The Use of Adhesive and Lyophilized Dura in the Treatment of Cerebrospinal Rhinorrhea

Technical Note


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Ever since Dandy performed the first successful repair of a cerebrospinal fluid fistula, reports of the treatment of this condition have emphasized the importance of water-tight closure. Meningitis is an ever present danger if such a fistula remains unclosed, and an attempt at primary closure should be made if conservative treatment has been unsuccessful. Operative techniques have usually aimed at closure of the defect in the dura rather than the bone, but adequate closure of either defect is sufficient to achieve a cure.6

Dural suture remains the most frequently employed method of repair. If the dural edges cannot be approximated, dural flaps or muscle, fascial, or pericranial grafts may be sutured to the dural margins.6 Suture techniques are often difficult to carry out, particularly when defects are in relatively inaccessible areas or surrounded by friable dura. This problem has led some surgeons to advocate the use of various other techniques. Iodoform packs,7,12 cauterization of the fistula followed by plugging with muscle,7,9 and sutureless repair of the defect with fascial grafts8,10,14 or gelatin sponge11,13 have all been successfully employed. However, none of these procedures assures a watertight closure.

Bone wax has been used by some surgeons to fill the fracture site.1,4,11 More recently, encouraging reports of cases treated solely by sealing the bony defect with methyl methacrylate have appeared.12,20,21 This method permits sutureless repair but involves the introduction of a foreign material and requires adequate exposure of the fractured bone.

Experiments in our laboratory have demonstrated that the alkyl-2-cyanoacrylates can provoke a fibrocytic reaction capable of covering a dural defect with an adequate layer of connective tissue. These compounds, especially those with short alkyl groups, have a bacteriostatic action which may help to reduce the possibility of infection.17 Of the homologous series, the shorter chain members (methyl and ethyl) are probably too toxic for use, while those with longer chains tend to produce less acute tissue reaction and take much longer to be resorbed.13,16

Isobutyl cyanoacrylate* seems to possess a high degree of bacteriotoxicity and relatively less histotoxicity.17 Because of its bacteriotoxicity it was decided to use this material rather than a less histotoxic homologue for the repair of cerebrospinal fluid fistulae. When applied to brain surfaces, isobutyl cyanoacrylate may produce direct tissue damage at depths up to a few millimeters. It is therefore important to avoid application of this material to critical areas such as the circle of Willis and the hypothalamus. We place a patch between the adhesive and the brain to minimize the risk of damage to neural tissue. The great advantage of the method is the watertight sutureless dural closure.6

We are reporting four cases treated in this manner. All of the repairs were performed intradurally.

Case Reports

Case 1. On June, 18, 1965, a 50-year-old Greek military officer was rendered unconscious by a head injury resulting from an automobile accident. At the time of admission he was confused and had spastic left hemiparesis. Skull films showed multiple fractures across the vertex and the right side running anteriorly into the right frontal sinus and medial wall of the right orbit. Aside from a pneumothorax which developed shortly after admission, the patient gradually improved. On September 10, 84 days after the accident, the patient experienced the sudden onset of a copious flow of cerebrospinal fluid from the right nostril. Skull films taken at that time showed air present in ventricles of normal size and in two small pockets immediately behind and to the right of the frontal sinus. Antibiotics were begun.

First operation. On September 14, using a right frontotemporal osteoplastic craniotomy, the frontal lobe was dissected free from adherent dura and retracted. This uncovered a 1 3/4 x 2 1/4 cm defect in the dura and bone overlying the posterior frontal sinus. A patch of pericranium closely approximating the size and shape of the defect was glued to the margins of the defect with

* This material can be obtained for experimental use in the form of IBC-1, supplied by Ethicon, Inc., Somerville, N. J. Clinical use is made possible by filing IND application with the Food & Drug Administration.

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isobutyl cyanoacrylate. However, undiminished rhinorrhea was evident on the first postoperative day and continued unabated until the second operation on October 1.

**Second operation.** The previous incision was reopened and the repair inspected. Surprisingly, there was no observable defect in the pericranial graft which had become well vascularized. Exploration of the middle fossa revealed a suspicious area of attenuated dura in the region of the anterior and medial wall. A small piece of cadaver dura† coated with a drop of isobutyl cyanoacrylate was glued over this point. A piece of cottonoid was then cut to the shape of the floor of the right anterior fossa. This was used as a backing for a slightly larger piece of cadaver dura which was held against the dependent margin of the floor of the anterior fossa. Drops of isobutyl cyanoacrylate were then placed in the crevice between the cadaver dura and the cranial floor.

