUSIONS: VAS in iNPH patients not only restores gait but also significantly ameliorates upper-limb executive functions, which were found to have pathological patterns in our patients. These findings support an expansion of Hakim's triad to formally include upper-limb motor-executive assessment and underscore the need for refined clinical tools that capture the full spectrum of functional recovery.

EFFECTS OF A VENTRICULOPERITONEAL SHUNT ON HEARING IN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS – INTERIM RESULTS OF A PROSPECTIVE COHORT STUDY

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is defined by a triad of dementia, gait disturbance, and urinary incontinence. Treatment usually involves the surgical placement of a ventriculoperitoneal shunt (VPS). Subjective hearing loss is a frequently reported complication following VPS placement, but it is rarely documented with audiometric testing.

METHODS: We aimed to determine the incidence of hearing loss following VPS placement in patients with NPH. This prospective cohort study included patients aged 65 to 85 years with NPH referred to the CHU de Québec, a tertiary academic referral center. Patients underwent audiograms before surgery and three months postoperatively.

RESULTS: Interim data from our consecutive series of 16 patients showed that 75% were women, with a mean age of 74 years. One patient developed a significant and asymmetric hearing loss on the postoperative audiogram at three months. A loss of 35 dB was noted in the right ear at 250 Hz, 20 dB at 500 Hz, and 15 dB at 8000 Hz. The remaining patients did not demonstrate significant hearing loss on postoperative testing.

CONCLUSIONS: Persistent and severe hearing loss appears to be under-documented in this at-risk population. Only a limited number of case reports and series have documented hearing loss following VPS placement. Audiograms are not routinely performed postoperatively in this patient population. We aim to integrate audiometric testing and otologic follow-up into the comprehensive care of patients undergoing VPS placement for NPH.

Patient Consent: The patient has provided their consent for the publication of this abstract.

CLINICAL OUTCOMES OF LUMBOPERITONEAL SHUNT SURGERY FOR NORMAL PRESSURE HYDROCEPHALUS: A 5-YEAR SINGLE-CENTER RETROSPECTIVE STUDY OF PATIENTS WITH AT LEAST 1 YEAR OF FOLLOW-UP

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INTRODUCTION: Lumboperitoneal (LP) shunt surgery is a widely used treatment for idiopathic normal pressure hydrocephalus, especially in East Asia. However, its long-term outcomes and complication profiles, particularly in elderly patients who are reluctant to undergo general anesthesia, remain underreported. This study evaluated outcomes and complications of LP shunt surgery under local anesthesia with mild sedation.

METHODS: A retrospective review was conducted on 244 idiopathic normal pressure hydrocephalus patients who underwent LP shunt surgery between February 2020 and February 2025. Valve pressures were initially set high and gradually lowered based on clinical response. Functional outcomes (from the modified Rankin Scale, Timed Up and Go, 10-meter gait test, Mini-Mental State Examination) were assessed at 1 year and up to 4 years. Complications were categorized by type and need for surgical intervention.

RESULTS: Among the 244 patients, 119 completed at least 1 year of follow-up. At 1 year, 53.8% showed improvement in modified Rankin Scale and 66.4% in gait. Stable or improved functional status was observed in 93.3% of patients. Mini-Mental State Examination showed no significant change. The overall complication rate was 16.8%, with 11.1% requiring surgical intervention (e.g., chronic subdural hematoma, catheter issues). No surgery-related mortality occurred. However, three patients (1.2%) with improved gait died due to falls, emphasizing the need for fall prevention. Technical refinements, including improved anchoring, reduced the annual revision rate to 5.6%, with 7 out of 125 patients requiring revision surgery in 2024. Most revisions were performed under local anesthesia.

CONCLUSIONS: LP shunt surgery under local anesthesia is effective and safe, offering favorable long-term outcomes with manageable complication rates. Further integration of advanced valve systems—such as siphon guards and magnetic resonance imaging-resistant mechanisms—may enhance safety and support more individualized pressure management.

Patient Consent: The patient has provided their consent for the publication of this abstract.

The Institutional review board of Kyungpook National University Chilgok Hospital approved this study (KNUCH 2025-02-020).

GERIATRICS AND NORMAL PRESSURE HYDROCEPHALUS: A SCIENCE MAPPING REVIEW

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INTRODUCTION: As population is aging worldwide, idiopathic normal pressure hydrocephalus (iNPH) is a disease of geriatric concern. Though, it remains frequently underrecognized and misdiagnosis may lead to a worsening of condition due to a lack or late treatment. Interest in the topic of iNPH in the geriatric field seems to be growing in recent years, according to Literature.

METHODS: A science mapping review was driven on a database obtained on Scopus. The research query involved the following keywords: ("geriatric*") AND ("iNPH" OR "NPH" OR "normal pressure hydrocephalus"). The analysis was conducted via "R" software using package "bibliometrix".

RESULTS: A total of 100 papers, published from 1990 up to April 2025, were identified. Up to now, these contributions received 2298 citations (mean = 23, median 8). Among them, 72% were published in the last 15 years. The maximum frequency is observed in 2024 with 8 papers (8%). Countries writing the most about the issue were: USA, Japan, Germany, covering the 42% of the total. 80 scientific journals are involved. Four journals published at least 3 contributions: among them, three are of neurosurgical interest, while one is dedicated to post-acute and long-term care issues. Concerning author keywords, dementia is observed in 26 works, followed by Alzheimer's disease (9).

CONCLUSIONS: The underestimation of iNPH in the older population, its impact on the functional and cognitive health of patients and its potential reversibility require adequate knowledge of this pathology in the geriatric field. Furthermore, the common conditions of multimorbidity, frailty and global complexity of older patients impose a multidisciplinary approach. The present explorative bibliometric analysis reveals that the interaction between Neurosurgery and Geriatrics in the field of iNPH is still lacking and it represents a promising starting point for both methodological and applied research, as well as systematic reviews of the Literature.

DESH SCORE RELIABILITY IN CHRONIC HYDROCEPHALUS

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INTRODUCTION: Chronic hydrocephalus (CH) in older adults is often underdiagnosed, although its identification is crucial due to the availability of effective surgical treatment. Disproportionately enlarged subarachnoid space hydrocephalus (DESH) serves as a qualitative radiological indicator. The DESH score, developed from morphologic MRI data, offers a quantitative evaluation using the criteria of DESH and measurements of the callosal angle. This study aims to assess the reliability of the DESH score.

METHODS: A retrospective analysis was conducted on 68 patients with CH who had undergone ventriculoperitoneal shunt placement (58 showing improvement, 10 not improved). The preoperative DESH scores were calculated by a senior neurosurgeon and a neurosurgery resident to evaluate inter-observer variability. Comparative analysis was performed for each patient's results. Sensitivity (Se), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV) were calculated for DESH score, callosal angle (CA), and Evans' index (EI).

RESULTS: The DESH score demonstrated excellent interobserver reliability, with an intraclass correlation coefficient of 0.94. Agreement levels for individual items ranged from fair (for Sylvian fissure dilatation, local focal sulci dilatation, and tight high convexity) to excellent (for the callosal angle). For the DESH score, Se was 83%, Sp was 40%, PPV was 89%, and NPV was 29%. For CA, Se was 88%, Sp was 40%, PPV was 89%, and NPV was 36%. For EI, Se was 71%, Sp was 60%, PPV was 91%, and NPV was 26%. There was no significant difference in Se, Sp, PPV and NPV between senior and resident analyses.

CONCLUSIONS: The DESH score proves to be a reliable measure when using brain MRI. Its excellent reliability supports its use in routine clinical practice. However, due to low specificity and NPV, it should be incorporated into a comprehensive multi-modal diagnostic approach.

Patient Consent: The patient has provided their consent for the publication of this abstract.

ELEVATED CSF ACCELERATION AT THE CRANIOSPINAL JUNCTION SUGGESTS REDUCED SPINAL COMPLIANCE IN INPH: A PHASE-CONTRAST MRI STUDY

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INTRODUCTION: Idiopathic Normalpressure Hydrocephalus (iNPH) is a common, yet treatable CSF disorder with an estimated prevalence of 1.5% at 70 (Constantinescu et al 2023). In previous work, we demonstrated that combined phase-contrast MRI of the CSF and the spinal cord motion at the craniocervical junction may offer a viable, non-invasive window into intradural dynamics and its compliance among patients with CSF loss. The study aims to explore the potential of these measurements in patients with iNPH.

METHODS: We conducted a case-control subanalysis within a prospective study on healthy volunteers and patients with suspected CSF circulation disorders. Healthy controls aged 50 years or older and patients diagnosed with iNPH based on clinical criteria (min. 2/3 core symptoms), positive response to lumbar tap-testing, and Evan's index >0.3 , as well as a corpus callosum angle $<90^\circ$. ECG-triggered, high spatial resolution phase-contrast MRI of CSF and spinal cord velocity curves at segment C2/C3 were applied prior to invasive tests. Automated postprocessing included automated segmentation based on a trained convolutional neural networks, and correction for aliasing and off-set errors (www.nora-imaging.com). In addition to velocity range, CSF stroke volume, and total displacement of the spinal cord, accelerations a proxy for compliance were evaluated.

RESULTS: 22 healthy volunteers (age 60 years (IQR55-63), 60% women), and 18 patients (age 79 years (IQR72-83), 50% women, RadScale 8 (IQR7-8.3)) were identified. Velocity ranges, CSF stroke-volume, and spinal cord total displacement did not differ between the cohorts. The caudocranial CSF acceleration during the diastolic phase was much higher among iNPH patients (4.8 (IQR4.5-6.3) vs. 7.5 (IQR5.5-10.0), $p=0.004$).

CONCLUSIONS: The increased CSF acceleration from the spinal towards the cranial compartment during diastole suggests reduced compliance, particular within spinal compartment. These findings support pathophysiological models of impaired spinal compliance in iNPH and highlight the potential of this non-invasive MRI approach.

THE IMPACT ON THE CAREGIVER IN THE TREATMENT IN PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a neurological condition characterized by gait disorders, cognitive impairment and urinary incontinence, with a significant impact on the quality of life of the patient and his/her caregiver. The role of the caregiver is fundamental in daily support and the clinical improvement of the patient could also have a positive impact on his/her well-being. This study allows to analyze this correlation through the administration of the "Caregiver Burden Inventory" (CBI test), which evaluates the level of burden perceived by the caregiver.

METHODS: the study involved 15 patients affected by iNPH, undergoing surgical treatment, and their respective caregivers. The following neuropsychological tests were used: MMSE, FAB, MOCA, KATZ, RAVLT, TMTa, TMTb, TMTb-a; STROOP, Tinetti. The G-Walk sensor was used to evaluate gait, which allowed to evaluate the duration, quality, symmetry of walking, support cycles and flight phases of both sides. Patients and their caregivers are evaluated in the immediate post-operative period and at one month of follow-up.

RESULTS: clinical improvement was evident in all patients, as well as caregivers who showed improvements in quality of life and physical and psychological well-being during the follow-up stages.

CONCLUSIONS: this study highlights that, although the clinical improvement of the patient can represent a benefit for the caregiver, not everyone benefits from the same advantage. It therefore appears necessary to investigate the factors that influence the quality of life of the caregiver.

CREATIVE STRATEGIES IN MANAGING COMPLEX CEREBROSPINAL FLUID DYNAMICS: A CASE SERIES ON MULTI-VALVE SHUNT SYSTEMS

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INTRODUCTION: Effective management of hydrocephalus and cerebrospinal fluid (CSF) disorders demands precise regulation of intracranial pressure (ICP), particularly in complex cases where traditional single-valve shunt systems fail. This case series explores the application of multi-valve shunt configurations to optimize CSF dynamics and achieve refined ICP control, emphasizing innovative strategies for differential pressure management.

METHODS: Three complex cases were analyzed: a 4-year-old male with postoperative hydrocephalus and compartmentalized ventricular pressures (Case 1), a 32-year-old male with obstructive neoplastic hydrocephalus and lateral ventricle compartmentalization (Case 2), and a 36-year-old female with idiopathic intracranial hypertension (IIH) complicated by overdrainage (Case 3). Multi-valve systems, including independent shunt circuits and tandem valve configurations, were employed to customize CSF flow. Fine-tuning through valve reprogramming was critical to achieving optimal drainage balance.

RESULTS: In Case 1, two independent shunt systems successfully managed differential supratentorial and infratentorial pressures, restoring CSF flow dynamics. In Case 2, bilateral valve systems stabilized ICP following tumor resection. In Case 3, a dual tandem valve configuration effectively mitigated overdrainage symptoms. All patients demonstrated significant clinical improvement without requiring further surgical revision.

CONCLUSIONS: Multi-valve shunt systems offer a dynamic, patient-specific approach to managing complex CSF hydrodynamics. By facilitating differential pressure regulation and allowing iterative adjustment, these configurations enhance long-term shunt function, reduce the need for reintervention, and improve clinical outcomes. A deeper understanding of CSF fluid mechanics is essential for maximizing the therapeutic potential of these advanced configurations.

SENSITIVITY OF PHYSIOTHERAPY-BASED CLINICAL TESTS IN DETECTING GAIT AND BALANCE PERFORMANCE FOLLOWING A 50 ML CSF TAP TEST IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Cerebrospinal fluid tap test (CSF TT) is a key predictive tool for selecting patients with idiopathic normal pressure hydrocephalus (iNPH) for shunt surgery. Its sensitivity is limited by the commonly used 10-meter walk test (10MWT) and Timed up and go (TUG). This study aimed to evaluate the responsiveness of a broader set of physiotherapy-based clinical measures for detection of changes following CSF TT in a selected group of iNPH patients and to explore potential sex-based differences in these responses.

METHODS: Ninety-five iNPH patients (mean age 77±6; 41 Female, 54 Male) undergoing CSF TT at the NPH Research Unit, Sahlgrenska University Hospital, were assessed using a standardized battery of gait and balance tests pre- and post-CSF TT. Tests included 10MWT (self-selected (SS) and maximum speed (MS)), 3-meter backward walking (3MBW), TUG (duration and steps), 6-minute walking test (6MWT) distance, 30-second chair stand test (30sCST) stands, and static balance tests such as tandem stance-eyes open (EO)/eyes closed (EC), one-leg stance; both on firm floor and foam cushion, heel or feet together EO/EC. Post CSF-TT changes adjusted for baseline performance presented with fold change and sex-based differences were analyzed.

RESULTS: Significant improvements were observed in all gait and most balance tests. The largest improvement was found in reduced 3MBW duration (32%) and steps (23%), TUG duration (27%), increased 6MWT distance (25%) and decreased 10MWT-SS duration (21%) ($p<0.001$). Among static balance measures, the highest responsive outcomes were increased Romberg (4.9 seconds(s), foam-based stance (feet together-EO (3.9 s); heel together-EO (3.8 s) and tandem-EO (3.1 s) tests. Despite some baseline functional differences, no significant sex-based differences in response to CSF TT were found.

CONCLUSIONS: This study supports the integration of a broader physiotherapy-based assessment iNPH protocol, including challenging tests such as 3MBW and 6MWT, along with foam cushion and tandem tests into CSF TT evaluation to enhance detecting functional changes and identifying shunt responders.

EVALUATING OUTCOME OF SHUNT INSERTION IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (INPH) PATIENTS WITHIN A DEDICATED NPH CLINIC

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INTRODUCTION: To evaluate the outcomes in iNPH patients following ventriculoperitoneal (VP) shunt insertion since the inception of an NPH clinic and assess a modified version of the iNPH-radscale.

METHODS: Electronic and paper medical records retrospectively reviewed. Patients with incomplete clinical records excluded. Besides the standard Evans index (EI), we used the frontal width at the same antero-posterior level as the widest frontal horns, which we label here as the Frontal index (FI).

RESULTS: 147 patient notes reviewed. 114 patients shunted due to suspected iNPH. Incomplete medical records for 18 of these, 96 available for analysis (Male/Female: 64/32. Mean age 74 (SD 6.4) years). Lumbar drain (LD) was performed in 51 (53%) patients, lumbar puncture (LP) in 30 (31%), and neither in 15 most often due to procedural difficulty. A higher proportion of patients improved immediately post-LP (28/30) than post-LD (43/51). Post-operative improvement recorded in 77 (80%) in between 6 months to 8 years. Programmable valves were used in 62 patients (65%). There was no statistically significant difference in the improvement rates between the use of fixed (25/32 improved) vs programmable (52/62 improved) valves ($p=0.49$). Patients with available pre-operative volume scans ($n=86$), the median iNPH radscale in this cohort was 10/12 (IQR 9-11). The mean EI and FI were 0.41 (SD=0.05) and 0.46 (SD=0.06) respectively. For predicting response to shunting, there was no difference between the EI and FI (**AUC 0.559 vs 0.555, $p=0.91$**).

CONCLUSIONS: Improvement of symptoms following VP shunting in our suspected iNPH cohort was 80%. No significant difference between programmable vs fixed shunts. A Frontal index (FI) that is not affected by CT gantry is as sensitive as Evans Index in predicting the response to shunting.

REAL-TIME PHASE CONTRAST MRI OF CSF FLOW IN PATIENTS WITH HYDROCEPHALUS. HEART OR LUNG! WHICH IS THE DRIVER?

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INTRODUCTION: Conventional cine phase-contrast MRI (CINE-PC) is reference technique for quantifying CSF flow dynamic but can only reconstruct one mean cardiac cycle and is not able to quantify respiratory impact on the neurofluids Dynamics. In contrast, real-time phase-contrast MRI (RT-PC) enables continuous measurement of multiple cardiac cycles over breathing cycles. Recently we showed that CSF dynamics is also modulated by respiratory activities. The aim of this work is to evaluate the feasibility of using RT-PC MRI to quantify cardiac and respiratory-driven spinal CSF oscillations in chronic hydrocephalus (CH) patients.

METHODS: Five patients with suspected CH underwent RT-PC acquisitions in addition to their routine CINE-PC at the C2–C3 spinal level to capture continuous CSF flow oscillations over cardiac cycles and free breathing. CINE-PC uses 32 velocity maps to represent dynamic CSF flow over only ONE average cardiac cycle, while RT-PC continuously quantifies CSF flow every 83 ms over 45-seconds and can then represents ALL the cardiac cycles. We developed a software dedicated to RT-PC images to reconstruct the CSF flow amplitude dynamics signal. We applied two frequencies filtering to calculate the relative driving part of the cardiac and respiratory component in the CSF flow. We compared this cardiac-driven measured by RT-PC and CINE-PC and finally we compared cardiac-driven with respiratory-driven.

RESULTS: cardiac-driven measurements presented no significant difference between RT-PC and CINE-PC respectively (0.75 ± 0.38 ml versus 0.78 ± 0.39 ml). Cardiac-driven was significantly higher ($p < 0.0001$) than respiratory-driven amplitudes (0.30 ± 0.18 ml).

CONCLUSIONS: These preliminary findings demonstrate clinical feasibility of RT-PC to quantify spinal CSF oscillations dynamics in hydrocephalus patients without any synchronization but able to measure cardiac and respiratory influences. Even if the breathing component of CSF dynamics plays a moderate role during free breathing, it could be mainly different during deep breathing in hydrocephalus patients, as it has been shown in healthy population.

Patient Consent: The patient has provided their consent for the publication of this abstract.

MAPPING CLINICAL MEASURES OF CSF RESPONSIVENESS VS. NON-RESPONSIVENESS IN COMPLEX NORMAL PRESSURE HYDROCEPHALUS USING THE STRATEGY OF THE PERIODIC TABLE OF DTI ELEMENTS

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INTRODUCTION: We previously described a novel taxonomy, the Periodic Table of DTI Elements, for consistent classification of reversibility vs. irreversibility in distinct cohorts with Normal Pressure Hydrocephalus (NPH). In this study, we mapped clinical thresholds of CSF responsiveness vs. non-responsiveness during lumbar drainage (LD), by individual domain metrics, global NPH scales and imaging biomarkers, to Orders of the Periodic Table.

METHODS: We performed advanced imaging processing to derive metrics of glymphatic function (ALPS index) and diffusion tensor imaging (DTI) profiles in pre- vs. post-LD patients with CoNPH (n=12) vs. 47 global controls-in-common (ADNI). Statistical analyses were performed for comparisons. DTI profiles were mapped as per our published algorithm for the Periodic Table.

RESULTS: DTI profiles corroborated the partial reversal of glymphatic function post-LD. Pre-LD, high levels of radial diffusivity (RD) were strongly positively correlated to Tinetti Gait, e.g. in Inferior Longitudinal Fasciculus (left, $r=0.892$, $p<0.001$) and Inferior Fronto- Occipital Fasciculus (left; $r=0.870$, $p=0.002$). High axial diffusivity (AD), indicative of tract compression, e.g. in right Meyer and Inferior Longitudinal Fasciculus, was strongly correlated to faster gait pre-LD (TUG manual; $r=-0.968$ and -0.900 , $p<0.001$ and 0.006 , respectively) and better Japanese GS and Gothenburg ordinal rating of gait (e.g. Parietal Corpus Callosum; $r=-0.801$ and -0.745 , $p=0.010$ and 0.021 , respectively). Clinical and imaging measures were correlated to post-LD outcomes; CSF Responders vs. Non-Responders were mapped to Orders of the Periodic Table.

CONCLUSIONS: Using the strategy of the Periodic Table, we could classify patients by their thresholds of reversibility vs. irreversibility of brain injury. Here we provide baseline clinical scoring characteristics to supplement the description of patients with CoNPH by their Orders of the Periodic Table; diverse cohorts from the global spectrum of NPH are needed to deepen our understanding of how the Periodic Table can be utilized to supplement clinical scoring of NPH.

CLINICAL RELEVANCE OF DESH SUBTYPES IN NORMAL PRESSURE HYDROCEPHALUS (HAKIM'S SYNDROME): IMPLICATIONS FOR THERAPEUTIC OUTCOMES

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INTRODUCTION: Normal pressure hydrocephalus (NPH) presents with the classic triad of gait disturbance, cognitive decline, and urinary incontinence. Diagnosis remains challenging due to symptom overlap with other age-related conditions. A hallmark imaging feature is disproportionately enlarged subarachnoid space hydrocephalus (DESH), characterized by ventriculomegaly, enlarged Sylvian fissures, and narrowed high convexities. DESH can be subclassified into complete DESH, ventriculomegaly (DESH-V), convexity tightness (DESH-C), Sylvian fissure dilation (DESH-S), and non-DESH variants, each potentially influencing response to cerebrospinal fluid (CSF) shunting. This study aims to evaluate the association between DESH subtypes and postoperative clinical improvement.

METHODS: A retrospective cohort study included 55 NPH patients who underwent shunt surgery at our institution. Preoperative MRI was analyzed to classify DESH subtypes. Gait, cognition, and urinary continence were assessed pre- and postoperatively. Descriptive statistics characterized the cohort. Associations between DESH subtypes and outcomes were evaluated using Mann-Whitney and chi-square tests. Odds ratios (OR) with 95% confidence intervals (CI) quantified the likelihood of improvement.

RESULTS: The mean age was 79 years, with 54.5% male patients. Subtype distribution was complete DESH (14.8%), DESH-C (44.4%), DESH-S (3.7%), and non-DESH (37%). Complete DESH was significantly associated with postoperative improvement in cognition ($p = 0.048$), urinary continence ($p = 0.041$), and gait ($p = 0.043$). DESH-C correlated with cognitive improvement ($p = 0.040$). Complete DESH demonstrated higher odds of improvement across multiple metrics: INECO (OR 1.33, 95% CI: 1.033–1.667), MMSE (OR 1.28, 95% CI: 1.004–1.646), Timed Up and Go (OR 1.25, 95% CI: 1.028–1.521), and 10-meter walk test (OR 1.26, 95% CI: 1.029–1.551).

CONCLUSIONS: Complete DESH was significantly associated with greater clinical improvement across the NPH symptom triad following shunting. DESH subtyping on MRI may serve as a valuable prognostic marker for surgical outcomes in NPH.

ASSOCIATION BETWEEN CEREBRAL MICROBLEEDS AND IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: The idiopathic normal pressure hydrocephalus (iNPH) is a type of neurodegenerative disorder of gait impairment, dementia and incontinence. Ventriculo-peritoneal (V-P) shunt was commonly treatment method. iNPH with comorbid vascular dementia (VD) often have significantly associated with prognosis such as poor response to shunt and may increase Intracerebral hemorrhage risk after shunt. This study aims to analyze if cerebral microbleeds (CMBs) detection is essential in iNPH.

METHODS: A total of 60 iNPH patients were prospectively enrolled and subjected to magnetic resonance-susceptibility weighted imaging (SWI) besides conventional brain imaging scanning. Microbleed Anatomical Rating Scale was used to score CMBs.

RESULTS: A high proportion (40%, 24/60) of CMBs was found in iNPH patients by SWI. Our results showed that in addition to common hypertension and CAA, a certain proportion of patients exhibited genetic mutations leading to cerebral microbleeds. 11 patients with CMBs underwent further genetic testing, of which 6 patients were found to have genetic abnormalities, such as 2 patients with high-temperature requirement serine peptidase 1 (HTRA1) gene mutation.

CONCLUSIONS: SWI was recommended as a routine magnetic resonance test for iNPH patients especially preceding V-P shunt treatment. Further research is necessary to observe the relationship between different causes of CMBs and surgical safety/ effectiveness.

Keywords: susceptibility weighted imaging (SWI), idiopathic normal pressure hydrocephalus (iNPH), cerebral microbleeds (CMBs)

Patient Consent: The patient has provided their consent for the publication of this abstract.

QUANTIFICATION OF THE CONTRIBUTION OF METABOLISM-DERIVED WATER TO CEREBROSPINAL FLUID IN HUMANS AND RATS

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INTRODUCTION: Cerebrospinal fluid (CSF) is vital to maintain brain homeostasis by facilitating waste removal, nutrient transport, and regulation of intracranial pressure. Despite decades of research establishing the choroid plexus as the primary source of CSF secretion, the origin of CSF remains a subject of debate, with hypotheses suggesting that water produced during cellular metabolism in the brain and spinal cord parenchyma, may contribute significantly to total CSF production. This study aims to estimate the contribution of metabolic water production to the collective CSF pool in humans and rats.

