CEREBROSPINAL RHINORRHEA—SURGICAL REPAIR*

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CEREBROSPINAL RHINORRHEA is a relatively common complication of craniocerebral injuries in the frontal region, especially when the site of impact is near the glabella.† Spontaneous arrest of the rhinorrhea may be expected within ten days in a large percentage of patients, and Adson has noted spontaneous recovery as long as eight weeks after the injury. The problems and methods of surgical treatment of acute cerebrospinal rhinorrhea have been discussed by "Dandy,4 Teachenor,11 Munro,9 Cairns2 and Coleman.3 Cairns2 report leaves no doubt concerning the serious potentialities of chronic leak of cerebrospinal fluid into the nose. A series of twenty-one cases from the literature was reviewed by Johnston;5 injury was an etiologic factor in six instances. The rhinorrhea persisted in nine cases and the patients were alive at the time of report; the flow had ceased in six cases. Six of the patients were dead when the reports were published.

Chronic cerebrospinal rhinorrhea may appear after an interval of several weeks following the injury. Gissane and Rank6 designated this type as "delayed post-traumatic cerebrospinal rhinorrhea." Such a delayed onset was noted in each of the four traumatic examples in the present report. Two of these patients had recovered from pneumococcus meningitis, under intensive chemotherapy; the rhinorrhea was apparently unaltered by the meningeal infection. One instance of rhinorrhea from a nasal encephalocele is included in the present report, the nasal leak appearing after a considerable interval following intranasal "snare" excision of a "tumor." Intracranial pneumatocele was noted in one of the traumatic cases.

At present there is unanimity of opinion concerning the advisability of surgical repair of chronic cerebrospinal rhinorrhea. The methods of repair have varied considerably: Insertion of an iodoform gauze wick beneath the dural defect has been advised by Peet;10 direct suture of the dural defect or fascia lata graft has been used by Cairns;2 plugging the bone defect with bone wax was suggested by Graham;7 interposition of a free periosteal graft from the tibia, between the bone defect and the dura, was successful in Gissane and Rank’s case.6 Adson1 described a method of direct dural suture, involving bifrontal exposure, ligation of the longitudinal sinus, elevation of the dura from the floor of both anterior fossae, interposition of a muscle graft in the suture line and plugging the bone defect with bone wax which is covered with Luken’s animal membrane. This procedure was used successfully in eight cases. The methods so far described depended upon extradural

* Reported in part at the meeting of the Harvey Cushing Society, May 30, 1941, Rochester, N. Y.
† Cairns states this type of injury is not infrequent in aeroplane accidents.
exposure of the dural defect. Eden\textsuperscript{1} described successful closure of cerebrospinal fistulae in two cases by fascia lata graft, applied by extradural operation.

The site of the fistula is of considerable importance in the selection of the most appropriate method of surgical repair. Anterior fistulae into the frontal sinuses can be readily exposed by the extradural approach and repaired by direct suture or suitable grafts. However, defects at the cribriform plate appear to be at least as frequent as those in the frontal sinuses; all five patients in the present report had fistulae through the cribriform plate. The extradural approach to fistulae through the cribriform plate is much more difficult because of the thin dura with its firm attachments to the bone and the tendency for these fistulae to be located more posteriorly. Extradural repair of such defects is subject to the further handicaps of the small working-space available at the side of the crista galli and the limitation of direct visualization of the dural defect by the overhanging frontal lobe. These handicaps apparently may be overcome, to a large extent, by Adson's procedure.\textsuperscript{1} The chief reason for avoiding an intradural repair has been the potential source of meningeal infection at the fistulous site. At present, the availability of adequate chemotherapy materially reduces this hazard.

The purpose of the present report is to present a simple method of intradural repair of cerebrospinal rhinorrhea which has been used successfully for the past five years. The method of Adson\textsuperscript{1} was not available when the first case in this series was treated in 1938. It appeared that the ideal form of repair should be one in which a dural flap could be utilized to cover the defect in the cribriform plate; the dura covering the crista galli suggested itself as the logical source for this flap. Repair was readily effected in this manner, even in the limited space available in a child of eleven months.