The head was placed in an almost lateral position with the sagittal plane horizontal. The patch was first glued in the midline alongside the crista galli and back to the tuberculum sellae. By gradually gluing the dura in place, a new covering was created for the entire floor of the right anterior fossa. This extended from the midline to the lateral margin of the orbital roof and forward onto the anterior wall of the skull. After this had been accomplished the cottonoid backing for the dura was removed and replaced by a piece of gelfoam. During the 4½ months since his second operation, the patient has remained afebrile with gradual improvement of mood and mentality. There has been no recurrence of rhinorrhea.

**Case 2.** A 29-year-old enlisted man sustained multiple skull fractures as a result of an airplane accident in May, 1962. He subsequently developed cerebrospinal rhinorrhea from the left nostril.

**First operation.** In July, 1962, craniotomy disclosed a bony defect 1½ cm in diameter leading into the left frontal and anterior ethmoid sinuses. The defect was filled with methyl methacrylate and a piece of temporal fascia sutured over it. Rhinorrhea persisted postoperatively.

**Second operation.** Three weeks later the site was re-explored. At this time a defect involving the posterior ethmoid was treated in similar fashion. The patient remained well for 3 months until cerebrospinal rhinorrhea recurred.

**Third operation.** At a third operation the previous defects were again filled with methacrylate and the dural lining cauterized and sewn over with pericranium. This, however, proved unsuccessful.

**Fourth and Fifth operations.** A trans-septal sphenoidotomy during March, 1963, was also unsuccessful. At the end of March another craniotomy was performed and muscle was packed about the optic chiasm. Once again rhinorrhea persisted and the patient had three bouts of bacterial meningitis. Following the last of these in January, 1965, the rhinorrhea disappeared for 2 months only to recur in gradually increasing frequency and amount.

**Sixth operation.** On November 4, 1965, the middle fossa was explored through a left frontotemporal craniotomy. There was an abnormal area of elevated dura which proved to be due to a wooden plug that had been wedged into the foramen spinosum at a previous operation. After removal of the plug, a 4×4 cm patch of cadaver dura was glued over this area with the aid of a cottonoid backing. A small 1×1 cm patch was also stuck down anterior to this. Close examination of the tuberculum sellae revealed a fracture line a few millimeters medial to the left optic nerve. A 2×2 cm patch of cadaver dura was placed over the tuberculum sellae and its edges insinuated 1 mm or so between the bone and optic nerves laterally and the bone and chiasm posteriorly. This protected the neural structures from the glue which was placed beneath the patch anteriorly. The patch was then pressed into place. Rhinorrhea recurred 2 weeks postoperatively.

**Comment.** This was the only case in which a bony defect was not discovered at the time of operation. Instead, a fracture line in the tuberculum sella and a plug in the foramen spinosum were found at exploration. These areas were adequately patched but rhinorrhea continued. We believe that this happened because we never found the true source of the spinal fluid leak.

**Case 3.** On May 23, 1963, this 17-year-old boy was struck over the right eyebrow with a baseball bat. Skull films showed a fracture of the supraorbital margin. At first he did well but developed pneumococcal meningitis a month later. This was followed by intermittent drainage of pink fluid from the right nostril and in February, 1965, the patient had another attack of pneumococcal meningitis. Roentgenograms including laminograms were normal.

**First operation.** On June 13, 1965, a right frontotemporal osteoplastic craniotomy was performed. Retraction of the frontal lobe exposed a diagonal linear fracture of the right orbital plate with dura caught in it. The dural defect was located 1½ cm anterior to the crista galli and just lateral to the midline. A stamp of pericranium was sutured over the hole. Bilateral rhinorrhea recurred within 1 month. Repeated x-ray studies were normal.

**Second operation.** On November 9, 1965, the area was re-explored. The previous repair was found to be intact but the dura over the cribiform plate posterior to this was attenuated. Occasional bubbles could be seen coming through this area when it was covered with fluid. A 3×1½ cm patch of pericranium with cottonoid backing was glued alongside the crista galli. This did not prove totally satisfactory and a second smaller patch was placed anterior to this just behind the site of the previous operative repair. A small patch of pericranium was also glued to the anterior floor of the temporal fossa. In the 4½ months since surgery, there has been no recurrence of rhinorrhea, and the patient has returned to college.

**Case 4.** A 17-year-old enlisted man received a gunshot wound of the face on November 6, 1965. He sustained bilateral orbital blow-out fractures with total blindness. A right Krönlein procedure the next day disclosed a friable, soft optic nerve and tears of all the extraocular muscles. The patient was started on antibiotics but complained of headache, drowsiness, and aural and posterior synechope. From the time he entered the hospital he was noted to have a browmish nasal discharge on the right side. Cerebrospinal fluid obtained by lumbar puncture on November 13 was normal.

**First operation.** On November 19, the patient underwent debridement of both maxillary antra. The next day he spiked a fever of 102°F. Lumbar puncture and

† Courtesy of the Tissue Bank Department, National Naval Medical Center, Bethesda, Md.