METHODS: High resolution volumetric magnetic resonance imaging was employed to assess brain and spinal cord parenchyma volumes in humans (n=6) and rats (n=6). Segmentation techniques were applied to quantify non-parenchymal components, including CSF and blood, allowing for calculation of parenchyma mass in the brain and spinal cord following subtraction of the non-parenchymal components. Metabolic water production was estimated from established rates of mitochondrial oxygen converted to water.

RESULTS: Our findings show that metabolic water production within the brain and spinal cord parenchyma accounts for a minor part of total CSF production.

CONCLUSIONS: Our results support the longstanding view that choroid plexus is the predominant contributor to CSF secretion, with potential implications for future understanding and managing of pressure-related brain disorders. A better understanding of the mechanisms underlying CSF secretion is essential in the development of targeted pharmacological treatments to regulate intracranial pressure, and for a better outcome for patients.

MAPPING HUMAN GLYMPHATIC FLOW WITH 7T MRI: A SAFER ALTERNATIVE TO INTRATHECAL IMAGING

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INTRODUCTION: The glymphatic system is essential for clearing metabolic waste from the brain and has been implicated in neurodegenerative diseases. However, studying this system in humans remains challenging due to a lack of safe and reliable imaging methods. Current approaches typically involve intrathecal contrast administration with 3 Tesla (3T) MRI, which, although effective, is invasive and carries risks such as infection, headache, and neurotoxicity, limiting its clinical utility. Intravenous contrast offers a safer alternative, but contrast uptake in the CSF is often slow and subtle with conventional 3T MRI. The aim of this study is to develop a minimally invasive method for visualizing CSF contrast clearance using intravenous administration of gadobutrol and 7 Tesla (7T) MRI, leveraging its higher resolution and improved signal-to-noise ratio.

METHODS: In this ongoing study, healthy participants aged 18–65 undergo five MRI scans in a single day: one baseline scan followed by four post-contrast scans at 30, 90, 180, and 240 minutes. The imaging protocol includes 3D heavily T2-weighted FLAIR sequence optimized for detecting small amounts of gadolinium contrast.

RESULTS: Preliminary findings demonstrate visible CSF enhancement as early as 30 minutes post-injection, notably around the superior sagittal sinus and choroid plexus. By 180 minutes, enhancement becomes more prominent in the prepontine and suprasellar cisterns and extends into the brain parenchyma. At 240 minutes, enhancement is also observed within the brain ventricles. Notably, no enhancement has been detected in the cerebral veins.

CONCLUSIONS: Our 7T imaging protocol shows promise as a minimally invasive alternative to intrathecal methods and may provide a valuable tool for future glymphatic system research in humans. Our findings may reflect the role of meningeal lymphatic vessels in facilitating fluid exchange between the glymphatic system and the venous circulation.

IS SAGITTAL T2 FLOW VOID MRI IN DIAGNOSING THIRD VENTRICULOSTOMY RELIABLE?

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INTRODUCTION: Aqueductal stenosis (AS) is one of the most common causes of cerebrospinal fluid (CSF) intraventricular blockage, often leading to obstructive triventricular hydrocephalus. In rare cases, spontaneous rupture of the third ventricular floor - known as spontaneous third ventriculostomy (STV) - can occur.

METHODS: We present an illustrative case of pseudo-STV in a 67-year-old man who presented with long-standing obstructive triventricular hydrocephalus. Despite the neuroimaging findings suggesting STV, the endoscopic third ventriculostomy (ETV) showed an intact floor of the third ventricle.

RESULTS: This case highlights the potential for neuroimaging to mislead the diagnosis of STV. A flow void artefact observed on sagittal T2 sequences of the floor of the third ventricle may be misinterpreted as a patent stoma, while actually representing the fast motion of a thin third ventricular floor or CSF flow through the Monro foramina. This misinterpretation can lead to an erroneous diagnosis of STV, which can significantly impact clinical decision-making.

CONCLUSIONS: Endoscopic exploration remains the gold standard for confirming the presence of a ventriculostomy. However, other advanced imaging techniques may aid in distinguishing true CSF intraventricular motion from artifacts. Techniques such as dimensional phase-contrast velocity mapping, including time-SLIP (arterial spin labeling) MRI, could help differentiate flow artifacts mimicked by the rapid motion of the pulsating floor of the third ventricle from CSF flow through a true ventriculostomy.

VENTRICULOMEGALY AFTER VESTIBULAR SCHWANNOMA TREATMENT: ASSESSING CEREBRAL HYDRODYNAMICS TO GUIDE HYDROCEPHALUS MANAGEMENT

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INTRODUCTION: Hydrocephalus is a recognized complication of vestibular schwannoma (VS) treatment. Differentiating vestibular ataxia from hydrocephalus-induced gait disorders remains challenging. We hypothesized that structured evaluation of CSF dynamics and brain imaging could improve diagnosis and management.

METHODS: We retrospectively analyzed 33 patients with ventriculomegaly and signs of CSF disturbance after VS treatment. Morphological brain imaging was assessed using the iNPH Radscale. Lumbar infusion testing measured baseline intracranial pressure (ICP) and resistance to CSF outflow (Rout).

RESULTS: Treatments included surgery (16.7%), radiosurgery (13.9%), and radiotherapy (25.0%), no treatment (41.8%). The cohort showed predominantly high-grade tumors (mean grade 3.4). Imaging revealed Evans' index >0.25 , narrowed high-convexity sulci, and dilated temporal horns. iNPH Radscale scores ranged from 5 to 8. Elevated ICP (>16 mmHg) was present in 17.6%, and elevated Rout (>12 mmHg/ml/min) in 63.6%. Overall, 55.6% of patients underwent ventriculo-peritoneal shunting. Among shunted patients, 85% experienced significant improvement, underscoring the strong therapeutic benefit of shunting when guided by hydrodynamic assessment.

CONCLUSIONS: After VS treatment, ventriculomegaly frequently reflects hydrodynamic dysfunction but not necessarily shunt-responsive hydrocephalus. Structured imaging and CSF dynamics evaluation refine diagnosis and support targeted management, with shunting offering substantial benefit in selected patients.

GLIOBLASTOMA AND VENTRICULOMEGALY: HYDRODYNAMIC DISTURBANCES AS EMERGING BIOMARKERS FOR HYDROCEPHALUS DIAGNOSIS AND MANAGEMENT

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INTRODUCTION: Hydrocephalus is an underrecognized complication in glioblastoma (GBM), especially during progression or after treatment. Cranial radiotherapy may further impair CSF resorption by inducing arachnoid fibrosis, contributing to disproportionate ventricular enlargement. Therefore, differentiating passive ventricular enlargement due to brain atrophy from active hydrodynamic dysfunction remains critical. Recent evidence suggests altered cerebrospinal fluid (CSF) dynamics as a core hallmark of secondary hydrocephalus, requiring objective biomarkers. We hypothesized that systematic evaluation of CSF hydrodynamics and imaging could refine diagnosis and guide management.

METHODS: We retrospectively analyzed 20 GBM patients with ventriculomegaly and suspected CSF disturbance. Brain imaging was assessed using the iNPH Radscale criteria, and CSF dynamics were evaluated through lumbar infusion testing, measuring baseline intracranial pressure (ICP) and resistance to CSF outflow (Rout).

RESULTS: Evans' index >0.25 was found in 87.1% of patients, narrowed high-convexity sulci in 32.3%, and temporal horn dilation in 45.2%, suggesting disturbed CSF resorption patterns. Elevated ICP (>16 mmHg) was observed in 6.3%, while elevated Rout (>12 mmHg/ml/min) was found in 37.5%. Based on hydrodynamic criteria, 40.6% of patients were considered potential candidates for ventriculo-peritoneal shunting.

CONCLUSIONS: In GBM patients with ventriculomegaly, CSF hydrodynamic impairment is frequent but heterogeneous. Imaging alone is insufficient for diagnosis. Elevated Rout emerged as a more sensitive indicator of hydrodynamic alteration, rather than baseline CSF pressure as a surrogate marker of ICP, supporting its use as a functional biomarker. Radiation-induced arachnoid fibrosis may play an underrecognized role in CSF circulation failure. Early identification of increased CSF outflow resistance may guide personalized management and improve outcomes, aligning with precision medicine strategies in secondary hydrocephalus.

ENVIRONMENTAL IMPACT OF SHUNT SURGERY: A GREEN WORK OF THE FRENCH NEUROSURGERY SCIENTIFIC COMMITTEE ON ECO-RESPONSIBILITY

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INTRODUCTION: In response to the ecological emergency, the need for a resilient and decarbonized health system has been identified as a priority by the World Health Organization. Following an encouraging survey, the Société Française de Neurochirurgie (SFNC) has recently created a French scientific committee on eco-responsibility, to promote initiatives and projects in this field. In this study, we present the preliminary results of the evaluation of the environmental impact of shunt surgery for hydrocephalus, which is a common and reproducible procedure in neurosurgery.

METHODS: We asked the centers that were members of the committee to provide us with the contents of their surgical trays for shunt surgery (VA or VP procedure) to know the number of instruments taken out for surgery and to assess the environmental cost of sterilization. During the procedures, the participating centers also completed a form specifically designed to assess the number of instruments and consumables really used.

RESULTS: A total of 5 centers have transmitted the contents of their data. The average surgical tray contained 59 instruments, with extremes ranging from 42 to 85 depending on the center. On average, only 41.8% [31.3 - 56.7] of the instruments were used during surgery. Regarding consumables, an average of 15 pairs of sterile gloves were used, and more than 50% of procedures involved the use of a disposable metal navigated stylet.

CONCLUSIONS: One of the key findings is that a significant number of instruments are not used but are sterilized, which requires energy and water consumption. Optimizing and standardizing the composition of surgical trays and consumables could help to reduce the environmental impact of surgery. Because shunt surgery is associated with a high-risk infection, surgeons are accustomed to regularly changing sterile gloves, but the real effectiveness should be studied. Navigation manufacturers could provide reusable stylet for catheter insertion.

EVALUATING BASELINE COGNITIVE IMPAIRMENT AND IMPACT OF TREATMENT IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (INPH) USING A STANDARDISED ASSESSMENT BATTERY AND COMPOSITE SCORE

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INTRODUCTION: There is currently no consensus on the optimal battery of tests for evaluating cognitive function in iNPH, despite its importance in baseline assessment and monitoring post-surgical outcomes. We previously developed a simple scoring system for reliable stratification and assessment of shunt responsiveness and sought to apply this within an iNPH specialist service.

METHODS: A standardised protocol was assembled based on a systematic review, incorporating the ACE-III and tests of core iNPH cognitive deficits. Values from TMT-A, TMT-B and Symbol Search were used to construct a single iNPH Cognitive Deficit Score, stratified on a seven-point severity scale (0=No impairment, 6=Very severe). Cognitive improvement was defined as a ≥ 1 point improvement on this scale, in alignment with established clinical significance thresholds. The battery was administered to all patients attending a multidisciplinary iNPH clinic at baseline and three months following ventriculoperitoneal shunt insertion.

RESULTS: A total of 94 adults (64 males; $M_{age}=75.4$, $SD=7.3$) completed the battery at baseline and post-surgery (compliance rate=98.9%). At baseline, 89.4% ($n=84$) demonstrated cognitive deficits of varying severity in processing speed, psychomotor speed and executive function, while 34.5% ($n=29$) had deficits on testing despite no subjective cognitive concerns. Of these 84 patients, 62 had simple iNPH and 22 had complex iNPH. Post-treatment, 95.2% ($n=59$) of 'simple iNPH' patients exhibited clinically significant improvement or resolution of mild cognitive deficits. Mean Cognitive Deficit Scores improved from mild-moderate impairment to normal-mild post-surgery.

CONCLUSIONS: We report the application of a targeted test battery and composite Cognitive Deficit Score for quantifying impairment severity in routine practice. Using this score, the incidence of cognitive impairment was 89.4% in treated patients, highlighting the need for accurate assessment in diagnosis and monitoring. Incorporating a global cognitive screen aids differential diagnosis, particularly in complex cases. Establishing a reliable cognitive baseline facilitates accurate evaluation of treatment response.

FUNCTIONAL RESPONSE TO LARGE VOLUME LUMBAR PUNCTURE PREDICTS SHUNT SURGERY AND PERCEIVED BENEFIT IN SUSPECTED NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Large-volume lumbar puncture (LVLP) is commonly used to identify patients with suspected idiopathic normal pressure hydrocephalus (iNPH) who may benefit from shunt surgery. This study aimed to evaluate functional changes after LVLP and identify predictors of subsequent shunt placement and patient-perceived improvement.

METHODS: We analyzed data from 215 patients (age:74.6-years) evaluated at Johns Hopkins University between 2016-2024 for suspected iNPH who underwent diagnostic LVLP. Patients with missing data were excluded. Post-LVLP changes in measurements on gait (time up and go test [TUG], 10-meter walk test [10MWT], balance (30 second-sit-to-stand [30SS], 4 stage balance test [4SBT], endurance (2-minute walk test [2MWT] and global rating of change (GROC) were compared between responders (63.7%) who were eventually shunted and non-responders (36.3%). T-test and Chi-square were used for the comparison of quantitative and qualitative variables. Correlations were assessed using the Spearman test. Predictive models were proposed using backward selection using AIC on logistic and linear regressions.

RESULTS: Shunted patients demonstrated significantly greater improvements in mobility metrics: TUG (28.5% vs. 18.0%, $p<0.001$), 10MW (25.5% vs. 15.9%, $p<0.001$), and 30SS (2.12 vs. 1.03 repetitions, $p<0.001$). Subjective improvement, GROC, was higher among shunted patients (5.08 vs. 3.38, $p<0.001$). More shunted patients met domain-level improvement thresholds in Gait speed, Balance, and Endurance. Functional test correlations were strongest between TUG and 10MW ($r=0.67$), with moderate associations to Endurance measures. Regression analyses identified 10MWT and 30SS as independent predictors of higher GROC. Logistic regression showed that TUG improvement (OR=1.04[1.02–1.06]), 30SS (OR=1.32 [1.09–1.59]), and volume removed (OR=1.09[1.01–1.17]) independently predicted shunt placement.

CONCLUSIONS: Objective improvements in functional performance following LVLP, particularly in gait speed and balance, are associated with both patient-perceived benefit and likelihood of proceeding to shunt surgery. These findings support the utility of structured functional assessment after LVLP to guide clinical decision-making in suspected NPH.

BRAIN COMPLIANCE IN NORMAL PRESSURE HYDROCEPHALUS AND POST-TRAUMATIC HYDROCEPHALUS: USE OF NOVEL RADIOGRAPHIC AND NON-INVASIVE INTRACRANIAL WAVEFORM METHODOLOGIES

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INTRODUCTION: The clinical and radiographic stigmata of Normal Pressure Hydrocephalus (NPH) and post-traumatic hydrocephalus (PTH) are known and have been extensively studied. A consistent feature with NPH and PTH is some persistent ventriculomegaly even after a ventriculo-peritoneal shunt (VPS). This may be related to brain compliance. We examined this in patients with NPH and PTH.

METHODS: NPH and PTH patients at our institution have routine brain CT scans and non-invasive brain compliance measurements as part of standard care. The latter are done using a US FDA (Food and Drug Administration) approved device specifically for brain compliance. Institutional Review Board Approval for retrospective review of patient related care was obtained. NPH (n=10) and PTH (n=9) patients treated with VPS were identified. Pre and post-operative ventricular volumes were calculated using our previously reported automated Artificial Intelligence (AI) derived algorithm utilizing a web-based platform (BisQue-Bio-Image Semantic Query User Environment). Brain compliance measurements were done at routine clinic visits with non-invasive evaluation of brain compliance waves P2/P1.

RESULTS: The pre and postoperative comparisons of ventricular volume demonstrated a mean decrease after VPS of 13.68% (St. Deviation = 0.059%) for the NPH patients and a slight increase of 0.43% (St. Deviation= 0.055%) for the PTH patients. 5 of the NPH patients had decreased P2/P1 on post-operative non-invasive measurements, 4 of the PTH patients had minimal change or increased P2/P1. The remainder P2/P1 measurements were incomplete because pre-or-post-op measurements were not completed at the clinic visit to date.

CONCLUSIONS: The changes in ventricular volume detected by our CT measurements suggest a more compliant brain in NPH than PTH. The non-invasive measurements of P2/P1 support these findings. These CT and P2/P1 measurement tools have great potential for longitudinally tracking changes in brain/ventricular volume as part of the natural history of NPH/PTH and after VPS treatment.

TO SHUNT OR NOT TO SHUNT : IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS AND PHYSICAL FRAILITY

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (INPH) is a pathology affecting older adults. The incidence of patients who undergo a shunt surgery 0.5 to 1.2 per 100000. However, limited data exist on the impact of physical frailty, comorbidities following surgery, and the predictive value of commonly used physical performance test is unknown.

METHODS: 114 INPH patients were evaluated pre-operatively and 1 month postop at a specialised INPH clinic. Performance tests were done pre and post cerebrospinal fluid (CSF) removal testing to assess eligibility to surgery. Physical frailty was characterised as a walking speed of less than 0.8 m/sec, and the fall risk as a Time-up and go (TUG) of more than 12 seconds. Hospitalisation and survival were documented at 1 year.

RESULTS: At baseline, the mean age was 73 years and 52% were male. Mean walking speed was 0.7 m/sec. 62.3% of patients presented a physical frailty and 89.5% were considered risk of fall. At baseline, frail patients had a more frequent history of stroke, hypertension, diabetes and had worse cognitive and physical performances. At 1 year follow up, age and sex were not associated with mortality or hospitalization. There was no significant difference in mortality, hospitalisation between frail and non-frail patients. However, a mean difference between TUG pre and post CSF removal testing of less than 1,96 showed an increased mortality at 12 months in frail patients (HR 1.27 (1.01-1.59), $p=0.038$).

CONCLUSIONS: In shunted population, physical frailty is common as well as common comorbidities. Mortality and rehospitalisation were not associated with those comorbidities. Physical performance evaluated with the TUG pre and post CSF removal testing might be a tool associated with mortality and hospitalisation. If carefully selected, even patients deemed frail physically might benefit from the shunt procedure. Larger studies are needed to confirm our results and better optimise patient selection.

SURGICAL EFFECTS IN PATIENTS WITH NORMAL-PRESSURE HYDROCEPHALUS BASED ON CT PERFUSION IMAGING

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INTRODUCTION: To investigate the perfusion differences in patients with normal pressure hydrocephalus (NPH) before and after surgery using CT perfusion imaging, and to assess patients' functional recovery in conjunction with neurological assessments, thereby verifying the surgical outcomes and demonstrating the necessity of the procedure.

METHODS: A prospective study was conducted on the clinical data of 31 NPH patients who underwent ventriculoperitoneal shunt (VPS) surgery at the Neurosurgery Department of The First Affiliated Hospital of USTC (Anhui Provincial Hospital) from June 2020 to June 2023. All patients underwent CT perfusion scans and neurological assessments before surgery and one week after surgery. Outpatient follow-ups were conducted at 1, 3, and 6 months postoperatively to analyze and compare the differences in cerebral perfusion and neurological function before and after surgery.

RESULTS: After undergoing VPS surgery, NPH patients showed significant improvements in short-term cerebral perfusion, with statistically significant changes in postoperative cerebral blood volume (CBV), cerebral blood flow (CBF), mean transit time (MTT), and time to peak (TTP) compared to preoperative values. The differences in neurological assessment scores at 1, 3, and 6 months postoperatively were also statistically significant.

CONCLUSIONS: Active VPS surgery for NPH patients can significantly improve cerebral perfusion in the short term, and the long-term surgical effects are evident, significantly enhancing the quality of life for these patients.

Patient Consent: The patient has provided their consent for the publication of this abstract.

ASSOCIATION OF PRE-SHUNT MRI METRICS WITH GAIT OUTCOMES AFTER SHUNT IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: While there are several imaging markers that provide diagnostic value in evaluation of idiopathic normal pressure hydrocephalus (iNPH), markers predictive of outcomes after shunt placement are lacking, in part due to limited quantitative outcome data. The goal of this work was to evaluate the association of baseline MRI metrics with quantitative gait outcomes after shunt placement in patients with iNPH.

METHODS: We included 106 patients (median age 75 years) with iNPH, shunt placement, pre-shunt MRI, and gait assessments before and after shunt placement. Quantitative gait assessments were performed on a pressure sensitive walkway. We used linear regression to evaluate the association of pre-shunt posterior callosal angle, Evan's index, and ventricular volume with percent change in gait velocity, stride length, step width, stability ratio, total support time, and single support time at 1-3 months, 4-12 months, and 1-3 years after shunt placement.

RESULTS: Median (range) baseline callosal angle, Evan's index, and ventricular volume were 66° (34°-121°), 0.4 (0.3-0.5), and 135 (64-288) cc, respectively. Most patients showed improvement in gait metrics at the early follow-up (1-3 months) with subsequent plateau (1-3 years post-shunt). A lower callosal angle was associated with improvement (decrease) in the stability ratio at 1-3 months ($p=0.023$) and 1-3 years ($p=0.049$) after shunt placement. Evan's index and ventricular volume were not significantly associated with change in any of the gait metrics.

CONCLUSIONS: Preliminary analyses suggest that a more acute pre-shunt callosal angle is associated with improvement in some gait metrics after shunting. These associations are limited by noise in both the MRI measurements and gait outcomes. Ongoing work includes increasing sample size, application of mixed effects models including interactions with time, and addressing potential biases in patients with longer follow-up durations to better understand how pre-shunt MRI features may be used to predict shunt response.

Patient Consent: The patients provided consent for their data to be used for research.

DIAGNOSTIC PERFORMANCE OF THE MAIN DIAGNOSTIC TOOLS IN CHRONIC HYDROCEPHALUS

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INTRODUCTION: Patient selection for shunt surgery for suspected chronic hydrocephalus (CH) remains difficult due to the lack of standardized diagnostic criteria. Many diagnostic tools exist but none of them is perfect. The goal was to evaluate diagnostic performance of a multimodal preoperative approach including the cerebrospinal fluid (CSF) tap test, DESH score, callosal angle, Evans index and infusion study parameter.

METHODS: We included 68 patients who underwent shunt surgery for suspected CH. Preoperatively, all patients underwent CSF tap test with clinical evaluation using the iNPH grading scale (iNPHgs), infusion study to calculate the resistance to CSF outflow (Rout), brain-MRI to assess the DESH score, callosal angle, and Evans index. We calculated the diagnostic performance indexes (sensitivity (Se), specificity (Sp), positive and negative predictive values (PPV, and NPV) of each diagnostic tool.

RESULTS: Of the 68 patients, 58 (85.3%) improved clinically at one year (increasing of iNPHgs above 10%). For DESH score above 6, Se was 0.83, Sp 0.40, PPV 0.89, NPV 0.29. For callosal angle inferior less than 90°, Se was 0.88, Sp 0.4, PPV 0.89, NPV 0.36. For Evans' index above 0.35, Se was 0.7, Sp 0.56, PPV 0.90, NPV 0.25. Improvement after CSF tap test showed Se at 0.67, Sp 0.9, PPV 0.98, NPV 0.32. Increased Rout (above 14mmHg/mL/min) showed Se at 0.54, Sp 0.50, PPV 0.85, NPV 0.17.

CONCLUSIONS: No single test can predict improvement after shunt surgery. All tests lack NPV, so no patient can be excluded from shunt placement with certainty. The risk is not operating on patients who might have improved after surgery. Therefore, all diagnostic tools are potentially complementary to refine the probability of improvement after surgery.

Patient Consent: The patient has provided their consent for the publication of this abstract.

NO PREDICTIVE VALUE OF AQUEDUCT CSF FLOW DYNAMICS FOR SHUNTING EFFICACY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: INPH is diagnosed based on clinical criteria and physiological measurements, including brain imaging parameters. Increased aqueductal CSF flow dynamics, assessed with Phase-Contrast MRI (PC-MRI), is one of the supportive features in iNPH diagnostic guidelines. A predictive value has been suggested but remains largely debatable. This study aimed to clarify the role of aqueductal flow in supporting diagnosis and shunt selection for iNPH patients.

METHODS: We retrospectively included 92 iNPH patients with preoperative PC-MRI together with pre- and post-operative gait speed measurement. Aqueductal CSF flow dynamics were calculated and correlated with gait outcomes and baseline gait speed. Additionally, we compared our cohort with 42 age-matched healthy controls.

RESULTS: We found no significant differences in CSF flow parameters between shunt responders and non-responders: Stroke volume was 130 ± 100 and $150 \pm 100 \mu\text{l}$, $p=0.293$ respectively, with net flows of -0.018 ± 1.77 and $-0.07 \pm 1.51 \text{ ml/min}$, $p=0.915$. There were no correlations of aqueduct CSF dynamics with baseline gait performance, nor with gait change ($-0.15 < R < 0.1$, $p > 0.5$ for all parameters). Furthermore, comparisons with healthy controls revealed differences in stroke volume ($100 \pm 110 \mu\text{l}$ iNPH vs 78 ± 41 healthy, $p < 0.001$) but not in net flow ($p > 0.05$).

CONCLUSIONS: Our findings indicate no significant predictive value of aqueductal CSF dynamics for shunt efficacy in iNPH patients. The heterogeneity of iNPH and variability in CSF dynamics across its time course, may contribute to these negative results. From a clinical point of view, the 2D PC MRI technique appears to have very limited value for selecting patients for shunting.

CSF LYSOPHOSPHOLIPIDS AS POTENTIAL BIOMARKERS FOR HYDROCEPHALUS

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INTRODUCTION: Finding novel CSF biomarkers for hydrocephalus is one of the research topics in hydrocephalus research. Lipidomic analysis using LC-MS/MS is one of the assays to discover novel CSF biomarkers. Lipid mediators like lysophosphatidic acid (LPA) cause hydrocephalus in mouse models. CSF lipidomics studies focusing on relationships between lysophospholipids and hydrocephalus are limited. It is plausible to speculate that specific lysophospholipids in CSF could be elevated in patients with hydrocephalus.

METHODS: CSF samples from 14 cases of hydrocephalus and 18 control subjects were analyzed for lipidomic analysis for lysophospholipids using LC-MS/MS at The University of Tokyo Hospital. Control subjects were selected from patients with hematologic cancer without any neurological involvement, matched with the age and sex of hydrocephalus cases.

