Intestinal Activity Visualized on Radionuclide Cisternography in Patients with Cerebrospinal Fluid Leak

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Several methods are used in conjunction with radionuclide cisternography for detecting cerebrospinal fluid (CSF) rhinorrhea or otorrhea, including positioning of the patient to induce drainage, placing cotton pledgets in the nostrils and ears for scintillation counting, and increasing the CSF pressure within the subarachnoid space. Presented here are three surgically proven cases of CSF leak where intestinal activity was detected at different intervals following the lumbar intrathecal administration of indium-111-DTPA for radionuclide cisternography. We recommend the addition of an abdominal image during radionuclide cisternography for CSF liquorrhea.

J Nucl Med 1991; 32:151–153

Following the introduction of computed tomography (CT), there was a significant drop in the number of cases referred for radionuclide cisternography. Normally, cerebrospinal fluid (CSF) circulation is confined to the cerebral ventricular system and subarachnoid spaces. The diagnosis of CSF leakage is made with radionuclide cisternography when tracer concentrates outside of the subarachnoid space (*1–4*). Several methods are used to increase the detectability of CSF rhinorrhea or otorrhea, including positioning of the head or increasing CSF pressure in such a manner as to induce drainage (*5,6*); placing cotton pledgets in the nostrils or external ears for scintillation counting (*7,8,9*); and measuring activity in gastric juices (*10*). A more invasive technique is the frontal subarachnoid injection method (*11*).

Our protocol for cisternography in cases of CSF leak is the following: cotton pledgets are placed in different areas of the nasal cavity before the intrathecal administration of the indium-111-diethylenetriaminepentaacetic acid (^{111}In-DTPA) in the lumbar subarachnoid space, and these are counted in a scintillation counter after the 6- or 24-hr session. Images of the head in the anterior, posterior, and both laterals are obtained at 2, 6, 24, and, if needed, 48 hr. The images are acquired on a gamma camera interfaced to a dedicated nuclear medicine computer so as to add the capability of image enhancement in cases of a small leak. At 24 hr we routinely image the lumbar area in all cases of radionuclide CSF studies to rule out extravasation at the lumbar puncture and to assess the degree of renal activity. The CSF is absorbed in the bloodstream at the arachnoid villi (*12*), and ^{111}In-DTPA as a chelate is excreted by the kidneys; therefore, the renal activity represents a gross estimate of the CSF absorbed. Since intestinal activity was detected in one case of CSF leak, our protocol now includes anterior abdominal imaging at each imaging time.

CASE REPORT

Patient 1

A 51-yr-old female was admitted to hospital with a 1-yr history of clear-fluid drainage from her left nostril. There was no history of previous trauma to the head. A computed tomography (CT) scan demonstrated a defect in a left temporal extension of the sphenoid sinus. An ^{111}In-DTPA cisternography was done. The 24-hr lateral view images of the skull showed the presence of a cone-shaped area of activity corresponding to the defect in the left sphenoid sinus (Fig. 1A). The scintillation counts from the cotton pledgets left overnight in the left nostril were 1500 cpm, as compared to 120 cpm from the right nostril. The 24-hr images of the lumbar region showed prominent activity throughout the colon from swallowing of the labeled CSF (Fig. 1B).

Patient 2

A 23-yr-old male was admitted for the repair of a CSF leak following a surgically repaired gunshot wound to the head. The high resolution CT scan revealed the presence of severely comminuted fractures in the floor of the frontal fossa, more to the right than the left, with herniation of the brain tissue into the orbital region. An ^{111}In-DTPA cisternography was performed to verify the primary leakage site. The nasal cotton pledgets at 6 hr revealed the presence of bilateral leaks, with

Received Mar. 20, 1990; revision accepted June 11, 1990.

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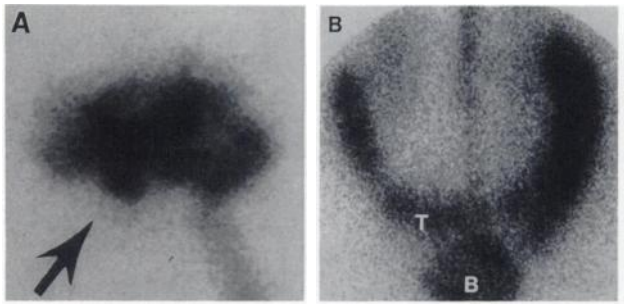

FIGURE 1
(A) The left lateral view at 24 hr shows pooling of the activity in the left sphenoid sinus, arrow. (B) The posterior image of the abdomen shows sequestered activity along the spinal cord and prominent activity throughout the colon. T = transverse colon and B = urinary bladder.

7000 cpm from the right side and 2500 cpm from the left side. The images at 24 hr showed prominent activity in the right orbital region and, to a lesser extent, in the right nasal cavity (Fig. 2A). The abdominal images at 24 hr showed prominent activity in the right side (Fig. 2B), and at 48 hr the tracer concentration was visualized throughout the colon.

