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To evaluate the role of Intrathecal Iohexol-enhanced Mr Cisternography in detecting CSF Rhinorrhea with correlation to Ct Cisternography

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Abstract
Background: Cerebrospinal fluid (CSF) leak occurs when there is a bony and dural defect at the skull base, with direct communication of the subarachnoid space to the extra cranial space, usually a paranasal sinus. Recognition of the leak site and source and appropriate treatment are necessary to avoid rhinorrhea or otorrhea, low-pressure headaches, and meningitis, known complications of CSF leak.
Aims & Objectives: To Evaluate the role of MR Cisternography in detecting CSF Rhinorrhea with correlation to CT Cisternography. To aid in identifying defects for timely management of a treatable disorder.
Materials & Methodology: The study was conducted for eight months in patients referred to the Department of Radiology at Bapuji Hospital, Davangere. MR and CT Cisternography were performed on patients presenting with persistent clear nasal discharge, and head trauma with symptoms of postural headache.
MRI brain protocol was performed T23D, – Axial & Coronal, FLAIR axial, DWI, contrast-enhanced sequence with CISS and T2 fat suppression using fast spin-echo sequences. 64 Slice GE CT Scanner was used allowing Trendelenburg position.
Results: We observed objective CSF leakage in 20 patients (80%). 11 cases revealed a defect in the cribriform plate with an active leak along the lamina papyracea (44%). 6 cases revealed a defect in the sphenoid bone; 2 in the greater wing of the sphenoid bone with downward herniation of meninges and adjacent brain parenchyma (24%). 2 cases revealed a defect in the temporal region (8%). 1 case revealed a defect in the bilateral cribriform plate and the sphenoid bone (4%). 5 patients did not reveal any defect.
Conclusion: Intrathecal Iohexol-enhanced MR Cisternography is a promising technique that may permit direct, sensitive visualization of the site of spontaneous, posttraumatic, or postsurgical CSF leakage. It is also apparent that thin-section CT is complementary to gadolinium-enhanced MR Cisternography and therefore should be performed in all cases.

Keywords: MR Cisternography, Cerebrospinal fluid (CSF), Rhinorrhea

Introduction
Cerebrospinal fluid (CSF) rhinorrhea implies an abnormal communication between the subarachnoid space and the nasal cavity, with subsequent leakage of CSF through the anterior nasal apertures. CSF rhinorrhea is generally classified as traumatic, non-traumatic (i.e., spontaneous), or postsurgical in origin [1]. Most cases are traumatic, and the most common site of traumatic CSF rhinorrhea is the anterior cranial fossa, where the dura mater is particularly adherent to the thin overlying bone [2-4]. CSF rhinorrhea occurs in 2%–3% of all cases of head injury and becomes clinically apparent within 48–72 hours after the traumatic incident. Approximately 70% of traumatic CSF fistulas close spontaneously without surgical intervention within 1 week after the injury [2, 3]. Despite early spontaneous closure, and even in the absence of gross CSF rhinorrhea, patients remain at risk for recurrent CSF leakage, pneumocephalus, and infectious meningitis [2]. Precise identification of the location of the CSF fistula properly focuses surgical planning, optimizes the chance of a successful repair, and can ultimately lead to the prevention of subsequent infectious complications [5, 6].

Currently, the most common method for evaluating a patient suspected of having CSF rhinorrhea is a combination of thin-section CT and subsequent CT Cisternography. However, contrast-enhanced CT Cisternography is not without risk of side effects, including headache, nausea, vomiting, seizures, allergic reaction, and rarely, intracerebral hemorrhage [7, 8]. Although thin-section CT is highly sensitive for detecting a fracture at the skull base, the actual site of the dural tear, and therefore the active CSF leak, is impossible to confirm with this technique alone. To be accurate, however, the less severe reactions observed in patients undergoing Cisternography studies (e.g., headache, nausea, and vomiting) are due to the lumbar puncture, not the Cisternography contrast medium [16]. Results of recent studies support the application of magnetic resonance (MR) imaging with T_2-weighted sequences without the need for an intrathecal contrast agent to prove the presence of a CSF fistula. This support is based on the following criteria: (a) demonstration of an area of high signal intensity (i.e., fluid) on T_2-weighted images that extend directly into the paranasal sinuses "apparently" from the CSF cisterns at the skull base, (b) an "apparent" cortical bone defect involving the cribriform plate, and (c) brain herniation directly through the cribriform plate into the subjacent paranasal sinuses [2, 4, 9-17].

