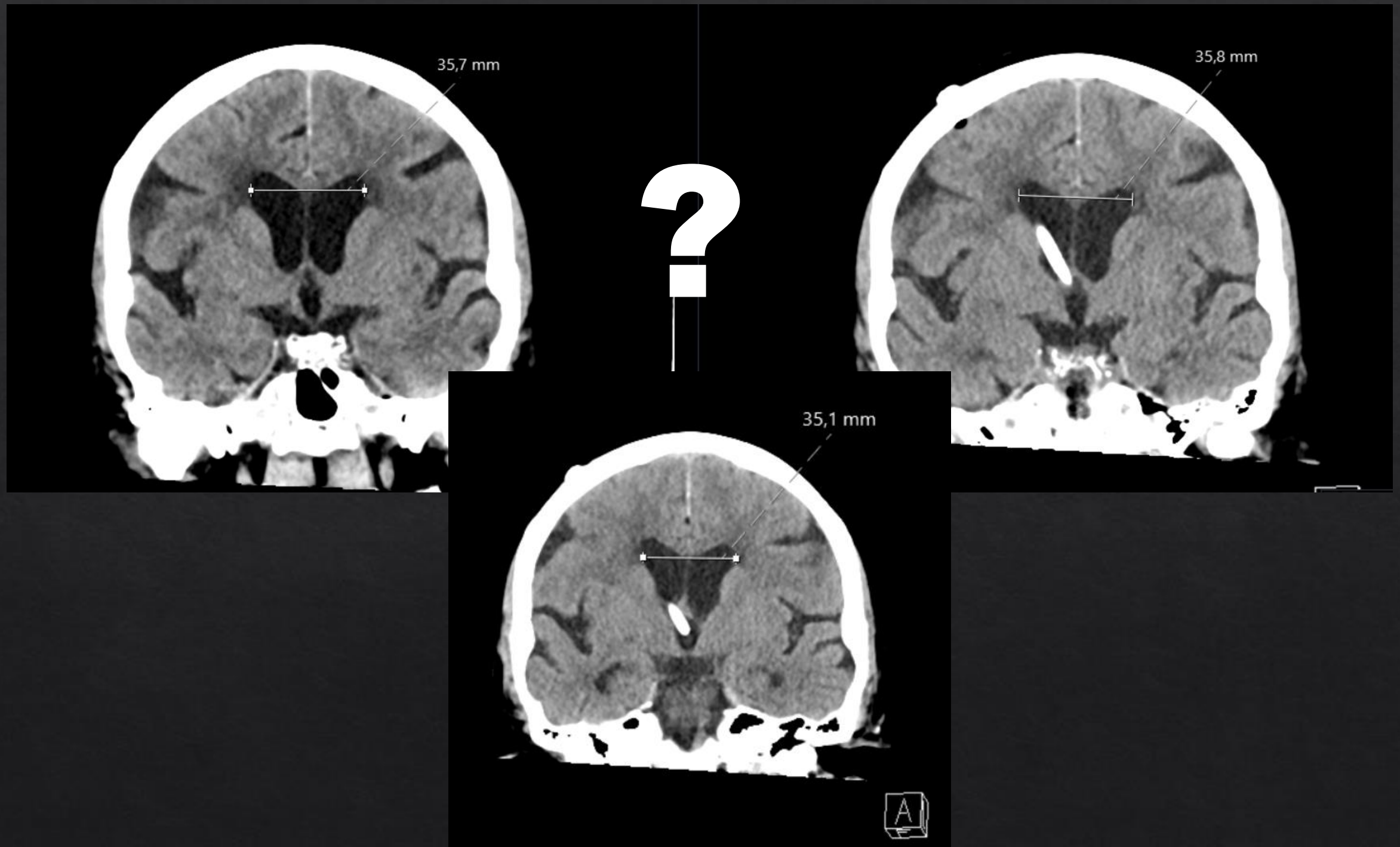
Longitudinal imaging in hydrocephalus -

Time to let go of 2D for 3D

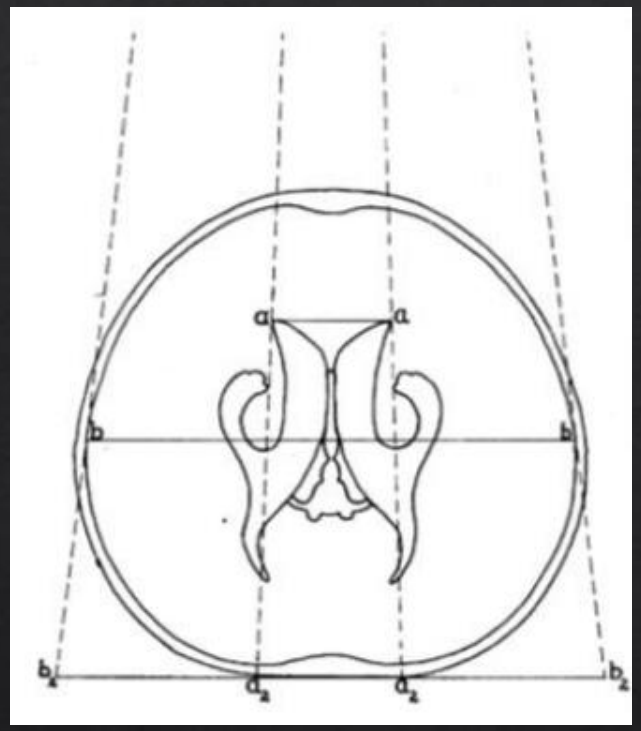