**DURAL-FLAP METHOD OF REPAIR**

A frontal osteoplastic bone flap is elevated on the side corresponding to the nasal leak and the dura opened along the anterior margin of the exposure. The frontal lobe is gently retracted until the floor of the anterior fossa can be seen. The site of the fistula may be identified by the attachment of the adjacent cerebrum to the dural defect. This attachment was composed of meningeocortical scar in the four traumatic cases in this series. The scarred cerebral parenchyma may be herniated through the defect; this is probably an important mechanism, preventing spontaneous closure. The attachment is divided with an electro-surgical unit and the meningeocortical scar may be excised if desired. A dural flap (Fig. 1) is then constructed from the dura covering the crista galli and this flap may be continued to include the anterior portion of the falx, if considerable dura is required. The flap is hinged at the base of the crista galli, folded across the defect in the cribriform plate and sutured to the dura at the lateral aspect of the defect, using small curved needles and fine silk. In two cases it was necessary to use a supplementary procedure, due to an extensive dural defect lateral to the fistula. In one in-
stance, a lateral dural flap was constructed from the dura covering the lateral portion of the floor of the anterior fossa; this flap was folded medially and sutured to the margins of the medial flap. In the other case, a free periosteal graft from the bone flap was used to cover the large lateral defect; the graft was sutured to the dural margins and to the medial flap. Topical application of sterile sulfonamide powder may be used in the bone defect. Bone wax has not been used because of potential contamination at the fistulous site. Since the dural flap from the crista galli and falx tends to span the olfactory groove, a small muscle graft is tucked under the posterior edge of the dural flap, filling this portion of the olfactory groove. The olfactory nerve is usually found to have been severely damaged at the initial injury, but in one case it was possible to preserve the olfactory nerve.

This procedure has been used successfully in five cases. Sulfonamide medication is given for an appropriate period before and after operation.

CASE REPORTS

Case 1. (N.H.H. #A78145). A girl of eleven months, whose left nostril was noted to have been obstructed, shortly after birth, had a nasal “tumor” excised with a snare at the age of seven months. The pathological diagnosis of the excised tissue was encephalocele. During the succeeding three months the nasal encephalocele gradually increased in size. Cerebrospinal rhinorrhea appeared one week before admission to the hospital, July 12, 1938. Sulfonilamide was started shortly after rhinorrhea began.
CEREBROSPINAL RHINORRHEA

Examination revealed a slightly retarded child of eleven months, who was unable to sit without support. The left nostril was obstructed by a gray mass from which clear fluid leaked, with changes of head position; the fluid contained 10 lymphocytes per c.mm.: nose culture: staphylococcus. X-rays of the skull were normal; there was no demonstrable air within the cranium. Laboratory findings were normal except for leucocytosis of 19,500.

Operation: A left frontal osteoplastic bone flap was elevated and the dura was opened. The frontal lobe was elevated and the stalk of the meningocele was identified as it passed through a defect, 8×3 mm., in the left olfactory groove, posterior to the olfactory bulb. The stalk was fulgurated and a flap from the dura covering the crista galli was sutured over the defect in the olfactory groove. There was no recurrence of cerebrospinal rhinorrhea and the nasal mass gradually decreased in size. Convalescence was complicated by local infection of the edge of the bone flap.

Case 2. (N.H.H. #A91643). A woman of 26 years was struck on the right side of the forehead by a stone which fell from a truck while passing the automobile in which she was riding. She was unconscious four days and later noted intermittent dripping of clear fluid from the right nostril. On one occasion the rhinorrhea was absent for three years but then returned spontaneously. Nine and one-half years after the injury, an upper respiratory infection was followed by pneumococcus type VI meningitis. She was treated with sulfapyridine and antipneumococcus (rabbit) serum, type VI. Convalescence was uneventful but the rhinorrhea continued. Six months later she entered the hospital for surgical repair of cerebrospinal rhinorrhea.