Materials and Methodology

The study was conducted for eight months in patients referred to the Department of Radiology at Bapuji Hospital, Davangere. MR and CT Cisternography were performed on patients presenting with persistent clear nasal discharge, and head trauma with symptoms of postural headache.

MRI brain protocol was performed T23D, – Axial & Coronal, FLAIR axial, DWI, contrast-enhanced sequence with CISS and T2 fat suppression using fast spin-echo sequences.

64 Slice GE CT Scanner was used allowing Trendelenburg position.

Table 1: Show Inclusion Criteria and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Patients presenting with persistent clear nasal discharge.	Patients with nasal discharge attributed to causes other than CSF rhinorrhea, such as allergic rhinitis, vasomotor rhinitis, or sinusitis.
Patients with clinical symptoms suggestive of CSF Rhinorrhea, such as postural headache, halo sign (ring of fluid around nasal discharge on a gauze pad), or a history of head trauma.	Patients with contraindications to MR or CT imaging, such as severe claustrophobia, pregnancy (for certain imaging techniques), or renal insufficiency (for intravenous contrast administration).
Patients who have consented to undergo MR and CT cisternography for further evaluation of CSF leaks.	Patients who have previously undergone surgical repair of CSF leaks.
	Patients with incomplete medical records or missing essential data necessary for analysis.

Protocol

Fluoroscopic guided lumbar puncture is performed optionally.

3-10 mL of an iodinated non-ionic low-osmolar contrast agent is slowly instilled into the thecae sac under intermittent fluoroscopy. The spinal needle is withdrawn. The patient is tilted with foot-end elevation (Trendelenburg position) and intermittently imaged until the contrast column flows into the cervical spinal canal.

The table is returned to a horizontal position and the head is flexed into a neutral position under imaging to document the flow of contrast into the basal cisterns.

CT is performed immediately in prone and/or supine positions; concurrent maneuvers that provoke an active CSF leak, such as head hanging or sneezing, can also be performed [18, 19].

The study protocol was reviewed and approved by the ethics committee of JJM Medical College and Bapuji Hospital. Consent was obtained from all the patients, who were informed before the study about the adverse effects following contrast administration.

This article will highlight the importance of comprehensive imaging in accurately diagnosing CSF rhinorrhea.

Results

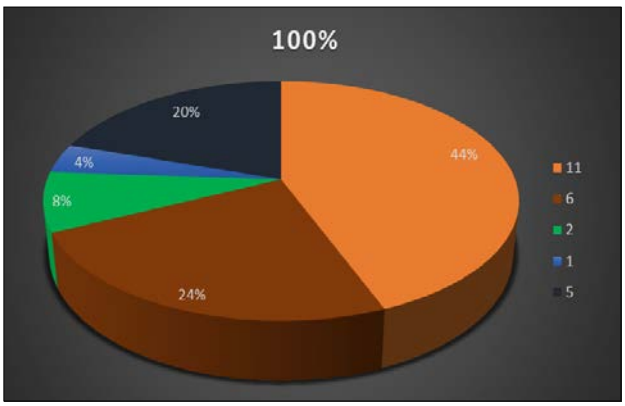
We observed objective CSF leakage in 20 patients (80%).

11 cases revealed a defect in the cribriform plate with an active leak along the lamina papyraceous (44%). 6 cases revealed a defect in the sphenoid bone 2 in the greater wing of the sphenoid bone with downward herniation of meninges and adjacent brain parenchyma (24%).

2 cases revealed a defect in the temporal region (8%).

1 case revealed a defect in the bilateral cribriform plate and the sphenoid bone (4%).

5 patients did not reveal any defect.



In our study 11 cases revealed defects in cribriform plate imaging findings consistent with active leak along the lamina papyracea, 6 cases revealed defect in sphenoid bone (2 in greater wing of sphenoid bone imaging findings consistent with predominant downward herniation of meninges and adjacent minimal brain parenchyma), 2 cases revealed defect in temporal region and 1 case revealed defect in bilateral cribriform plate as well as sphenoid bone.