RESULTS: Lysophosphatidyl choline (22:0) was higher in hydrocephalus CSF compared with control CSF (1.6 [0.0-5.1] vs 0.0 [0.0-0.0] nM; $P=0.003$). Lysophosphatidyl inositol (18:0) was also higher in hydrocephalus CSF than in control (87.7 [65.8-120.9] vs 68.6 [23.5-90.1] nM; $P=0.04$). LPA (16:0), the most abundantly detected LPA, was not different between case and control (815 [200-1732] vs 927 [181-1444] nM; $P=0.96$).

CONCLUSIONS: Lysophosphatidyl choline and lysophosphatidyl inositol could be novel lipid CSF biomarkers for the diagnosis of hydrocephalus. Further work with a larger sample size and detailed clinical characterization would be warranted to validate the utility of specific lysophospholipids as hydrocephalus biomarkers.

Patient Consent: Informed consent was obtained in the form of an opt-out option on the website of the hospital.

LP SHUNT IN PATIENTS WITH INPH : SURGICAL TECHNIQUE

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INTRODUCTION: The low-invasive LP shunt that does not require ventricular puncture is preferred and has become the first-line procedure for iNPH in Japan. The SINPHONI-2 study (Japanese prospective multicenter cohort studies) was carried out and showed the safety and efficacy of LP shunt surgery for iNPH. We show a video of our LP shunt procedure.

METHODS: A total of 991 probable iNPH patients underwent LP shunt surgery at our NPH center between April 2009 and December 2024 (mean age of 77.5 ± 6.3 years). Aspects of our surgical technique include: 1) General anesthesia, 2) Use of the original drape, 3) Upward insertion of the spinal tube through L2/3 via a paramedian puncture for highly deformed lumbar spine patients, using the intraoperative C-arm imaging, 4) Placement of a CERTAS Plus valve with Siphonguard™ in the back, 5) Inclination of the table at 30°angle. 6) Laparotomy via rectal muscle splitting, and 7) Running the peritoneal tube obliquely from the upper lateral to lower medial (to eliminate the space permitting tube expulsion).

RESULTS: Of the 762 patients followed up at the NPH Center for 1 year after LP shunt surgery. During the first year after surgery, 68 of 693 patients (9.8%) developed postoperative complications including catheter occlusion in 24(3.5%), chronic subdural hematoma requiring evacuation in 18(2.6%), migration of the spinal or abdominal catheter in 12(1.7%), lower limb numbness in 7, rupture of the spinal catheter in 5, and shunt infection in 2

CONCLUSIONS: LP shunt require higher pressure setting than VP shunt. We set the initial pressure setting to QRT + 4cmH₂O. Intraoperatively, we check the contrast medium in spreading from the tip of spinal catheter to confirm correct placement of the catheter. We anticipate that these will greatly reduce the incidence of over drainage and shunt malfunction.

MRI-BASED CHARACTERIZATION OF TORCULAR CONFIGURATIONS IN CHRONIC HYDROCEPHALUS PATIENTS AND HEALTHY CONTROLS

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INTRODUCTION: The torcular is the confluence where the superior sagittal sinus (SSS) and the straight sinus (SS) meet, giving rise to the lateral transverse sinuses, which then drain into the jugular and accessory veins that exit the skull. It is a strategic anatomical location, although anatomical variability of this confluence is well documented. Venous compliance is an important part of the overall intracranial compliance. Its potential pathophysiological impact is unknown in chronic hydrocephalus (CH). The objective of this study was to characterize by MRI the different configurations of the torcular.

METHODS: We analyzed the anatomy of the torcular, using phase-contrast MRI, in 29 CH patients who underwent surgery and showed clinical improvement, and 36 healthy controls. Subjects were classified into two groups: one in which the SSS drains into a single transverse sinus ("one-side"), and another in where the SSS goes on both transverse sinuses ("two-sides"). The same classification approach was applied to the SS.

RESULTS: In controls, there was a majority of two-sided configuration compared with one-sided one (respectively: 27 vs. 9 for SSS, 29 vs. 7 for SS). In CH patients, there was no dominant configuration (respectively: 13 vs. 16 for SSS, same for SS). Chi-square statistical analyses revealed a significant association between the confluence type (one-side vs. two-sides) and the presence of pathology ($p=0.02$ for the SSS and $p=0.006$ for the SS).

CONCLUSIONS: Our study demonstrates a significant association between the anatomical configuration of the torcular and the presence of CH, suggesting that venous asymmetry may play a role in its pathophysiology. Torcular anatomy can be linked with venous compliance changes. We can therefore question the link between the anatomical configuration of intracranial veins and a possible predisposition to the development of CH. This potential link needs further investigation in future studies.

Patient Consent: The patient has provided their consent for the publication of this abstract.

PERICATHETER CYSTS AS A POSTOPERATIVE COMPLICATION OF VP AND VA SHUNT PROCEDURES

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INTRODUCTION: Pericatheter cysts (PCs) are considered rare complications after ventricular puncture, with only about 30 cases reported in relation to shunt surgery. Because of their rarity, they have not received much attention. Recently, we experienced a symptomatic case of PC and recognized its potential clinical importance. Therefore, we aimed to investigate the incidence of PC after ventriculoperitoneal (VP) or ventriculoatrial (VA) shunt placement by reviewing imaging data from patients who underwent shunt surgery and continued clinical follow-up at our hospital.

METHODS: This was a single-center retrospective observational study. We included all patients who underwent VP or VA shunt placement at our institution and had at least three months of postoperative clinical follow-up. We reviewed their clinical records and head imaging to evaluate the presence of PC.

RESULTS: A total of 73 patients were included. Among them, 64 patients (88%) had idiopathic normal pressure hydrocephalus (iNPH) and 9 patients (12%) had secondary NPH (sNPH). VP shunts were performed in 70 patients (96%), and VA shunts in 3 patients (4%). The mean follow-up period was 23.5 ± 14 months. PCs were observed in 3 cases (4.1%), with an incidence of 2.2% per person-year. In one representative case, a cyst approximately 50 mm in diameter was found in the right temporal and parietal lobes surrounding the catheter. The cyst resolved spontaneously without further intervention, but visual field deficits remained.

CONCLUSIONS: PCs may occur more frequently than previously thought and should not be considered extremely rare. Ventricular puncture should be performed at a safe location to reduce the risk of this complication.

ATYPICAL MANIFESTATIONS OF IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a potentially reversible form of dementia, estimated to account for 6% of all dementia cases. This neurological syndrome is characterized by Hakim's triad. However, there is a subset of patients with atypical presentations, which influences diagnosis and management. Atypical symptoms are poorly understood and underreported in the literature and the pathophysiology underlying these atypical presentations is not defined. The primary objective of this systematic review is to collect the existing evidence regarding atypical symptoms of iNPH. The classic triad remains the cornerstone of diagnosis; however, emerging evidence points to a wide range of atypical presentations, like psychiatric disorders, motor dysfunctions and infrequent neurological deficits, including visual abnormalities and dysphagia.

METHODS: 3814 abstracts were initially retrieved from PubMed database searching "normal pressure hydrocephalus symptoms". Most of the studies considered were case reports, therefore conducted on a limited number of patients. Here, one or more atypical symptoms were described, associated or not with those of the classic triad. Some patients were implanted with a ventriculoperitoneal shunt with resolution of symptoms not immediately attributable to the primary pathology. A total of 27 studies were qualified for analysis and systematically reviewed.

RESULTS: The results verify heterogeneous nature of the symptoms, such as psychosis, mania, depression and aggression were observed to form important early or concomitant symptoms in a group of patients. These observations make it clear that frontal-subcortical impairment, secondary to ventriculomegaly, can manifest itself in behavior long before gait impairment and cognitive deterioration occur.

CONCLUSIONS: Recognition of atypical symptoms in iNPH is important to improve diagnostic accuracy and optimize therapeutic success. The observations in this review provide a strong rationale for an expansion of the clinical perception of iNPH, with an argument for increased awareness in clinicians and offering opportunities for intervention at an early stage.

PHASE-CONTRAST MRI CEREBROSPINAL FLUID FLOW PARAMETERS AS PREDICTIVE MARKERS OF ETV EFFICACY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: PROSPECTIVE OBSERVATION STUDY.

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a neurological disorder characterized by the clinical triad of gait disturbance, cognitive impairment, and urinary incontinence, accompanied by ventricular enlargement without elevated intracranial pressure. Endoscopic third ventriculostomy (ETV) represents an alternative and controversial treatment modality to ventriculoperitoneal (VP) shunt placement. The aim of this study was to evaluate the efficacy of ETV in patients with iNPH and to determine the predictive value of cerebrospinal fluid (CSF) flow parameters measured by phase-contrast magnetic resonance imaging (PC-MRI).

METHODS: This prospective, single-center, non-randomized study included 31 patients with iNPH who underwent ETV. Pre- and postoperative measurements of peak velocity (PV), aqueductal stroke volume (ASV), and Net ASV were obtained in the aqueduct. Clinical outcome was assessed using the Kiefer score, and the NPH recovery rate was calculated; ETV was considered effective when the recovery rate was ≥ 3 . Statistical analyses included correlation tests, logistics regressions, receiver operating characteristic (ROC) curve analysis, and cross-validation.

RESULTS: Clinical improvement following ETV was observed in 32.3 % of patients. Responders had significantly higher preoperative ASV values and Net ASV. The calculated ASV cut-off value of 280 μl predicted a positive clinical outcome with 90 % sensitivity and 71 % specificity. Although PV showed lower overall predictive power, it demonstrated high negative predictive value (93 %), with a cut-off determined at 8.1 cm/s. Multivariate regression identified preoperative ASV as the only independent predictor of ETV success. Lower cognitive impairment scores were associated with a higher likelihood of clinical improvement.

CONCLUSIONS: ETV may be an effective treatment option in a carefully selected subset of iNPH patients, particularly those with hyperdynamic CSF flow. A preoperative ASV value $\geq 280 \mu\text{l}$ appears to be a clinically relevant predictor of response. These findings support the importance of individualized treatment strategies in iNPH and highlight the need for larger randomized trials to validate the observed associations.

THE IMPACT OF ALZHEIMER'S AND VASCULAR DEMENTIA ON SHUNT OUTCOMES IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS, A SYSTEMATIC REVIEW OF 1.394 PATIENTS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (INPH) is characterized by gait disturbance, urinary incontinence, cognitive decline, and ventricular enlargement with normal cerebrospinal fluid (CSF) opening pressure, with a prevalence of around 0.2% in individuals aged 70-79, rising with age. This study examines the impact of comorbidities on shunt outcomes and complications in INPH.

METHODS: We systematically searched PubMed, Web of Science, Embase, and the Cochrane Library (up to October 2024) for studies reporting comorbidities associated with INPH.

RESULTS: A total of twenty-one studies involving 1,394 elderly individuals with INPH were included. Eleven studies addressed Alzheimer's disease (AD), while five focused on vascular dementia (VD). Although AD and VD pathology do not significantly affect initial responses to shunt surgery, patients with these comorbidities show poorer long-term outcomes and reduced cognitive improvements, particularly in executive functions. A prevalence of AD-related neuropsychological findings, correlating with shunt outcomes. Despite these challenges, shunt surgery remains effective, significantly improving gait and urinary function. Key predictors of cognitive enhancement include baseline cognitive scores and age. Neuropsychological assessments, especially the EU-INPH scale, help identify comorbidities and refine prognoses after CSF shunting. Noninvasive screening methods may improve evaluations, while cortical biopsies as a research tool provide insights correlating with clinical outcomes.

CONCLUSIONS: These findings underscore the impact of AD and VD on INPH treatment outcomes. The high prevalence of AD contributes to variable shunt surgery success rates, with gait improvement at 64% in INPH-only patients versus 41% in those with AD. Cognitive improvement was 40% in the INPH group compared to 27% in the AD + INPH cohort, highlighting the need for accurate diagnosis and targeted management of AD and VD in INPH patients.

LONG-TERM BODY WEIGHT CHANGES IN THE PATIENTS WITH NORMAL PRESSURE HYDROCEPHALUS RECEIVED VENTRICULOATRIAL SHUNT

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INTRODUCTION: The adjustable valve is recommended in the shunt surgery for the NPH treatment and the pressure setting is strongly related to the body length (BL) and weight (BW) in the VP or LP shunts. Although the BW can change, its changes after the surgery have not yet been elucidated. We investigated the long-term BW changes in the NPH patients received ventriculoatrial (VA) shunt.

METHODS: We retrospectively investigated 86 NPH patients with VA shunt over 60 years old whose pre-surgical BL and BW and the BW beyond 5 years after the surgery were available. The maximum gain and loss of BW and their timings, the symptoms due to BW changes, and the valve pressure settings associated with BW changes were investigated. The BW changes were categorized as follows; A (5kg≤, <10kg), B (10kg≤, <15kg), C (15kg≤, <20kg), D (20kg≤). Data were shown in mean (SD).

RESULTS: The mean age was 75.1 (5.5) years old (male (n=48): 75.1 (5.8), female (n=38): 75.2 (5.3)). Mean follow up year was 8.6 (2.6) years, mean BW gain was 4.7 (5.0) kg, and mean BW loss was 6.4 (5.7) kg. Twenty patients gained weight over 5kg; A:12, B: 7, C: 0, D: 1, and thirty patients lost weight over 5kg; 18, 6, 3, 3 respectively. Twelve patients gained weight over 5 kg and nineteen patients lost weight over 5kg beyond 5 years after the surgery. BW changes did not induce under or over drainage symptoms. The valve pressure settings were not changed due to the BW changes.

CONCLUSIONS: BW changed widely even beyond 5 years after the surgery. The patients with VA shunt were not affected by the BW changes regarding the symptoms and the pressure settings. These results mandate the study of the BW changes in VP or LP shunts for a long time.

Patient Consent: The patient has provided their consent for the publication of this abstract

AWARENESS OF NORMAL PRESSURE HYDROCEPHALUS IN HEALTHCARE PERSONNEL

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a common reversible disease in adulthood, associated with cognitive decline, gait disturbances and urinary incontinence. Despite its prevalence, iNPH is often underdiagnosed or misdiagnosed by medical and nursing staff. This study involved administering a 9-item questionnaire to doctors and nurses in the Emergency Department of our hospital to assess their level of awareness about normal pressure hydrocephalus.

METHODS: There were 131 participants, of whom 39 abstained; 59 responses came from nursing staff (45%) and 33 from medical staff (25%). Among the doctors, 20 were employed in the Emergency Department (60.6%) and 11 were radiology specialists (33%). Although most had heard of the acronym NPH during their studies, 36% had never seen patients with NPH in the last 5 years and 30% did not remember having seen any or did not respond. Among nurses, there was greater learning of the pathology in specialist training (52.5%), but many had not seen any patients with NPH in the last 5 years (62.7%).

RESULTS: The analysis revealed significant differences between specialties, with greater awareness among radiologists. Poor knowledge of the pathology emerged among older doctors, while younger doctors were already aware of it during their studies. Despite this, there was a common opinion among doctors and nurses that the pathology is underdiagnosed and that there is no age limit for possible surgical treatment.

CONCLUSIONS: The results indicate an urgent need for targeted educational interventions for emergency department staff, in order to improve timely recognition of symptoms and implementation of appropriate treatments.

SIMULTANEOUS CLINICAL ASSESSMENT OF SIBLINGS WITH FAMILIAL NORMAL PRESSURE HYDROCEPHALUS (HAKIM'S SYNDROME)

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is a chronic, progressive disorder of uncertain etiology and pathogenesis. Diagnosis currently hinges on clinical improvement following cerebrospinal fluid (CSF) shunting, as no specific genetic markers or reliable biomarkers have been identified to date. Although traditionally considered sporadic, emerging evidence suggests potential familial aggregation. This report presents two siblings with NPH, underscoring striking similarities in clinical presentation, disease progression, and therapeutic response, thereby supporting a possible familial component.

METHODS: Demographic information, detailed family history, and comprehensive pre- and post-CSF tap test studies were done (including gait, cognitive, and urinary assessments). Multidisciplinary evaluations by neurosurgery, neuroradiology, neuropsychology, neurology, geriatrics, psychiatry, and urology were performed. No additional family members had a confirmed diagnosis of NPH.

RESULTS: Both siblings presented in their eighth decade of life with the classic NPH triad: cognitive decline, gait disturbance, and urinary incontinence. Neurocognitive symptoms consisted of episodic forgetfulness and spatial disorientation, progressing to behavioral abnormalities and loss of autonomy. Gait disturbances were characterized by magnetic gait, bradykinesia, and recurrent falls. Urinary dysfunction evolved from urge incontinence to complete urinary loss. Neuroimaging revealed congruent findings in both patients, including an Evans Index of approximately 0.40, ventriculomegaly, periventricular white matter hyperintensities, and narrowed high convexities. Post-CSF tap test follow-up demonstrated substantial clinical improvement across cognitive, motor, and urinary domains, as documented through clinical examination and caregiver reports. Shunting was indicated in both cases, follow up continues. No secondary NPH causes were identified.

CONCLUSIONS: These cases reinforce the hypothesis of a heritable predisposition to NPH, potentially exhibiting an autosomal dominant inheritance pattern. Although familial clusters have been previously reported, larger cohort studies are needed to delineate the genetic and environmental contributions to pathogenesis. Confirming heritability could significantly enhance early detection strategies and deepen the etiological understanding of this syndrome.

FROM CURE TO CONTROL: REDEFINING SUCCESS IN NORMAL PRESSURE HYDROCEPHALUS MANAGEMENT

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INTRODUCTION: In published case series evaluating shunt outcomes for normal pressure hydrocephalus (NPH), a positive result is typically defined as clinical improvement from baseline. Similarly, prognostic studies have used improvement following tests as a criterion to proceed with shunt insertion. In the European iNPH Multicentre Study, all patients with clinical and radiological diagnoses of NPH received shunt implantation. At 12 months, outcomes followed a normal distribution: approximately 25% of patients showed no improvement, but also no deterioration. This raises the question of whether shunting in these patients may have had a protective effect, slowing or preventing further neurological decline.

METHODS: We conducted a single-centre retrospective case series. A local database was searched for patients with suspected NPH who showed no objective or subjective improvement in walking speed following extended lumbar drainage (LD-negative). Outcomes at one year were assessed based on survival and changes in gait and balance.

RESULTS: Most LD-negative patients who did not receive a shunt died within one year. Eight LD-negative patients underwent shunt insertion; all were alive at one year, and four demonstrated clinical improvement. Risk of complications from lumbar drainage was similar to that of shunt insertion.

CONCLUSIONS: In idiopathic NPH (Hakim's disease), shunt benefit may follow a normal distribution—ranging from clear symptom improvement to stabilization or slowing of neurological decline. This spectrum should be considered when designing future studies assessing need for prognostic tests use, shunt insertion indications and postoperative outcomes.

MATERNAL-CHILD CHARACTERISTICS AT BIRTH AND CONGENITAL HYDROCEPHALUS: A POPULATION-BASED CASE-CONTROL STUDY

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INTRODUCTION: Congenital hydrocephalus (CH), marked by cerebrospinal fluid accumulation in the brain's ventricles, lacks well-defined risk factors. This study investigates maternal-infant factors linked to CH in Brazilian live births (2021–2023).

METHODS: A case-control study analyzed microdata from Brazil's Live Birth Information System. Cases (CH, ICD-10 Q03; *n*=1,046) were compared with frequency-matched controls (*n*=4,184; 1:4 ratio) by maternal age and gestational week. Variables included maternal (marital status, education, occupation, pregnancy type, fetal losses/abortions) and perinatal factors (birth weight, prenatal visits, delivery type, sex). Logistic regression (OR, 95% CI) and chi-square tests (Python) were used. Public, anonymized data exempted from ethics review per Resolution 510/2016.

RESULTS: Significant associations (*p* < 0.05) emerged for prenatal visits, maternal occupation, marital status, pregnancy/delivery type, education, and fetal losses. Higher CH odds occurred with: ≥3 fetal losses (OR=1.88, *p*=0.028); beauty/domestic/food occupations (OR>1, *p*<0.05); and single pregnancies (OR=1.81, *p*=0.002). Vaginal delivery (OR=0.18, *p*<0.001) and college education (OR=0.53, *p*=0.002) reduced odds. Each additional fetal loss raised odds by 16% (*p*=0.003), while birth weight had no effect. Prenatal visits were protective (7+ visits: OR=0.51, *p*<0.05 vs. 1–3 visits).

CONCLUSIONS: Multiple fetal losses strongly correlated with CH. Higher-risk occupations and lower education suggested socioeconomic influences. Cesarean overuse in CH cases likely explained the apparent vaginal delivery "protection." Increased prenatal care significantly reduced risk, underscoring its preventive potential. Findings highlight modifiable factors (e.g., prenatal access) and socioeconomic disparities in CH risk.

MOLECULAR GENETICS AS A TOOL FOR PERSONALISED TREATMENT OF HYDROCEPHALUS

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INTRODUCTION: The rapidly expanding understanding of molecular genetic aetiologies of hydrocephalus, including brain ciliopathies, holds an important diagnostic potential ultimately enabling personalised treatment.

METHODS: A total of 47 paediatric patients of primary and secondary subtypes and their biological parents were whole-exome sequenced based on DNA from whole-blood samples. The trios were screened for likely pathogenic variants in currently known hydrocephalus and cilia-associated genes. Genetic findings were combined with information on radiological findings, comorbidities, and retrospective information on the response to surgical treatment/valve adjustments.

RESULTS: The available preliminary results revealed significant, but highly heterogenic, genetic predispositions to hydrocephalus and contributed to a better understanding of specific molecular disease mechanisms in individual cases. This is exemplified by a patient, who at an age of 6 months presented with hydrocephalus, symptoms of elevated intracranial pressure (ICP) and delayed motoric development. CTC and MRC showed mild hydrocephalus, otherwise no abnormal findings. After insertion of a VP-shunt with a low-pressure valve, symptoms of elevated ICP were relieved, yet the frontal horn of the right lateral ventricle collapsed and persistent irritative symptoms and hyperarousal was observed. After insertion of an adjustable valve, multiple upregulations of valve resistance, attempting to treat what was interpreted as overdrainage, resulted in worsening of symptoms. An MRI-scan at age 4 years revealed frontotemporal polymicrogyria. The genetic analysis disclosed the diagnosis; mTOR-related megaloecephalopathy with hydrocephalus, which changed the treatment strategy into downregulation of valve resistance. Furthermore, the patient could be offered experimental adjuvating treatment with the mTOR-inhibitor, rapamycin.

CONCLUSIONS: As illustrated above, understanding the specific molecular genetic mechanism of hydrocephalus in individual patients is an important diagnostic adjunct that may aid in establishing the correct diagnosis, explain additional neurological symptoms that cannot be assigned to hydrocephalus or shunt treatment, and enable a personalised treatment strategy.

Patient Consent: The patient has provided their consent for the publication of this abstract.

HEAD CIRCUMFERENCE IN HYDROCEPHALIC CHILDREN: DIFFERENTIAL PRESSURE VALVE VERSUS ANTI SIPHON DEVICES

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INTRODUCTION: Head circumference (HC) is occasionally reduced in shunted children with shunted hydrocephalus during infancy, thus developing microcephalus. It is believed to be due to. The use of anti-siphon devices is known to significantly reduce the rate of overdrainage. If this may protect infants from microcephalic development is not yet investigated.

METHODS: This retrospective study involved all children from our hospital who were treated with a CSF shunt within the first 6 months of life from 1 January 1990 to 31 December 2015. The development of the HC during their first six years of life was documented as well as the etiology of the hydrocephalus and the valve type used. Patient's gender, weight and height, shunt revision rate, the extent of lost brain tissue, and the severity of disability were also collected.

RESULTS: Sixty-two children were eligible for the study. Thirty-four children were treated with differential pressure valves, and twenty-eight children with anti-siphon devices. The comparison of HC between shunt treated patients and the normal population showed significantly smaller heads only in boys regardless of the used valve type. HC was mainly influenced by weight and height as well as by the loss of brain tissue and the severity of disability. The smaller and slimmer the children and the worse cerebral tissue loss and disability was, the smaller were their heads. In this cohort boys were more severely affected neurologically and in general development compared to girls

CONCLUSIONS: The development of the HC in hydrocephalic children is influenced by the general and neurological development of the entire child and not by the use of a certain valve type. Developmentally and growth retarded children experience smaller heads than their less affected counterparts. Furthermore, boys are prone to a more severe course and hence stay with growth restriction and smaller heads.

IMPLEMENTATION OF CSF FLOW MRI IN THE MANAGEMENT OF PEDIATRIC HYDROCEPHALUS IN IVORY COAST

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INTRODUCTION: Hydrocephalus is the most commonly treated condition in pediatric neurosurgery. It affects 3-5/1000 live births in Europe, mainly due to cerebral hemorrhage. In Africa incidence of hydrocephalus is much more important and mainly due to infection often with macrocephaly. Cerebral hemo-hydrodynamics in pediatrics is not well known but should help to better identify CSF blockage. Such information could improve the surgeon treatment. Phase contrast (PC-MRI) is the unique noninvasive technique to quantify neurofluids flows. The objective of our project is to implement PCMRI in Ivory Coast to improve management of specific African pediatric hydrocephalus.

METHODS: We added PCMRI scans in sixteen hydrocephalic children aged from 3 months to 12 years, with a mean age of 37 ± 35 months. The main symptoms were macrocephaly (9 patients) and delayed psychomotor development. CSF flows dynamic synchronized on cardiac cycle were studied in the aqueduct and cervical spaces to calculate CSF stroke volume and evaluate potential alteration of CSF circulation between the CSF cranio spinal compartments.

RESULTS: children presented triventricular hydrocephalus ($n=4$) or tetraventricular hydrocephalus ($n=12$) 4 of them with anomaly of the posterior cerebral fossa. 10 children presented perinatal infections. Stroke volumes were very different among the patients. Between 0 and 280 micro liter for the aqueduct and between 30 and 440 microliter for the spinal canal. No correlation was observed between the two levels. 6 patients presented restrictions of the CSF oscillations in the aqueduct and 3 in the spinal canal. It was not shown by traditional morphological imaging.

CONCLUSIONS: We quantified CSF flows dynamics in the first months of life of hydrocephalus children. We have shown that Hydrocephalus following infection in children modified CSF circulation in different manners and different locations. This is a promising project that has never been carried out in our African context.

