THE USE OF GELATIN SPONGE IN PREVENTION AND TREATMENT OF CEREBROSPINAL RHINORRHEA

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Probably one of the most dangerous and distressing complications of fractures or operations on the frontal bones of the skull is the development of cerebrospinal rhinorrhea. The resultant fistula through the cribiform plate, frontal or ethmoid sinuses and, more recently described, through the eustachian tube with direct communication between the nasal and intracranial cavities, opens a direct pathway for infection, and meningitis is the inevitable result. Before the days of chemotherapy the mortality of this complication was very high. The mortality rate of untreated cases has been given as 39 per cent and Lawson stated, “These traumatic cases are always fatal in course of time from a secondary meningitis, unless the leakage is arrested by virtue of a healing process or by operative interference.” The surgical attack on the problem required courage and skill, for the operative mortality in the best hands has been given as 30 per cent. This high death rate was due to sepsis. But, according to Gissane and Rank “This mortality rate could be reduced if an effective method of occlusion of the fistula could be established by using a technique requiring no buried suture material, and a graft of high viability to cover the bone defect.”

Numerous operative methods and techniques to occlude the fistula have been described. Either the defect in the bone or the dura was closed—usually the latter. Closure of both was unnecessary. Dandy claimed the first successful closure (1926) using an autogenous fascia lata graft. Rand (1930) and Cairns (1937) also used fascia lata. Learmonth described turning a flap over the forehead, elevating the frontal lobe, inserting several packs soaked in iodine between the dura and cribiform plate, and removing these singly at intervals of several days! Trotter, cited by Lawson, used temporal fascia or pericranial fascia. These free grafts were sutured in place, presumably with silk.

Gissane and Rank employed an osteoperiosteal transplant from the tibia, placing it over the defect in the skull without sutures. Stuck and Weatherby used fascia lata in the same manner without sutures. Echols and Holcombe cauterized the fistula and plugged it with muscle. Graham and Adson used Horsley’s bone wax to obliterate the bone defect. More recently German and Gurdjian and Webster described a method of turning down...
an oval dural flap from the falx and suturing it over the defect to close the fistula.

The pioneering work of Ingraham and Bailey\(^\text{10}\) in developing fibrin foam for hemostasis in neurosurgery was hailed with enthusiasm. These authors demonstrated the use of fibrin films in repair of dural defects and in prevention of meningeocerebral adhesions. The experimental work of Light and Prentice\(^\text{13}\) demonstrated the efficiency of the gelatin sponge, dipped in topical bovine thrombin, as a hemostatic agent to arrest bleeding from lacerations of dura, brain and sagittal sinuses with minimal tissue reaction.

Pilcher and Meacham\(^\text{15}\) and Naffziger and Boldrey\(^\text{14}\) showed that the advantages of thrombin-soaked gelatin sponges are: ready hemostasis, adherence to the bleeding surface and lack of tissue reaction.

We have recently treated 3 patients by this method. In 2 cases, a rhinorrhea was prevented. In one, a neoplasm, and in the other, an extensive depressed skull fracture, resulted in a large bony defect in the floor of the frontal fossa of the skull communicating with the nasal cavity. They were both closed by placing a loose piece of tantalum over the bony defect and covering it with strips of gel foam. The dura at the periphery of the defect was scarified to produce a bleeding surface. The gelatin became rapidly adherent. In the third case, in which there was a spontaneous rhinorrhea of 4 months' duration due to a congenital defect in the cribiform plate, the defect was covered with gel foam after the oval dural flap (after the method of German) was found too small to cover the opening. The patient was cured.

Case 1. M. M., Queen's Hospital #208,691. A Caucasian female, aged 44, entered the hospital on Nov. 4, 1946 because of severe headaches. She had been in bed for 5 weeks because of their severity. She gave a history of having had severe attacks of right frontal headaches for 10 years, associated with a chronic postnasal discharge. She had received considerable treatment for sinusitis and migraine. In a severe attack of headache 1 year before she had lost her sense of smell and since that time had been unable to recognize odors with either nostril.

The neurological examination disclosed a complete anosmia. The visual fields were full; the fundi appeared normal. The margins of the optic discs were slightly blurred but not elevated. The other cranial nerves were normal. She insisted that the left half of her body was less sensitive to pin and cotton, and the tendon reflexes were found much more active in the left extremities.