Five patients did not reveal any defect Headache was observed in 5 patients (20%), Radicular pain or paraesthesia (Transient) was seen in 2 patients (8%), Infection was seen in 8 patients (32%) and bleeding was not observed in any patient (0%).

Advice was given to the patients not to travel, drive, or sit in a squatting position.

Figures and Data

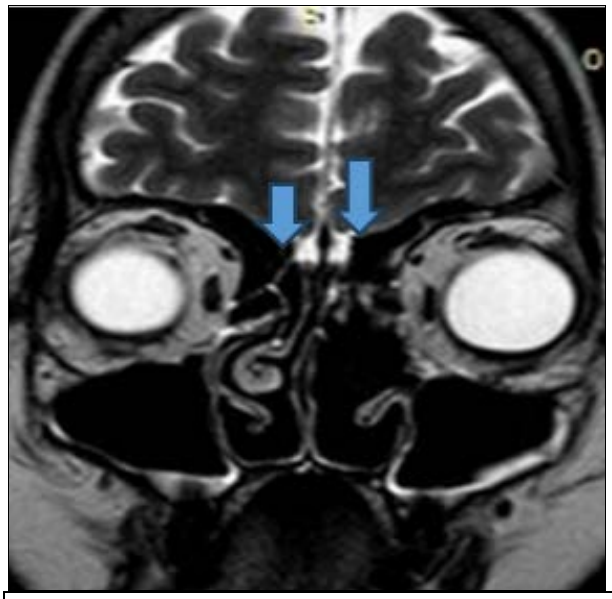


Fig 1: Coronal T1-weighted MR cisternogram obtained after intrathecal administration of Iohexol shows contrast leakage (arrow) bilateral cribriform plates at the level of olfactory bulb seen extending to bilateral anterior ethmoid, left frontal and bilateral lamina papyracea (L > R). Cribriform plate

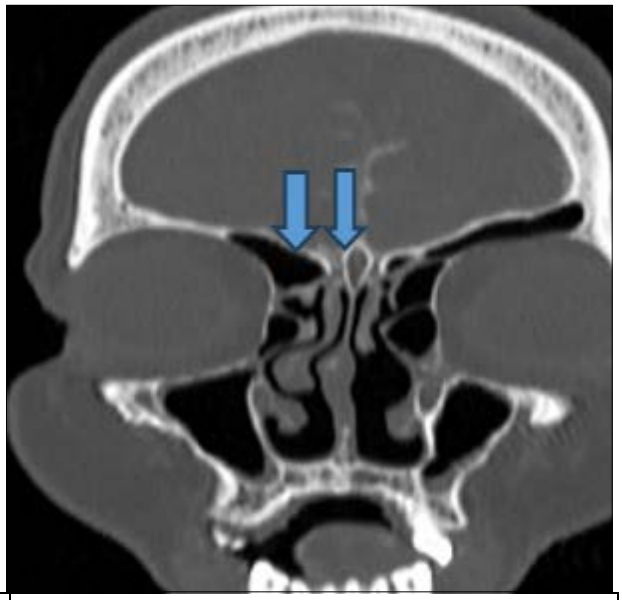


Fig 1.1: Coronal CT cisternogram obtained after intrathecal administration of Iohexol shows defect (arrow) in bilateral cribriform plates

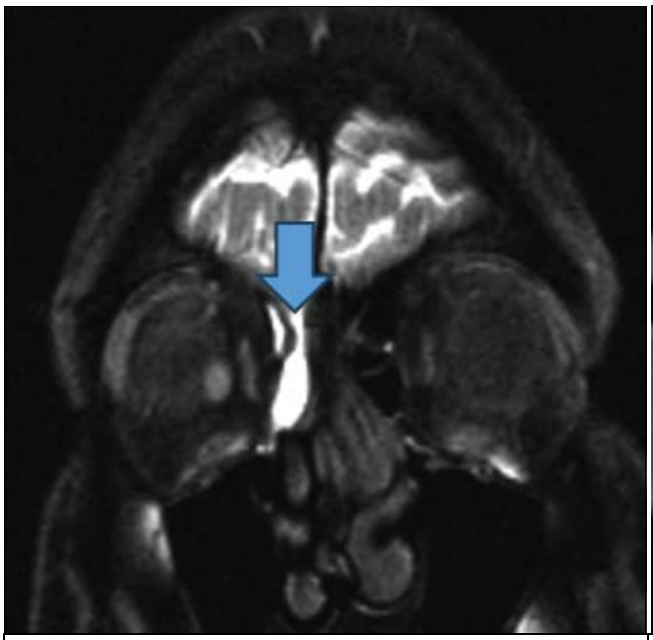


Fig 2: Coronal T1-weighted MR cisternogram obtained after intrathecal administration of Iohexol shows contrast leakage (arrow) extending from the cranial subarachnoid space into the ethmoid air cell region from a defect in the right side of the cribriform plate