Rafael T Holmgren, MD

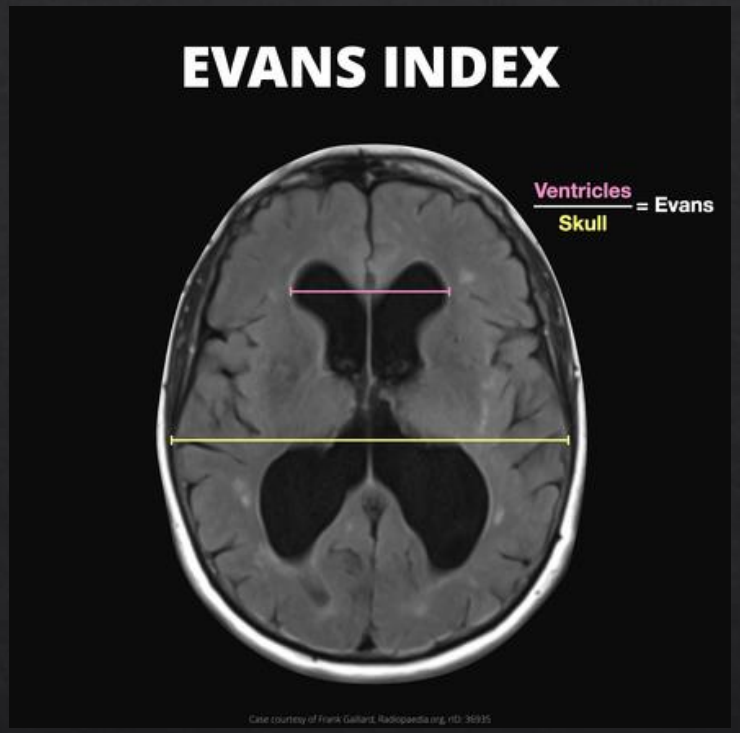
Head of pediatric neurosurgery & CSF disorders