NEURAL TUBE DEFECTS, HYDROCEPHALUS, AND ASSOCIATED CENTRAL NERVOUS SYSTEM MALFORMATIONS: A NATIONWIDE ECOLOGICAL STUDY IN LATIN AMERICA

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INTRODUCTION: Neural tube defects (NTDs) are a major contributor to lifelong disability, elevated healthcare costs, and perinatal and infant mortality. While the global prevalence of NTDs is estimated at 20 cases per 10,000 births, most data originate from high-income countries. In Latin America, rates of 8.13 per 10,000 births have been reported. Despite regional epidemiological efforts, nationwide prevalence data for NTDs in Colombia remain limited.

METHODS: This study aimed to estimate the prevalence of NTDs and associated congenital CNS anomalies in the Colombian pediatric population (0–17 years) between 2017 and 2023, with stratification by subtype and geographic distribution. Data were extracted from the national Individual Registry of Health Services Provision (RIPS) using ICD-10 codes and processed against official population statistics.

RESULTS: A total of 67,715 cases were identified, yielding a crude prevalence of 6.86 per 10,000 individuals under 18 years. Adjusting for an estimated underreporting rate of 7.2%, the corrected prevalence was 7.39 per 10,000. Cases occurred in 47.74% of females and 50.95% of males. Hydrocephalus was present in 24.4% of all cases (n=16,490). Diagnostic subtypes included CNS malformations (63.5%, n=43,000), NTDs (19.3%, n=13,075), and congenital hydrocephalus (17.2%, n=11,640). Among NTDs, 88.6% were attributed to spina bifida (n=11,580), with 37.1% of these complicated by hydrocephalus (n=4,850).

CONCLUSIONS: NTDs and associated CNS malformations impose a significant burden on the pediatric population. Hydrocephalus emerges as a critical comorbidity. These findings highlight the urgent need for enhanced surveillance, targeted prevention strategies—including folic acid supplementation, large-scale food fortification—and expanded access to pediatric neurosurgical care. Strengthening national registries will be essential for effective public health interventions.

SHUNT REVISION AND LONG-TERM DURABILITY IN HYDROCEPHALUS: INSIGHTS FROM 589 PATIENTS

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INTRODUCTION: Shunt surgery is a cornerstone in the treatment of hydrocephalus, yet shunt failure remains a common and clinically significant complication. While shunting can lead to significant improvements, a substantial proportion of patients experience shunt-related complications or treatment failure. Shunt failure remains a barrier to long-term treatment success. Therefore, understanding the incidence and causes of shunt failure is essential for optimizing surgical outcomes. This study aimed to assess patterns of shunt failure, revision timing, and overall shunt durability in a cohort of patients treated at Odense University Hospital, OUH, Denmark.

METHODS: We conducted a retrospective cohort study of patients who underwent shunt surgery at OUH in the period 2007-2017. Clinical data were recorded in a database at the time of primary shunt implantation and at each subsequent shunt revision. Variables included patient demographics, shunt type, timing and indication for revision, and type of shunt failure.

RESULTS: 585 patients underwent shunt surgery across ten different clinical indications, with INPH and secondary hydrocephalus following SAH accounting for 52% of the cohort. Of all patients, 189 (32.1%) experienced at least one shunt revision during follow-up. The median time to first shunt revision was 111 days. When considering overall shunt durability, including revision, death, or end of follow-up, the median event-free survival time was 5825 days. Notably, there was significant variation across diagnoses. Furthermore, there was a significant difference in durability between shunt types.

CONCLUSION: Shunt failure remains a frequent occurrence following CSF shunt surgery. While overall shunt durability appears favorable in the long term, the risk and timing of revision vary substantially between diagnostic groups. Particularly, patients with IIH demonstrate markedly shorter event-free survival. These findings highlight the need for diagnosis-specific follow-up strategies.

ENDOSCOPIC THIRD VENTRICULOSTOMY VS VENTRICULOPERITONEAL SHUNT FOR INPH: EFFECTS ON NEUROPSYCHOLOGICAL AND MOTOR FUNCTION—ENVENTOR-INPH: STUDY PROTOCOL

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INTRODUCTION: Idiopathic Normal Pressure Hydrocephalus (iNPH) is a progressive neurological disorder characterized by cognitive decline, gait disturbances, and urinary incontinence. Surgical interventions, including Ventriculoperitoneal Shunt (VPS) and Endoscopic Third Ventriculostomy (ETV), are the primary treatment options. While VPS is the standard of care, ETV offers a minimally invasive alternative with potentially fewer complications. However, comparative evidence on their impact on cognitive, motor, and structural outcomes remains limited.

METHODS: This protocol is designed as a multicenter, randomized, controlled trial to compare the effects of ETV and VPS in iNPH patients. The study will enroll 100 patients, randomly assigned to undergo ETV (n = 50) or VPS (n = 50). The protocol is structured to enable future large-scale multicenter studies. Assessments will include cognitive and motor function evaluations, quality-of-life metrics, and advanced neuroimaging (MRI with flowmetry, Diffusion Tensor Imaging [DTI]). Functional outcomes will be further assessed using navigated transcranial magnetic stimulation (nTMS). Data collection will occur preoperatively and at 1 week, 3 months, 6 months, and 12 months postoperatively.

RESULTS: Primary outcomes include cognitive and motor function improvements. Secondary endpoints are surgical complications, hospital stay duration, and changes in quality of life. Neuroimaging will assess changes in white matter integrity and cerebrospinal fluid dynamics, while nTMS will provide insights into neuroplasticity and motor pathway recovery. ETV is expected to demonstrate comparable or superior outcomes with fewer complications compared to VPS.

CONCLUSION: This protocol establishes the framework for a comprehensive, multicenter study comparing ETV and VPS in iNPH patients. Findings from this initial study will inform the design of larger-scale multicenter trials, guide clinical decision-making, and potentially position ETV as a preferred treatment option for eligible patients.

DEVELOPMENT OF A NEW GAIT RATING TOOL FOR PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a neurodegenerative condition with gait characteristics often overlapping other conditions and normal aging. Increasing prevalence and limitations of current subjective, specialist center-based diagnostic methods necessitate more accessible and reliable approaches. We therefore propose development and validation of a standardized video-based assessment tool for identifying iNPH-specific gait patterns and outcomes after intervention, offering a cost-effective solution for widespread telemedicine use to improve early diagnosis and treatment pathways.

METHODS: This study employs a three-phase design. **Tool Development:** Existing videos and corresponding 3D motion-capture data from confirmed iNPH patients and age-matched healthy controls will be analyzed to extract objective features indicative of iNPH gait. These features will form the basis of observer criteria, evaluated for diagnostic sensitivity and responsiveness to pre- to post-CSF tap-test changes and for comparisons with a group of age-matched healthy controls. The tool will be iteratively refined through consultation with experienced physiotherapists. **Data Collection:** Additional iNPH participants from two clinical sites will undergo video-recorded gait assessments before and after shunt surgery alongside standard clinical evaluations to enhance the tool's robustness across settings. **Validation and Reliability Testing:** A panel of physiotherapists will review the videos using the developed tool. Inter-/intra-rater reliability will be assessed.

RESULTS: The project anticipates the development of a video-based assessment tool with demonstrated validity against objective motion capture data and high inter- and intra-rater reliability. The tool is expected to exhibit strong diagnostic sensitivity in distinguishing iNPH gait from healthy controls and reflect changes post-CSF tap-test. The iterative refinement process, incorporating physiotherapist feedback, will ensure the tool's clinical usability and relevance.

CONCLUSIONS: When validated, this video-based tool may offer a significant advancement over current subjective methods for assessing iNPH gait with potential to improve early and accurate diagnosis, streamline referrals, facilitate timely interventions, and ultimately enhance patient outcome.

NON-INVASIVE ICP WAVEFORM ANALYSIS IN HYDROCEPHALUS: COMPARING ASYMPTOMATIC PATIENTS AND THOSE WITH SHUNT DYSFUNCTION

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INTRODUCTION: Accurate identification of shunt malfunction in patients with hydrocephalus is essential, as malfunctions can result in a broad spectrum of clinical manifestations. Given the diagnostic challenges, this study aimed to evaluate the utility of non-invasive intracranial pressure waveform (nICPw) monitoring by comparing $\Delta P2/P1$ ratios between asymptomatic shunt patients and those presenting with shunt dysfunction, including both underdrainage and overdrainage.

METHODS: We prospectively monitored patients with suspected shunt dysfunction alongside asymptomatic individuals using a non-invasive nICPw device. The $\Delta P2/P1$ ratio—reflecting intracranial compliance—was measured in three positions: supine, 30-degree head elevation, and standing. We compared average values across the three groups using the Kruskal-Wallis test, a non-parametric alternative to ANOVA suitable for non-normally distributed data. To determine specific between-group differences, we conducted pairwise Wilcoxon rank-sum tests with Holm correction to control for multiple comparisons.

RESULTS: A total of 35 patients were included: Overdrainage ($n = 8$), Underdrainage ($n = 8$), and Asymptomatic ($n = 19$). Overall, there was a statistically significant difference in $\Delta P2/P1$ values among the groups (Kruskal-Wallis $H = 11.04$, $p = 0.004$). Patients with overdrainage demonstrated significantly higher $\Delta P2/P1$ values (mean 0.611 , $SD = 0.210$) compared to asymptomatic patients (mean 0.227 , $SD = 0.171$) ($p = 0.0024$). Additionally, significant differences were observed in the $P2/P1$ ratio between asymptomatic patients and those with dysfunction in the supine ($p = 0.0489$) and 30-degree ($p = 0.0269$) positions. However, comparisons between Underdrainage and Asymptomatic, and between Overdrainage and Underdrainage, did not reach statistical significance.

CONCLUSION: Our findings suggest that non-invasive ICP waveform monitoring can reliably distinguish asymptomatic hydrocephalus patients from those with shunt malfunction, particularly in cases of overdrainage. This method holds promise as a supplementary diagnostic tool that could reduce the need for invasive procedures and improve clinical decision-making.

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PATIENT OUTCOMES AND CHALLENGES IN HYDROCEPHALUS MANAGEMENT: A KENYAN PERSPECTIVE

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INTRODUCTION: Hydrocephalus is a complex neurological disorder characterized by cerebrospinal fluid (CSF) accumulation, leading to increased intracranial pressure and potential neurological impairment. While advancements in diagnosis and treatment have been made, significant gaps and controversies persist. This study aims to explore the experiences and outcomes of patients who have undergone hydrocephalus treatment, focusing on surgical advancements, post-operative challenges, and long-term management strategies.

METHODS: This research will involve a prospective and retrospective study of patients who have undergone hydrocephalus treatment, including shunt placement and endoscopic third ventriculostomy (ETV). Data will be collected through patient medical records, structured interviews, and follow-up assessments to evaluate treatment outcomes, complication rates, quality of life, and patient-reported experiences. The study will also analyze factors influencing treatment success, including age, type of procedure, and access to post-operative care.

RESULTS: The expected findings will provide insights into patient recovery patterns, shunt failure and revision rates, and the effectiveness of ETV compared to shunting. The study will highlight key factors contributing to treatment success or failure and assess disparities in healthcare access affecting patient outcomes. Additionally, it will explore patient-reported challenges, including post-operative complications, neurocognitive impacts, and quality of life considerations.

CONCLUSIONS: This study will offer a patient-centered perspective on hydrocephalus management, addressing both progress and ongoing challenges in treatment. By identifying factors that influence long-term outcomes, the findings will help inform clinical decision-making, improve patient care protocols, and highlight areas where further research and healthcare policy adjustments are needed to enhance treatment success and quality of life for individuals with hydrocephalus.

AN ARTIFICIAL NEURAL NETWORK MODEL FOR THE DIAGNOSIS AND MANAGEMENT OF HYDROCEPHALUS

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INTRODUCTION: The diagnosis of hydrocephalus primarily relies on imaging findings, yet the interpretation of these indicators can vary, particularly in degenerative diseases, potentially leading to misdiagnosis.

METHODS: This study investigated the utility of common morphological parameters and typical radiographic findings in the diagnosis of hydrocephalus. Patient imaging data were categorized into three groups: hydrocephalus, symptomatic, and normal control. Multiple machine learning methods were employed to compare the diagnostic accuracy and importance of various parameters across these groups.

RESULTS: Our findings revealed that Evans' ratio is the most valuable diagnostic indicator when comparing the hydrocephalus group to the normal control group. However, the frontal horns' ratio proves more useful in diagnosing symptomatic patients. Additionally, the presence of a disproportionately enlarged subarachnoid space and third ventricle enlargement emerged as effective diagnostic indicators across all groups.

CONCLUSIONS: Both morphometric parameters and radiological features play crucial roles in the diagnosis of hydrocephalus, although their importance may vary depending on the clinical context. Machine learning approaches can be leveraged to optimize the diagnosis of other diseases and to continually refine clinical diagnostic criteria.

SIMPLIFIED LUMBOPERITONEAL SHUNT SURGERY USING TWO SMALL SKIN INCISIONS

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BACKGROUND: Lumboperitoneal shunt (LPS) is an extracranial cerebrospinal fluid diversion procedure that minimizes intracranial complications. Despite advancements in valve technology addressing issues such as overdrainage and frequent revisions, many neurosurgeons remain hesitant to adopt LPS due to unfamiliarity with the technique and its perceived complexity.

METHODS: LPS surgery requires a lumbar puncture and is typically initiated with the patient in the lateral decubitus position. However, conventional techniques often necessitate repositioning for a periumbilical laparotomy, which can be particularly cumbersome in obese patients, prolonging surgery and increasing procedural complexity and risk.

To simplify LPS, we modified the surgical approach by shifting the peritoneal catheter insertion site from the anterior to the lateral side of the trunk. This modification allows the entire procedure to be performed in a single stage, eliminating the need for patient repositioning or significant bed tilting. Additionally, the lateral approach provides a shallower surgical field by utilizing the natural gravitational shift of abdominal fat in the lateral position.

The Institutional Ethics Committee approved this study. Written informed consent was obtained from all participants and their first-degree relatives.

RESULTS & CONCLUSION: Our modified LPS technique enhances procedural efficiency, reduces operative time, and improves surgical safety. By streamlining the approach with minimal incisions and avoiding unnecessary repositioning, this technique may promote wider adoption of LPS among neurosurgeons.

Patient Consent: The patient has provided their consent for the publication of this abstract.

REVERSIBLE MIMIC OF NORMAL PRESSURE HYDROCEPHALUS: A CASE HIGHLIGHTING THE NEED FOR CAREFUL PRE-SHUNT ASSESSMENT

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INTRODUCTION: Cerebrospinal fluid (CSF) diversion via shunt placement is considered the definitive treatment for normal pressure hydrocephalus (NPH). However, given the short and long-term risks associated with shunting, it is crucial to evaluate for conditions that can mimic or co-exist with NPH before proceeding with surgery.

CASE DESCRIPTION: We report the case of a 78-year-old male with a six-year history of progressive gait disturbance, cognitive decline (Addenbrooke's Cognitive Examination-III 82/100), and urinary incontinence—fulfilling the classic triad of NPH. He was wheelchair-using at presentation. The patient's medication history revealed chronic use of valproic acid (VA) 500mg BD for epilepsy over five years and Co-careldopa for a presumed diagnosis of Parkinson's disease (PD) over three years. Neurological examination revealed a slow magnetic gait, difficulty turning and reduced arm swing bilaterally. There was an asymmetric rest and postural tremor with mild rigidity and bradykinesia but normal eye movements. A CT scan demonstrated radiological features suggestive of NPH (Radscale score 10). Lamotrigine was initiated while VA was gradually tapered and discontinued. A dopamine transporter (DaT) scan ruled out PD, leading to the cessation of antiparkinsonian medication. Six months after discontinuing VA, the patient demonstrated dramatic improvement in gait, regaining independent ambulation, with both the patient and family reporting significant cognitive recovery (ACE-III 88/100).

CONCLUSIONS: This case highlights the importance of recognizing reversible NPH mimics, such as VA-induced parkinsonism and cognitive impairment, before considering CSF diversion surgery. A thorough review of medication history and evaluation for alternative diagnoses, ideally using a multidisciplinary approach, is essential. Given the imaging findings, close follow-up is warranted to monitor for potential progression to symptomatic NPH that may eventually require shunt placement.

Patient Consent: The patient has provided their consent for the publication of this abstract.

VENTRICULOPERITONEAL SHUNT INFECTION IN PEDIATRIC PATIENTS – A BIBLIOMETRIC ANALYSIS

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INTRODUCTION: Ventriculoperitoneal (VP) shunt infection remains one of the most serious and potentially life-threatening complications associated with procedures in the treatment of hydrocephalus. Research on strategies to prevent infections during VP shunt procedures continues to evolve, focusing on various methods to prevent the risk of infection. However, there is still a gap in landscape research in this field. This study aims to gather comprehensive data on the worldwide scientific research trend concerning VP shunt infections in pediatric patients by conducting a bibliometric analysis.

METHODS: Extraction data retrieved from Scopus were extracted and downloaded in "BibTeX and CSV" format with "all information" for further bibliometric analysis.

RESULTS: A total of 773 literature were included in the study for bibliometric analysis. There has been an increasing trend in publications related to VP shunt infection in pediatrics, with an annual growth rate of 5.57%. Child's Nervous System was the top performer in terms of productivity. Kestle JRW is ranked as the most prolific author and cited publication, and the United States is the most productive country. From 1990 until 1996, the most frequently cited terms in academic literature were "antibiotic prophylaxis," "prevention," "neonate," and "infections." By 2022, the focus shifted markedly towards "csf," "neuroendoscopy," "shunt failure," "vps," and "ventriculoatrial shunt".

CONCLUSIONS: This study provides a comprehensive overview of current research trends on VP shunt infections. The dataset presented can be utilized by academics and researchers worldwide to help expand scientific work and future research directions, mainly to prevent and treat VP shunt infection.

A PRAGMATIC DIAGNOSTIC PATHWAY FOR INPH PATIENTS : INTEGRATING GERIATRIC AND HYDRODYNAMIC ASSESSMENT IN A TERRITORIAL HOSPITAL

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (INPH) is a reversible cause of gait disturbance, cognitive decline, and urinary incontinence in older adults. It remains underdiagnosed, particularly in small and mid-sized territorial hospitals, due to symptom overlap with other neurodegenerative conditions and limited access to specialized assessment tools. We present a pragmatic and easily implementable diagnostic protocol combining geriatric and cerebral hydrodynamic assessments in a real-world geriatric hospital setting.

METHODS: Patients over 65 presenting with at least one core symptom underwent a standardized diagnostic pathway. This included brain imaging (MRI or CT) with Evans Index and callosal angle measurements, a comprehensive geriatric or neurological assessment focusing on frailty and autonomy, and lumbar infusion testing to quantify cerebrospinal fluid (CSF) outflow resistance. Multidisciplinary meetings determined shunt candidacy based on clinical findings and CSF hydrodynamic profiles.

RESULTS: Over 18 months, 34 patients were evaluated. Sixteen (47%) had elevated CSF outflow resistance (>12 mmHg/ml/min). Six underwent shunting, with significant improvement in gait and/or continence observed at 6-month follow-up. Four patients are awaiting a final decision on surgery. Five had clinical features suggestive of degenerative disease but normal CSF dynamics. Ten patients (30%) showed vascular lesions with variable CSF resistance. Cognitive outcomes were heterogeneous, reflecting underlying comorbidities. No major complications were reported.

CONCLUSIONS: This geriatric-centered approach enhances diagnostic accuracy and patient selection for shunting in INPH. Its simplicity, minimal resource demands, and adaptability make it highly transferable to local hospitals. By reaching patients often left undiagnosed and untreated in their own communities, the protocol strengthens care equity, fosters interdisciplinary collaboration, and promotes autonomy-driven, patient-centered outcomes for vulnerable aging populations.

THE ROLE OF HYDRODYNAMIC TESTING IN THE DIAGNOSTIC WORKUP OF 3 OLDER PATIENTS WITH SUSPECTED INPH: A CASE SERIES

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a potentially reversible cause of gait and cognitive impairment in older population. Its diagnosis is challenging due to symptomatic, radiological overlap with neurodegenerative conditions. Traditionally defined by clinical triad and ventricular enlargement, iNPH is increasingly recognized as disorder of altered CSF dynamics. In this context, resistance to CSF outflow (Rout), measurable via lumbar infusion testing (LIT), emerges as a mechanistic biomarker, directly reflecting impaired CSF resorption and the core pathophysiological hallmark of the disease.

METHODS: Three elderly patients with suspected iNPH underwent MRI, neuropsychological, geriatric assessments, tap tests, and CSF hydrodynamic evaluation via LIT to measure Rout.

RESULTS: Case 1 : A 65-year-old male with bipolar disorder and progressive gait disturbance had inconclusive tap tests despite worsening symptoms. LIT revealed elevated Rout, and endoscopic third ventriculostomy resulted in marked functional improvement. Case 2 : A 75-year-old male presented with gait imbalance. While imaging showed ventriculomegaly, mild benefit of tap test, but LIT showed normal Rout. Subsequent clinical deterioration and dopaminergic imaging led to diagnosis of multiple system atrophy. Case 3 : A 78-year-old male with depressive history and subacute cognitive and gait decline showed borderline ventriculomegaly and hippocampal atrophy on MRI. Biomarker studies for Alzheimer's and Parkinson's diseases were negative. Elevated Rout confirmed impaired CSF outflow, supporting the diagnosis of iNPH.

CONCLUSION: These cases highlight diagnostic value of measuring Rout in older patients with suspected iNPH, particularly when conventional tests are inconclusive. Rout offers a mechanistic biomarker that reflects the hallmark of altered CSF dynamics. We propose a shift from symptom-based diagnosis toward a mechanism-driven framework that incorporates hydrodynamic assessment. Despite clinical heterogeneity of iNPH and overlap with neurodegenerative diseases, integrating fluid mechanics into routine evaluation supports earlier identification of surgical candidates and more personalized care for older adults.

CORRELATION BETWEEN BLOOD-BRAIN BARRIER INTEGRITY IN CEREBROSPINAL FLUID AND VISUAL RATING SCALE ON BRAIN MRI IN PATIENTS WITH HYDROCEPHALUS

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INTRODUCTION: The blood-brain barrier (BBB) regulates molecular transport between the peripheral circulation and the central nervous system. Disruption of the BBB is increasingly recognized as a contributor to neurodegeneration. This study examined the association between cerebrospinal fluid (CSF) BBB index and brain structural changes, assessed by the comprehensive visual rating scale (CVRS) on MRI, in patients with hydrocephalus and dementia.

METHODS: Forty-six patients (20 males, 26 females) were included. The mean age was 71.4 ± 11.9 years; education, 10.5 ± 5.4 years. Mean MMSE was 18.8 ± 8.3 , CDR 1.0 ± 0.7 , and CDR-SB 6.0 ± 4.8 . BBB integrity was assessed using the CSF/serum albumin ratio. Structural ventricular markers—Evans Index and Callosal Angle—were measured. The CVRS (range 0–30) included ratings for hippocampal atrophy, cortical atrophy, ventricular enlargement, and small vessel disease. Correlation analyses assessed associations between the BBB index, CVRS subcomponents, and ventricular markers.

RESULTS: The BBB index correlated significantly with total CVRS ($r = 0.456$, $p = 0.001$), hippocampal atrophy ($r = 0.431$, $p = 0.003$), cortical atrophy ($r = 0.428$, $p = 0.024$), and ventricular enlargement ($r = 0.484$, $p < 0.001$). No significant associations were found with PVH ($r = 0.258$, $p = 0.091$), DWMH ($r = 0.111$, $p = 0.475$), lacunes ($r = 0.166$, $p = 0.282$), or microbleeds ($r = 0.292$, $p = 0.054$). The BBB index was associated with the Evans Index ($r = 0.365$, $p = 0.021$), but not with Callosal Angle ($r = -0.116$, $p = 0.475$).

CONCLUSIONS: CSF-based BBB disruption is linked to greater structural brain abnormalities in hydrocephalus and dementia. These findings support further longitudinal and AI-based studies to predict BBB dysfunction using neuroimaging biomarkers.

Patient Consent: The patient has provided their consent for the publication of this abstract.

BATTLING THE BUGS: WHAT WORKS BEST FOR TREATING VP SHUNT INFECTIONS IN HYDROCEPHALUS? - A META-ANALYSIS

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INTRODUCTION: Shunt infections are among the most serious complications in hydrocephalus management. Therapeutic strategies following a shunt infection vary widely, and there is limited consensus regarding the most effective approach. This meta-analysis aims to evaluate outcomes associated with different treatment modalities for shunt infections.

METHODS: A comprehensive literature search was performed in compliance with PRISMA standards across MEDLINE, Scopus, Embase, Cochrane, and Web of Science. We included studies reporting outcomes of three strategies: (1) antibiotics alone (AO), (2) antibiotics with shunt removal (ASR), and (3) antibiotics with shunt removal followed by shunt replacement (ASRSR). The primary outcome was mortality. Secondly, we analyzed treatment failure—defined as reinfection or shunt malfunction.

RESULTS: Twenty-eight studies met inclusion criteria, encompassing 440 patients in the AO group, 244 in the ASR group, and 628 in the ASRSR group. When comparing AO versus ASR, mortality was significantly higher in the AO group (OR=3.342; 95% CI: 0.650–∞; $p<0.001$). A similar finding was observed when comparing AO versus ASRSR (OR=4.866; 95% CI: 0.997–∞; $p<0.001$). No significant difference in mortality was found between surgical strategies (OR=0.686; 95% CI: –1.257 to 0.492; $p=0.420$). Regarding treatment failure, a statistically significant difference was observed between the three strategies ($\chi^2=100.241$, $p<0.001$), with the highest failure rate in the AO group. Compared to this group, both surgical approaches showed lower odds of failure: ASR (OR=0.239, 95% CI: 0.958–∞, $p<0.001$) and ASRSR (OR=0.591, 95% CI: 0.272–∞, $p<0.001$).

CONCLUSIONS: Although both surgical strategies outperformed antibiotics alone, fewer data were available regarding failure in the ASR group, which may partially explain its slightly lower failure rate compared to the ASRSR group. These findings reported more favorable outcomes with surgical approaches over conservative management

IMPACT OF ANTIBIOTIC-IMPREGNATED CATHETERS ON RESISTANT PATHOGEN PROFILES IN HYDROCEPHALUS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Antibiotic-impregnated catheters (AICs) have been increasingly adopted to prevent cerebrospinal fluid (CSF) shunt infections. However, concerns remain regarding potential shifts in microbial resistance patterns. This systematic review and meta-analysis aimed to assess the occurrence of resistant bacterial infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), gram-negative bacteria (GNB), and non-staphylococcal species, in patients undergoing shunting with AICs versus standard catheters.