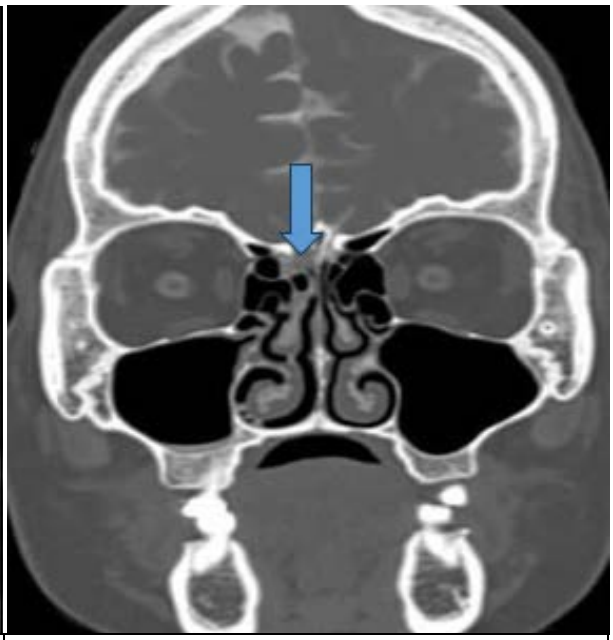


Fig 2.1: Coronal CT cisternogram obtained after intrathecal administration of Iohexol shows defect (arrow) in right side of the cribriform plate

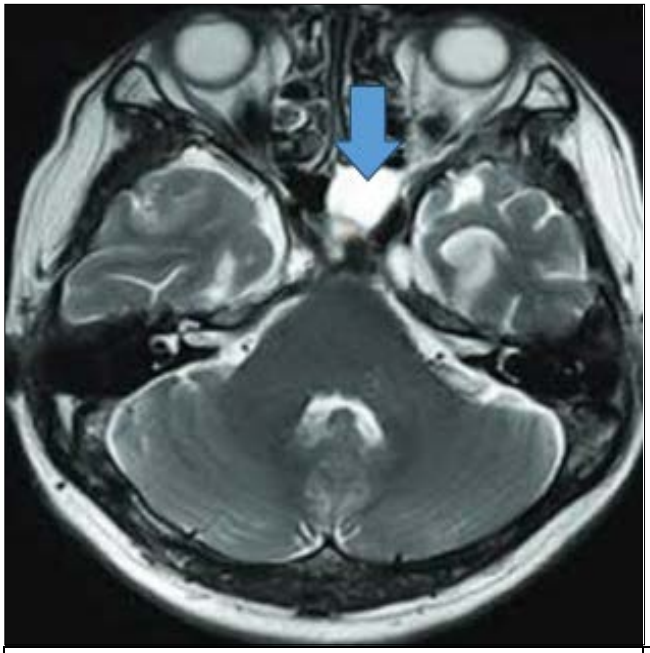


Fig 3: Axial T1-weighted MR cisternogram obtained after intrathecal administration of Iohexol shows contrast leakage (arrow) from defect in left sphenoid bone at the level at the perisellar region and the lateral recess of the sphenoid sinus extending to left anterior ethmoid and lamina papyracea

