Cerebrospinal Fluid Fistula: Clinical Aspects, Techniques of Localization, and Methods of Closure*

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The management of cerebrospinal fluid fistula continues to be troublesome despite the apparent simplicity of the problem; as Dandy noted in 1944, “disclosure of the fistulous tract may be exceedingly difficult, perhaps even impossible.” In many instances, preoperative evaluation identifies the site of the fistula, but often the patient undergoes craniotomy without the defect having been precisely localized. Even during operative exploration the site of the fistula may not be disclosed, yet measures must be taken to stop the leak.

This report, based on the experience at The New York Hospital-Cornell Medical Center, emphasizes the problems of localizing and closing the fistulas and describes an operative technique helpful in localizing leaks when the preoperative search has failed.

Clinical Data

Between 1932 and 1967, 53 patients were operated on for cerebrospinal fluid fistulas; the following account deals with 41 of these patients. Excluded from the discussion are 12 patients who developed rhinorrhea following transphenoidal implantation of Yttrium⁶⁰ into the sella turcica for destruction of the pituitary gland.

Etiology. In these 41 patients, 27% of the fistulas resulted from skull fracture; 10% were thought to be congenital; 37% were associated with intracranial tumors; 47% occurred following neurological or otolaryngological surgery, most often after manipulation of tumors which had encroached on nearby sinuses. In 24% of the patients there was a history of associated meningitis. In 7% the presence of increased intracranial pressure necessitated a shunting procedure before the leak could be closed.

In five patients of the series (12%) the fistulas followed intracranial hypophysectomy (at the time of this study, 950 hypophysectomies had been performed). In the majority of these operations the frontal sinus was traversed; in a few the sphenoid sinus was opened in the process of removing the tuberculum sellae for exposure of the sella turcica.

Location. In 39% of the patients the fistulas were in the area of the cribiform plate and cells of the ethmoid sinus. In 15% the fistulas extended into the frontal sinus, and in another 15% they extended from the sella turcica to the sphenoid sinus. In one patient, a fracture through the floor of the skull and the maxilla resulted in a fistula from the frontal fossa through the ethmoid sinus to the maxillary antrum. In two patients, the fistulas led from the middle fossa to the mastoid cells, and in a single patient the fistula led from the posterior fossa to the mastoid cells. In 22%, the site of the leak was never verified.

Operative Results. Some of the results emphasize the difficulties that may be encountered. In 27% of the patients a recurrent leak developed following the initial repair and required one or more additional operations. In several patients multiple procedures were required, and in one, five craniotomies were necessary before the leak was stopped. In three patients it was found at a subsequent craniotomy that the initial attempt at closure had been anatomically misdirected. Eventually, 90% of the fistulas were closed. In two patients rhinorrhea was still present during the last follow-up visit. The one patient in the series who died had an unrecognized associated hydrocephalus and herniation of the brain in the immediate postoperative period.

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Techniques of Localization

Detection of Fistula. Some of the fistulas had gone unrecognized for a number of years, and the rhinorrhea was commonly ascribed to allergic rhinitis. In one instance 17 episodes of pneumococcal meningitis had occurred before the leak was detected. Several methods to verify spinal fluid rhinorrhea have been described. Various dyes or radioactive tracers have been injected into the lumbar subarachnoid space to be identified in the leaking fluid, but toxic reactions have been reported. Methylene blue and fluorescein appear to be particularly toxic.

A simpler method, namely, analysis of the nasal drainage for sugar content has been uniformly satisfactory. It is often difficult to collect enough fluid for chemical evaluation, and the “test-tape” paper employed in urine analysis for detection of sugar has been used to good advantage. These strips can be inserted into the nostril and will detect the presence of sugar with but a single drop of fluid.

Following head injury or intracranial surgery, a cerebrospinal fluid leak is usually transient, and closure of the defect is facilitated by repeated lumbar puncture or by other means of reducing the intracranial pressure. However, once the presence of a persistent fistula has been established, surgical closure is indicated.

Preoperative Localization. Numerous procedures have been advocated to demonstrate the precise site of the fistula before craniotomy. Plain roentgenograms of the skull may demonstrate a fracture or an air-fluid level in a particular sinus, while the additional use of tomography may reveal skull defects and fluid levels not otherwise visible. Pneumoencephalography has rarely been helpful in delineating the fistula. However, in cases of repeated meningitis, air studies may demonstrate an increase in cerebrospinal fluid pressure and an acquired hydrocephalus which requires a shunting procedure before the fistula can be closed successfully. Pantopaque studies in some instances accurately demonstrate a fistula but the high viscosity of the material prevents free flow of the contrast medium throughout the subarachnoid spaces and precludes the demonstration of small fistulas. Scanning procedures after injection of radioactive iodine serum albumin (RISA) into the lumbar subarachnoid space have been employed with some success. This test does not lend itself readily to precise localization of the fistula, and aseptic meningitis has been reported as a sequela although with low concentrations of albumin the procedure is well tolerated.

In our experience no single preoperative test has consistently established the location of the fistulas, but plain x-rays of the skull, tomographic films, and RISA scans were sometimes helpful.

Operative Localization. The frontal fossa is usually explored through a coronal incision, the scalp and periosteum being reflected over the brows. A free bone plate is ordinarily removed from the right frontal area; this is done from the left frontal area if the rhinorrhea is clearly lateralized to the left. As in hypophysectomy, the operative exposure is facilitated by placing the bone plate well anteriorly and medially, often unavoindably traversing the frontal sinus. The intravenous administration of urea (Urevert) or Mannitol to reduce the size of the brain, and the withdrawal of cerebrospinal fluid after the dura has been opened, permit good exposure and easy retraction without damage to the frontal lobe. The ipsilateral olfactory tract is divided behind the olfactory bulb. If a unilateral exposure is found to be inadequate the coronal incision permits a bifrontal craniotomy.

During a unilateral exploration, the contralateral olfactory bulb and cribiform plate may be exposed by dividing the anterior portion of the falx cerebri at the crista galli. The passage of exploratory probes through the cribiform plate risks possible production of a fistula where one did not exist; therefore, the fistulas in these areas are determined by observation alone.

The site of the leak sometimes is immediately apparent, verifying what was presumed by the preoperative evaluation. But in some instances unsuspected sites of fistulas are encountered. The presence of skull defects, fractures, adhesions, or cerebral fungus are aids in identifying the location of the fistulas.

Techniques of Closure

A variety of methods has been found appropriate for closure of fistulas in the frontal area of the cranial fossa. In the case of an