The Diagnosis of Traumatic Cerebrospinal Fluid Rhinorrhea

Pyogenic meningitis occurs in up to 25% of untreated patients with traumatic cerebrospinal fluid (CSF) rhinorrhea. The rhinorrhea usually commences within 48 hr of injury, but in some cases may be delayed for months or even years. One reported case presented 15 yr following an accident (*1*). The cause of leakage is a rent in the meninges following a fracture at the base of the skull, particularly those fractures passing through the frontal or ethmoidal sinuses. A fracture through the petrous bone frequently involves the middle ear, and CSF otorrhea is present if the tympanic membrane ruptures. Although basal skull fractures were present in only 7% of one series of head injuries, CSF rhinorrhea developed in 30% of the cases with basal fractures (*2*). Traumatic CSF rhinorrhea usually begins as a bloody discharge and then becomes clear. Usually the leakage spontaneously ceases within 1 wk, but may persist in 5–10% of cases. Anosmia is common, and other evidence may suggest the presence of a CSF leak such as a fluid level in a sinus, intracranial air, periorbital edema, or accompanying neurological deficit secondary to damage to contiguous structures such as visual pathways.

Most cases of CSF rhinorrhea and otorrhea are secondary to trauma, but on occasion "spontaneous" fistula may develop in the absence of identifiable injury. A current classification of CSF rhinorrhea avoids the term "spontaneous," and categorizes CSF rhinorrhea etiologically as either traumatic or non-traumatic (*3*). Clinically, nontraumatic CSF rhinorrhea is a relatively rare condition, usually presenting with an insidious onset of mild intermittent rhinorrhea that may spontaneously cease, may become profuse, and commonly is accompanied by headache when there is a cessation of flow. Nontraumatic CSF rhinorrhea can further be categorized as either high pressure (hydrocephalus or tumor) or normal pressure (osteomyelitis, congenital, or focal atrophy such as in patients with an empty sella). Meningitis is not a major complication of nontraumatic CSF rhinorrhea.

Multiple tests and techniques have been described to diagnose the presence of CSF leaks and identify the site of the leak. The measurement of glucose levels in nasal discharge has been shown to be nonspecific in the diagnosis of CSF rhinorrhea if glucose-oxidase test papers are used (*4*). This finding may be due to the normal presence of glucose in lacrimal secretions. Dyes (indigo carmine, methylene blue, fluorescein) injected into the CSF and recovered from the nasal discharge have been used with variable success. The site is identified by recovering the agent on pledgets placed in the nose near the cribiform plate, under the middle turbinate and at the eustachian tube orifice. Reports of transient neurological complications including hemiparesis and seizure have limited the use of such agents.

The localization of a CSF fistula by measurement of radioactivity on nasal pledgets was first reported in 1956 following an i.v. injection of Na-24 into the cisterna magna (*5*). Others have measured radioactivity on nasal pledgets after the lumbar intrathecal injection of radiopharmaceuticals, particularly I-131 human serum albumen. The normal values for nasal secretion of intrathecally injected In-111 DTPA have been determined and shown not to exceed plasma by a ratio greater than 1:3 (*6*). Radionuclide cisternography can be used to pictorially demonstrate and localize CSF leaks (*7*) and nearly 100% of CSf leaks can now be diagnosed by a combination of these radioisotopic techniques (*8,9*). Appropriate images should be taken from 2 to 24 hr after intrathecal injection, with the patient positioned so as to augment the leakage. The demonstration of the fistula itself is not indispensable for localization of the site of the leak. Basal cisternal pouches or sphenoidal collections may pinpoint the site without the actual demonstration of the fistula tract. The fistula was seen only on the 24-hr images in 17 of 28 patients in one series (*9*). Controlled "over pressure" cisternography performed by infusion of up to 5 ml per minute of artificial CSF has been used recently to induce a detectable leak in those patients with intermittent CSF rhinorrhea, when it could not otherwise be diagnosed (*10*). The current report by Drs. Doge and Johannsen (*11*) is an additional potential test for the detection of CSF leakage in patients with severe acute head trauma in whom neither the intranasal pledget nor imaging techniques may be appropriate. The ratio of gastric radioactivity to plasma 4 hr following intrathecal injection of a Yb-169 DTPA exceeded 0.25 in 11 or 12 patients with proven CSF leakage. The technique, however, does not permit the lateralization or definition of the leakage site.

What then may be considered as an acceptable protocol in the management of trauma patients with possible CSF leakage? Most of these patients will be admitted to the hospital following a motor vehicle accident or gunshot wound. In those who have sustained a basal skull fracture and developed acute CSF leakage, examination of the ears, the nose, and the throat will usually reveal frank bloody rhinorrhea. The fistula generally closes spontaneously. Prophylactic antibiotic therapy is advocated to prevent occurrence of the major complication—meningitis. In the advent of a depressed frontal skull fracture, any rent in the dura may be repaired incidently at the time of surgery. Acute CSF leakage is not an indication for emergency surgery. At this point the aim of any diagnostic procedure is to determine whether CSF does in fact leak, and if so where the fistula is located. There are many potential sites for leakage, several of which may occur simutaneously. The side of the apparent leakage on examination may not be an indication of the point of origin of the fistula. Skull radiographs and polytomes may demonstrate fractures, defects in the bones, or abnormal fluid levels in the sinuses indicative of the probable point of origin of the fistula. The role that nuclear medicine techniques may play initially then is to *detect* the presence of CSF rhinorrhea, and this may be accomplished by either measurements of gastric or nasal pledget radioactivity or visualization of nasal, pharyngeal, or middle ear radioactivity on radionuclide cisternography. If surgical intervention is indicated to close a persistent CSF fistula following head trauma, then either radionuclide cisternography or the radionuclide nasal pledget technique may be used to further *localize* the site of origin. In those patients who, following recovery from acute head trauma, develop intermittent CSF rhinorrhea or recurrent meningitis secondary to occult CSF rhinorrhea, the quantitative radionuclide nasal pledget test may be the most accurate method available for both the diagnosis and localization of the CSF fistula.

KENNETH A. McKUSICK, M.D.
Massachusetts General Hospital
Boston, Massachusetts

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