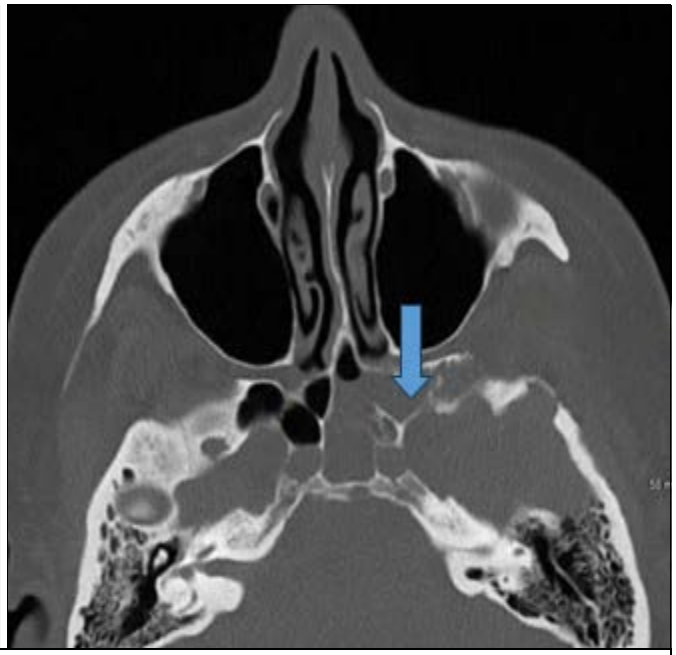


Fig 3.1: Axial CT cisternogram obtained after intrathecal administration of Iohexol shows defect (arrow) in left sphenoid bone at the level at the perisellar region and the lateral recess of the sphenoid sinus

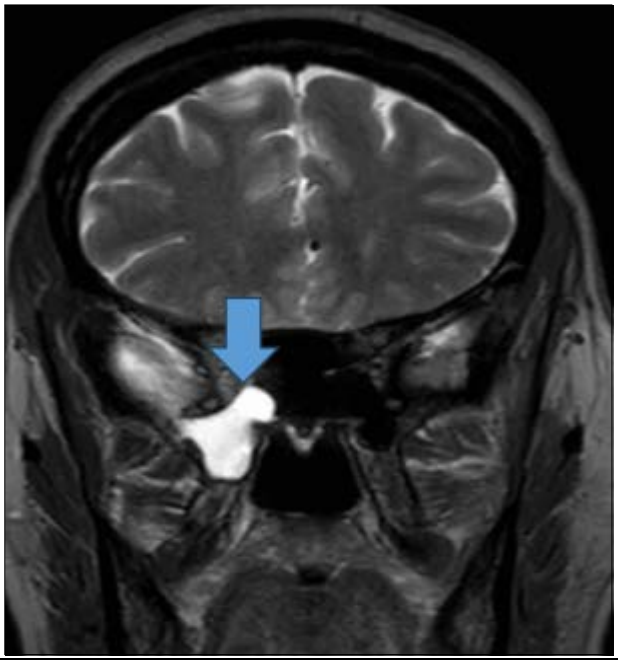


Fig 4: Coronal T1-weighted MR cisternogram obtained after intrathecal administration of Iohexol shows contrast leakage (arrow) from defect in right greater wing of sphenoid with predominant downward herniation of meninges and adjacent minimal brain parenchyma

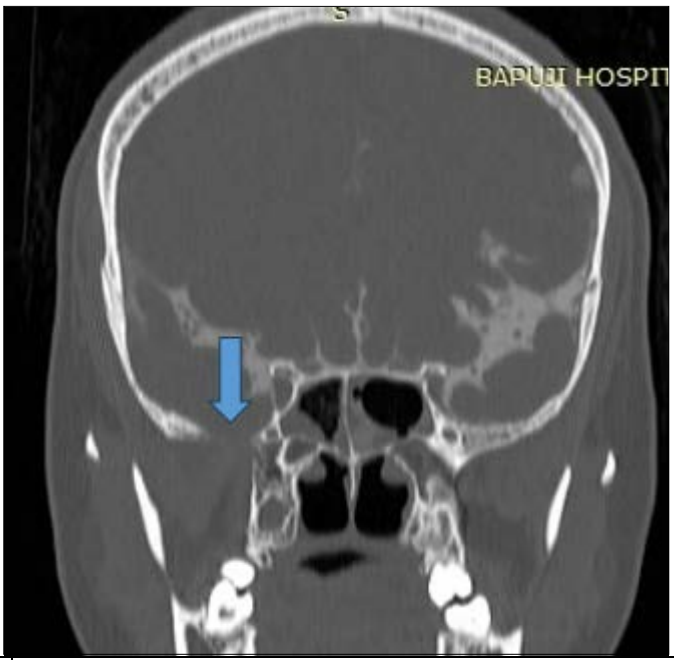


Fig 4.1: Coronal CT cisternogram obtained after intrathecal administration of Iohexol shows defect (arrow) in right greater wing of sphenoid