Examination revealed a normal appearing woman of 26 years. There was complete anosmia, slight pallor and blurring of the margins of the optic discs; the right pupil was a trifle larger than the left. Rhinorrhea was absent at the time of the examination. X-rays of the skull failed to demonstrate abnormalities other than hyperostosis frontalis interna and calcification of the falx. Sulfapyridine was given for two days, resulting in a preoperative blood level of 11.9 mg.m. per cent.

Operation: A right frontal bone flap was elevated and the dura was opened along the anterior margin of the exposure. The frontal lobe was elevated, exposing a menincoxorial scar attaching the inferior portion of the frontal lobe to a deep fissure, 35×8 mm., in the cribiform plate. The scar was freed and a flap of dura from the crista galli and adjacent falx was sutured over the defect. Small muscle grafts were inserted beneath the anterior and posterior edges of the dural flap, to fill the olfactory groove. The right olfactory nerve had been completely destroyed by the original trauma. Sulfapyridine medication was continued for five days after operation. Convalescence was uneventful except for the late appearance of sterile fluid at the site of the anterior-medial burr hole of the bone flap. Cerebrospinal rhinorrhea has not recurred.

Case 3. (N.H.H. #B11169). A 30 year old motorcycle policeman was injured in a head-on collision with a truck, October 9, 1940. He was unconscious for about 24 hours and remained in a hospital elsewhere for three weeks. Three days after leaving the hospital a blood clot was discharged from his left nostril, followed by a profuse flow of clear fluid. Fever appeared the following day, accompanied by chills, but these subsided under sulfathiazole and sulfanilamide therapy. He was readmitted to the hospital and kept on isolation precautions, including masks. In spite of this, pneumococcus meningitis occurred, Dec, 3, 1940; it was rapidly controlled by intravenous sulfapyridine therapy. He continued to receive sulfapyridine, 4 gm. daily, until his transfer to the New Haven Hospital, Jan. 7, 1941.

Examination revealed a large, irregular scar in the midforehead. A few drops of clear fluid could be obtained from the left nostril by appropriate changes in head position. X-rays of the skull demonstrated multiple, small fragments of cortical bone behind the frontal sinuses. The preoperative sulfapyridine blood level was 5.5 mg.m. per cent.

Operation: A left frontal osteoplastic bone flap was elevated, disclosing several rough, bony projections on the inner table, apparently representing spicules of bone which had been thrown off from the inner table at the time of injury. The dura was slightly thickened in this region and showed evidences of an old laceration. The dura was opened and the frontal lobe
elevated, revealing a meningo cortical scar attaching the inferior surface of the frontal pole to a defect in the bone and dura, 15×10 mm., at the cribriform plate. The meningo cortical scar was fulgurated and excised. A dural flap from the falk and crista galli was sutured across the defect, after the application of a small amount of sterile sulfapyridine powder to the defect. At the hinge of the dural graft, a fracture was found at the base of the crista galli. A small muscle graft was tucked under the hinge of the dural flap to cover this fracture line. Small muscle grafts were also inserted beneath the anterior and posterior margins of the dural flap to fill the olfactory groove. Convalescence was uneventful except for two convulsions. Cerebrospinal rhinorrhea has not recurred.

Case 4. (N.H.H. #B16615). A young man of 19 years fell asleep while driving an automobile and received a compound frontal craniocerebral injury when the car struck a tree.

When admitted to a hospital elsewhere, macerated cerebral tissue was noted, extruding from the left nostril, the left pupil was dilated and he remained unconscious for twenty-four hours. He remained in the hospital twenty-five days and cerebrospinal rhinorrhea was first noted five days after he returned home. Following this there were progressive headache, nausea and vomiting, weakness, intermittent stupor and fever. He was admitted to the New Haven Hospital on July 3, 1941, two months after the accident.