METHODS: A systematic search was conducted in MEDLINE, Cochrane Library, Scopus, and Embase. The review followed PRISMA guidelines and included 22 studies encompassing 12,055 procedures. Comparative and proportional meta-analyses were performed using random-effects models, evaluating the relative risk (RR), risk difference (RD), and pooled proportions for key resistant pathogens. Random-effects models were applied where appropriate to account for inter-study variability.

RESULTS: AICs were associated with a significantly reduced risk of infection by gram-negative bacteria (RR=0.44, 95% CI: 0.27–0.70, $p=0.0006$), MRSA (RR=0.54, 95% CI: 0.30–0.97, $p=0.04$), and non-staphylococcal organisms (RR=0.67, 95% CI: 0.47–0.96, $p=0.03$) when compared to conventional catheters. No significant difference was observed in the rate of documented multidrug-resistant infections (RR=0.88, 95% CI: 0.50–1.57, $p=0.67$). Although the overall infection rate was lower with AICs, the relative proportion of non-staphylococcal infections among total infections was higher in the AIC group (33% vs 25%). This was further supported by the risk difference analysis between the two groups (RD=0.12, 95% CI: 0.03–0.22, $p=0.01$), indicating a potential shift in the microbial profile.

CONCLUSIONS: The use of AICs in CSF shunting procedures is associated with a significant reduction in infections by major resistant pathogens, including MRSA and gram-negative bacteria. However, a relative increase in non-staphylococcal infections may indicate an evolving microbial landscape, underscoring the need for surveillance and tailored prophylactic strategies. These results may support evidence-based strategies for empirical

ENDOSCOPIC THIRD VENTRICULOSTOMY VS. VENTRICULOPERITONEAL SHUNT IN POSTERIOR FOSSA TUMOR HYDROCEPHALUS: A META-ANALYSIS

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INTRODUCTION: Hydrocephalus secondary to posterior fossa tumors requires urgent intervention to mitigate intracranial hypertension. Endoscopic third ventriculostomy (ETV) restores physiological cerebrospinal fluid (CSF) dynamics, while ventriculoperitoneal shunting (VPS) is associated with chronic complications. This meta-analysis compares the efficacy and safety of ETV versus VPS, with subgroup analyses by age and tumor type.

METHODS: Following PRISMA guidelines, a systematic search was conducted across MEDLINE, Scopus, Embase, Cochrane and Web of Science. Studies comparing ETV versus VPS were included. Primary outcomes included clinical success (shunt independence at 6 months); secondary outcomes encompassed complications (hemorrhage, infection, CSF leak). Pooled risk ratios (RR), risk differences (RD), number needed to treat (NNT), and heterogeneity (I^2) were calculated using random-effects models. Publication bias was assessed via Egger's test.

RESULTS: Ten comparative studies ($n = 1,284$ patients: ETV = 559, VPS = 725) were identified. ETV demonstrated superior clinical success ($RR = 1.25$; 95% CI: 1.10–1.42; $p < 0.001$; $NNT = 8$) and a near-significant reduction in complications ($RD = -0.05$; 95% CI: -0.10 to 0.00 ; $p = 0.06$). Heterogeneity was moderate ($I^2 = 45\%$), with no significant publication bias ($p = 0.12$). Subgroup analyses revealed greater ETV efficacy in children (1–18 years: $RR = 1.40$; $p < 0.001$) and pineal/medulloblastoma tumors ($RR = 1.50$; $p = 0.001$), whereas VPS was preferable for infants (<1 year: $RR = 0.60$; $p = 0.03$). Major ETV complications included intraoperative hemorrhage (5.3%) and CSF leak (3.1%), versus VPS associated infection (9.4%) and shunt obstruction (33.9%).

CONCLUSIONS: ETV offers higher efficacy and a favorable safety profile for hydrocephalus secondary to posterior fossa tumors, particularly in pediatric patients and specific tumor types. VPS remains preferable for infants. These findings support an age and tumor tailored surgical approach. Further studies should explore sources of heterogeneity and long-term outcomes.

VALIDATION OF MRI-BASED QUANTIFICATION OF AQUEDUCTAL NET CSF FLOW IN HUMANS AS A PROXY FOR CSF PRODUCTION

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INTRODUCTION: Emerging evidence suggests that some forms of hydrocephalus may arise by a component of cerebrospinal fluid (CSF) hypersecretion. However, the lack of a reliable and validated manner to quantify CSF secretion in patients prevents delineation of the mechanisms underlying pathological CSF accumulation. Non-invasive quantification of net CSF flow through the cerebral aqueduct using phase-contrast magnetic resonance imaging (PC MRI) has been suggested as a method for estimating supratentorial CSF production, based on the hypothesis that net flow may serve as a proxy for the CSF secretion rate. In this study, we assess the reliability and validity of PC MRI-based quantification of aqueductal net CSF flow as a proxy for CSF secretion.

METHODS: Twenty-five healthy volunteers (age range 40-60 years) underwent cardiac-gated PC MRI at 3T, and a pixel-by-pixel correlation analysis was performed to estimate the net flow in the cerebral aqueduct. A repeated-measures design was utilized to determine the precision of aqueductal net flow measurements. Intravenous administration of acetazolamide, an agent previously shown to reduce CSF production, was employed in a randomized, double-blinded placebo-controlled cross-over study to examine a connection between the production rate and aqueductal net flow of CSF.

RESULTS: We will perform a statistical analysis of intra- and inter-individual variability of net CSF flow based on repeated measures of baseline values to determine the same-day and inter-day reproducibility. Moreover, we will determine the changes in net CSF flow, stroke volume and cerebral blood flow induced by acetazolamide.

CONCLUSIONS: Based on these data, we will conclude on the reliability of MRI-based measurements of net CSF flow in the cerebral aqueduct. Furthermore, we will conclude on the validity of using net CSF flow as a marker of CSF production.

SHUNT SURVIVAL OF 809 iNPH PATIENTS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a neurological disease characterized by ventriculomegaly and Hakim's triad. At present, symptoms can be alleviated only by cerebrospinal fluid (CSF) shunt surgery. Yet, various complications after shunting may occur, occasionally requiring repeated shunt revisions. In this retrospective, population-based study, our objective was to compare revision rates and causes for revision surgeries between adjustable shunt valve and fixed-pressure valves in iNPH patients.

METHODS: 1220 patients were evaluated for iNPH at Kuopio University Hospital between 1991 and 2023. INPH was diagnosed in 809 patients who received their first ventriculoperitoneal shunt (VPS). Of the patient cohort, 566 were shunted using an adjustable valve (2008-2023) and 243 received a fixed pressure valve (1991-2012). Hospital records and nationwide registries were used to construct a timeline for each patient beginning with the shunt insertion and ending until death (n=430) or the end of 2023.

RESULTS: Overall revision rate was lower in iNPH patients receiving an adjustable valve (14% vs. 30%, $p < .001$). The incidence of multiple revisions was also lower in the adjustable valve group (27% vs. 32% $p = 0.002$). The most common cause for revision was peritoneal catheter malposition in the adjustable valve group (44%) and shunt underdrainage in the fixed-pressure valve group (25%). Risk for the first revision was lower for the adjustable valves than the fixed pressure valves.

CONCLUSIONS: Adjustable shunt valves have decreased the need for shunt revision surgeries due to under- and overdrainage.

VENTRICULOPERITONEAL SHUNTING IN INPH WITH NEURODEGENERATIVE COMORBIDITIES: A META-ANALYSIS OF FUNCTIONAL OUTCOMES

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INTRODUCTION: The impact of neurodegenerative comorbidities on cerebrospinal fluid (CSF) shunting outcomes in idiopathic normal pressure hydrocephalus (iNPH) remains uncertain. This meta-analysis evaluated the effectiveness of shunt surgery in patients with iNPH and neurodegenerative diseases (complex iNPH), including subgroup analyses and associations with follow-up duration.

METHODS: Following PRISMA guidelines, a systematic search was conducted across MEDLINE, Scopus, Embase, Cochrane, and Web of Science. Studies reporting shunting outcomes in patients with iNPH and neurodegenerative disease were included. Standardized mean difference (SMD), risk ratio (RR), and odds ratio (OR) were calculated using random-effects models. Meta-regression assessed associations between follow-up and clinical response.

RESULTS: Nine studies were analyzed, comprising 302 patients (167 with pure iNPH and 135 with neurodegenerative comorbidities). In complex iNPH, shunting significantly improved gait (SMD=5.12 [0.78;9.45], $p=0.02$; $I^2=95\%$) and urinary incontinence (RR=1.81 [1.33;2.47], $p=0.0002$; $I^2=0\%$). Cognitive outcomes varied by comorbidity: Alzheimer patients showed no significant change (SMD=-0.17 [-0.94;0.59], $p=0.66$), whereas those with Parkinsonism had marked improvement (SMD=1.64 [0.95;2.33], $p<0.00001$; $I^2=0\%$). The difference between subgroups was significant ($p<0.0001$). Meta-regression in the Alzheimer subgroup suggested reduced benefit over time ($\beta=-0.0253$, $p=0.065$), possibly due to progressive neurodegeneration masking early postoperative gains. Comparison with pure iNPH showed a non-significant trend favoring higher response in the pure group (OR=0.65 [0.35;1.20], $p=0.17$).

CONCLUSIONS: Shunting is associated with meaningful clinical benefits in complex iNPH, particularly in gait and Parkinson-related cognitive function. Although patients with Alzheimer comorbidity may experience attenuated or time-limited improvements, the findings support the continued consideration of CSF diversion in carefully selected cases. These results reinforce shunting as a viable intervention despite neurodegenerative pathology and emphasize the importance of individualized strategies. Longitudinal monitoring, consideration of disease trajectory and cognitive reserve may optimize decision-making and refine patient selection. Future research should explore predictive tools and biomarker-based models to guide treatment in this heterogeneous population.

DOES PHYSICAL REHABILITATION ENHANCE GAIT RECOVERY AFTER SHUNT SURGERY IN INPH? A META-ANALYSIS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is characterized by gait disturbance, cognitive impairment, and urinary incontinence. While ventriculoperitoneal shunt (VPS) remains the standard treatment, the potential additive effect of physical rehabilitation (PR) on gait outcomes remains underexplored. This meta-analysis evaluates whether combining PR with VPS improves gait performance in iNPH patients.

METHODS: According to PRISMA guidelines, a systematic search was conducted in MEDLINE, Cochrane Library, Web of Science, Embase, and Scopus. We included studies comparing gait improvement between iNPH patients treated with VPS plus PR versus VPS alone. The primary outcome was the post-operative gait performance. Secondly, we analysed the improvement of other complications from the iNPH, which encompassed cognition and urinary incontinence. Standardized mean difference (SMD) with 95% confidence intervals was calculated using a random-effects model.

RESULTS: Six studies met the eligibility criteria, comprising 139 patients from the VPS plus PR group and 134 from the VPS-alone arm. The post-operative gait performance comparison showed a non-significant trend favoring the rehabilitation group (SMD=0.23; 95% CI -0.02 to 0.48; $p=0.07$; $I^2=0\%$). Regarding secondary outcomes, cognitive improvement was observed primarily in patients undergoing VPS, with no consistent additional benefit from adjunctive rehabilitation. Similarly, urinary incontinence improved following VPS in some cohorts, but no significant additive effect of physical rehabilitation was demonstrated. The small number of studies and variability in outcome measures limited further subgroup analyses.

CONCLUSIONS: Although not statistically significant, the combination VPS + PR in iNPH patients demonstrated a consistent trend towards greater gait improvement compared to VPS alone. The strength of the evidence is limited by the small number of studies and the heterogeneity of outcome measures. Future large-scale, standardized trials are warranted to better define the role of physical rehabilitation in optimizing post-shunt functional recovery.

COMBINING UNILATERAL BIPORTAL ENDOSCOPIC SURGERY WITH LUMBOPERITONEAL SHUNT SURGERY FOR PATIENTS WITH COEXISTING NORMAL-PRESSURE HYDROCEPHALUS AND LUMBAR SPINAL STENOSIS

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INTRODUCTION: Normal-pressure hydrocephalus (NPH) is a condition characterized by an abnormal cerebrospinal fluid (CSF) homeostasis in the brain, resulting in cognitive decline, gait disturbances, and urinary incontinence. Globally, the frequency of NPH becomes has become a major clinical concern with an increase in the elderly population. A lumboperitoneal (LP) shunt surgery is one therapeutic intervention, which diverts CSF from the brain to the peritoneal cavity to mitigate NPH symptoms. However, LP shunt surgery can be precluded by lumbar spine degeneration.

METHODS: In cases of comorbidity involving NPH and lumbar spine degeneration, the combination of unilateral biportal endoscopic (UBE) surgery, which is a minimally invasive spinal procedure, and LP shunt surgery is a new alternative. Both spinal degeneration and NPH are concurrently addressed in this approach.

RESULTS: In two cases, patients with NPH and severe lumbar spinal stenosis successfully underwent the aforementioned combined surgery, leading to marked improvement in symptoms related to both conditions, without any postoperative complications such as CSF leakage.

CONCLUSIONS: While the result are promising, the efficacy of this method warrants validation by conducting larger studies. Nonetheless, combining UBE and LP shunt surgeries could redefine treatment for elderly patients with NPH and spinal stenosis.

Patient Consent: The patient has provided their consent for the publication of this abstract.

NEUROENDOSCOPIC THIRD VENTRICULOSTOMY COMBINED WITH ENDOSCOPIC BIOPSY IN PINEAL REGION TUMORS: META-ANALYSIS OF DIAGNOSTIC YIELD AND HYDROCEPHALUS CONTROL

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INTRODUCTION: Pineal region tumors, though rare (<1% of adult intracranial neoplasms), pose significant challenges due to their deep-seated anatomy and frequent association with obstructive hydrocephalus. Neuroendoscopy offers a dual approach for biopsy and hydrocephalus management, yet comprehensive evidence on its pooled efficacy and safety remains underexplored.

METHODS: In accordance with PRISMA guidelines, a systematic search was performed across MEDLINE, Scopus, Embase, Cochrane and Web Of Science. Studies evaluating neuroendoscopic biopsy and endoscopic third ventriculostomy (ETV) were included. Inclusion criteria encompassed prospective/retrospective studies with ≥ 4 patients; exclusion criteria included non-English studies and incomplete outcome data. Meta-analysis calculated pooled rates (random-effects model) with 95% confidence (CI) and prediction intervals (PI). Heterogeneity (I^2) and publication bias (Egger's test) were assessed.

RESULTS: Twelve cohorts (489 patients; age 6–87 years; 56% male) were analyzed. Diagnostic success was 94.6% (95% CI 91.5–97.8; PI 83.6–100; $I^2=99.9\%$), with ≥ 6 biopsy samples correlating with higher accuracy. Hydrocephalus control via ETV was achieved in 96.2% (95% CI 94.2–98.3; PI 94.2–98.3; $I^2=0\%$). Transient complications included intraventricular hemorrhage (8–18%), fever (10–15%), and headache (5–7%). Permanent deficits were rare: cognitive (1%), motor (2%), and visual (1%). Procedure-related mortality was 1.8% (range 0–5%), primarily linked to vascular tumors.

CONCLUSIONS: Neuroendoscopy demonstrates high diagnostic yield and hydrocephalus control rates, with low morbidity, supporting its role as a first-line minimally invasive strategy. Standardized biopsy protocols and cautious patient selection—particularly for vascular or large (>2.5 cm) lesions—are critical to mitigate risks. Future prospective trials should address technical heterogeneity and long-term outcomes to solidify this approach as a gold standard.

PRESSURE CHALLENGES: THE JOURNEY OF IDIOPATHIC INTRACRANIAL HYPERTENSION MANAGEMENT FROM PAST TO FUTURE: A NARRATIVE REVIEW OF TREATMENT OPTIONS IN OBESITY PATIENTS

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INTRODUCTION: Idiopathic intracranial hypertension (IIH), or pseudotumor cerebri, is characterized by increased intracranial pressure (ICP), leading to symptoms such as headaches, papilledema, and vision loss, and the cerebrospinal fluid (CSF) composition remains normal. This study focuses on weight loss strategies for managing IIH, emphasizing that weight reduction is crucial for alleviating symptoms and lowering ICP.

METHODS: A narrative review was performed to investigate the relationship between weight and IIH. A systematic search was conducted across PubMed, Embase, and the Cochrane Library using the Boolean search string: Weight loss AND (pseudotumor cerebri OR idiopathic intracranial hypertension OR IIH), resulting in 269 articles. The focus was on systematic reviews that addressed weight management in IIH. Additionally, references from the included systematic reviews were manually screened for relevant studies. Ultimately, seven systematic reviews were selected for inclusion, providing detailed insights into weight-related interventions and outcomes for IIH patients.

RESULTS: Very low-energy diets (VLEDs) improve quick weight loss, but sustaining this weight loss requires support. Multicomponent interventions, combining balanced calorie deficits with exercise, are the most effective. Bariatric surgery offers significant weight loss, especially for patients with severe obesity, and leads to substantial reductions in body mass index (BMI). Non-surgical approaches remain beneficial for patients with mild obesity or unable to undergo surgery. The study also explores the potential of glucagon-like peptide-1 receptor agonist (GLP-1 RAs), such as semaglutide, which aid in weight loss and can improve headache symptoms.

CONCLUSIONS: This study highlights the importance of effective weight management in treating IIH. An integrated approach is essential for improving patient outcomes and enhancing the quality of life.

Patient Consent: The patient has provided their consent for the publication of this abstract

FACTORS INFLUENCING THE OUTCOMES OF CEREBROSPINAL FLUID TAP TEST IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (INPH) PATIENTS

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INTRODUCTION: To investigate the impact of epidemiological characteristics, clinical features, biomarkers, and cerebrospinal fluid (CSF) pressure on the outcomes of CSF tap test (TT) in patients with idiopathic normal pressure hydrocephalus (iNPH), aiming to improve the clinical diagnosis of iNPH and predict the efficacy of CSF diversion.

METHODS:A retrospective analysis was conducted on 49 patients diagnosed with probable iNPH at the Department of Neurology, Aviation General Hospital, between January 2019 and April 2024. All patients underwent a CSF tap test. Based on the results, patients were divided into a TT-positive group (n=37) and a TT-negative group (n=12). Differences between the two groups were analyzed in terms of:Epidemiological factors (age, sex, disease duration, years of education),Clinical characteristics (MMSE, MoCA, 10-meter walking test, BOON results),Imaging features (presence of DESH sign, Evans index, callosal angle),Biomarkers (total Tau, Aβ1-42, p-tau, 181p-tau/T-tau, 181p-tau/Aβ1-42), and CSF pressure parameters (opening pressure, closing pressure, and pressure difference).

RESULTS:Compared with the TT-negative group, the TT-positive group showed significantly lower levels of CSF total Tau, 181p-tau, and 181p-tau/Aβ1-42. No significant differences were observed in other variables.

CONCLUSIONS:CSF biomarkers (total Tau, 181p-tau, and 181p-tau/Aβ1-42) may influence the outcome of the CSF tap test in iNPH patients. However, whether they are independent predictors requires further validation in larger-scale studies.

	tap test-negative (n=12)	tap test-positive (n=37)	p-value
Age (years)	67.08 ± 8.45	70.22 ± 6.81	0.198
Male sex, n (%)	8 (66.7%)	24 (64.9%)	0.599
Disease duration (months)	43.50 ± 32.27	44.32 ± 37.98	0.946
Education (years)	8.83 ± 3.43	10.11 ± 3.82	0.309
MMSE	18.83 ± 6.66	20.57 ± 5.73	0.386
MoCA	11.50 [8.75, 15.00]	15.00 [10.00, 19.00]	0.169
10-meter walk time (s)	19.49 ± 12.00	21.91 ± 9.76	0.484
BOON score	19.50 ± 10.60	22.43 ± 9.31	0.364
DESH sign present, n (%)	5 (41.7%)	24 (64.9%)	0.140
Evans index	0.335 [0.313, 0.340]	0.330 [0.320, 0.350]	0.762
Callosal angle (°)	106.58 ± 24.14	98.46 ± 20.42	0.258
181p-tau (pg/ml)	43.81 [28.92, 66.00]	30.32 [23.86, 38.82]	0.018
Total Tau (pg/ml)	256.42 ± 92.85	170.58 ± 289.78	0.004
Aβ1-42 (pg/ml)	486.35 [270.19, 765.01]	594.16 [384.60, 852.93]	0.216
181p-tau/T-tau (pg/ml)	12.80 ± 8.77	59.54 ± 24.15	0.287
181p-tau/Aβ1-42	28.46 ± 23.82	10.12 ± 8.13	0.001
Opening pressure (mmH ₂ O)	137.00 [106.25, 177.00]	140.00 [120.00, 167.50]	0.521
Closing pressure (mmH ₂ O)	60.17 ± 17.72	64.73 ± 19.29	0.530
Pressure difference (mmH ₂ O)	77.50 [58.75, 99.75]	80.00 [60.00, 100.00]	0.472

Patient Consent: The patient has provided their consent for the publication of this abstract.

PREVALENCE OF ANXIETY AND DEPRESSION SYMPTOMS AMONG PATIENTS WITH IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS (INPH) – A CROSS-SECTIONAL STUDY

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INTRODUCTION: iNPH significantly impairs quality of life and social interaction of patients. As a result, this clinical condition is frequently accompanied by psychiatric symptoms. However, its evaluation through objective psychiatric scales is lacking in the literature. Therefore, we aim to evaluate the prevalence of anxiety and depression symptoms within this population through objective and validated psychiatric scales.

METHODS: Patients with established diagnosis of iNPH admitted to undergo ventriculoperitoneal shunt (VPS) in a single institution from October 2024 to April 2025 were included. We assessed anxiety and depression symptoms with the Geriatric Anxiety Inventory (GAI) and the Geriatric Depression Scale (GDS), respectively. GAI scores > 10 indicate a degree of anxiety symptoms, while GDS scores > 4 indicate a degree of depression symptoms. Other variables included were sex, age, and the baseline Japanese Scale for iNPH.

RESULTS: A total of 13 patients were included (9 men and 4 women), with a mean age of 73.1 years old (95%CI=69.6 to 76.7). The mean baseline Japanese Scale for iNPH was 5.54 (95% CI=4.5 to 6.6). The mean GAI score was 4.8 (95%CI = 2.4 to 7.2), while the mean GDS score was 5.8 (95%CI = 4.3 to 7.4). Only one patient (7.7%) had a GAI score >10, whereas 8 (61.5%) patients had a GDS score >4. There was no correlation between the baseline Japanese Scale for iNPH and GAI scores (Pearson's $r = -0.36$; $p = 0.23$), as well as between the baseline Japanese Scale for iNPH and GDS scores (Pearson's $r = -0.40$; $p = 0.181$).

CONCLUSIONS: The majority of patients with iNPH had abnormal depression scores, while anxiety symptoms do not appear to be a major concern. Neither anxiety nor depression was correlated with the severity of iNPH. Whether VPS improves such symptoms is yet to be known.

COGNITIVE AND EDUCATIONAL OUTCOMES IN CHILDREN WITH INFANTILE HYDROCEPHALUS: A META-ANALYSIS AND SYSTEMATIC REVIEW

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INTRODUCTION: Cognitive impairment is a major concern in pediatric hydrocephalus, with potential long-term consequences on neurodevelopmental outcomes. However, the true magnitude of its impact on intelligence quotient (IQ) remains unclear. This meta-analysis aims to assess the effect of congenital or infantile hydrocephalus on IQ compared to children without hydrocephalus.

METHODS: A comprehensive literature search was performed in compliance with PRISMA standards across MEDLINE, Scopus, Embase, Cochrane, and Web of Science. We included studies reporting IQ outcomes in children with hydrocephalus compared to healthy controls. The primary outcome was the mean difference in IQ scores between groups. As a secondary outcome, we evaluated educational achievement, assessed by school performance indicators such as normal progression through grades, need for academic support, or enrollment in special education programs. A random-effects model was applied due to anticipated heterogeneity.

RESULTS: Nine studies met inclusion criteria, encompassing 514 children with hydrocephalus and 5,639 controls. Overall, hydrocephalus was associated with significantly lower IQ compared to healthy peers (mean difference = -16.35; 95% CI: -18.79 to -13.92; $p < 0.00001$). Heterogeneity among studies was moderate ($I^2 = 35\%$). Regarding educational achievement, data from five studies showed that approximately 40–50% of children with hydrocephalus were able to attend regular schooling without support, whereas the remainder required academic assistance or placement in special education programs. Rates of normal schooling were consistently lower than those observed in healthy controls.

CONCLUSIONS: Infantile hydrocephalus significantly impairs cognitive development, as evidenced by lower IQ scores compared to healthy children. Educational outcomes were also negatively affected, with only about half of the patients achieving normal schooling without support. These findings highlight the substantial long-term impact of hydrocephalus on both cognitive and academic trajectories, reinforcing the need for early diagnosis, neurosurgical intervention, and continuous educational support to optimize developmental outcomes.

ASSOCIATION BETWEEN TRIAD AND NEUROPSYCHIATRIC SYMPTOMS AND CAREGIVING BURDEN IN INPH PATIENTS FOLLOWING SHUNT SURGERY

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INTRODUCTION: Shunt surgery has been shown to improve triad symptoms, such as gait disturbance, cognitive impairment, and urinary incontinence, of idiopathic normal pressure hydrocephalus (iNPH); however, residual symptoms may persist, contributing to an ongoing caregiving burden. This study aimed to identify residual symptoms associated with continued caregiving burden following shunt surgery.

METHODS: We included 24 patients with definite iNPH (five males, 19 females; mean age 77.3 ± 5.0 y; MMSE: 23.0 ± 4.6) who (1) met the criteria for probable iNPH according to Japanese clinical guidelines, (2) demonstrated improvement of at least one level in one or more triad symptoms on the iNPH grading scale 12 months post-surgery, and (3) had Zarit Burden Interview (ZBI) scores available pre- and post-operatively. The following assessments were performed: MMSE, WAIS-III Digit Symbol Substitution Test, Gait Status Scale-Revised (GSSR), Timed Up & Go (TUG) test, Overactive Bladder Symptom Score (OABSS), and the apathy and depression subitems of the Neuropsychiatric Inventory (NPI). Univariate analyses examined the correlations between these measures and the ZBI total score at 12 months.