Fig 5: Sagittal T1-weighted MR cisternogram obtained after intrathecal administration of Iohexol shows contrast leakage (arrow) from defect in bilateral sphenoid bone at the level at the perisellar region and the lateral recess of the sphenoid sinus extending to the bilateral anterior ethmoid and lamina papyracea

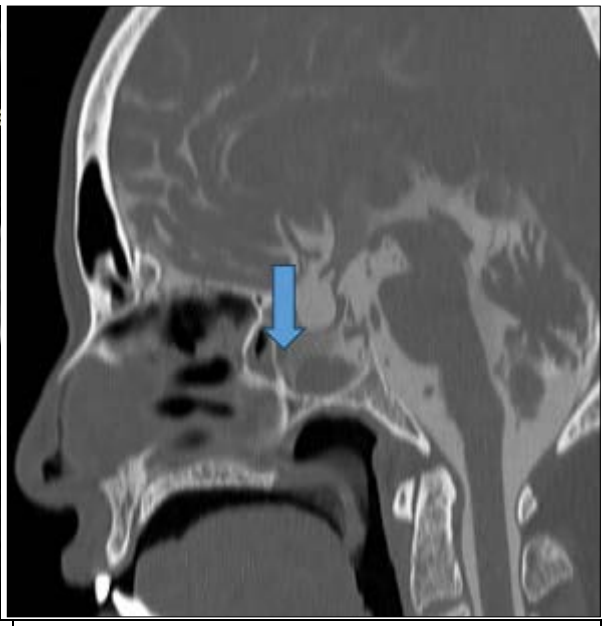


Fig 5.1: Sagittal CT cisternogram obtained after intrathecal administration of Iohexol shows defect (arrow) in bilateral sphenoid bone at the level at the perisellar region and the lateral recess of the sphenoid sinus

Discussion

In this pilot study, intrathecal Iohexol administration was used to enhance CSF leakage through a putative dural defect in patients clinically suspected of having CSF rhinorrhoea. Although the results of previously published studies have demonstrated that nonenhanced MR imaging has some utility in demonstrating CSF fistulas [20, 21], there is a relatively high frequency (42%) of false-positive findings, especially in the presence of intercurrent, nonspecific paranasal sinus disease [22]. False-negative findings have also been reported on nonenhanced MR images that subsequently revealed skull base fractures and frank CSF leaks at surgery [22]. In the present study involving 25 patients with preceding positive T_2-weighted MR imaging findings (i.e., an area of hyperintensity in the ethmoid or sphenoid air cells) and positive thin-section CT findings (i.e., anterior skull base fracture), Iohexol-enhanced MR Cisternography was performed in all 25 patients and demonstrated positive findings in 20 patients and negative findings in five. Fifteen patients had surgical confirmation and repair of the dural tear. There were no false-positive Iohexol MR Cisternography studies that is, MR cisternogram did not reveal any case that was positive when in fact there was no tear in the dura mater in the cribriform plate or planum sphenoidal region at the surgery. However, five patients with positive and five with negative MR cisternogram did not have surgical confirmation. Because these patients did not have an operative evaluation, these eight cases at present cannot be proved to be either true or false with regard to Iohexol enhanced MR Cisternography, or with regard to T_2-weighted MR imaging or thin-section CT, for that matter. Nevertheless, the accuracy rate of Iohexol-enhanced MR Cisternography within the surgical group was 100%. Furthermore, the results of initial human studies [23, 24] have shown that the low doses of intrathecal Iohexol that are adequate for diagnostic enhancement of the subarachnoid space of humans at MR imaging do not manifest clinical evidence of gross physical or neurologic abnormalities, CSF changes, or electroencephalographic alterations after Iohexol-enhanced MR Cisternography.

Conclusion

Intrathecal Iohexol-enhanced MR Cisternography is a promising technique that may permit direct, sensitive visualization of the site of spontaneous, posttraumatic, or postsurgical CSF leakage.

It is also apparent that thin-section CT is complementary to gadolinium-enhanced MR Cisternography and therefore should be performed in all cases.

Conflict of Interest

Not available

Financial Support

Not available

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