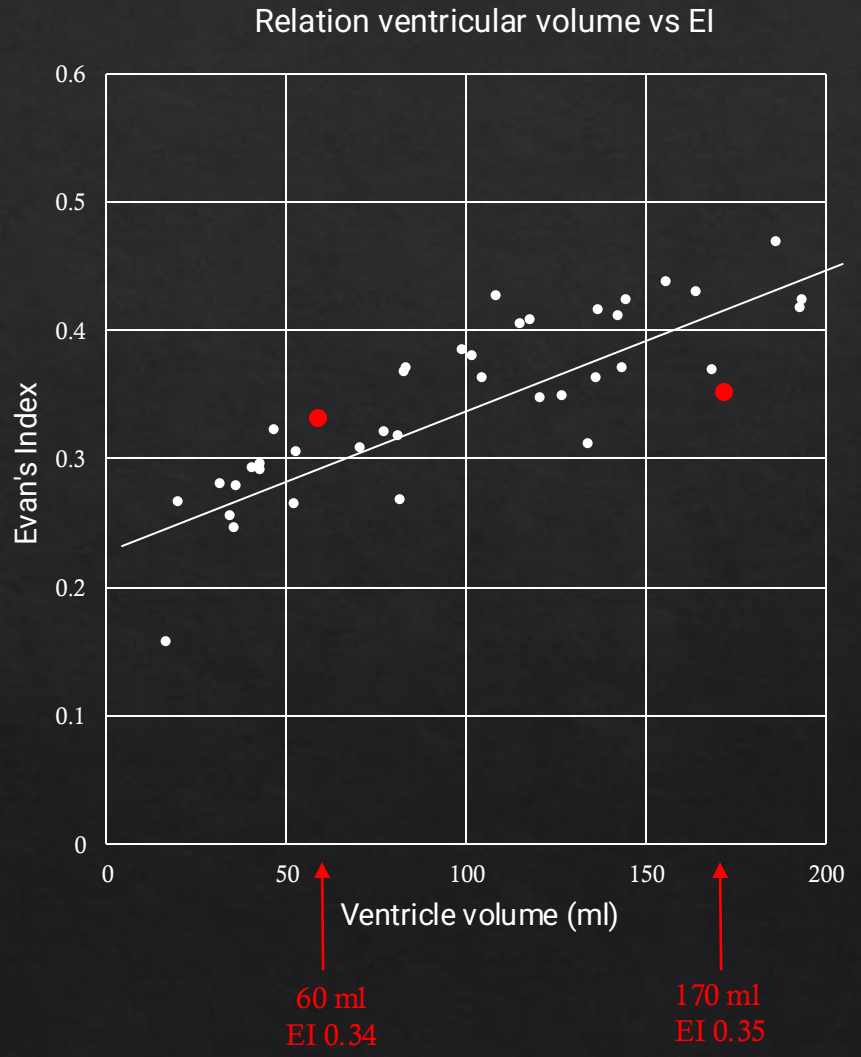
University Hospital Linköping
Sweden


35,7 mm
?
35,8 mm
35,1 mm
A

Evans and his index...







Evans' Index Revisited: The Need for an Alternative in Normal Pressure Hydrocephalus

Toma, Ahmed K FRCS (Neuro Surg); Holl, Etienne MD; Kitchen, Neil D MD; Watkins, Laurence D FRCS (SN)

Author Information

Neurosurgery 68(4):p 939-944, April 2011. | *DOI:* 10.1227/NEU.0b013e318208f5e0

Ventricular volumetry

AJNR

Ventricular Volume Is More Strongly Associated with Clinical Improvement Than the Evans Index after Shunting in Idiopathic Normal Pressure Hydrocephalus

J. Neikter, S. Agerskov, P. Hellström, M. Tullberg, G. Starck, D. Ziegelitz and D. Farahmand

AJNR Am J Neuroradiol 2020, 41 (7) 1187-1192
doi: https://doi.org/10.3174/ajnr.A6620
http://www.ajnr.org/content/41/7/1187

JNS

CLINICAL ARTICLE

Volumetric effect of shunt adjustments in normal pressure hydrocephalus: a randomized, double-blind trial

Simon Lidén, MD,[1,2] Dan Farahmand, MD, PhD,[3] and Katarina Laurell, MD, PhD[1,4]

