



Disproportionately Enlarged Subarachnoid-space Hydrocephalus (DESH): Evaluation of Its Usefulness in the Diagnosis of Idiopathic Normal Pressure Hydrocephalus (iNPH).

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The accurate diagnosis of iNPH and the prediction of its outcome following shunt placement still remains a challenge. MRi is a powerfull non-invasive tool for the evaluation of this disorder. The narrowing of the cerebrospinal fluid space at high-convexity and midline areas with enlarged ventricles and expanded Sylvian fissure have been reported to be a morphologically distinctive feature of iNPH that supports the diagnosis of shunt-responsive iNPH. We conducted a single-center prospective cohort study to assess the value of these findings in the diagnostic and prognostic of iNPH.

Methods

We conducted a single-center prospective cohort study recruiting iNPH suspected patients beginning in January 2011, with last follow-up completed on December 2013. The inclusion criteria were: (1) aged between 60 and 85 years, (2) presence of one or more symptoms of the classic triad (gait disturbance, urinary incontinence, dementia) measurable on the iNPH Grading Scale proposed by Sahuquillo et al., (3) MRi findings of ventriculomegaly of Evans’ index > 0.3, (4) absence of other diseases that could explain clinical symptoms, (5) no obvious preceding diseases possibly causing ventricular dilatation, and (6) written informed consent given by the patient or his representatives.

We used preoperative MRi to evaluate the presence or absence of morphologic distinctive features of iNPH in the suprasylvian and sylvian subarachnoid spaces by visual assessment (Figure 1), and we measured the callosal angle on coronal T1-weighted images as suggested by Ishii et al. ICP monitoring was performed with an intraparenquimal Codman ICP MicroSensor during 24 hours. Both static ICP and pulsatile ICP were analyzed using LabChart software.

All patients received a ventriculoperitoneal shunt using Codman Hakim programmable valves with an initial pressure setting of 11cmH2O. Clinical assessments were performed using the iNPHGS and the modified Rankin Scale both before surgery and at 12 months after surgery.

Table 1 Baseline characteristics of the study participants (n=89)

Age	72.5 ± 6.6
Sex	
male	42 (47.2%)
female	47 (52.8%)
CVRF	36%
Evan’s Index	0.366 ± 0.051
iNPH total score	12 (11 – 13)
gait score	4 (3 – 4)
cognitive score	4 (4 – 4)
urinary score	4 (3 – 4)
Modified Rankin Score	2 (1 – 2)
Data are mean ± standard deviation, median and IQR or percentage.	

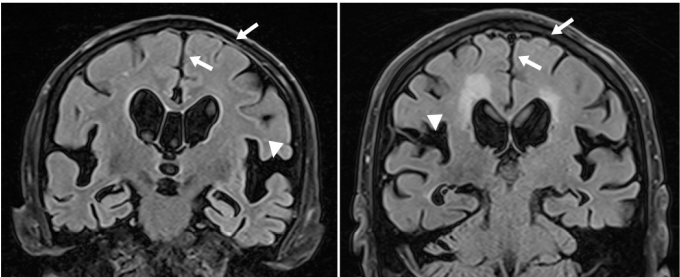


Fig. 1 iNPH findings on MRi: Coronal FLAIR images selected from 2 included patients showing tight high-convexity and medial surface subarachnoid spaces, enlarged ventricles and expanded Sylvian fissures.

Shunt responder was defined as improvement by one point or more on the iNPHGS at one year after surgery.

Results

A total of 89 patients were included in the study, 42 men and 47 women with a mean age of 72.5 ± 6.6 (SD). The baseline characteristics of these patients are summarized in Table 1. Objective symptoms measurable on the iNPHGS were noted in 96.6% for gait disturbance, 75.3% for cognitive impairment, and 78.7% for urinary symptoms. The visual assessment of MRi revealed the presence of DESH findings in 56 of 89 patients (62.9%) (Table 2).

Shunt surgery was successfully completed in all patients. Clinical improvement of one point or more on the iNPHGS after one year (shunt responder) was achieved in 64 of the 89 patients (71.9%). The functional improvement was significantly different with a follow-up score of 14 (13-15) (median,IQR) p<0.001 (Table 3). The distributions of patients’ functional status at baseline and at 12 months are presented in Figure 2.

Table 2 Results of diagnostic tests in shunt responders and non responders

	Responder n=64	Non-responder n=25	p value
DESH positive n=56	91.1%	8.9%	p<0.001 ^a
DESH negative n=33	39.4%	60.6%	
Mean ICP pulse amplitude (mmHg)	15.5 ± 5.8	4.3 ± 3.3	p<0.001 ^b
ICP Pulsatility ≥ 5,2 (mmHg) n=61	96.7%	3.3%	p<0.001 ^a
ICP Pulsatility < 5,2 (mmHg) n=28	17.9%	82.1%	
B-Wave frequency (%)*	19.1% ± 9.1	10.9% ± 7.5	p<0.001 ^b
CC Angle (°)	35.8° ± 14.7	57.8° ± 13.7	p<0.001 ^b

Data are percentage per row, or mean ± standard deviation.
a. Chi-square test, b. t-test, * percentage of 30-second time periods with a mean ICP higher than 15 mmHg.

Shunt responders were more likely to present with preoperative DESH findings on MRi with a sensitivity of 79.7% and a specificity of 80%. Among the 56 patients presenting with DESH findings 51 where found to be shunt responders, with a positive predictive value of 91.1% (p < 0,001), showing a clinical improvement of 2 (2–3) (median,IQR 25th-75th) points on the iNPHGS at one year follow-up (p<0,001).

Fig 2 Bar charts showing patients' functional status based on the iNPHGS

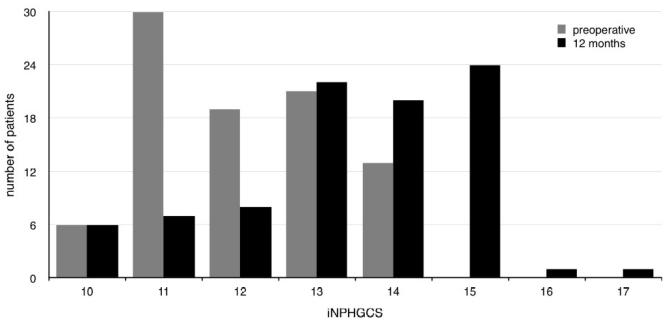


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Conclusions

Disproportionately enlarged subarachnoid space hydrocephalus MRi features support the diagnosis of iNPH and provide additional prognostic value for predicting shunt-responsive patients. Our data indicates that improvement after surgery can be anticipated in 9 of 10 iNPH patients with DESH findings. Preoperative MRi evaluation of iNPH patients may aid in a non-invasive selection of candidates for surgery.

Disclosure

The authors report no conflict of interest concerning the materials or methods used, or the findings specified in this study.