Patient 3

A 36-yr-old white female was admitted to the hospital with acute meningitis. The patient gave a history of multiple trauma sustained 2 yr before admission. On 2 occasions in the past 2 yr, she had noticed clear-fluid drainage from her right nostril but had not sought medical attention. On admission, a neurologic exam was essentially unremarkable, and she had no active spinal fluid drainage from her nostrils. The patient was treated with antibiotics and she improved. Subsequently, she again started to have clear-fluid drainage from her right nostril. A CT scan showed a questionable abnormality in the cribriform plate of the ethmoid. An ^{111}In-DTPA cisternography was performed to locate the site of drainage. At 2 hr there was activity in the right nostril best seen in the computer enhanced images (Fig. 3A). The 24-hr images of the abdomen exhibited well-delineated colonic activity (Fig. 3C).

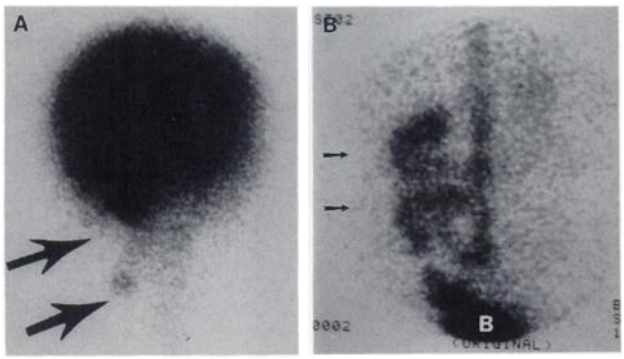

FIGURE 2
(A) The anterior view of the head at 24 hr shows focal activity in the right orbital region and right nasal cavity, arrow. (B) The 24-hr images of the abdomen in the anterior view show prominent activity in the right side of the abdomen, arrow. B = urinary bladder.

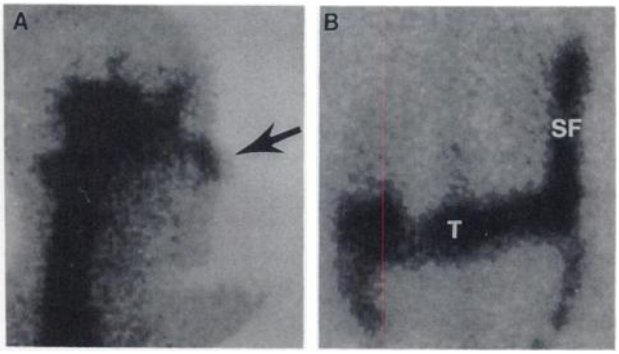

FIGURE 3
(A) The computer-enhanced 2-hr image in the RL view shows activity in the right nasal cavity. (B) The 24-hr anterior images of the abdomen exhibit the presence of sequestered activity along the spinal cord and activity throughout the colon. T = transverse colon and SF = splenic flexure.

The nasal pledget counts were as follows: right nostril, 2338 cpm; left nostril, 122 cpm; background counts, 53 cpm.

A craniotomy was performed and a 4-mm defect was found along the posterior part of the cribriform plate of the ethmoid. The defect was repaired and the postoperative course was unremarkable with no further CSF leak from the right nostril.

DISCUSSION

Prior to the introduction of CT, the radionuclide cisternography was the method of choice for the study of CSF circulation (*13*). The high resolution CT, with its superior anatomic detail, proved to be effective in demonstrating the presence and localization of a CSF leak (*14,15*) and almost replaced the radionuclide cisternography in our institution. However, the CT cisternography is limited in that the leak is not detected unless there is active drainage during the procedure (*14*). With an intermittent CSF leak, the radionuclide method has one advantage in that it is performed over a long period of time, thus increasing the chance of detection. We suggest the addition of abdominal imaging during the different time intervals of the radionuclide cisternography to demonstrate gastrointestinal activity from swallowed CSF in the presence of rhinorrhea. We feel that the addition of the abdominal images would be very helpful in case the cotton pledgets were negative, if the drip were to fall posteriorly and were swallowed. Technetium-99m-DTPA has been advocated for gastrointestinal bleeding investigation (*16*) and in inflammatory bowel disease (*17*). Intestinal activity may be seen in such cases after absorption of the ^{111}In-DTPA labeled CSF in the bloodstream at the arachnoid villi. Thirty cases of radionuclide cisternography performed for reasons other than CSF leak were reviewed and none showed the presence of activity in the area of the intestine on the posterior images of the lumbar area.

CONCLUSION

In the absence of inflammatory bowel disease or gastrointestinal bleed, the presence of pooled activity in the gastrointestinal tract during ^{111}In-DTPA cisternography is indicative of a CSF leak. Such a finding in the absence of a definite localization on the CT metrizamide, or routine radionuclide cisternography, would then justify a more invasive approach.

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