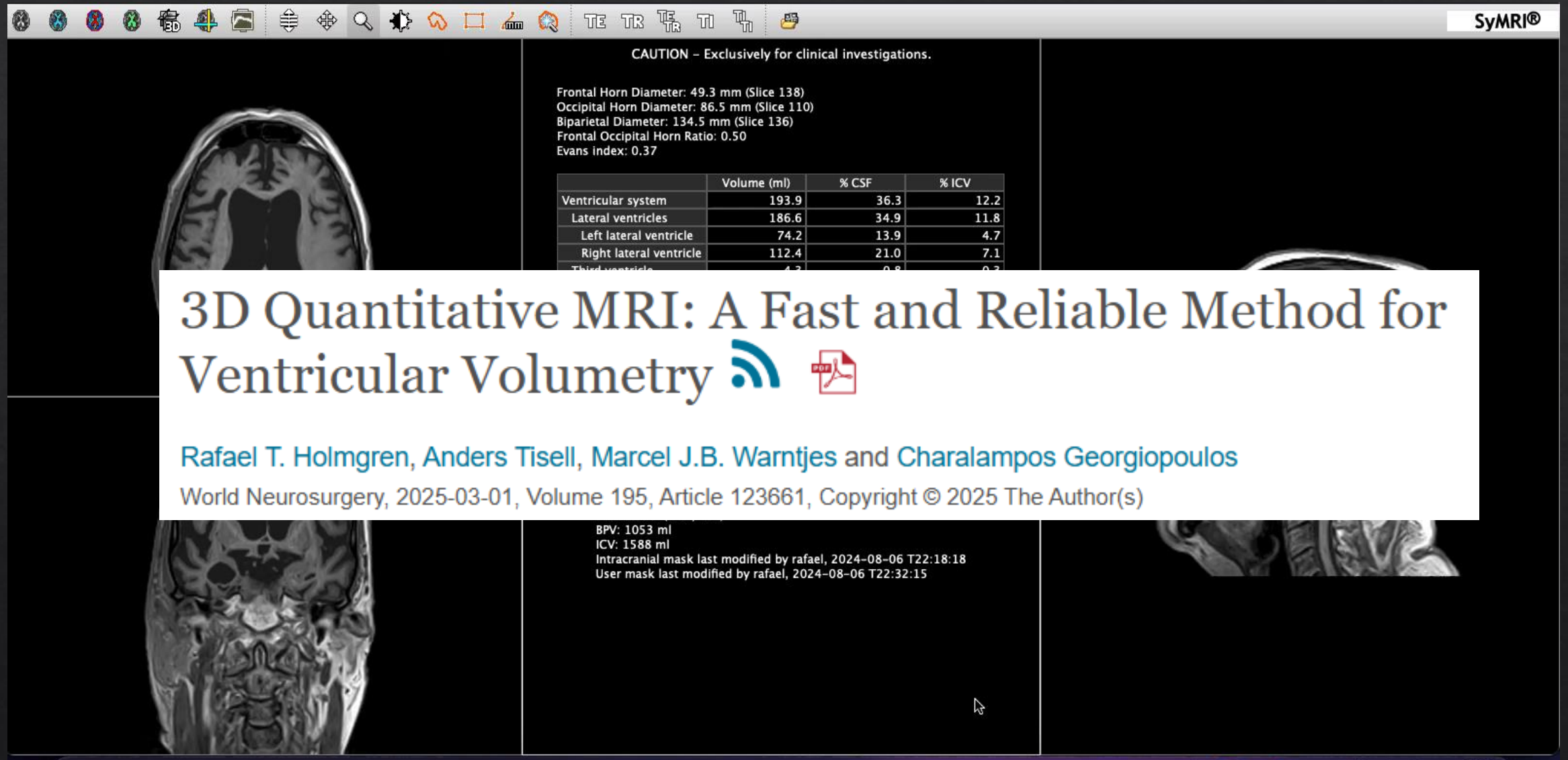
Longitudinal changes in ventricular volume after treating aqueduct stenosis through endoscopic third ventriculostomy in adults

Florian Ebel, Caterina Mariani, Raphael Guzman & Jehuda Soleman

Fluids and Barriers of the CNS **22**, Article number: 42 (2025) | Cite this article

Quantitative MRI - qMRI

SyntheticMR



3D Quantitative MRI: A Fast and Reliable Method for Ventricular Volumetry

Rafael T. Holmgren, Anders Tisell, Marcel J.B. Warntjes and Charalampos Georgiopoulos

World Neurosurgery, 2025-03-01, Volume 195, Article 123661, Copyright © 2025 The Author(s)

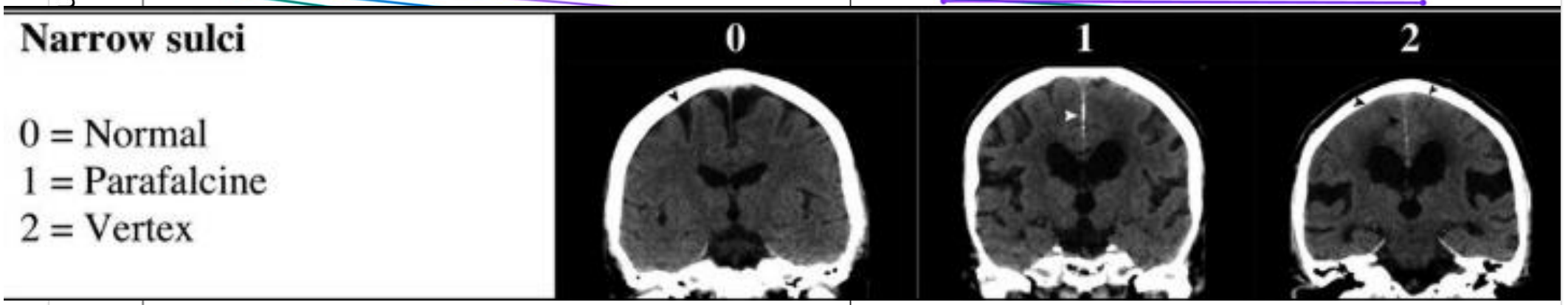
A randomized double-blinded clinical study of early volumetric changes after shunt surgery and MRI-resistance of the Codman Certas® Plus shunt valve

