Clinical Practice

Surgical Repair and Detection of Cerebrospinal Fluid Rhinorrhea using Magnetic Resonance Cisternography and Skull Base Coronal Thin-section Computed Tomography Scan

Hong-Sheng Du, Guang-Shuo Ma, Jing-Jian Ma
Department of Neurosurgery, Tianjin First Central Hospital, Tianjin 300192, China

Key words: Cerebrospinal Fluid Rhinorrhea; Detection; Magnetic Resonance Cisternography; Surgical Repair; Thin-section Computed Tomography Scan

Introduction
Cerebrospinal fluid (CSF) rhinorrhea is a common condition managed by neurosurgeons. The accurate identification of the site of leak plays a key role in facilitating successful surgical repair. We reported two surgery-proven cases of CSF rhinorrhea examined by magnetic resonance (MR) cisternography (Siemens, Berlin, Germany) and skull base coronal thin-section computed tomography (CT) scan (Siemens, Berlin, Germany) before surgical treatment.

A 38-year-old man with primary complaints of “a sudden onset of headache and nausea and vomiting for 3 h” was admitted. He had a CSF rhinorrhea caused by head injury from a car accident 9 years ago, and his CSF leak resolved after conservative treatment. Since then, multiple recurrent episodes of CSF rhinorrhea and brain infection had developed. After admission, the patient had CSF rhinorrhea, grand mal seizures, hyposmolarity, hyperglycemia, aspiration pneumonia, meningoencephalitis, and coma. After treatment, all symptoms disappeared except for CSF rhinorrhea. Skull base coronal thin-section CT scan showed a fracture in the left side of ethmoid plate, and MR cisternography revealed high-signal-intensity CSF column in the left side of the floor of anterior cranial fossa and sinus [Figure 1-case 1]. The patient was treated with “the surgical repair of CSF rhinorrhea via a left-sidè subfrontal approach with a coronal incision” in December 2012, and his CSF leak resolved after the surgery. He was managed with lumbar drain for 1 week and had had no recurrence of CSF rhinorrhea at 3-month follow-up.

A 32-year-old man with a chief complaint of “fluid leaking from his nose for 1 month” was admitted. Three months ago, the patient had “a left temporal epidural hematoma and CSF rhinorrhea” when his head was struck by a heavy object and was given emergency “left temporal evacuation of epidural hematoma and decompressive craniectomy.” The patient was managed with the lumbar CSF drainage after surgery and was discharged after his CSF leak resolved. One month ago, the patient had a recurrence of CSF rhinorrhea and came to the current hospital. Skull base coronal thin-section CT scan showed a fracture in the right side of ethmoid plate, and MR cisternography revealed high-signal-intensity CSF column in the right side of the floor of anterior cranial fossa and sinus [Figure 1-case 2]. He was treated with “the surgical repair of CSF rhinorrhea via a right-sidè subfrontal approach with a coronal incision” in March 2013, and his CSF leak resolved after the surgery.

CSF rhinorrhea refers to the flow of CSF through skull base fracture or defects and dural tears into the nasosinus or nasocavity, and CSF drains from the nose. Using imaging techniques to precisely localize the leak site before surgery plays a key role in managing CSF rhinorrhea and facilitating a successful surgical repair.

Address for correspondence: Dr. Hong-Sheng Du, Department of Neurosurgery, Tianjin First Central Hospital, 24, Fukang Road, Nankai District, Tianjin 300192, China E-Mail: hongshengdu1@163.com

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Received: 02-04-2016 Edited by: Yi Cui
How to cite this article: Du HS, Ma GS, Ma JJ. Surgical Repair and Detection of Cerebrospinal Fluid Rhinorrhea using Magnetic Resonance Cisternography and Skull Base Coronal Thin-section Computed Tomography Scan. Chin Med J 2016;129:2005-6.
High-resolution CT examination, in particular, coronal thin-section CT scan, can assist the diagnosis of almost all types of CSF rhinorrhea, help detect the skull base defects, localize the leakage site, select the surgical approach, and is independent on leak activity at the time of imaging. However, due to the complexity of skull base structure and partial volume effect, it has difficulty localizing single or multiple leaks in complex and multiple skull base fractures.

CT cisternography has a success rate of 90% in locating active CSF leaks and only 40% in inactive leaks. It is only used for patients with their CSF being actively leaking at the time of examination but has a low success rate in locating intermittent or small CSF leaks. The invasive procedure of administering contrast-enhanced agent through lumbar puncture carries the risks of brain hernia and allergic reaction. The ability of radionuclide cisternography to precisely localize the site of CSF leak is also limited when the site of leak is too small, the leak produces a small volume of fluid, there is temporary adhesion at the site or no active leak. Similarly, radionuclide cisternography is an invasive procedure and carries the risk of brain hernia.

MR cisternography is performed using a three-dimensional thin-section heavily T2-weighted image fast spin-echo sequence or steady-state gradient-echo sequence (Constructive Interference in Steady State or Fast Imaging Employing Steady State Acquisition). It can not only clearly show the larger CSF fistula but also demonstrate the smaller CSF fistula where CT cisternography fails to identify the sites of defect, inactive CSF leak, and CSF leak with multiple fistulae. MR cisternography is easily accepted by patients since there is no need to perform lumbar puncture or administer contrast agent; the procedure is simple, noninvasive, can be easily performed, lasts shorter periods of time, and does not cause discomfort or risk of radiation exposure to patients. However, it cannot demonstrate clearly bony structure and bone defects.

In the two cases, MR cisternography and skull base coronal thin-section CT scan were used combined in diagnosis and complemented each other. The skull base coronal thin-section CT scan was performed first to detect the site, number, and type of skull base fracture. Then, the MR cisternography was used to observe the continuous or noncontinuous long T2 value high-signal column from the subarachnoid space through dural tears or fistula into the paranasal sinuses. The MR cisternography also helped detect the herniation of brain tissue or meninges through bony defect. The combination of two techniques could accurately localize the site of CSF leak and confirm the diagnoses, which were both proved surgically. Both patients’ CSF leak resolved after surgery. Indeed, MR cisternography and skull base coronal thin-section CT scan can complement each other in their application and facilitate accurate diagnosis. The combination of two techniques proves useful and is worth implementing on a wide basis.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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