RESULTS: At 12 months post-surgery, significant improvements were observed in the ZBI total and personal strain scores, MMSE, WAIS-III Digit Symbol, GSSR, TUG, OABSS, and NPI apathy scores. No significant changes were noted in the ZBI role strain or NPI depression scores. The ZBI total score correlated significantly with MMSE ($r_s = -0.42$, $p = 0.040$), WAIS-III Digit Symbol score ($r_s = -0.50$, $p = 0.014$), and NPI apathy ($r_s = 0.62$, $p = 0.001$) and depression ($r_s = 0.46$, $p = 0.025$) scores but not with gait or urinary symptoms.

CONCLUSIONS: Cognitive impairment, apathy, and depression were significantly associated with persistent caregiving burden after shunt surgery in iNPH patients. Addressing these factors may help reduce caregiver strain.

A REDUCED CEREBRAL COMPLIANCE IS ASSOCIATED WITH AN INCREASED RISK OF CHRONIC POST-HEMORRHAGIC HYDROCEPHALUS IN PATIENTS WITH SUBARACHNOID HEMORRHAGE

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INTRODUCTION: Aneurysmal Subarachnoid Hemorrhage (aSAH) is associated with high mortality and morbidity rates. Approximately one-third of patients with aSAH develop chronic hydrocephalus, the pathophysiology of which remains poorly understood. In recent years, increasing attention has been given to the glymphatic system as a cerebrospinal fluid (CSF) clearance pathway, and its dysfunction has been implicated in the development of post-hemorrhagic hydrocephalus. The aim of our study was to identify predictive factors associated with an increased risk of developing chronic hydrocephalus following aSAH, with a particular focus on potential indices of cerebral compliance.

METHODS: We conducted a retrospective single-center study including patients with aSAH treated at our institution between 2019 and 2024. Demographic data, admission radiological findings (Fisher grade, hemorrhage distribution, optic nerve sheath diameter [ONSD], eyeball transverse diameter [ETD], Evans' index), and clinical variables (mortality, Glasgow Coma Scale [GCS], Hunt and Hess grade, CSF analyses) were collected. Univariate and multivariate analyses were performed to evaluate the prognostic value of clinical and radiological parameters in predicting the development of chronic hydrocephalus requiring ventriculoperitoneal shunting (VPS).

RESULTS: A total of 150 patients were included. A logistic regression model ($R^2 = 0.298$) identified the following independent predictors of chronic post-aSAH hydrocephalus: ONSD ($p = 0.01$) and Evans' index ($p < 0.001$). Patients presenting with more severe hydrocephalus at admission (higher Evans' index) and smaller ONSD values (compared to the study population, though still elevated relative to the general population) were at increased risk of developing chronic hydrocephalus requiring VPS.

CONCLUSIONS: These findings suggest that ONSD and Evans' index may serve as prognostic markers for the development of normal pressure hydrocephalus in patients with aSAH. Moreover, considering the ventricular system and the optic nerve sheaths as a continuum, our results support the hypothesis of reduced cerebral compliance and impaired CSF redistribution and clearance via the glymphatic system in this patient population.

Patient Consent: The patient has provided their consent for the publication of this abstract.

MAGNETIC RESONANCE ELASTOGRAPHY AS A BIOMARKER FOR DIAGNOSIS AND MANAGEMENT OF INPH

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) remains a challenging condition to diagnose and manage effectively. Current diagnostic strategies are invasive and demonstrate limited sensitivity and specificity. Moreover, treatment outcomes following shunt surgery are variable, highlighting the need for more precise tools for patient selection and management. This project aims to integrate magnetic resonance elastography (MRE) into the diagnostic and clinical follow-up protocols to provide noninvasive, quantitative markers of brain tissue properties that can better predict treatment response and monitor disease evolution.

METHODS: Suspected iNPH patients undergo MRE imaging prior to standard clinical evaluation (gait analysis, MMSE, DESH-score, and tap-test). Patients offered shunt surgery undergo repeated imaging 1 month postoperatively. Non-responders receive shunt adjustment according to clinical practice and are reassessed with imaging and clinical testing at 3 months. In cases of suspected over- or underdrainage, MRE is performed after clinical evaluation but prior to valve adjustment, followed by imaging and reassessment after 1 month. Image evaluation will focus on viscoelastic properties of periventricular white matter and cortical convexities. Additional T1-weighted and diffusion-weighted imaging (DWI) sequences are acquired to adjust for edema and provide anatomical references. Clinical assessments are conducted at each imaging time point using standardized evaluations.

RESULTS: Patient enrollment and imaging are currently ongoing. The project is expected to generate viscoelastic brain profiles in iNPH patients before and after shunt treatment, and in cases of suspected over- or underdrainage. Data analysis will focus on the association between imaging-derived biomarkers and clinical outcomes, with the goal of improving diagnostic accuracy and optimizing management strategies.

CONCLUSIONS: This study seeks to validate MRE as noninvasive radiological biomarkers for the diagnosis and longitudinal management of iNPH. If successful, the approach could reduce dependence on invasive procedures, enhance therapeutic decision-making, and improve patient outcomes in iNPH care.

SUBDURAL HEMATOMA AFTER SHUNT SURGERY: INCIDENCE, RISK FACTORS, AND TREATMENT OUTCOMES—A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Subdural hematoma (SDH) is a common complication following cerebrospinal fluid (CSF) shunt placement, particularly in patients with normal pressure hydrocephalus. Treatment options range from conservative valve adjustments to surgical evacuation, but the optimal approach remains uncertain. Therefore, this systematic review and meta-analysis aims to compare clinical outcomes between surgical and non-surgical management of post-shunt SDH.

METHODS: In accordance with PRISMA guidelines, a systematic search was performed across MEDLINE, Scopus, Embase, Cochrane and Web Of Science. We included studies comparing surgical versus non-operative approaches for SDH following CSF shunt placement. The primary outcome was treatment-related adverse events, which encompassed mortality, SDH recurrence and the need for subsequent surgeries. Secondly, we analysed the incidence of SDH and risk factors for its occurrence after shunt surgery. Meta-analysis and Fisher's exact test were performed to evaluate the primary outcome.

RESULTS: Nine studies were included, comprising 127 patients in the surgical group and 119 in the non-surgical group. The incidence of SDH ranged from 6% to 15% across studies and was most frequently associated with low valve opening pressures, fixed-pressure valves, cerebral atrophy, elevated lumbar puncture opening pressure and antiplatelet therapy. Among patients who developed SDH, adverse events occurred in 13.4% of those managed surgically, compared to 6.7% in the non-operative arm. Although this difference did not reach statistical significance (Fisher's exact test, $p=0.094$; $OR=2.14$), surgical management was consistently associated with a higher absolute rate of complications. Several reports linked the use of programmable valves to successful conservative management and a reduced need for surgical intervention.

CONCLUSIONS: Although not statistically significant, surgical management of SDH after shunt placement was associated with a higher rate of complications and mortality when compared to non-operative strategies. These findings support a conservative first approach when feasible, and highlight the need for further prospective studies to refine treatment selection.

EFFICACY AND SAFETY OF VENTRICULOPERITONEAL SHUNT ACROSS AGE GROUPS IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS.

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INTRODUCTION: Ventriculoperitoneal shunt (VPS) remains the standard treatment for idiopathic normal pressure hydrocephalus (iNPH). However, concerns persist regarding its efficacy and safety in older populations. This study aimed to evaluate age-related differences in both objective and subjective outcomes following VPS.

METHODS: We retrospectively analyzed 52 patients diagnosed with iNPH who underwent VPS at our institution between 2022 and 2025. Patients were categorized into three age groups: <70 years, 70–79 years, and ≥80 years. Objective outcomes were assessed using the iNPH grading scale for gait, cognition, and urinary function, comparing preoperative and postoperative scores. Subjective outcomes were evaluated based on patient-reported perceptions, categorized as improvement, no change, or worsening. The length of postoperative hospital stay and incidence of complications were also compared across age groups.

RESULTS: All age groups demonstrated statistically significant improvement in postoperative gait scores ($p < 0.01$). The <70 years group showed significantly greater gait improvement compared to the ≥80 years group ($p = 0.033$). In contrast, cognitive and urinary scores did not show significant postoperative changes, with most patients maintaining stable or minimally altered scores. Subjectively, over 70% of patients across all age groups reported symptomatic improvement in gait. Patients aged ≥80 years reported the highest rates of perceived improvement in cognitive function and overall response, despite limited objective cognitive improvement. No significant differences were observed in postoperative hospital stay among age groups ($p > 0.05$). The overall complication rate was similar across groups. Subdural hemorrhage or hygroma related to valve adjustment occurred in five patients, all within the 70–79 years group. One medical complication was noted in the ≥80 years group.

CONCLUSIONS: VPS is a safe and effective treatment for iNPH across all age groups. Even in patients aged 80 years and older, VPS should be actively considered when clinical symptoms are present.

Patient Consent: The patient has provided their consent for the publication of this abstract.

PREDICTIVE ACCURACY OF PREOPERATIVE TESTS FOR CLINICAL IMPROVEMENT AFTER SHUNT SURGERY IN IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS: A META-ANALYSIS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a neurodegenerative disorder characterized by gait disturbance, cognitive decline, and urinary incontinence. Preoperative predictive tests such as lumbar infusion tests (LIT), cerebrospinal fluid (CSF) tap tests, MRI pulsatility analysis, and combined protocols are used to identify surgical candidates, but their predictive accuracy remains inconsistent.

METHODS: Following PRISMA guidelines, a systematic search was conducted across MEDLINE, Scopus, Embase, Cochrane and Web of Science. Inclusion criteria: studies evaluating preoperative tests in iNPH patients undergoing shunting. Exclusion criteria: sample size <20 patients or follow-up <6 months. Random-effects meta-analysis of clinical improvement proportions was performed, with heterogeneity assessed via Q-statistic, I^2 , and τ^2 . Subgroup analyses compared six test modalities: LIT, tap test, Timed Up and Go (TUG), MRI pulsatility, combined tap test + lumbar drainage, and lumbar perfusion.

RESULTS: The pooled improvement rate across all tests was 79.3% (95% CI 71.3–85.5%; $I^2=76.5\%$, $\tau^2=0.398$). Subgroup analysis revealed significant variation ($Q=17.96$, $p=0.003$): LIT showed 76.3% improvement (95% CI 67.0–83.7%), tap test 79.9% (48.5–94.3%), TUG 100%, MRI pulsatility 71.9% (95% CI 52.8–85.4%), combined tap test + lumbar drainage 90.5% (95% CI 80.1–96.0%), and lumbar perfusion 83.3% (95% CI 58.6–95.1%). Meta-regression showed no association between follow-up duration and improvement rates ($p>0.05$). Funnel plot symmetry and non-significant Egger's test ($p=0.12$) indicated low publication bias.

CONCLUSIONS: Approximately 80% of iNPH patients selected via preoperative testing improve after shunting. Combined protocols (tap test + lumbar drainage) demonstrated the highest predictive accuracy (90.5%), while MRI pulsatility had the lowest (71.9%). Standardization of testing algorithms and head-to-head comparative studies are critical to optimize patient selection, reduce heterogeneity ($I^2=76.5\%$), and validate cost-effective protocols. Therefore, clinicians should prioritize multimodal approaches to enhance surgical outcomes in this elderly population.

RISK FACTORS FOR SHUNT FAILURE IN NEONATES WITH POSTHEMORRHAGIC HYDROCEPHALUS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Posthemorrhagic hydrocephalus (PHH) is a major cause of morbidity in preterm neonates, often requiring cerebrospinal fluid diversion through shunt placement. Identifying reliable risk factors for shunt complications is crucial for improving patient outcomes. This study aimed to systematically review the literature and perform a meta-analysis to evaluate clinical predictors of shunt failure in neonates with PHH.

METHODS: A systematic search was conducted across Web of Science, MEDLINE, Scopus, Embase, and Cochrane databases. Studies reporting shunt outcomes in neonates with PHH were included. Meta-analysis of proportions was performed to estimate the pooled shunt failure rate. Meta-regression and Pearson correlation analyses were conducted to explore associations between clinical variables such as gestational age, birth weight, head circumference and rate of shunt failure.

RESULTS: Eight studies comprising 440 patients were included. The pooled shunt failure rate was 54.69% (95% confidence interval [CI]:41.36–67.38%), with high heterogeneity ($I^2=86.4\%$). Among the evaluated variables, only head circumference at the time of shunt placement demonstrated a statistically significant association with shunt failure ($p<0.0001$), with smaller head circumference correlating with higher failure rates. Age at surgery showed a non-significant trend toward association ($p=0.1617$). Gestational age ($p=0.9305$), birth weight ($p=0.8596$), weight at surgery ($p=0.5352$), and male sex ($p=0.4601$) were not significantly associated with shunt failure.

CONCLUSIONS: In neonates with PHH, smaller head circumference at the time of shunt placement appears to be a strong risk factor for subsequent shunt complications. This finding suggests that head circumference could serve as a practical clinical marker for risk stratification. The high heterogeneity observed underscores the need for individual-level data to clarify causal pathways, support multivariable predictive modeling, and guide evidence-based clinical decision-making in neonatal PHH. This analysis highlights the limitations of current aggregated data and the urgent need for harmonized, prospective datasets to enable more robust risk modeling in this vulnerable population.

EVALUATING HEALTH INEQUALITY IN THE DIAGNOSTIC PATHWAY OF THOSE WITH SUSPECTED NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Inequalities in access to healthcare is well recognised and can be related to socioeconomic factors and geographic location which are further amplified in the older population. Our neurosurgical centre covers a geographically dispersed, mixed rural and urban population with wide ranging degrees of deprivation. We investigated for potential inequality in treatment across our population.

METHODS: Retrospective review of demographic data and indices of deprivation of patients seen in the regional Normal Pressure Hydrocephalus clinic.

RESULTS: Between January 2019 and November 2024, 259 patients were evaluated in the diagnostic NPH clinic. Of these, 155 were offered a trial of CSF drainage, 99 were discharged and five were excluded from the analysis. Those that were offered a trial of CSF diversion were slightly younger (mean difference 1.99 years, $p=0.0045$), however, there was no difference in gender (56.1% vs 64.6%, $p=0.129$), Index of multiple deprivation (IMD) rank (14419 vs 14800, $p=0.715$), IMD decile (5 vs 5, $p=0.72$), years of education (12 vs 11, $p=0.136$), distance travelled to hospital (30.4 vs 32.5 miles, $p=0.65$) and hospital source of referral (65.2% vs 54.5%, $p=0.064$). Of those who had a trial of CSF drainage with complete data ($n=119$), 71 were subsequently offered a shunt and 48 were not. There was no difference in age (mean age 76.2 ± 5.7 vs 75.8 ± 5.5 , $p=0.71$), gender (male 66.2.7% vs 54.2%, $p=0.9$), IMD rank (14430 vs 15423, $p=0.516$), IMD decile (5 vs 5, $p=0.547$), years of education (12 vs 12, $p=0.735$), modified Rankin Scale (3 vs 3, $p=0.72$) or Clinical Frailty Scale (6 vs 4, $p=0.147$).

CONCLUSIONS: Decisions to treat are not influenced by socioeconomic or geographic factors in our cohort however it remains unknown whether inequalities exist prior to the point of referral.

QUANTITATIVE STUDY OF AQUEDUCTAL CSF PRESSURE GRADIENT IN CHIARI SYNDROME

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INTRODUCTION: In Chiari syndrom (CS), quantitative alterations in neurofluid dynamics during cardiac cycle (CC) has been demonstrated using phase-contrast MRI (pcMRI) in patients with CS. Stroke volume of CSF at the midbrain aqueduct (SVCSF) represents the volume of CSF oscillating between the 3rd (V3) and fourth (V4) ventricles via the aqueduct during CC. According to Poiseuille's equation, the driving force of CSF oscillations is changes in the pressure gradient between V3 and V4 ($\Delta P = RAQU * QCSF$) (RAQU : resistance to CSF flow through the midbrain aqueduct; QCSF : flow rate of CSF through the aqueduct). The aim of our study was to analyze P in CS population.

METHODS: 70 patients with CS and 36 controls were retrospectively included. Each people underwent PCMRI processed using Flow software developed at Amiens University Hospital. We calculated SVCSF and QCSF using pcMRI, RAQU using morphologic BFFE MRI sequence. We applied Poiseuille equation to measure the maximum and minimum ΔP at the origin of CSF flow peaks bidirectionally. We defined the parameter stress_ ΔP ($= \max \Delta P - \min \Delta P$).

RESULTS: in CS population, SVCSF was $39.73 \pm 37.58 \text{ mL}$, QCSF $310.26 \pm 344.08 \text{ mm}^3/\text{s}$ and RAQU $113.4 \pm 123.10 \text{ mPa/s/mm}^3$. There was no statistically significant difference between control patients (stress_ $\Delta P = 14.05 \pm 6.50$) and those with CS (stress_ $\Delta P = 17.61 \pm 13$) ($p=0.25$). 36% of controls and 19% of patients have stress_ ΔP between 10 and 15 mmHg, 36% of controls and 49% of patients have stress_ ΔP above this 15mmHg and 30% of controls and 31% of patients have stress_ ΔP below 10mmHg.

CONCLUSIONS: It is possible to measure barometric stress within the aqueduct of Sylvius. We found significant heterogeneity of stress_ ΔP in the CS population which allows us to show that majority of patients present an increase in stress_ ΔP . Previous studies shown link between symptomatic CS and CSF dynamics potentially related to barometric stress disturbance.

Patient Consent: The patient has provided their consent for the publication of this abstract.

UNDERSTANDING QUALITY OF LIFE AND THE ROLE OF SLEEP MONITORING IN NORMAL PRESSURE HYDROCEPHALUS.

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INTRODUCTION: Normal Pressure Hydrocephalus (NPH) is a neurodegenerative condition affecting approximately 3.7% of over 65-year-olds. It is characterized by impairment of cognition, gait, balance and urinary function, factors which significantly increase the risk of dementia, falls, and diminish Quality of Life (QoL). Little is known about the specific impact of NPH on QoL. This study uses existing QoL scales (15D and PSP-QoL), complemented by qualitative patient interviews, to identify gaps in the current understanding of QoL in NPH. Sleep is a major outcome domain of QoL scales but unlike traditional QoL assessments, sleep can be monitored passively and continually over time with under-mattress and wearable sleep monitors (Withings TM). Such monitoring is an attractive potential proxy marker for NPH outcomes, including QoL. This study also explores the feasibility of long-term sleep monitoring in a prospective NPH cohort and examine relationships between sleep and QoL scores.

METHODS: Pilot qualitative data was collected and thematically analysed from five semi-structured patient interviews. Quantitative data was collected using QoL scales (15D and PSP-QoL) on ten NPH patients and five NPH patients had sleep monitoring for three months .

RESULTS: Thematic analysis shows that NPH leads to significant impacts on QoL, and NPH-specific domains, such as identity disruption, fear of falling or the impact of slowness, are not reflected in the 15D or PSP-QoL. Early patient feedback on digital sleep monitors has been positive, with patients being monitored for over four weeks, supporting its feasibility as a long-term continuous measurement tool in neurodegenerative research.

CONCLUSIONS: Findings highlight the critical need for a better understanding of how NPH impacts QoL and how it can be accurately measured. Digital monitors show promise as a method to better understand the role of sleep in NPH, and as a tolerable device to capture continuous, blinded proxy data on QoL.

Patient Consent: The patients have provided their consent for the publication of this abstract.

PRIMARY ANGIOPLASTY VS STENTING IN PATIENTS WITH IDIOPATHIC INTRACRANIAL HYPERTENSION: A SYSTEMATIC REVIEW AND META-ANALYSIS

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INTRODUCTION: Idiopathic Intracranial Hypertension (IIH) is a condition characterized by increased intracranial pressure without a clear etiology, often leading to headaches, visual disturbances and neurological impairment. Angioplasty and stent replacement are two common interventions for the management of IIH, aiming to reduce intracranial pressure and improve patient outcomes. This systematic review and meta-analysis compares the effectiveness and safety of primary angioplasty vs stenting in patients with IIH.

METHODS: This study was conducted in accordance with the PRISMA 2020 guidelines for the conduct and reporting of systematic reviews and meta-analyses. A comprehensive search for studies was performed in the PubMed, Embase, Google Scholar and Web of Science databases. Retrospective studies and controlled studies evaluating patients undergoing primary angioplasty were considered for inclusion, comparing clinical outcomes between those treated with stenting with or without balloon angioplasty in the management of idiopathic intracranial hypertension.

RESULTS: This meta-analysis included 3 studies with a total of 191 patients, evaluating safety and efficacy outcomes for headache, tinnitus, visual disturbances, papilledema and stenosis pressure gradient. There was statistically significant difference in favor of stenting compared to angioplasty in outcomes of tinnitus (OR = 0.10; 95% CI = 0.05-0.24), papilledema (OR = 0.07; 95% CI = 0.02-0.21) and visual disturbances (OR = 0.19; 95% CI = 0.08-0.46). Headache and stenosis pressure gradient showed no significant difference between groups.

CONCLUSIONS: This meta-analysis suggests that primary stenting is associated with better functional outcomes in tinnitus, papilledema and visual disturbances. Limitations of this study include the low number of patients in the available studies, highlighting the need for further investigation. More randomized studies and larger trials are needed to validate findings and address limitations.

HYDROCEPHALUS AS AN INDEPENDENT RISK FACTOR FOR MORBIDITY IN PEDIATRIC PATIENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS OF CLINICAL OUTCOMES

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INTRODUCTION: Hydrocephalus is a prevalent neurosurgical condition in children, often arising from congenital malformations or acquired insults. While its treatment has advanced, the condition itself may independently drive long-term morbidity. This study aimed to systematically evaluate hydrocephalus as an independent factor contributing to adverse clinical outcomes in pediatric populations.

METHODS: This systematic review and meta-analysis were conducted in accordance with PRISMA guidelines. Searches were performed across PubMed, Embase, and Scopus to identify studies reporting clinical outcomes in pediatric patients with hydrocephalus. Studies were included if they assessed morbidity or mortality and reported adjusted or comparative data. Data extraction focused on neurological sequelae, functional deficits, and mortality. Random-effects models were used to pool proportions, and adjusted effect estimates where available.

RESULTS: Twenty-eight studies, which encompassed data from over 3,000 pediatric patients, were analyzed. Hydrocephalus was consistently associated with a higher burden of neurological morbidity. The pooled prevalence of epilepsy was 18.6%, visual impairment 14.3%, and motor or cognitive delay over 25% in several cohorts. Importantly, studies that adjusted for underlying etiologies demonstrated that hydrocephalus independently increased the risk of adverse outcomes. One study reported an adjusted odds ratio (OR) of 2.45 (95% CI: 1.53–3.94) for a poor neurodevelopmental outcome attributable to hydrocephalus. Complication rates related to treatment (e.g., shunt malfunction or infection) were also high (32.4%, 95% CI: 25.2–39.5%), further compounding long-term morbidity. Mortality remained significant in patients with

complex hydrocephalus, with a pooled rate of 7.2% (95% CI: 5.1–10.3%). Heterogeneity across studies was moderate to high ($I^2 > 50\%$).

CONCLUSIONS: Hydrocephalus is an independent and significant contributor to long-term morbidity in pediatric patients. Even when controlling for underlying causes, the condition itself predisposes children to a spectrum of neurological and functional impairments. These findings underscore the need for risk-adjusted care strategies and long-term follow-up in this population.

THE ROLE OF AMPLITUDE FOR COMPREHENSIVE REPORTING OF THE INTRACRANIAL PRESSURE

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INTRODUCTION: Cerebrospinal fluid (CSF) dynamics are complex and the current method of reporting intracranial pressure (ICP) as a mean value alone represents an oversimplification. Advances in our understanding of intracranial hydrodynamics have revealed that abnormalities in ICP pulsatility, beyond elevated mean ICP, play a critical role in various neurological disorders, but the ICP amplitude is not routinely reported in clinical practice and research.

METHODS: We examined the limitations of not reporting the ICP amplitude in conditions like Normal Pressure Hydrocephalus, Idiopathic Intracranial Hypertension, Chiari malformation and Traumatic Brain Injury. These limitations are analogous to focusing exclusively on the mean arterial pressure in cardiovascular medicine. We propose a new reporting method for ICP that includes both mean and amplitude and a potential new format is by using the symbol underscore to separate the two values.

RESULTS: We found that amplitude has diagnostic, predictive and prognostic roles. Integrating the amplitude in reporting ICP measurements will capture the dynamic nature of CSF pressure and will provide a comprehensive and more meaningful parameter compared to the mean alone. Sophisticated methods of ICP monitoring, including telemetric techniques, enable accurate measurements of both the mean and amplitude. Examples of reporting ICP in the format “mean_amplitude” include 15_4 mmHg, 15_8 mmHg, 28_11mmHg, -2_4 mmHg etc.

CONCLUSIONS: The ICP amplitude represents a critical biomarker and routine reporting alongside the mean value of the ICP provides more clinically meaningful information. A potential new method of reporting ICP is with the format “mean_amplitude”, which is a concise, readable and more accurate representation of CSF dynamics.

Patient Consent: The patient has provided their consent for the publication of this abstract

RISK OF CHRONIC HYDROCEPHALUS FOLLOWING ANEURYSMAL SUBARACHNOID HEMORRHAGE: ASSESSING THE SAH-VP AND MAGE SCORES

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INTRODUCTION: Chronic hydrocephalus after aneurysmal subarachnoid haemorrhage (aSAH) is a common condition requiring shunting of cerebrospinal fluid often to the peritoneal cavity (VPS). Different scoring systems have been proposed to determine the risk of VPS, most recently the Mayo age, grade and EVD score (MAGE score) and the SAH-VP score. Our aim was to test these scoring systems to determine their accuracy, and to see if we could create a scoring system that predicted the risk of VPS better.

METHODS: A retrospective quality study of 220 patients admitted with CT-verified aSAH between September 1st 2018 and January 21st 2025 was conducted. Patients were divided into two groups: those requiring a VPS (n=62) and those who did not (n=52). The Mann-Whitney U test, chi2 test or Fisher's exact test were used to test for significance. A p-value <0.05 was statistically significant. A Least Absolute Shrinkage and Selection Operator (LASSO) logistic regression and the Extended Bayesian Information Criterion (EBIC) were used, and statistically significant variables were entered into a generalized linear model (GLM). A clinical risk score was developed by scaling and rounding the bootstrapped regression coefficients relative to the smallest significant effect.

