

THE ROLE OF MRI-CSF FLOWMETRY IN THE EVALUATION OF POST ENDOSCOPIC THIRD VENTRICULOSTOMY

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Introduction

The intracranial volume is made up by the CSF volume, the blood volume and the brain parenchyma. The inflow of blood to the skull in systole temporarily increases the intracranial volume. According to the Monroe-Kellie doctrine an increase in one volume should cause a decrease in one or both of the remaining two volumes in order to maintain constant volume. The imbalances that occur in this process of cerebral homeostasis have been linked to different pathologies.

Endoscopic third ventriculostomy is used as an aqueductal bypass procedure for the treatment of obstructive hydrocephalus. Early indications for ETV included hydrocephalus due to congenital and acquired aqueduct stenosis secondary to brainstem and tectal tumors. Today, many patients with hydrocephalus may be considered candidates for ETV.

The cine sequences of phase contrast MRI with cardiac synchronism allow quantifying the CSF flow during a cardiac cycle.

The PC technique provides data about CSF flow velocity and direction during a single cardiac cycle. Not only quantitative velocity information is available, but the image format provides a visual display of the velocity distributions.

The Cine PC-MR technique to confirm CSF flow has been regarded as a standard method for evaluating the patency of a third ventriculostomy. Patency on cine PC-MR Images correlates well with clinical prognosis.

Aim of the work

The aim of the work was to demonstrate the role of phase-contrast magnetic resonance imaging in assessment of post endoscopic third ventriculostomy (ETV).

Patients and Methods

PATIENTS: The study was conducted upon 16 patients concerned with obstructive hydrocephalus who underwent ETV operation.

Patients referred to MRI unit of the diagnostic radiology and medical imaging department of Alexandria university hospital.

METHODS: All patients included in the study were subjected to the following:

- Thorough history taking including operative data.
- Conventional magnetic resonance imaging including (axial T1, axial T2, sagittal T1, sagittal T2 and thin cuts 0.5mm SSFP.)

- Two series of cine phase-contrast MR imaging techniques were applied after performing spin-echo coronal T1-weighted images to locate the third ventriculostomy and evaluating ventricular size after surgery:
- In the axial plane, with through plane velocity encoding in the craniocaudal direction for flow quantification.
- In the sagittal plane, with in-plane velocity encoding in the craniocaudal direction for qualitative assessment.
- Measurements were done using retrospective peripherally gated PC cine MRI (data retrospectively reconstructed according to pulsimeter systolic peak as detailed previously) on a 1.5 Tesla MR System.

Results

Among the 16 patients included in the study; 13 cases (81.2%) showed morphologically patent ETV stoma including 12 patients with detected flow across the stoma and one case with no detected flow despite a morphologically patent stoma , the remaining 3 cases (18.7 %) showed obstructed stoma with absent flow .

In all patients with morphologically patent ETV stoma, the following CSF flowmetry measurements were calculated to assess the functional status of the stoma.

- Stroke volume, which is the mean volume of CSF passing through the aqueduct during both systole and diastole a value > 75 microliters is a strong indicator of ETV patency and successfulness.
- Peak systolic velocity, which is highest CSF velocity during systole.

Table (1):

ETV patency (CSF flowmetry)	No.	%
Stroke volume	(n = 12) [#]	
Min – Max.	6.0 – 700.0	
Mean ± SD.	147.3 ± 195.4	
Median	93	
Peak systolic velocity	(n = 12) [#]	
Min – Max.	0.6 – 16.9	
Mean ± SD.	6.13 ± 4.6	
Median	5.9	

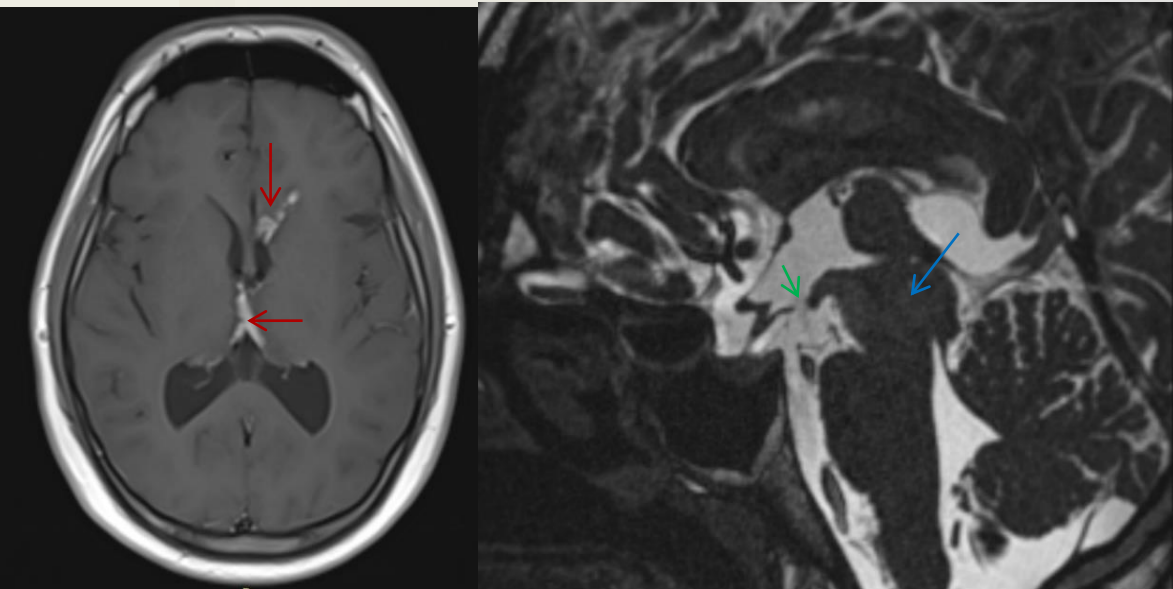


Figure (1) : Figure (1): (left) axial post contrast T1 images show enhancing subependymal and intraventricular lesions (black arrows) with resolution of the hydrocephalus. (Right) Sagittal T2 DRIVE images show morphologically patent ETV stoma (green arrow) as well as obstructed aqueduct (blue arrow).

Conclusion

- PC MRI is a reliable method in evaluation of ETV patency.
- Follow up with PC-MRI CSF flow is recommended to assess the flow parameters especially when low stroke volume is noted in the immediate postoperative study.
- Adding SSFP is very helpful adjuvant in the assessment of CSF pathway and excellent demonstration of the surgical defect and causes of aqueductal obstruction.