--Manuscript Draft--

	Valve set to 4	Valve set to 8	P
Reduction of ventricular volume from pre- to postop MRI (ml)	16 (9)	5 (5)	**<0.001**
% left of preop ventricular volume	88 (0.07)	96 (0.03)	**<0.001**
Reduction of ventricular volume - %	12	4	

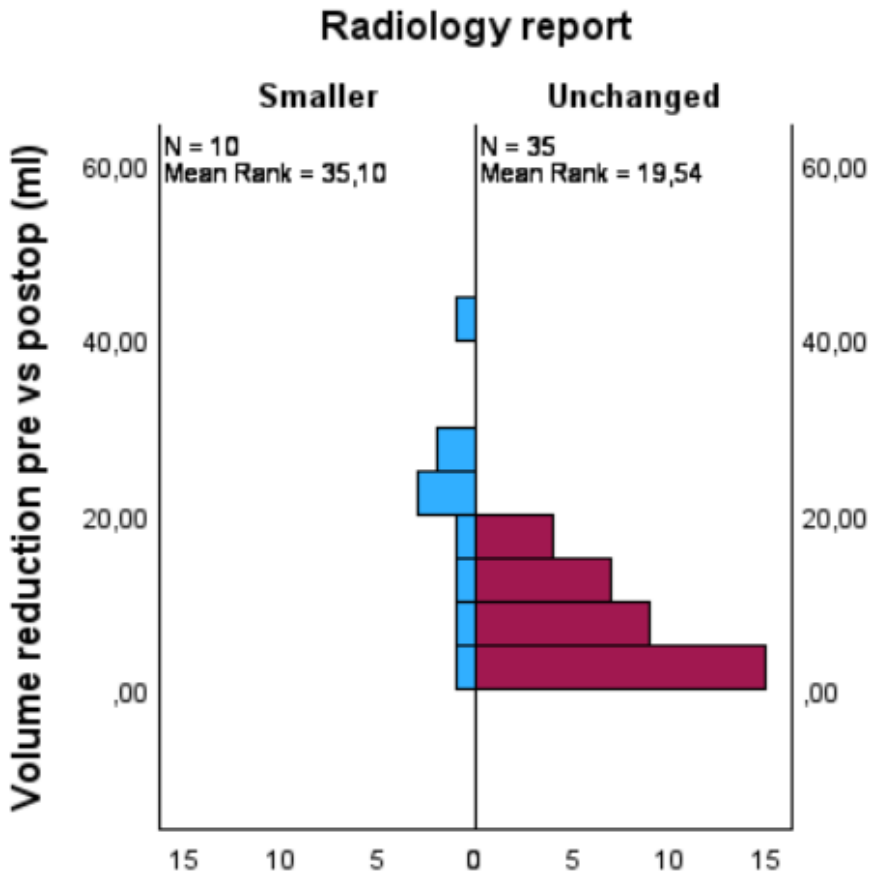
A | Valve setting 4 B | Valve setting 8

		Whole sample	Valve set to 4	Valve set to 8	P-value
Narrow sulci (0-2)	pre op	0.4 (0.62)	0.4 (0.60)	0.4 (0.65)	0.42
	post op	0.3 (0.46)	0.1 (0.31)	0.4 (0.51)	**0.006**