RESULTS: LASSO regression identified seven predictors: ICU stay >10 days (p<0.01), WFNS score (OR=10.85), EVD duration >14 days (OR=1.35), two or more failed weaning attempts (OR=5.38), clamp failure (OR=2.99), CSF output >200 mL in the first 3 days (OR=3.67), and failed closure after weaning (OR=4.42). The final model, which we called the Islamagić-shunt score (IS-score) demonstrated a bootstrapped AUC of 0.914 (95% CI: 0.87–0.95). In comparison, the SAH-VP- and MAGE score yielded an AUC of 0.738 (95% CI: 0.67–0.81) and 0.780 (95% CI: 0.72–0.84), respectively.

CONCLUSIONS: The IS-score better predicted the need for VPS after aSAH compared with the MAGE and SAH-VP score in our cohort.

Patient Consent: This is a quality study performed under Danish legal standards and consent therefore did not need to be obtained.

NORMAL PRESSURE HYDROCEPHALUS AND THE FOURTH STAGE OF EPIDEMIOLOGICAL TRANSITION

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INTRODUCTION: NPH is a disease of older people. Its prevalence increases with age (0.5% in people aged 70+, rising to 5% in those over 80). Improved life expectancy means more people survive to ages where NPH manifests. Most epidemiological transition studies focus on heart disease, cancer, or diabetes. No studies have looked into NPH from that perspective. In addition, NPH prevalence is understudied in low/middle-income countries (where life expectancy is rising but NPH awareness and diagnostic tools are limited).

METHODS: Study of projected demographics of people born in 1945, 1955 and 1965, based on life expectancy data from UN World Population Prospects and WHO Global Health Estimates. These results were projected on expected prevalence of normal pressure hydrocephalus prevalence in developed and developing countries.

RESULTS: In developed countries, higher absolute numbers of people in their 80s are expected over the next 30 years, due to increase longevity, with slower growth in people in their 70s. While in developing countries, more rapid growth in people in their 70s and 80s is expected due to larger birth cohorts and improving health care. Globally, total number of people in their 70s and 80s is expected to increase by at least three folds. e.g. 2020s ~20–25M (born in 1945 cohort in their 80s) compared with 2040s ~75–81M (born in 1965 cohort in their 80s). Largest increase in older people prevalence, and subsequently NPH patients, is expected in developing countries.

CONCLUSIONS: Improved diagnostics and aging societies is likely lead to significantly higher number of NPH patients within the next few years. Investment in education is needed, particularly in developing countries, with focus on early diagnosis and treatment.

REDUCTION OF THE PRESSURE GRADIENT OF THE MESENCEPHALIC AQUEDUCT BY MRI IN CHRONIC HYDROCEPHALUS

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INTRODUCTION: The stroke volume of CSF at the level of the mesencephalic aqueduct (SVCSF) is the volume of CSF oscillating between the third and fourth ventricles via the aqueduct during a cardiac cycle. CSF flow at the aqueductal level (QCSF) results from the pressure gradient between the third and fourth ventricles (ΔP) and the resistance to flow at the aqueduct (RAQU). ΔP is equal to the product of resistance and flow ($\Delta P = \text{RAQU} \times \text{QCSF}$). The objective of our study is to calculate ΔP and analyze this parameter in a population of patients with chronic hydrocephalus (CH).

METHODS: We included 28 patients with suspected CH (74 ± 6 years) who underwent morphological (morpho-MRI) (BFFE) MRI and phase-contrast (pcMRI) sequence at the aqueduct preoperatively. After a multimodal diagnostic assessment (DESH, TAP-test, infusion test), we divided this population into 2 groups: CH+ group (17 improved after shunt patients) and CH- group (11 patients excluded from surgical indication due to the negativity of the overall diagnostic assessment). Using software developed in our laboratory, we analyzed SVCSF and QCSF using pcMRI, RAQU using morpho-MRI, and ΔP . We measured maximal and minimal ΔP at CSF flow peaks bidirectionally and defined the stress_ ΔP parameter ($\Delta P_{\text{max}} - \Delta P_{\text{min}}$).

RESULTS: SVCSF ($\mu\text{L}/\text{cardiac cycle}$) were not different in CH+ and CH- groups (136 ± 98 versus 115 ± 84 ; $p=0.55$). RAQU ($\text{mPa}/\text{s}/\text{mm}^3$) and Stress_ ΔP (Pa) were significantly lower in CH+ group compared to CH- group (9.04 ± 7.30 versus 18.51 ± 19.77 , $p=0.04$ and 6.22 ± 3.09 versus 13.36 ± 14.70 , $p=0.04$). RAQU and Stress_ ΔP were correlated in the CH+ population ($R^2=0.63$, $p=10^{-3}$) but not in the CH- population ($R^2=0.35$, $p=0.054$).

CONCLUSIONS: Stress_ ΔP can be easily calculated and non-invasively by MRI. In CH, this parameter is paradoxically decreased indicating increased CSF pulsatility due to a decrease in the resistance to flow at the aqueduct, and thus an increase in the flow surface area.

Patient Consent: The patient has provided their consent for the publication of this abstract.

"STAR-T WAR"- INTRODUCTION OF CEREBROSPINAL FLUID DYNAMIC STUDIES IN DAILY CLINICAL PRACTICE

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INTRODUCTION: The cerebrospinal fluid (CSF) dynamic studies are used for understanding and diagnosing CSF disorders and malfunction of CSF shunts. The introduction and contribution of CSF dynamics studies by using the LIKVOR CELDA® system in clinical practice in Greece was evaluated.

METHODS: Retrospective analysis of 214 consecutive patients who were underwent CSF dynamics studies between August 2018 and March 2025 were studied.

RESULTS: 119 (56%) men and 95 (44%) women, aged 15 to 92 years (mean: 70, SD: 15.5). Their primary symptoms were gait disturbances (79%), dementia (8%), headache (5.5%), history of transnasal repaired of spontaneous CSF rhinorrhea (5.5%), vision disturbances (1%), tremor (0.5%) and tinnitus (0.5%).

139 (83%) of 167 patients had normal pressure hydrocephalus (NPH), 9 (38%) of 24 had pseudotumour cerebri syndrome, 3 (75%) of 4 had intracranial hypotension, and 7 (37%) of 19 had malfunctioning CSF shunt.

In 11 (5%) of 225 cases, CSF dynamic tests were not completed due to technical reasons (5 cases), inability to insert two spinal needles (4 cases), poor cooperation of a demented patient and needle phobia in one patient. 4 (2%) patients were treated conservatively for postural headache. 36 patients with NPH were operated on for insertion or revision of CSF shunt in Hygeia Hospital. 35 (97%) of 36 patients were improved clinically at 3 month follow up. 4 patients developed subdural collections (treated conservatively), 3 patients developed transient 6th CN paresis and two patients developed transient fluctuating hearing loss, one obese patient had subcutaneous migration of her peritoneal catheter.

CONCLUSIONS: The CSF dynamic studies are safe and valuable diagnostic tool in neurological armamentarium for accurate diagnosis of patients with possible CSF disorders or malfunctioning CSF shunts. Contribution of CSF dynamic studies in decision making increases the possibility of successful results after CSF shunting.

NON-INVASIVE TELEMETRIC MONITORING FOR INTRACRANIAL PHYSIOLOGICAL SUBTYPES ACROSS HYDROCEPHALUS CONDITIONS

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INTRODUCTION: The MScio (Miethke Sensor Reservoir) multimodal intracranial monitor enables real-time assessment of intracranial pressure (ICP) dynamics, providing critical insights into hydrocephalus management. MScio monitoring can explore ICP dynamics and symptom relief variations across hydrocephalus subtypes, and to assess the influence of valve setting differential pressure on clinical outcomes.

METHODS: We retrospectively analysed ICP metrics from shunted hydrocephalus patients, categorised by hydrocephalus subtype. All patients had adjustable valves, with follow-up assessments after each adjustment. Linear mixed models were used to evaluate associations between valve setting, ICP in the sitting position, clinical outcome across subtypes.

RESULTS: The effect of valve settings on ICP varied significantly across the different positions (sitting, standing, supine) and hydrocephalus subtypes. In general, valve settings had a significant impact on ICP in standing and supine positions, with some settings showing marked effects in Normal Pressure Hydrocephalus (NPH) and Long Standing Overt Ventriculomegaly in Adults (LOVA) and Idiopathic Intracranial Hypertension (IIH). Overall, the effect of valve setting on sitting ICP varied significantly across subtypes. Revision rates ranged from 20% in Cystic Lesions to 59.6% in Hydrocephalus Types, while symptom relief rates ranged from 60% in Cystic Lesions to 25% in Structural Brain Abnormalities. Complication rates after valve adjustment also varied by condition, from as low as 4% in Hydrocephalus associated Syndromes, including Dandy Walker syndrome, to as high as 33.3% in both Tumour -Related and Neoplastic- Associated hydrocephalus.

CONCLUSION: This study highlights the potential of MScio data in guiding personalised valve adjustment strategies, offering support in standardising effective subtype-specific care, alongside reducing revision need and improving patient outcomes.

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INFLAMMATORY PROTEIN SIGNATURE IN CSF DOES NOT PREDICT OUTCOME IN PATIENTS WITH iNPH

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INTRODUCTION: Neuroinflammation in the context of idiopathic normal pressure hydrocephalus (iNPH) is poorly studied but is theoretically an important part of the pathogenesis. Currently, no single objective test can reliably predict outcomes after shunt surgery. The aim was to investigate whether neuroinflammatory proteins in cerebrospinal fluid (CSF) are associated with the characteristic symptoms of NPH and whether they can predict outcome after shunting.

METHODS: Neuroinflammatory proteins were analyzed from preoperative CSF using proximity extension assay (PEA). In total, 92 proteins were analyzed from 74 patients with iNPH referred to shunt surgery at a single center, with follow-up at the same hospital. Symptoms were assessed before surgery and 12 months post-surgery, graded with the Swedish iNPH scale. Associations between protein levels and preoperative symptoms, as well as outcome, were analyzed using linear regression adjusted for age, sex, symptom level at baseline, and waiting time for surgery. Benjamini-Hochberg with FDR 10% was used to control for multiple analyses.

RESULTS: Of the 92 analyzed proteins, 60 had less than 50% missing values and were included in statistical analyses. None of these proteins, were significantly associated with preoperative symptoms or outcome after shunt surgery.

CONCLUSION: Of the sixty neuroinflammatory proteins analyzed from preoperative CSF, none were associated with preoperative symptoms or postoperative improvement after shunt surgery. Further investigation is needed on the possible role of neuroinflammation in iNPH.

THE OUTCOME OF CHILDRENS WITH HYDROCÉPHALUS AFTER POSTERIOR FOSSA TUMORS SURGERY

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INTRODUCTION: Tumors of the posterior cerebral fossa account for 54% of brain tumors in children. Hydrocephalus is an important prognostic factor and should be considered as a separate entity from neoplasia in the posterior cerebral fossa.

METHODS: 35 children were admitted in our department for tumors of posterior cerebral fossa over a two-year period. Neuroimaging revealed ventricular dilatation in 28 children, which was active in 18 patients. Ventriculo-cisternostomy was performed in 16 children and 12 patients underwent ventriculo-peritoneal shunting prior to tumor surgery. Total removal of the posterior cerebral fossa tumor was performed in 29 patients. MRI was also used to monitor the evolution of hydrocephalus, with 02 cases of ventriculomegaly observed in the group of children who had undergone VCS. In the group of patients who don't received shunt, 01 case of ventriculomegaly was observed who benefited from total resection

RESULTS: The surgical management of triventricular hydrocephalus in the posterior cerebral fossa depends on the technical resources and experience of the neurosurgeon. Ventriculocisternostomy is a minimally invasive surgical technique that usually used for obstructive hydrocephalus. Dysfunction, infection, metastasis, intra tumoral haemorrhage and engagement, as well as revision of the valve as the child grows, are the likely complications of DVP. we have seen a clear clinical improvement after restoration of the outflow tract. First-line treatment of hydrocephalus not only improves clinical symptomatology and saves vital and functional (visual) prognosis, but also ensures greater operative comfort during tumor excision and improved postoperative follow-up.

CONCLUSIONS: The management of hydrocephalus due to posterior cerebral fossa tumors has always been problematic, as 60-90% of children have ventricular dilatation preoperatively and 18-40% postoperatively.

COMPUTATIONAL MODELING OF CEREBRAL VENOUS COLLAPSE AND ITS IMPACT ON INTRACRANIAL PRESSURE DYNAMICS

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INTRODUCTION: The brain is enclosed within a rigid skull, making it highly sensitive to changes in intracranial volume. Even small variations in the volume of cerebrospinal fluid (CSF), blood, or brain tissue can cause significant changes in intracranial pressure (ICP), potentially impairing cerebral blood flow or causing tissue damage. Compliance mechanisms help buffer these volume changes to maintain physiological ICP. Among these, cerebral veins—due to their collapsible nature—are believed to play a key role. However, their behavior is difficult to assess with conventional imaging methods, and their precise contribution to ICP regulation remains poorly characterized. To address this gap, we developed a computational model to test the hypothesis that venous collapse significantly influences ICP dynamics.

METHODS: Our computational model simulating the coupling between cerebral venous dynamics and ICP relies on lumped-parameter representations of key processes. It includes CSF compartments, vascular bed resistance, vascular wall deformations, active autoregulation, and coupling with systemic circulation. Several formulations of venous collapse were implemented, including Starling resistor models and nonlinear tube law approaches.

RESULTS: The different venous collapse models were compared to available experimental data on venous pressure, venous flow, and ICP from animal models and clinical observations. The simulations show qualitative agreement with these data, supporting the validity of the modeling approach. Sensitivity analyses highlight the significant influence of venous collapse on ICP dynamics and its contribution to the overall compliance of the central nervous system.

CONCLUSIONS: We proposed an open-source computational tool for modeling intracranial fluid dynamics, incorporating collapsing cerebral veins. Preliminary results suggest that venous collapse significantly influences ICP dynamics. Further validation under various physiological and pathophysiological conditions is required. This modeling tool can improve understanding of brain pathophysiology and support therapeutic intervention design such as shunts, and clinical data interpretation.

BETWEEN CERTAINTY AND CHANCE: REFRAMING INPH DIAGNOSIS THROUGH PROBABILISTIC REASONING

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) illustrates the challenge of clinical decision-making under uncertainty: a potentially reversible condition within a spectrum of progressive disorders, yet lacking a deterministic diagnostic gold standard. Despite growing reliance on imaging, CSF biomarkers, and predictive testing, decisions about shunting remain shaped as much by intuition and institutional custom as by structured evidence. This work advocates for a probabilistic approach to iNPH management and examines the limitations of applying deterministic models under the banner of precision medicine.

METHODS: We conducted a narrative synthesis of clinical studies, cognitive decision theory, and hydrocephalus guidelines, focusing on the diagnostic yield of commonly used tests: tap test, CSF outflow resistance measured with infusion study, external lumbar drainage, and neuroimaging. Metrics such as sensitivity, specificity, and predictive value were analyzed not as binary cut-offs, but as components of evolving clinical probability. Cognitive and institutional factors influencing clinician behavior were also evaluated.

RESULTS: Current diagnostic tools for iNPH offer moderate predictive power individually and often yield discordant results across clinical settings. For example, the tap test provides high positive predictive value but low sensitivity, while infusion studies and ELD improve sensitivity at the cost of complexity and procedural burden. Clinicians must navigate these probabilistic indicators without standardized thresholds or reliable exclusion criteria. At the same time, decisions are shaped by anchoring, availability bias, and reliance on clinical gestalt, forms of intuitive reasoning that can both enhance and hinder judgment.

CONCLUSIONS: Precision medicine in iNPH cannot be reduced to deterministic algorithms. Embracing probabilistic frameworks, such as cumulative diagnostic likelihood and Bayesian updating, allows for more context-aware, ethically grounded decisions. Progress in this field depends not only on refining biomarkers but also on cultivating cognitive and institutional awareness of how uncertainty is perceived and managed in everyday practice.

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A RARE CAUSE OF HYDROCEPHALUS TREATED BY ENDOSCOPY: ARACHNOID CYST OF THE THIRD VENTRICLE

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INTRODUCTION: Arachnoid cysts of the sellar and suprasellar region represent only 10% of arachnoid cysts. They are often responsible for hydrocephalus due to obstruction of the CSF flow tract, and also for endocrine disorders due to compression of the pituitary stalk. Neuroendoscopy allows for a better understanding of the anatomical changes and the optimal treatment. The objective of this study is to share our experience through this clinical case.

CASE PRESENTATION: A 18-month-old male child was brought in hospital by his parents for macrocrania and lower limb spasticity. Clinical examination revealed an afebrile child with a head circumference of 53 cm, delayed gait acquisition, and spasticity in all four limbs, predominantly in the lower limbs. A cranioencephalic CT scan revealed biventricular hydrocephalus with an arachnoid cyst in the third ventricle. The child was treated by endoscopy. The procedure consisted of marsupialization of the cyst into the ventricular system, followed by the creation of a stomy at the floor of the third ventricle. The outcome was favorable, with a progressive decrease in spasticity and the onset of walking one month postoperatively. The follow-up CT scan showed a decrease in the size of the cyst.

CONCLUSION: Endoscopic treatment provides good outcomes in the treatment of hydrocephalus caused by third ventricular cyst.

KEYWORDS: Ventriculocisternostomy, third ventricular cyst, hydrocephalus

INTERMITTENT OBSTRUCTIVE HYDROCEPHALUS SECONDARY TO A PINEAL CYST. A CASE REPORT

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INTRODUCTION: Pineal cysts are clinically benign and usually asymptomatic, but symptomatic cases have been reported. We report a rare case of obstructive hydrocephalus due to a pineal cyst trapping the cerebral aqueduct. The symptom fluctuated and was treated with endoscopy.

METHODS: A 50-year-old male was admitted to our hospital with impaired consciousness, abnormal behavior, and vomiting. MRI revealed enlargement of the lateral ventricles and third ventricle, but the cause of hydrocephalus was unclear. Symptoms disappeared within one day, and imaging findings also improved spontaneously over the course of several days.

A follow-up MRI, including CISS images, revealed a pineal cyst potentially obstructing the cerebral aqueduct, leading to planned surgery.

RESULTS: A burr hole was made 9 cm cranial to the nasion and 3 cm to the right of the midline, and a sheath was inserted into the right lateral ventricle. Using a rigid endoscope, we passed through the Monro foramen and observed the posterior portion of the third ventricle, where a yellow cyst was identified extending from the pineal fossa to the cerebral aqueduct. The cyst was not distended, but part of it was protruding into the cerebral aqueduct, confirming it as the cause of obstructive hydrocephalus. The cyst was partially adherent to the posterior commissure, but it was successfully dissected and removed using forceps. After surgery, symptoms disappeared and there was no recurrence of hydrocephalus.

CONCLUSIONS: We considered that the mechanism of intermittent obstructive hydrocephalus may be that the cyst wall, which is not adhered to the surrounding tissue floating near the cerebral aqueduct, becomes trapped in the cerebral aqueduct due to cerebrospinal fluid flow, but the obstruction is relieved due to factors such as pressure differences in the ventricles or body position.

Patient Consent: The patient has provided their consent for the publication of this abstract.

SUCCESSFUL MANAGEMENT OF SYRINGOMYELIA SECONDARY TO CEREBROSPINAL FLUID VENOUS FISTULA

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INTRODUCTION: CSF venous fistula (CVF) is a well-recognised cause of spontaneous intracranial. However, syringomyelia is rare and less recognised complication of CVF.

METHODS: We describe two cases of syringomyelia secondary to CVF, and our MDT approach for diagnosis and subsequent treatment. Clinical and radiographic information were collected.

RESULTS: Two patients were identified with syringomyelia secondary to CVF. Both patients suffered from orthostatic headaches during their disease course and had a prolonged diagnostic delay (> 3 years). One patient had previously had a foramen magnum decompression without improvement in their symptoms, while the other patient had no improvement with multiple blood patches. Both patients underwent myelography to identify a thoracic CVF with subsequent surgical disconnection of the CVF by a minimally invasive, paramedian, extra-facetal approach. Both patients had near resolution of their headache after surgery with significant improvement in the size of the syrinx. There were no surgical complications. One patient had rebound hypertension which resolved with a short course of acetazolamide.

CONCLUSIONS: CVF should be considered as a cause of syringomyelia in patients with clinical and radiological features of SIH. Treatment should be targeted at treating the underlying CVF rather than surgery for the syrinx alone.

ASSESSING LUMBAR PUNCTURE TAP TEST V LUMBAR DRAIN IN THE PREDICTIVE DIAGNOSIS OF NPH PRIOR TO SHUNT INSERTION

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INTRODUCTION: The consensus guidelines on normal pressure hydrocephalus (NPH) management, published in 2005, identified multiple diagnostic options for predicting improvement following CSF shuntage in suspected NPH patients. There are benefits to each method, with lumbar puncture tap test (LPTT) being able to be done quickly and by referring clinicians, whilst others, such as prolonged lumbar drainage (LD), required an inpatient stay. The consensus guidelines in 2005 suggested prolonged LD had the best positive predictive measure. However, to our knowledge, multiple assessments have not been performed on the same patient to identify the best diagnostic option.

METHODS: All patients were admitted for prolonged LD, as per our standard practice. If consented, patients had their lumbar drain inserted in theaters and clamped immediately. On return from theatre, they underwent a large volume withdrawal via the lumbar drain of 40mls over 30minutes. Mobility was assessed pre LD insertion, 1 hour after 40ml CSF withdrawal, before progression with the standard lumbar drainage protocol (10-15mls / hr for 72hours). After 72hrs, mobility was again assessed. An improvement of 10% or more was considered significant.

RESULTS: 12 patients were recruited into the study (5f, 7m, median age 77). 6 patients saw an improvement after LP, 5 of these also saw an improvement after LD. Of the 6 patients that did not see an improvement after LP, 4 saw an improvement after LD.

CONCLUSIONS: These results in this small sample size suggest that a positive response following LP is often mirrored following LD. However, a negative response following LPTT is not always mirrored following LD suggesting some patients only having LPTT may be denied a shunt unnecessarily. One patient improved by LPTT but not LD, likely because of a LD induced headache. We plan to follow these patients and assess their improvement post shunt.

THRESHOLDS OF REVERSIBILITY VS. IRREVERSIBILITY IN COMPLEX NORMAL PRESSURE HYDROCEPHALUS WITH COMORBIDITIES – CORRELATING CLINICAL SCORES AND SCALES WITH THE ALPS INDEX AND DTI PROFILES

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INTRODUCTION: The application of standard guidelines for Normal Pressure Hydrocephalus is amenable for patients with comorbidities but some exhibit overlapping clinical factors that confound testing. This group, termed Complex NPH (CoNPH), has higher risks for intervention and lower but meaningful CSF responsiveness. We examined the utility of individual domain scores, global NPH scales and imaging biomarkers towards detecting reversibility in CoNPH.

METHODS: Patients in the NPH program with comorbidities, e.g. cardiovascular and neurological risks, were offered participation. Using our published pathway, CoNPH patients (n=12) underwent lumbar drainage (LD); clinical scores and scales were correlated with glymphatic function (ALPS index) and diffusion tensor imaging (DTI) metrics. Statistical analyses were performed for comparisons.

RESULTS: No statistically significant differences were found between pre- and post-LD clinical variables except for Tinetti Balance, which showed significant improvement ($p=0.022$). Despite low levels of CSF responsiveness, responders vs. non-responders could be distinguished by global NPH scales alone. 4/12 patients improved using the Japanese iNPH GS (-1) and Gothenburg Scale (+5), respectively. Imaging biomarkers showed more complex correlations. The right ALPS index was negatively correlated with pre-LD Tinetti Balance ($r=-0.791$, $p=0.004$) and remained negatively correlated with Tinetti Total and MMSE post-LD. Positive correlations with gait ($r=0.639$, $p=0.025$, Gothenburg) suggested partial reversal of glymphatic function. DTI metrics showed that increased fractional anisotropy (FA) in the left Arcuate fasciculus and left Aslant tract, strongly corresponded with faster gait (TUG, $r = -0.919$ and -0.872 , $p=0.001$ and 0.024 , respectively). Conversely, increased mean diffusivity (MD), showed both positive and negative correlations to gait times (left Aslant tract and Forceps Major, TUG, $r = 0.824$ and -0.728 , $p = 0.044$ and 0.041 , respectively).

CONCLUSIONS: Global NPH-specific scores and imaging measures were superior to individual domain metrics at predicting CSF-responsiveness in patients with CoNPH. Further work is needed to characterize clinical outcomes from shunting.

Abstract Body Word limit: 300 words

ASSESSING SHUNT MALFUNCTION IN NORMAL PRESSURE HYDROCEPHALUS: CLINICAL EXPERIENCE AND ROLE OF INFUSION TESTS IN BEAUJON HYDROCEPHALUS CENTER

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INTRODUCTION: Assessing the adequate functioning of a shunt is a challenge in normal pressure hydrocephalus (NPH). The resistance to cerebrospinal fluid (CSF) outflow (ROUT) is a reliable indicator and can play a crucial role in distinguishing between a true shunt malfunction and the worsening of the primary condition in patients with NPH.

METHODS: Retrospective study of cases of suspected shunt malfunctions investigated in a hydrocephalus reference center with a high case load between 2015 and 2025. To address the patency of shunt, a specific workflow was routinely applied to cases investigation.

RESULTS: We present our clinical experience in managing shunt malfunction. The malfunction workflow includes clinical, imaging and hydrodynamic investigations. CSF infusion test through the shunt antechamber allows to discriminate between true shunt malfunction and disease progression. The malfunction workflow allows to tailor revision surgery when needed, and to avoid unnecessary surgeries.

CONCLUSIONS: Using a standardized workflow to rule out shunt malfunction in normal pressure hydrocephalus allows more precise diagnosis and an individualized treatment tailoring. CSF infusion tests through shunt prechamber help delineate which part of the shunt is impaired to simplify shunt revision surgery.