Examination revealed a healed scar at the left supraorbital ridge. The left eye was slightly depressed by downward displacement of the left supraorbital ridge; there was left enophthalmos and the left pupil reacted sluggishly to light; upward gaze was limited on the left. There was bilateral anosmia and clear fluid dripped from the left nostril (total protein: 113 mgm. per cent; cell count: 5). He was confused at times, was unable to walk and made no apparent effort at urinary control. X-rays of the skull (Fig. 2) demonstrated a large, stellate fracture of the left frontal bone, extending downward to the region of the cribriform plate; air was present in both lateral ventricles, a small amount in the third ventricle and over both frontal lobes, apparently in the subdural* and subarachnoid spaces. Sulfapyridine was given pre-operatively.

Operation: A left frontal osteoplastic bone flap was elevated and the dura opened along the anterior margin of the exposure, revealing a traumatic porencephaly. The thin covering

* This air was verified at operation in a porencephalic cavity.
membrane was punctured and air escaped, deflating the left frontal lobe, which was then elevated. The inferior surface of the frontal pole was attached by a meningo cortical scar to a defect in the cribiform plate. The scar was excised and a large dural defect was found, extending 1.5 cm. lateral to the opening in the cribiform plate. A dural flap from the crista galli and falx was folded over the bone defect and sutured to a second dural flap hinged from the dura of the lateral floor of the anterior fossa. A muscle graft was tucked under the hinge of the lateral dural flap, which tended to pull away from the underlying bone. Sterile sulfathiazole crystals were applied to the bone defect, and the posterior portion of the olfactory groove was filled with a second, small muscle graft. Recurrent cerebrospinal rhinorrhea was noted on several occasions post-operatively but this ceased before his discharge from the hospital and has not recurred. Convalescence was complicated by sterile meningitis and by local infection along the margin of the bone flap, requiring revision of a portion of the wound.

Case 5. (N.H.H. #B17961). A man of 21 received a compound cranio cerebral injury in an automobile accident, Mar. 22, 1941. He was unconscious for about three days and was treated in a hospital elsewhere over a period of five weeks. Cerebrospinal rhinorrhea was noted from the right nostril, four weeks after the injury. He was admitted to the New Haven Hospital on July 21, 1941.

Examination disclosed a long crescentic scar above the glabella and a small scar just medial to the right eye. The nose was deviated to the right, the left nostril was partially occluded and anosmia was complete. Clear fluid dripped from the right nostril (total protein: 415 mgm. per cent; cell count: 95 lymphocytes). X-rays of the skull revealed a fracture of the frontal bone, extending into the frontal sinuses. Sulfapyridine was given preoperatively.

Operation: A right frontal osteoplastic bone flap was elevated and the dura opened along the anterior margin of the exposure. The frontal lobe was elevated, exposing a meningo cortical scar on the inferior surface of the frontal pole, attached to and wedged into a defect, 1 × .5 cm., in the cribiform plate. A large dural defect was present, lateral to the opening through the cribiform plate. A dural flap was reflected from the crista galli and falx and sutured to the remaining portion of dura. The dural flap was supplemented by a free graft of periosteum, from the bone flap; this was sutured at the margins of the large dural defect and to the edge of the dural flap. A small amount of sterile sulfathiazole powder was placed beneath the flaps and the olfactory groove was filled with a bit of muscle, tucked under the edge of the dural flap. Both olfactory nerves had apparently been completely destroyed at the time of the accident and there was evidence of injury to the left frontal lobe. Convalescence was uneventful but occasional drops of fluid were noted from the right nostril until about one month after operation. The cerebrospinal rhinorrhea ceased at that time and has not recurred.

COMMENT

Local infection along the margin of the bone flap occurred in two instances, attesting to the potential source of contamination in these fistulae. In all cases, operation was preceded and followed by sulfonamide medication. There was no postoperative meningeal infection, though one patient had sterile meningitis, with mild fever and pleocytosis. Delayed cessation of cerebrospinal rhinorrhea occurred in two cases having extensive dural defects; double dural flaps were necessary in these instances (Cases 4 and 5). The four adult patients have resumed normal occupations and there has been no recurrence of cerebrospinal rhinorrhea.

SUMMARY

A method is described for surgical repair of cerebrospinal rhinorrhea utilizing a dural flap from the crista galli and falx to cover the defect in the
cribiform plate. Five cases are presented in which this procedure was used successfully.

REFERENCES


