



MRI study of morphologic features and CSF flow study to predict ventriculoperitoneal shunt responsiveness in patients with normal pressure hydrocephalus.

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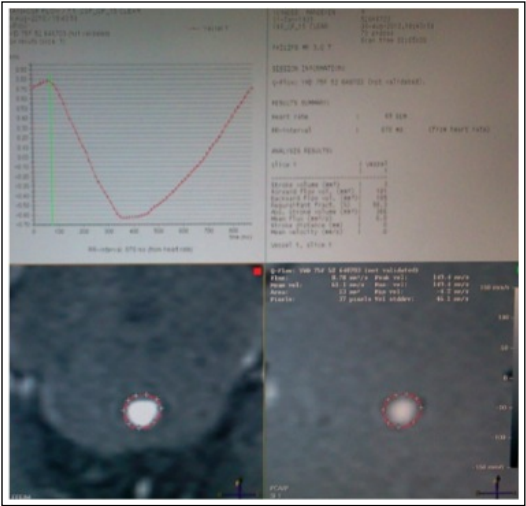


Introduction

To determine the predictor for shunt responsive cases in patients with normal pressure hydrocephalus (NPH) by means of conventional MRI and CSF flow study at Siriraj hospital.

Methods

The retrospective study was performed in patients suspected NPH and underwent MRI CSF flow measurement. The routine brain MRI was performed for anatomical assessment (narrowing parasagittal high convexity, bowing corpus callosum, widening sylvian fissure, callosal angle, Evans index, focal dilated sulci, and white matter change in term of Fazeka’s core) and 2D-phase contrast technique was used as CSF flow analysis at the aqueduct of sylvius (Achieva, 3 Tesla Philips, Best, the Netherlands).



VENC initial 10 cm/s, and adjust increasingly if aliasing artifact was presented. Flow measurement was done on non-aliasing artifact image. ROI was placed at middle part of cerebral aqueduct on axial view.

The preoperative and postoperative clinical outcomes (cognitive, gait, urinary incontinence) according to the iNPHGS (idiopathic normal pressure hydrocephalus grading scale) were collected and analyzed to determine predictive value of MRI study in shunt responsive patients.

grade	Gait disturbance	Urinary disturbance	Cognitive impairment
0	normal	normal	Normal
1	complaints of dizziness or drift and dybbasis but no objective gait disturbance	Pollakiuria or urinary urgency	complaints of amnesia or inattention but no objective memory and attentional impairment
2	Unstable but independent gait	occasional urinary incontinence (1-3 or more times per week but less than once per day)	existence of amnesia or inattention but no disorientation of time and place
3	Walking with any support	Continuous urinary incontinence ≥ 1 per day	existence of disorientation of time and place but conversation is possible
4	Walking not possible	bladder function is almost or completely deficient	disorientation for the situation or meaningful conversation impossible
iNPH grading scale		Kubo K et al. Dement Geriatr Cogn Disord 2008	

Results

During 5 years periods (2006-2011), 33 patients with clinical diagnosis of NPH(iNPH = 22) were treated with ventriculoperitoneal shunt placement and all improved at least 1 INPHGS. Twenty-one cases of 33 were defined as significant responsive group for overall improvement of outcome (sum of INPHGS equal or more than 3).

Using a mean velocity threshold 27 mm/sec to identify the significant responsive group, the sensitivity was 70%, specificity 80%, positive predictive value 87.5% and accuracy 73.3%. With the peak velocity threshold of 62 mm/sec, the sensitivity, specificity, positive predictive value and accuracy were 76.2%, 75%, 84.2%, 75.8% respectively. Less patients with severe white matter change(Fazeka grade 3,4) were shunt responsive (36.3% VS 66.7%).

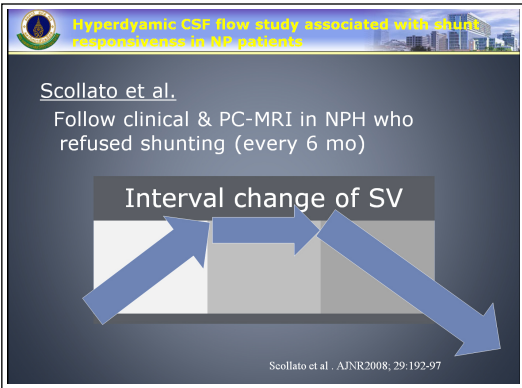
Type	studies	findings	Sensitivity	specificity
MRI Morphology	Kim MJ et al. (2011)	Evans index > 0.3 in Dx NPH	87.5%	80.0%
	Rekin N et al. (2005)	Evans index > 0.3 in Dx NPH	> 80.0%	74.0%
	Waldemar et al. (1993)	Evan index > 0.35 predict shunt response	50.0%	100.0%
	Kitapaki et al. (1998)	Enlarged sylvian fissure and focal dilate sulci predict shunt response	71%(axial) 74%(coronal)	97%(axial) 92%(coronal)
	Adachi et al. (2006)	Narrowing posterior cingulate sulcus	100%	100%
	Izhi et al. (2008)	Callosal angle < 90°	97.0%	88.0%
This study		No correlation of morphologic findings vs. clinical improvement after shunting		

Type	Studies	findings	Sensitivity	specificity
MRI CSF dynamics	Poca et al. (2002)	High velocity	90%	50%
	Bradley et al. (1991)	High velocity		
	Sharma AK et al. (2008)	PV 8.9-25.84 (14.4 cm/s)		
	This study	PV ≥ 62 mm/s	76.2%	75.0%
		MV ≥ 27 mm/s	70.0%	80.0%
	Luetmer et al. (2002)	flow rate> 18 ml/min		
	Parkkola et al. (2000)	Flow rate> 10 ml/min		
	Al-Zaini FT et al (2009)	Flow rate 24.5 ml/min	46%	95%
	Egeler-Peerdeman SM et al. (1998)	CFS flux twice of normal range		
	Dixon et al. (2002)	Increased CSF flow not significant related with shunt response		
	This study	Flux ≥ 0.22 mm³/s	66.7%	60.0%
	Bradley et al. (1996)	Stroke volume > 42 µl	80%	100.0%
	Babar et al. (2007)	Stroke volume NOT useful for shunt prediction		

Five of six cases with clinical diagnosis of Alzheimer’s disease were improved in cognitive outcome.

Conclusions

Using available commercial software in the authors’ institution, hyperdynamic CSF Flow parameters (Flux = 0.22 mm³/s, MV = 27 mm/s, and PV = 62 mm/s) can predict shunt responsiveness in NPH patients with high sensitivity and specificity. Severity of white matter change on conventional MRI can predict negative response of urinary magnitude in NPH patients.



The reason of significant responsive shunted NPH patients associated with high mean and peak velocity may explain by the study of Scollato A et al that shows changes in aqueductal stroke volume and progression of symptoms in unshunted NPH. Patients with lack of hyperdynamic CSF flow are likely to become less responsive to VPS.

Learning Objectives

By the conclusion of this session, participants should be able to predict shunt responsive in NPH patients using conventional MRI and CSF flow study.

References

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