

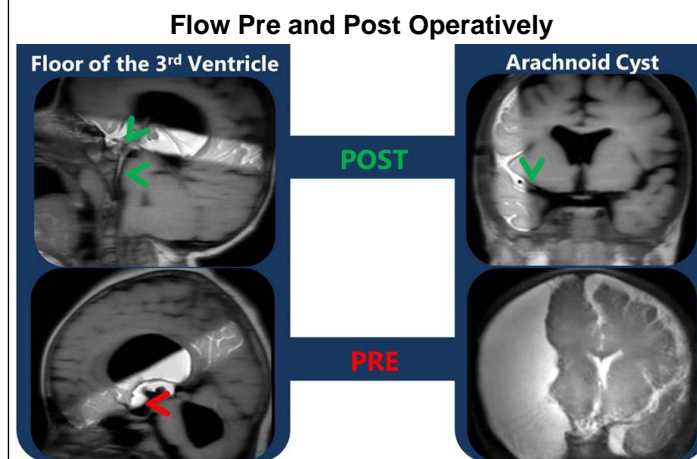
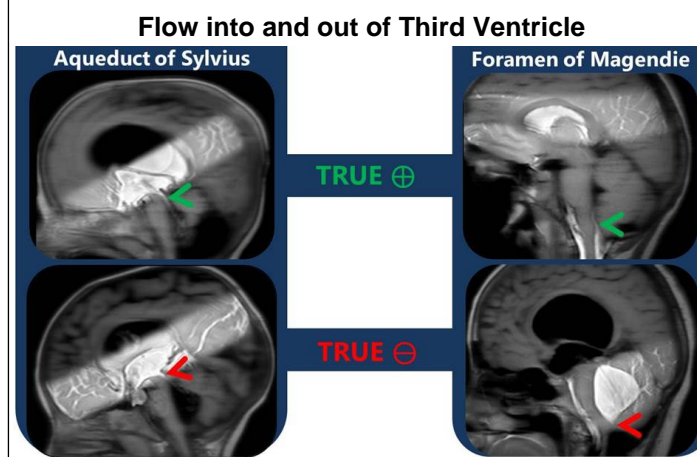
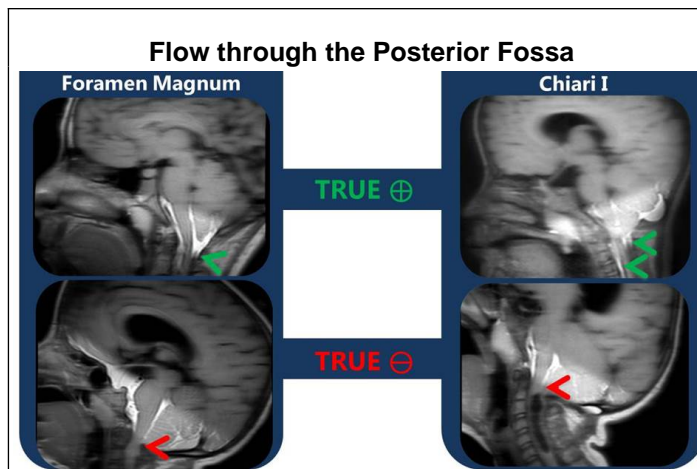
Using MRI to Establish Patency Between Adjacent CSF Compartments




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Introduction

The ability to establish patency of cerebral spinal fluid (CSF) flow between adjacent central nervous system (CNS) compartments is of importance in the diagnosis and treatment of patients with CSF flow obstruction in various areas. The method described was originally derived from arterial spin labeling (ASL) of blood flowing in vessels. This technique, referred to as time-spatial labeling inversion pulse (time-SLIP), was further modified to non-invasively visualize CSF pulsatile and turbulent flow between two regions of interest.



		Tagging Site			
		FMag	AS	3 rd V	FM
Positive	TRUE	49	40	15	9
	FALSE	0	0	0	0
Negative	TRUE	3	20	2	0
	FALSE	2	10	3	2
Total		54	70	20	11
Specificity		100%	100%	100%	n/a
Sensitivity		95%	80%	83%	82%
Negative Log Likelihood		0.04	0.20	0.17	n/a

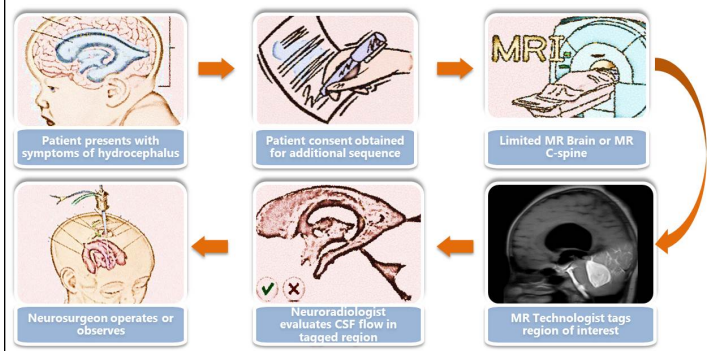
Discussion

This is a straightforward noninvasive method for determining whether CSF can flow between two spaces and whether flow has been restored after surgical intervention. This technique can be used post-endoscopic third ventriculostomy to evaluate the patency of the fenestration by observing CSF flow between the third ventricle and the basal cisterns, in addition to evaluating pre- and postoperative craniocervical decompression changes to CSF flow. This ASL variant is especially useful in regions where it is difficult or impossible to visualize CSF flow with phase contrast, such as in the lateral ventricles, subarachnoid spaces, or within a cyst, where there exists an absence of pulsatile flow.

Conclusions

Establishing qualitative patency between adjacent CSF compartments using MRI is possible with a modified ASL technique. The freely selectable tag allows CSF flow to be visualized in any direction or location. This technique can be used post-endoscopic third ventriculostomy to evaluate the patency of the fenestration in addition to evaluating pre- and postoperative craniocervical decompression changes to CSF flow. This technique has excellent (above 80%) sensitivity, specificity, and negative likelihood ratio at all sites studied.

Collaborative workflow required to implement this CSF visualization technique in a hospital setting



Methods

The presence of CSF flow was examined at the foramen Magnum (FMag), the aqueduct of Sylvius (AS), the floor of the third ventricle (3rd V), and at the foramen of Monro (FM). The studies were compared with clinical information and classified as true positive, true negative, false positive, and false negative based on expectation of patency.

References

1. Yamada, S. (2015). Physiological variability in CSF motion using magnetic resonance time spatial labeling inversion pulse (Time-SLIP)-real time imaging. *Fluids and Barriers of the CNS*, 12(Suppl 1), O27.
2. Yamada, S., Goto, T., & McComb, J. G. (2013). Use of a spin-labeled cerebrospinal fluid magnetic resonance imaging technique to demonstrate successful endoscopic fenestration of an enlarging symptomatic cavum septi pellucidi. *World neurosurgery*, 80(3), 436-e15.