Controlled Overpressure Cisternography to Localize Cerebrospinal Fluid Rhinorrhea

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Cerebrospinal fluid (CSF) rhinorrhea is often intermittent, thus complicating the cisternographic localization of the leakage. In four patients studied, this difficulty was overcome by lumbar infusion of artificial CSF to which a bolus of radionuclide was added. The tracer was moved in bulk to the basal cisterns, and the rise in CSF pressure elicited a profuse rhinorrhea. Sequential imaging was started during the infusion, and prompt identification of the site of leakage was easily obtained. Special precautions must be followed when this technique of overpressure is used.


Radionuclide cisternography has proved to be of great value in the diagnosis of CSF rhinorrhea (1). The site of leakage is best visualized when imaging is performed during heavy leakage of fluid containing a high concentration of the tracer. Consequently, the possibility of locating the fistula is reduced in patients having intermittent leakage. One way of overcoming this difficulty is to place the patient in various positions to elicit maximum leakage during the examination (2). We have tried to improve cisternographic localization of CSF rhinorrhea by adapting infusion cisternography (3) to this purpose. This report is concerned with the results of our study.

PATIENTS AND METHODS

Four patients were referred for investigation of CSF rhinorrhea. Three had sustained head injuries, and the fourth had been operated on for a pituitary adenoma. Two patients had had prior conventional cisternographic examination that had failed to locate the site of leakage.

Infusion. The equipment consisted of a 19-gage spinal needle, a pressure transducer fitted with disposable fluid chamber, plastic tubing, a 50-ml syringe driven by a constant-rate infusion pump, and a servorecorder (4). Following lumbar puncture, 400 μCi of 188Yb-DTPA was infused as a 3-ml bolus (first 3 ml in the tubing) followed by 47 ml of artificial CSF prepared by the method of Elliott and Jasper (5). The infusion rate was 5 ml/min, and the infusion was started when the patient had been positioned under the scintillation camera.

Imaging. Sequential imaging of the head was carried out. With the patient in a semiprone position, lateral views were made until CSF leakage was detected. The spinal needle was then removed, the patient was placed in the supine position, and frontal views were made.

RESULTS

During the infusion the lumbar CSF pressure in the four patients increased to 340, 240, 460, and 520 mm H2O, respectively. This was followed by an irregular pressure plateau or fall in pressure. The pressure recording from one of the patients is shown in Fig. 1. The rise in CSF pressure elicited a profuse rhinorrhea in all patients.

A high concentration of the radionuclide in the basal cisterns was observed after 6–8 min, and after 8–14 min the site of leakage could be identified in the lateral view. Sequential scintigrams in the lateral view from a patient with leakage in the ethmoid region are shown in Fig. 2.
The fistulas were judged to be in the ethmoid region in two patients and in the sphenoid region in the other two. The site of leakage was verified at operation in three patients. In the fourth patient, whose x-ray tomograms showed a fracture through the sphenoid sinus and whose scintigrams showed leakage in the same region, the rhinorrhea stopped spontaneously 3 days after the test. There were no adverse effects following the examinations.

**DISCUSSION**

A high rate of infusion and a concentrated bolus of radionuclide were chosen in order to obtain a rapid cephalad transport and a high concentration of the radionuclide in the basal cisterns, to elicit a substantial flow through the fistula, and to carry out the examination within a short period of time. This permitted sequential imaging to be performed with the patient in the same position, clearly showing the site of leakage.

**Precautions and complications.** The CSF infusion test (3,6–8) performed in patients suspected of hydrocephalus is, considering the precautions and possible complications, a test very similar to overpressure cisternography. The experience gained from the former test can therefore be utilized in the latter. The patient should have no symptoms or signs of elevated intracranial pressure, there should be no intracranial expanding lesion such as a hematoma or a tumor, and the test should not be performed in the early stage of a head injury with brain edema. An upper limit should be set to the rise in CSF pressure during the test so as not to reduce cerebral blood flow (9). Like Martins (8) we have used 800 mm H$_2$O as an upper limit in our CSF infusion tests (3), and we have performed more than 500 tests without complications. In 36 tests performed in 30 patients, the CSF pressure was elevated to between 400 and 800 mm H$_2$O. Other researchers (6,7) have used 600 and 550 mm H$_2$O as upper limits, and no complications due to the rise in pressure have been reported. If the initial rise in CSF pressure is steeper than in Fig. 1, the upper limit of the rise in pressure will be reached rapidly, and a slower rate of infusion should be chosen. Furthermore, it is important to follow a general precaution that the test should be discontinued if the patient should feel any kind of discomfort. Lastly, we strongly advise that continuous CSF pressure recording be carried out so that the overpressure cisternography really is controlled.

Adverse effects due to altered chemical composition of the CSF are probably related to the composition of the fluid infused, to the rate of infusion, and to the total volume infused (6–8). After infusion of normal saline, such adverse effects as transient hyperventilation, increased blood pressure, and paresthesias and contractions of the feet have been reported (7,8). On the other hand, no report has appeared of adverse effects due to infusion of artificial CSF. Infusion of artificial CSF at rates of up to 2.7 ml/min, and of total volumes of more than 100 ml, have been carried out without adverse effects (7). In more than 500 infusion tests, we have infused artificial CSF at a rate of 1.5 ml/min without complications. We have used a 5 ml/min rate of infusion only for overpressure cisternography. Until we gain more experience, therefore, we will limit the total volume of artificial CSF infused to 50 ml.

**Indications.** In hospital departments where cisternographies and CSF infusion tests are part of the daily routine, overpressure cisternography will prove a simple procedure. With observance of the same
precautions as for the infusion tests, overpressure cisternography should have the same safety, and the indications for using the overpressure technique must be determined accordingly. In our departments we will use controlled overpressure cisternography as the first test when an attempt to locate a site of CSF rhinorrhea is indicated.

REFERENCES


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