A lumbar puncture disclosed normal fluid except a high total protein, 103 mgm. per cent. A pneumoencephalogram was done. The x-rays demonstrated a good filling of the entire ventricular system which appeared normal. The lateral ventricles were small in size, symmetrical, in the midline and not distorted. The roentgenologist, Dr. L. L. Buzaid, however, described a demineralization and depression of the olfactory groove and adjacent ethmoid cells. A tentative diagnosis of an olfactory groove meningioma was made and an exploratory craniotomy recommended.

Operation. Under local anesthesia on Nov. 6, 1946, a right frontal bone flap was elevated, the dura opened and upon elevating the frontal lobe a large, hard meningioma of the olfactory groove was encountered. It was found to extend about 6 to 7 cm. in its transverse and anteroposterior diameter and 4 cm. vertically. After removing the tip of the right frontal lobe and splitting the falx, the tumor was removed piecemeal with the electric loop. One large artery was cut with the loop, resulting in furious bleeding. It was later identified as the right anterior cerebral artery. The bleeding was arrested by a silver clip and with gelatin-thrombin packs.
The tumor had grown posteriorly, completely surrounding the optic chiasm which was markedly compressed, and extending into the sella turcica. When all tumor tissue had been removed including the dural attachment, the cribriform plate appeared somewhat elevated. It was tapped with a chisel and found to be paper-thin. Upon removing it, the neoplasm was encountered beneath, having extended through the cribriform plate into the nasal cavity, and a globular mass, $1 \times 1\frac{1}{2}$ cm., was lifted out in one piece. The total tumor tissue removed weighed 27$\frac{1}{2}$ gm.

We now had a hole in the posterior part of the cribriform plate as large as a quarter through which we could look down into the nasal cavity and see all the turbinates covered with "infected" mucus! The lethal hazard to the patient's life which this situation presented was immediately obvious. The huge defect in the dura which could be impossible to patch,

the large area of raw, ragged exposed brain, and the basal cisternae all open—a fulminating, fatal infection seemed tantamount with the patient's first sneeze.

A small plate of tantalum was cut to fit the defect in the bone, but an attempt to drive it level into the hole was unsuccessful because of its extreme posterior position (Fig. 1).

The entire area of bone (and tantalum) denuded of dura was covered with long strips of gel foam soaked in thrombin, and about 10 cc. of thrombin were poured into the wound. The dural flap was closed, the bone flap was wired and the trephine holes in the exposed area of the forehead were covered with small tantalum scraps.

The postoperative course, much to our amazement, was smooth and uneventful. She was watched closely to prevent her from sneezing or blowing her nose. She received penicillin, 1.5 million units daily for 10 days. At no time did the temperature rise above 100°F. No signs of meningitis developed and not a drop of spinal fluid ran from her nose. She was walking about the ward on her 8th postoperative day. She was kept in the hospital for 30 days for fear of complications, but none developed. It is now 6 months postoperative and except for the personality changes from injury to her frontal lobes, she is symptom free.

Case 2. Within a few days after the above patient was operated upon, F. E., Queen's Hospital #209,352, a Caucasian male aged 61, was admitted as an emergency, having fallen from a height of 30 feet. He had struck his right forehead on a protruding ledge in the fall.
On admission he was conscious and rational. There was a contusion-laceration over the right eyebrow through which could be palpated a wide fracture of the supraorbital ridge. There was bleeding from the right nostril, and upon cleaning it, large quantities of serosanguinous fluid and some white brain tissue were recovered.

X-rays (Fig. 2) revealed an extensive fracture of the roof of the orbit depressed upward into the frontal fossa. There was also a compression fracture of the 3rd lumbar vertebra.

Operation. A low right frontal bone flap was elevated and the dura opened. The fractured bone fragments had lacerated the dura and inferior surface of the right frontal lobe over a wide area. When all loose bone fragments had been removed, the cribiform plate and several ethmoid cells as well as the frontal sinus had been opened into and direct communication with the nasal cavity was visible. After a thorough debridement of the brain and ragged dura, the latter was partially closed with a periosteal patch. A piece of tantalum was placed loosely over the roof of the orbit and covered with strips of gel foam. The wound was closed without drains. The patient was placed on penicillin for 1 week. Fig. 3 shows postoperative x-rays.