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THE UTILITY OF THE ADDENBROOKE'S COGNITIVE EXAMINATION IN THE DIAGNOSTIC ASSESSMENT OF PATIENTS SUSPECTED TO HAVE IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Idiopathic normal pressure hydrocephalus (iNPH) is a clinico-radiological syndrome combining decline in mobility, cognitive function and bladder control, prevalent in the elderly when alternative and/or coexisting conditions are increasingly common. Alzheimer's disease is the leading cognitive comorbidity. With the advent of neurodegeneration biomarkers Alzheimer's disease neuropathological change can now be diagnosed but they are not widely available. Further they are a risk factor for but not equivalent to a clinical diagnosis of Alzheimer's disease and are increasingly common in healthy elderly patients. There is a need for evidence of the utility of a "bedside" cognitive tool which can reliably raise the suspicion or even diagnose clinical Alzheimer's disease copathology. We assessed the performance of the Addenbrooke's cognitive examination (ACE) in patients with iNPH against CSF and MRI biomarkers of Alzheimer's disease.

METHODS: This was a retrospective, single centre cohort study of patients referred to a regional NPH clinic. They were assessed by a cognitive neurologist. The ACE was administered. Tap test was performed and CSF neurodegeneration biomarkers and MRI brain were obtained. The final diagnosis, an additional diagnosis of Alzheimer's disease, the intention to offer ventriculoperitoneal shunt surgery and the outcome of those shunted were recorded. Statistical analyses examining correlations between demographic, clinical and biomarker data and logistic regression analyses of categorical outcomes of diagnosis and shunt response were conducted.

RESULTS: 212 patients were included in the study. There were significant correlations between age, performance on the Addenbrooke's cognitive examination, CSF biomarker results and mesial temporal atrophy scores. The memory subscale of the ACE was a strong and significant predictor of a biomarker validated diagnosis of Alzheimer's disease.

CONCLUSIONS: The ACE is a freely available, easy to use, cognitive tool which provides clinical information supporting the clinician when to suspect Alzheimer copathology.

Patient Consent: The patient has provided their consent for the publication of this abstract

CEREBROSPINAL DIVERSION FOLLOWING ANEURYSM CLIPPING IN A NEUROSURGICAL CENTRE

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INTRODUCTION: A retrospective search of operations performed over a 6-month period at a Neurosurgical centre to calculate the risk of CSF diversion following aneurysm clipping.

METHODS: Electronic notes were reviewed for operations performed over a six-month period from the 10/11/2024 to the 10/5/2025 with review of cerebrospinal diversion performed in these patients.

RESULTS: Over a six-month period 26 aneurysm clippings were performed. 69.2 % of operated patients were female. 19.2 % of operations were performed as an emergency. 7.7 % were treated with an external ventricular drain and 7.7 % were treated with a lumbar drain. One patient (3.9 %) required ventriculo-peritoneal shunt insertion following lumbar drain insertion. The probability of CSF diversion in emergency admissions was 40.0 % and in elective admissions was 9.5%.

CONCLUSIONS: There is a low probability of CSF diversion following aneurysm clipping and patients are not likely to require permanent diversion. The probability of requiring CSF diversion is higher in emergency admissions.

THE OTHER SIDE OF THE VENTRICULO-PERITONEAL SHUNT

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INTRODUCTION: Congenital hydrocephalus is a very frequent pathology in neurosurgery and its management is costly and time-consuming, especially if it is associated with other nerve malformations.

METHODS: 120 children were admitted to the Annaba neurosurgery department for complications of ventriculo-peritoneal shunting over a period of 04 years.

Their ages ranged from 01 months to 15 years, 60% of these patients, 72 children, underwent ventriculoperitoneal shunting for hydrocephalus associated with dysraphism (spina bifida), 24 infants for post meningeal hydrocephalus and the remainder underwent surgery for hydrocephalus due to congenital stenosis of the aqueduct of Sylvius in 18 infants under two years of age, and hydrocephalus following ventricular hemorrhage in 06 children.

All these patients underwent VP shunting to drain cerebrospinal fluid and relieve intracranial hypertension.

RESULTS: The onset of complications following shunt placement ranged from 3 days to over 365 days, with an estimated 60% (72 patients). Complications were distributed as follows: exposed valve in 22 infants, sphincter migration in 15 children (late complication), chronic subdural hematoma due to hyperdrainage in 07 patients, meningitis in 18 infants and intra peritoneal resorption defect in 10 children.

CONCLUSIONS: The placement of a ventriculo-peritoneal shunt following hydrocephalus is a fairly easy and classic technique that allows excess CSF to be drained, thus preserving functional and vital prognosis, but exposes the child to a fairly high morbidity rate.

Patient Consent: The patient has provided their consent for the publication of this abstract.

HISTORICAL DETERMINANTS OF HYDROCEPHALUS IN LATIN AMERICA: A SCOPING REVIEW OF EPIDEMIOLOGICAL AND CLINICAL EVOLUTION

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INTRODUCTION: Normal pressure hydrocephalus (NPH) is a progressive neurological syndrome characterized by the triad of gait disturbance, urinary incontinence, and cognitive decline. In Latin America, NPH holds particular historical significance, as it was first described by Colombian neurosurgeon Dr. Salomón Hakim, who also pioneered the use of ventricular shunting as a therapeutic intervention. Despite this seminal contribution, there remains a paucity of documentation regarding the evolution and historical trajectory of NPH within the Latin American context. This scoping review aims to synthesize this historical literature.

METHODS: This scoping review was conducted following the Joanna Briggs Institute methodological framework. A comprehensive literature search was performed using MeSH and DeCS terms across six databases: PubMed, Embase, Scopus, Web of Science, Cochrane Library, and SciELO. Studies were eligible if they addressed the historical development of NPH in Latin America. Extracted variables included study objectives, country of origin, methodological design, population characteristics, principal findings, and recommendations for future research

RESULTS: A total of 121 articles pertaining to the historical aspects of NPH were initially identified. 24 articles were reviewed for full text screening. After full-text screening, 14 articles met inclusion criteria. The majority of publications originated from the United States (n=3) Germany (n=2) and Brazil (n=4), with fewer from Colombia (n=4) and England (n=1). The publications ranged from 1960 to 2024. Notably, only a minority specifically addressed historical developments within Latin America. Dr. Salomón Hakim is the principal contributor to the foundational understanding and early advancements in the field.

CONCLUSIONS: Although NPH was first identified in Latin America, the historical contributions of Latin American clinicians remain markedly underrepresented in the broader scientific literature. Enhanced recognition of regional innovations could inspire future generations of Latin American physicians and neurosurgeons to advance diagnostic and therapeutic strategies for hydrocephalus, reinforcing the region's legacy in global neurosurgical research.

WOMEN DRAWING BRAINS: DORCAS HAGER PAGET (1906 – 1976) & AUDREY JULIET ARNOTT (1901 – 1974)

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INTRODUCTION: Medical illustration is an essential device for the teaching of anatomy, physiology and pathology, and has been instrumental in the development the surgical art. This has required a close collaboration between surgeon and artist. This has been particularly evident in neurosurgery where surgeon and artist worked together with a "combined eye", to help develop and disseminate surgical techniques. Although Leonardo da Vinci, is the godfather of medical illustration within western culture Max Brödel is considered The man who put art into medicine, when we talk about modern medical illustration. We remember two of his early trainees Dorcas Hager Paget and Audrey Juliet Arnott.

METHODS: Relevant bibliography about this topic has been reviewed.

RESULTS: Dorcas Padget's story begins with Walter E. Dandy, when she went on to study medical illustration at Johns Hopkins School of Medicine under Max Brödel. She contributed to his book, Surgery of the Brain, and the reprinted versión, The Brain. After his death she continued to publish and researchher laborstory efforts on neuroembrology, especially on neural tuve development. She coined the term neuroschisis and explained thespectrum of spinal dysraphism. Audrey Juliett Arnott trained at the Royal College of Art, was first employed as an artist by Hugh Cairns at the London Hospital. Cairns arranged for Arnott to be trained as a medical illustrator under Max Brödel, a close friend of Harvey Cushing and founder of the first 'Department of Art as Applied to Medicine' at Johns Hopkins University. During her time at John Hopkins Arnott developed a close friendship with Dorcas Padget, medical illustructor to Walter Dandy.

CONCLUSIONS: Medical illustration is a specialist discipline that combines the worlds of art, medicine and science. We honor these two women and their contribution to our discipline.

NEW BIOMATERIALS IN NEUROENGINEERING: INNOVATION AT THE SERVICE OF HYDROCEPHALUS

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INTRODUCTION: In the field of neuroengineering, advances in biomaterials represent a key opportunity to improve everything related to hydrocephalus. This paper analyzes four emerging biomaterials—zirconium, graphene, carbon nanotubes, and nitinol—highlighting their properties and potential applications in implantable devices and cerebral shunt systems.

METHODS: A comprehensive review of the recent bibliography was conducted to gather and analyze relevant information.

RESULTS: Zirconium, traditionally used in dental implants and artificial organs, is emerging as an alternative to titanium in valves, thanks to its biocompatibility, low cost, and, recently, its use in transparent ceramics that allow optical access to the brain. Graphene, due to its high conductivity and compatibility with cortical neurons, offers great potential for the development of smart sensors and membranes in shunt systems. Carbon nanotubes, due to their nanometric diameter and functionalization capacity, could be used in CSF monitoring systems, although they face challenges in toxicity, biodegradability, and dispersion. Finally, nitinol—a shape-memory alloy with superelasticity—allows for the development of smart valves that respond to changes in pressure or temperature, opening up possibilities for automatic regulation of CSF flow.

CONCLUSIONS: The integration of these biomaterials into brain-based technologies could optimize the detection, monitoring, and treatment of hydrocephalus. However, further research into their long-term biocompatibility and impact on brain tissue is essential. Innovation in biomaterials thus offers a promising path toward more effective, less invasive, and adaptable solutions to the neurophysiological environment, such as new applications for the treatment of brain pathologies with nanorobots.

CEREBRAL VENOUS THROMBOSIS, A RARE AND UNDERESTIMATED BUT POTENTIALLY LIFE-THREATENING COMPLICATION FOLLOWING VENTRICULOPERITONEAL SHUNT PLACEMENT: A CASE REPORT AND REVIEW OF LITERATURE

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INTRODUCTION: Overdrainage is a common complication following shunt surgery and can lead to intracranial hypotension. Although commonly linked to infection, coagulopathy, or malignancy, cerebral venous thrombosis (CVT) can also result from cerebrospinal fluid (CSF) overdrainage leading to intracranial hypotension.

METHODS: We report a 68-year-old man who developed headaches, blurred vision, and tinnitus two months after a ventriculoperitoneal shunt (VPS) placement for secondary hydrocephalus after intraventricular postoperative hemorrhage.

RESULTS: Brain CT imaging revealed signs of overdrainage with slit ventricles, bilateral subdural collections. Despite valve adjustment to its highest-pressure setting (200 mmH₂O), the patient continued to deteriorate with the onset of epileptic seizures. An injected imaging revealed an extensive CVT involving the right lateral sinus and proximal jugular vein. An anticoagulant therapy was initiated following a negative etiological work-up. At five-month follow-up, the patient showed marked clinical improvement with resolution of symptoms, normalization of ventricular size, regression of subdural collections and the thrombosis on imaging. We identified four comparable cases linking CVT to VPS overdrainage in the literature. These cases reinforce intracranial hypotension as a plausible pathophysiological trigger through venous collapse, mechanical traction, or sinus compression. Patients ranged from pediatric to elderly, and outcomes improved with anticoagulation and correction of overdrainage.

CONCLUSIONS: CVT is a rare but could be a serious complication of VPS overdrainage. Awareness of this association is essential for timely diagnosis and effective treatment. Clinicians should monitor patients carefully after valve adjustments and consider CVT in cases of unexplained neurological decline. In such cases, imaging with injection should be considered.

UTILITY OF CSF SHUNT INFUSION STUDIES IN THE DIAGNOSIS OF SHUNT FAILURE IN NORMAL PRESSURE HYDROCEPHALUS

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INTRODUCTION: Delayed deterioration following initial improvement is a common clinical course in Normal Pressure Hydrocephalus (NPH). Programmable shunts are often adjusted to increase CSF drainage in this situation, but improvement in performance may not occur. Subsequent evaluation of suspected shunt malfunction can be challenging as ventricular size may not change on imaging. We evaluate the utility of the CSF shunt infusion test in patients with suspected shunt failure in NPH.

METHODS: Between 2020-2025, 44 patients with shunted NPH underwent CSF infusion studies, with 41/44 using the ICM+ software (Cambridge Enterprise), for suspected shunt failure. 42 were performed via the shunt reservoir, 1 via an implanted ventricular access device and 1 via lumbar infusion study. Patients reaching the threshold for shunt failure were offered surgical revision, patients with functioning shunts were offered a downward adjustment of the shunt valve setting.

RESULTS: 22 shunts were patent, of these only 11 patients wanted further adjustment; 5/11 improved gait, only 1/11 improved cognition. 5 were felt to be developing co-morbid dementia. 22 failed the infusion study, 3 were felt to be false positives due to idiosyncratic activation of the Siphoguard (Codman Integra Inc.) shunt component. 15 underwent revision; 14 had patent proximal and distal catheters and underwent valve revision for suspected malfunction, one distal complete block was revised. 10 had improvements in gait and/or cognition, with 8 improving in both domains. Only one revision, the complete distal catheter block, improved to their best post-shunt status, the remaining improvements were modest and often short-lived.

CONCLUSIONS: CSF infusion studies are a useful adjunct in the diagnosis of shunt failure, helping avoid unnecessary revision. Idiosyncratic Siphoguard activation may result in a false positive result; if suspected, infusion at a slower rate is recommended to prevent this. Once patients deteriorate, improvements with adjustment/revision are often modest and short-lived.

EVALUATING THE ROLE OF NON-TARGETED EPIDURAL BLOOD PATCH IN THE MANAGEMENT OF SPONTANEOUS INTRACRANIAL HYPOTENSION

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BACKGROUND: Non-targeted epidural blood patching (EBP) is a widely accepted approach in the initial treatment of spontaneous intracranial hypotension (SIH). Current consensus guidelines recommend administering up to two non-targeted EBPs before considering myelography and targeted interventions. However, there is limited evidence to support this approach, and it may risk delaying the initiation of time-critical and efficacious targeted treatments.

OBJECTIVES: To evaluate the treatment outcomes associated with up to two initial non-targeted EBPs in the management of SIH.

METHODS: Patients with clinicoradiological evidence of SIH, treated with >1 non-targeted EBPs, and available pre- and post-intervention clinicoradiological data after the last of up to two non-targeted EBPs were included. Radiological data required MRI brain with contrast, with or without the whole spine. The data was analysed by a specialist SIH multidisciplinary team to assess treatment response. A complete treatment response was defined as achieving both clinical and radiological resolution.

RESULTS: Seventy-one patients were included. Forty-three (60.6%) received >2 EBPs. Orthostatic headache was present in 80.3% prior to treatment. Spinal longitudinal epidural collection was present in 56.3%. Following the last of a maximum of two non-targeted EBPs, clinical resolution was observed in 23.9% and radiological resolution in 5.6%. Non-targeted EBP was associated with a complete clinicoradiological resolution in only one patient.

CONCLUSIONS: Non-targeted EBP has a limited role in the curative management of SIH; early myelography and targeted treatment may help improve outcomes.

EVALUATING THE PREVALENCE AND CHARACTERISTICS OF ORTHOSTATIC HEADACHES IN POSTURAL TACHYCARDIA SYNDROME

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BACKGROUND: Postural tachycardia syndrome (PoTS) is often considered a differential diagnosis for orthostatic headache (OH), yet prospective studies exploring this association are lacking. It is also uncertain whether there are distinct features that can differentiate OH caused by PoTS from that caused by spontaneous intracranial hypotension (SIH).

OBJECTIVES: To conduct a prospective study assessing the frequency of OH in PoTS and phenotyping its characteristics.

METHODS: One hundred consecutive patients with PoTS were recruited after confirmatory tilt-table testing at a tertiary Autonomic Unit. Participants underwent a structured interview to assess the frequency of all headache types, including OH. OH was categorised as either a component of a primary headache disorder or as isolated OH unrelated to a comorbid headache disorder. When OH was reported, its characteristics were systematically phenotyped.

RESULTS: Isolated OH was identified in 20%; onset was episodic in 52.6%, beginning typically in context of PoTS onset/exacerbation. It was triggered consistently with change in vertical position in 5%. Co-existing primary headache disorder was noted in all PoTS patients; migraine in 88%. An orthostatic component as part of primary headache attacks was observed in 49%. Orthostatic component was present consistently - as part of each primary headache attack - in 12.2%. The onset and offset times for headaches upon changes in position were often rapid and aligned with the typical characteristics of OH seen in SIH.

CONCLUSIONS: By reporting the frequency of OH and its distinct characteristics in PoTS, this study will aid clinicians in making more informed decisions when managing patients with OH.

UTILITY OF BRAIN MRI WITH CONTRAST AND WHOLE SPINE MRI IN THE FIRST-LINE INVESTIGATION OF SIH

Dwij Mehta¹, Ayman M. Qureshi³, Sanjay Cheema¹, Shah Islam³, Salwa Kamourieh¹, Parag Sayal², Indran Davagnanam³, Manjit Matharu¹

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BACKGROUND: Spontaneous intracranial hypotension (SIH) patients often experience diagnostic delays due to incomplete imaging protocols. Despite recent guidelines recommending brain (contrast-enhanced) and spine MRI as first-line investigations, radiological workup is frequently limited to brain MRI alone in clinical practice. This study assesses the proportion of SIH cases that could be missed if only non-contrast brain MRI is utilised in the diagnostic process.

METHODS: This retrospective study reviewed initial brain (contrast-enhanced) and spine MRI of 100 SIH patients to assess the frequency of isolated pachymeningeal enhancement without other typical intracranial SIH signs and the frequency of isolated spinal longitudinal extradural collection (SLEC) without corresponding intracranial SIH signs.

RESULTS: The median symptom durations prior to the initial contrast-enhanced brain MRI and initial spine MRI were 82.5 days (IQR 170, range 0-2912), and 81.5 days (IQR 195, range 5-2912), respectively. Pachymeningeal enhancement without other intracranial SIH features was observed in 4% of patients, while SLEC without corresponding intracranial signs was found in 5%. Subdural collections ($U = 729.0$, $p = .011$) and SLECs ($U = 624.5$, $p < .001$) were linked to shorter disease duration before the initial MRI, whereas brain sagging was more frequent with delayed imaging ($U = 1155.0$, $p = .042$).

CONCLUSIONS: In suspected SIH cases, initial imaging should include contrast-enhanced brain MRI and whole spine MRI to prevent missed diagnoses in up to 9% of patients. There was a higher prevalence of SLEC and subdural collections with earlier imaging, whereas brain sagging was more common with delayed imaging.

Program

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2025 HYDROCEPHALUS

World Congress

5-8 September | Toulouse, France

www.hydrocephalus-meeting.com

USEFUL INFORMATION

Official Language

The official language of the Congress is English.

Venue & Dates



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Please download the EventsAir Mobile app for Android and iOS!

Login instructions for the app have been shared with you via email. In case you have not received this email, please kindly contact the Congress secretariat.

Social Events

Welcome Reception

Friday 05 September 2025, 19:30

Pierre Baudis Congress Center

Congress Dinner

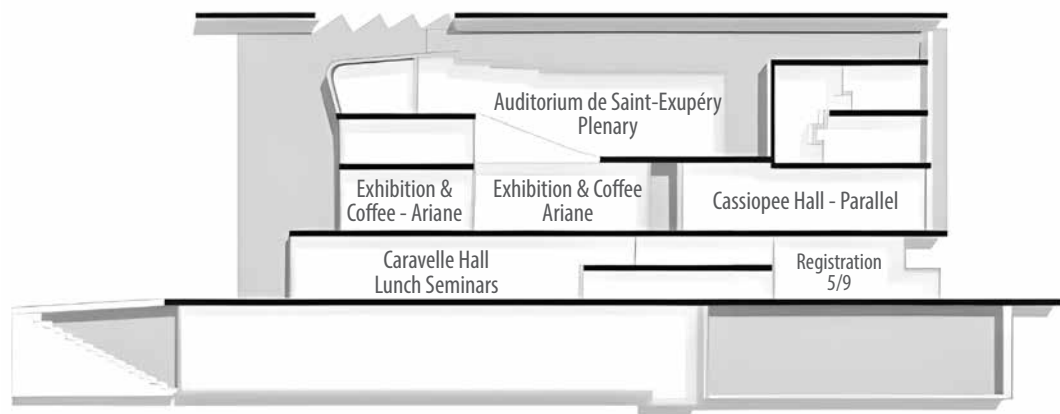
Join us at the Aeroscopia Museum for

Hydrocephalus 2025 Congress Dinner

Sunday 07 September 2025, 19:30



VENUE PLAN



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As seen in the picture above, the congress will be spread into 3 Areas:

Ground Floor

- Registration Area on 5/9
- Cloak Room
- Hall Caravelle 1+2: Educational Seminar on 5/9 and Lunch Seminars area on 6-8/9

1st Floor

- Ariane Lobby & Ariane 1 and 2: Exhibition area and Coffee Breaks
- Hall Cassiopee: Parallel Hall
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³ Brochure "In Hydrocephalus management Break Through the Uncertainty". Ref. 1296295-1-EN

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INDUSTRY SPONSORED LUNCH SEMINARS

Saturday, 6 September 2025



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Hall Caravelle 1-2, 12:50 - 13:50

Speakers:

Claudio G. Yampolsky, MD, PhD
Italian Hospital, Argentina

Alan Hoffer, MD
UH Cleveland Medical Center, USA

Stéphane Goutagny, MD, PhD
Beaujon Hospital, France

Yukihiro Goto, MD, PhD
Koto Memorial Hospital, Japan

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Sunday, 7 September 2025



ADULT HYDROCEPHALUS AND THE AGING BRAIN: A NEW THERAPEUTIC FRONTIER?

Chair: **Mats Tullberg**

Hall Caravelle 1-2, 12:45 - 14:00

Program:

Introduction, Epidemiology and Aging in iNPH

Mats Tullberg, *Sahlgrenska Academy, University of Gothenburg and Sahlgrenska University hospital, Gothenburg, Sweden*

This is what future holds for iNPH Physicians

Ahmed Toma, *National Hospital for Neurology and Neurosurgery (NHNN), Queen Square, UCLH NHS foundation trust London, UK*

Is Adult Hydrocephalus a Neurodegenerative Disease in the Older Population?

Eric Schmidt, *Hopital Purpan, Department of Neurosurgery Place du Dr Baylac Toulouse France*

iNPH from a geriatrician's perspective

Sevil Yasar, *Johns Hopkins School of Medicine Baltimore, USA*

Monday, 8 September 2025

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TELEMETRIC ICP MONITORING WITH M.scio® IN PRACTICE: EVIDENCE, EXPERIENCE, AND INNOVATION

Chair: **Dr. Laurence Watkins**

National Hospital for Neurology & Neurosurgery, Queen Square, London, UK

Hall Caravelle 1-2, 12:35 - 13:40

Program:

M.scio® - The Journey behind a Game-Changing Development in ICP Monitoring

Dr. Andreas Bunge, *Cristoph Miethke GmbH & Co KG*

Experience with M.scio® in managing patients with Idiopathic Intracranial Hypertension

Dr Samiya Abi Jaoudé, *Adolphe de Rothschild Foundation Hospital, Paris, France*

Redefining ICP monitoring: First Insights from a Next-Generation Telemetric System

Dr. Vincent Prinz, *University Hospital Frankfurt, Frankfurt, Germany*

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ROBERT H. PUDENZ AWARD

Awarding Excellence in Cerebrospinal Fluid and Hydrocephalus Research

Friday, 5 September 2025 at 15:45-16:15

WINNER: Maiken Nedergaard MD DMSc for the 2025 Pudenz Award.



Maiken Nedergaard, M.D., D.M.Sc. is a renowned Danish neuroscientist best known for her groundbreaking discovery of the glymphatic system, with major implications for neurodegenerative diseases like Alzheimer's. She serves as Professor of Neurosurgery and Neurology at the University of Rochester Medical Center and holds a joint appointment at the University of Copenhagen, where she co-directs the Center for Translational Neuromedicine. Dr. Nedergaard earned her M.D. and D.M.Sc. from the University of Copenhagen and completed postdoctoral training at both the University of Copenhagen and Weill Cornell Medicine.

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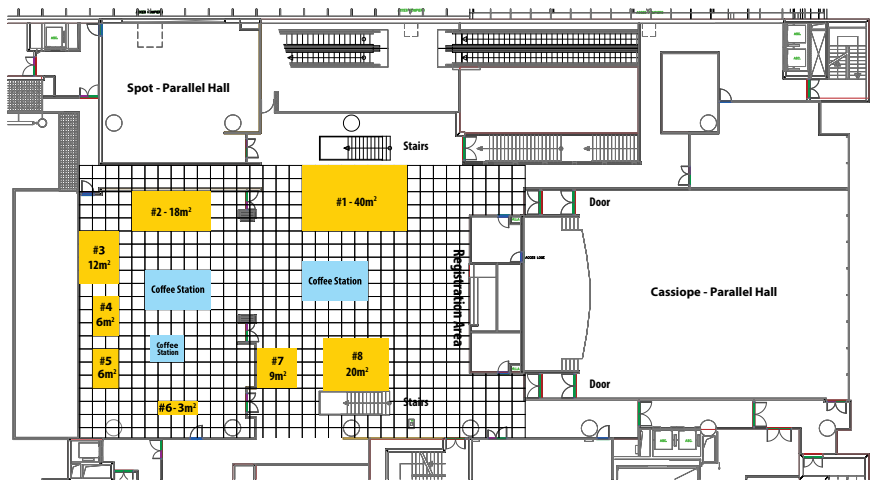
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ADDITIONAL INFORMATION

Secretariat & Information Desk

The Secretariat Desk will be located at the Congress Venue and will operate:

Friday, 5 September 2025, 14:00 - 18:00
Saturday, 6 September 2025, 07:00 - 17:00
Sunday, 7 September 2025, 07:30 - 17:00
Monday, 8 September 2025, 07:30 - 16:00

Name Badge

The Name Badge needs to be worn to get access to the Congress' sessions and its events.

Internet Facilities

Wi-Fi connection is provided at the Congress' premises.

Publication

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For any further information please contact the Congress' Secretariat.

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World Congress
5-8 September | Toulouse, France

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