Preop Postop Preop Postop

Radiologists ability to detect smaller ventricles using traditional MRI images

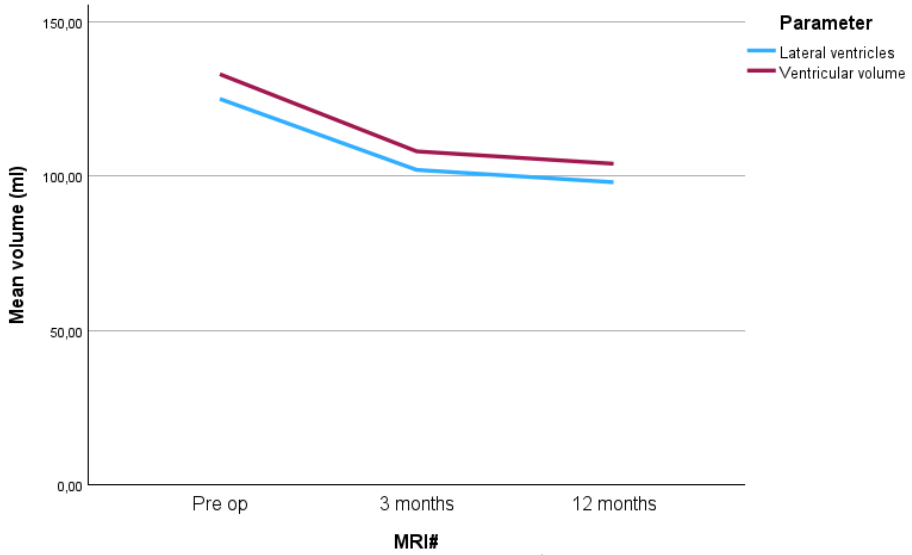


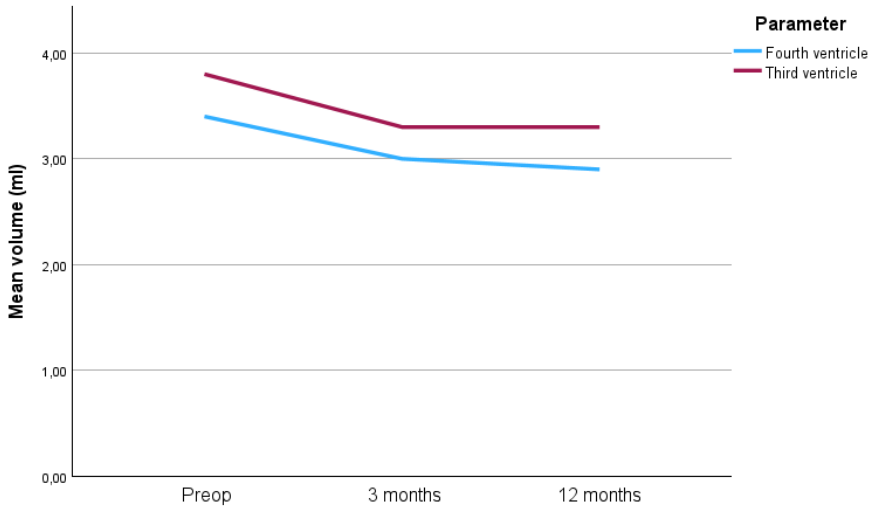
	"Smaller"	"Unchanged"	P-value
No of patients	10	35	
Mean volume reduction between pre- & postop MRI (ml)	20 (12)	7 (6)	0.001
Percentage of ventricle reduction (%)	15 (8)	5 (4)	0.001

Radiological and clinical outcomes up to 1 year

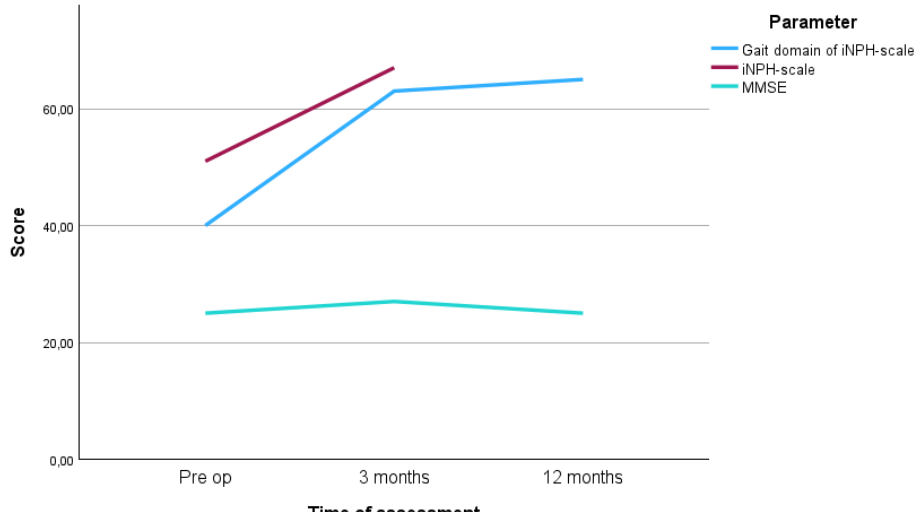
	PRE-OP BASELINE	POST-OP 3 MONTHS	p	POST-OP 12 MONTHS	p
Evan´s index	0.36 (0.03)	0.37 (0.04)	0.2	0.36 (0.03)	0.5
Automated ventricular volume (ml)	132 (33) = 100 %	107 (33) = 81 %	**0.001**	103 (32) = 78 %	0.07