Slight sero-sanguinous drainage was noticed from the nose on the day following surgery, but had stopped by evening. No evidence of infection or cerebrospinal rhinorrhea had developed by the 15th postoperative day, when the patient died. On Dec. 2, 1946 the blood pressure suddenly fell to shock levels, pulse became weak and thready and he became very cyanotic and expired. At autopsy the cause of the death was found to be a massive infarct of the heart from an arteriosclerotic thrombosis of the anterior descending branch of the coronary artery.
Inspection of the intracranial operation was interesting. The strips of gel foam were unrecognizable. Blood and serum had apparently soaked through the sponges, uniting with the thrombin to form a hemogenous solid sticky film, 2 to 3 mm. in thickness, which was literally glued to the floor of the skull, tantalum plate, and surrounding dura, forming a water-tight seal.

It was easy to see why the first patient with a wide open hole in her nose had leaked no cerebrospinal fluid. The prevention of a rhinorrhea and a possible fatal intracranial infection, we believe could not have been accomplished in any other manner in these 2 cases except by the use of the gelatin sponge or some similar substance to occlude the cranio-nasal opening.

Case 3. L. L., Queen's Hospital #206,180, a 37-year-old part Hawaiian woman, secretary to the Medical Director, noticed a serous discharge from the left nostril in April 1946. This increased in amount until June, when 10 to 15 cc. of fluid could be collected at one time. The fluid reduced Fehling's solution which identified it as cerebrospinal fluid rather than nasal secretions. Craniotomy and closure of the fistula was advised but ignored.

On Aug. 13, 1946 the patient was admitted to the hospital, semi-conscious and very restless. She had had severe headaches, backache, nausea, and pain on moving her eyes and neck, of 4 hours' duration. Admission temperature of 102.6 F. promptly rose to 105.2 F. White blood count was 28,400 with 96 per cent polymorphonuclear leucocytes. The clinical diagnosis of acute purulent leptomenigitis of nasal origin was verified by lumbar puncture. Alfa streptococci were cultured from both blood and spinal fluid. Large doses of penicillin, intramuscular and intravenous, were given with sulfadiazine by mouth. The temperature returned gradually to normal in 6 days, and she was discharged, 5 days later, recovered.

Following the meningitis the drainage of spinal fluid from her nose ceased, and her nose was dry for 4 months. Then on Jan. 15, 1947 the drainage recurred and within 2 weeks it was copious in amount, accompanied by headaches.
Operation. She was admitted to the hospital for surgery on Jan. 30, 1947. X-rays of the skull showed no intracraniol air. A low, unilateral (left) frontal bone flap was elevated through a "concealed" scalp incision and the dura opened. A lumbar puncture needle had previously been inserted into the lumbal canal. (The patient was lying on a mattress used for continuous spinal anesthesia.) By removing the stylette and allowing all spinal fluid to drain out, the frontal lobe fell back exposing the entire cribiform plate, making retraction of the brain unnecessary. After removing the olfactory bulb no single defect in the dura could be seen; the openings of the olfactory nerves appeared somewhat larger than normal. A dural flap was turned down from the falx and sutured with fine tantalum wire. The flap was found too small to completely cover the cribiform plate and when sutured was not water-tight. The entire area was then covered with gel foam strips. The wound healed per primum. There was no postoperative elevation of temperature or rhinorrhea. The patient was discharged and returned to her work as a stenographer 7 days after the operation. There has been no recurrence of the rhinorrhea to date, 7 months postoperative.

This case demonstrates the serious complication, meningitis, which invariably occurs when an open fistula between the nose and intracranial cavity exists. It also demonstrates the fact that if these lesions are treated surgically immediately, when first recognized, such complications can be averted. And finally an efficient agent to cover the fistula, intracranially, with confidence and assurance that it will be and remain water-tight, is the gelatin sponge soaked in thrombin.

SUMMARY AND CONCLUSIONS

1. In the prevention and treatment of cerebrospinal rhinorrhea "the ideal surgical treatment should include the use of a graft which has a high degree of viability and which does not require the use of buried sutures."18

2. We believe this ideal graft is the gelatin sponge (gel foam).

3. Two cases are described in which a fatal intracranial infection through a cranio-nasal opening was prevented and one case in which a chronic cerebrospinal rhinorrhea was arrested by the use of the gelatin sponge to seal the dural-bone defect and close the fistula.

REFERENCES


GELATIN SPONGE IN TREATMENT OF CSF RHINORRHEA


