

Role of MRI in Assessment of hydrocephalus in Pediatric Patients

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radiodiagnosis**

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Abstract

- Hydrocephalus can be defined broadly as a disturbance of formation, flow or absorption of CSF that leads to an increase in volume of fluid in the CNS. Acute hydrocephalus occurs over days, sub acute over weeks and chronic over months or years. Hyperproduction of CSF is seen only in secondary hydrocephalus in patients with papillomas of the choroid plexus. In the rest of cases, hydrocephalus is usually a result of impaired resorption of CSF, or may be due to blockage of CSF pathways. On the one hand, decrease of resorption may be a result of blockage of arachnoid villi.
- The average volumes of CSF are 90 mL in children 4 to 13 years old and 150 mL in adults. The rate of formation is approximately 0.35 mL/min or 500 mL/day. Normal pressure ranges from 10 to 100 mm H₂O in young children, 60 to 200 mm H₂O after eight years of age, and up to 250 mm H₂O in obese patients. 80% of CSF enters directly into the cisternal system with subsequent drainage from the cerebral subarachnoid space into the cortical venous system; 20% circulates into the subarachnoid space of the spinal cord.
- **Criteria for hydrocephalus in MRI:**

Temporal horns are greater than 2 mm; transependymal absorption is translated on images as periventricular hyperintensities representing periventricular edema, ballooning of frontal horns of lateral ventricles and third ventricle (i.e., "Mickey mouse" ventricles). Upward bowing of the corpus callosum on sagittal MRI.
- MRI can also evaluate for Chiari malformation or cerebellar or periaqueductal tumors. It affords better imaging of the posterior fossa than CT and check for flow voids in the ventricle and cerebral aqueduct. Flow void in cerebral aqueduct based on (T2 and proton density MRI analysis) is diagnostic for hydrocephalus and its reduction after ventriculo-peritoneal shunt correlated with neurological improvement.

- Unlike CT cisternography, MR Ventriculography and MR Cisternography do not have the problems related to radiation. Although radionuclide cisternography has a lower radiation exposure, MR Ventriculography determining the functional status of third ventriculostomies , assessing communication between cysts and the ventricles and in determining the site of CSF block in noncommunicating hydrocephalus.
- Cine PC MR imaging is a reliable method for evaluating the patency of a third ventriculostomy. Minor flow in the third ventricle should be considered an early sign of obstruction. It is possible that CSF flow studies may detect obstruction before symptom recurrence or clinical deterioration.
- Cine MR CSF flow studies are indicated whenever it is necessary to evaluate the flow of CSF, rule out an obstruction in the CSF pathway, evaluate CSF flow around Chiari I and II malformations, evaluate spinal canal stenosis, evaluate postoperative decompressive procedures on the spine and brain, and evaluate third ventriculostomy. Therefor pathological CSF flow dynamics in the obstructive and non-obstructive hydrocephalus have been extensively analyzed using phase-contrast MR imaging.

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List of Abbreviations

ACC	<i>Agenesis of corpus callosum</i>
CNS	<i>Central nervous system</i>
CSF	<i>Cerebrospinal fluid</i>
CSFV	<i>Cerebrospinal fluid void</i>
CT	<i>Computed Tomography</i>
CTC	<i>Computed Tomography cisternography</i>
CTVG	<i>Computed Tomography Ventriculography</i>
ETV	<i>Endoscopic third ventriculostomy</i>
FLAIR	<i>fluid attenuation</i>
FV	<i>Forth ventricle</i>
Hz	<i>Hertz</i>
IVH	<i>Intra ventricular haemorrhage</i>
IVOH	<i>Intra-ventricular obstructive hydrocephalus.</i>
LV	<i>Lateral ventricle</i>
MCM	<i>Mega Cisterna Magna</i>
M.R.I	<i>Magnetic resonance imaging</i>
NF	<i>Neurofibromatosis</i>
PC	<i>Phase contrast</i>
PCMRI	<i>Phased contrast magnetic resonance imaging</i>

ROI	<i>Region of interest</i>
SV	<i>Spontaneous ventriculostomy</i>
SAS	<i>Subarachnoid space</i>
T	<i>Tesla</i>
TV	<i>Third ventricle</i>
TE	<i>Time of echo</i>
TR	<i>Time of repetition</i>
2D	<i>Tow dimension</i>
TS	<i>Tuberous sclerosis</i>
TSC	<i>Tuberous sclerosis complex</i>
VGAM	<i>Vein of Galen Malformation</i>
Venc	<i>Velocity encoding</i>
WI	<i>Weighted image</i>

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