Ventricular volumes:





Clinical outcome:

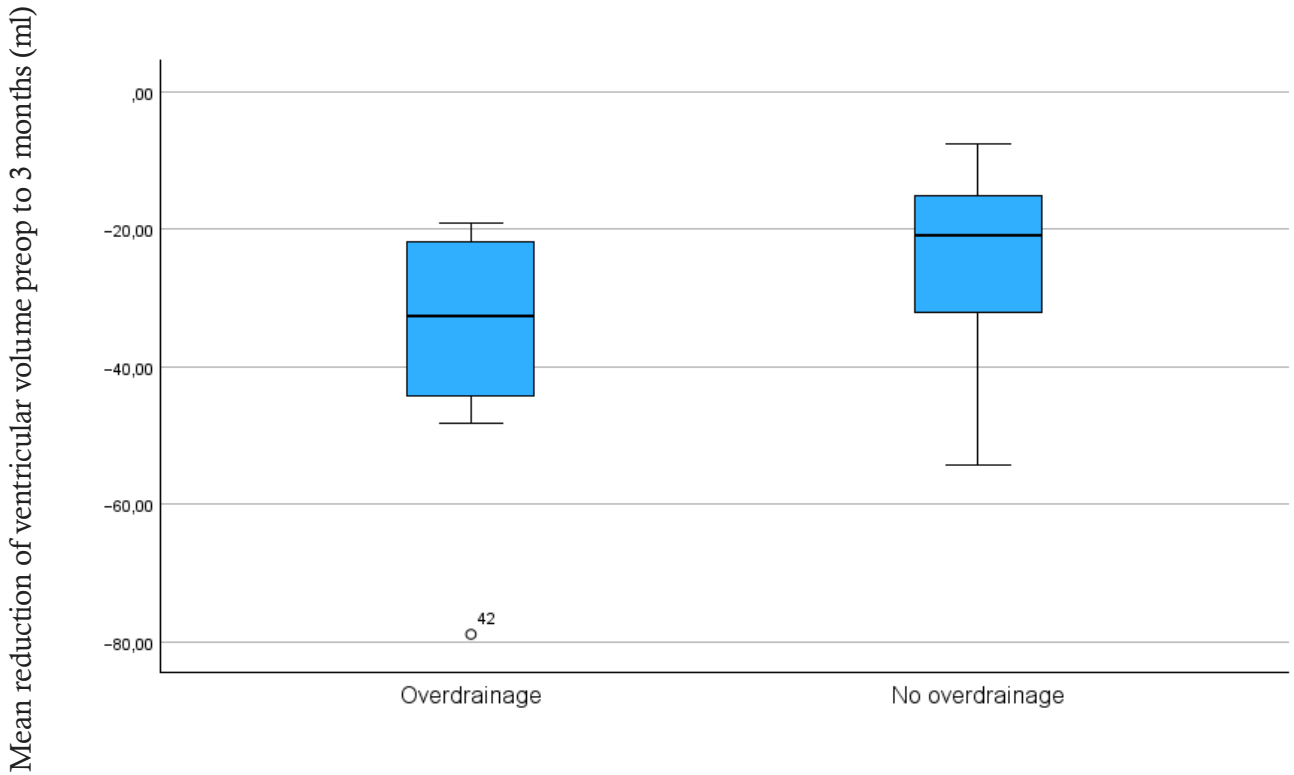


Region Östergötland

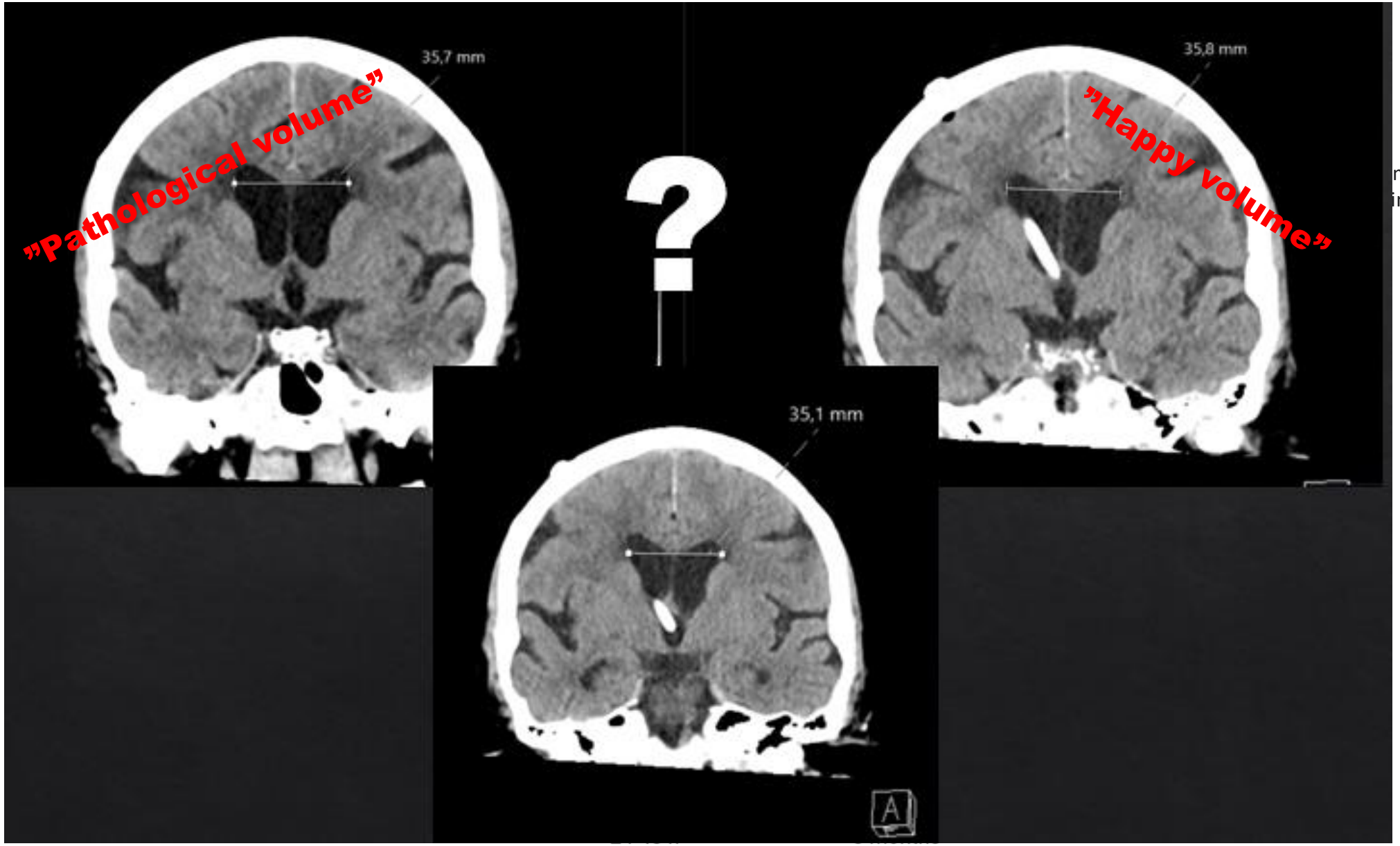
Overdrainage symtoms vs no overdrainage @ 3 months

Complaints @ 3 months 42 patients	Overdrainage	No complaints	P
No of patients (%)	7 (17 %)	35 (83 %)	
Symptoms	Postural headaches (7) Vertigo (4) Tinnitus (5)		
Ventricular volume preop (ml)	147 (36)	132 (34)	0,3
Average ventricular volume at 3 months (ml)	109 (48)	107 (30)	0,9
Reduction of VV from preop to 3 months (ml)	– 38 (21)	– 24 (12)	**0,03**
Fraction of MRI 3M/preop	71 % (22)	81 % (9)	**0,05**
Reduction of ventricular volume (%)	29 %	19 %	
Patients with early overdrainage treated before MRI @ 3 months (N)	2		
Patients excluded @ 3 months due to overdrainage events (N)	Hygromas (2) Chronic subdural hematoma (1)		
Overall clinical overdrainage frequency	12/45 = 28 %		
Treated with valve adjustment only	8/45 = 18 %		
Reop with antisiphoning device	4/45 = 9 %		

Values are means (SD) unless otherwise stated.
Comparisons made using independent samples t-test



months
inage @ 3 months



Back to pathological volume – shunt valve adjustment or revision
Happy volume – shunt functional, seek other cause
Even smaller volume – overdrainage, adjust valve

Conclusions

- Volumetry is the better alternative
- Softwares have improved significantly
- qMRI provides reliable automated anwers from a 6 minute MRI scan
- Volumetry holds promise as a non-invasive tool to assess:
  - Shunt failure
  - Overdrainage

- Let´s start using it!

Ventricular volumes up to 3 years post op in 7 patients