Cerebrospinal fluid leakage after endonasal dacryocystorhinostomy

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Les auteurs n’ont aucun intérêt financier dans les produits cités dans l’article.

INTRODUCTION

Cerebrospinal fluid (CSF) leakage, or rhinorrhea, is a very rare complication of dacryocystorhinostomy (DCR) [1-6] and functional endoscopic sinus surgery (FESS) [7-9]. CSF leakage has not been previously documented following endonasal DCR, although one clinically suspected case was reported by Dolman [1]. It can have serious consequences, including bacterial meningitis [2, 4]. The occurrence of CSF leakage after DCR may be explained by either direct or indirect injury to the base of the skull. Direct damage may occur when inadvertent extension of the osteotomy to the anterior part of the skull occurs.

Anatomical studies measuring the distance between the upper limit of a DCR osteotomy and the skull base indicated that the usual safety margin could be reduced in case of prior trauma or congenital malformation, such as the underdevelopment of the frontal sinus [10-12]. This is in accordance with published CSF cases following DCR. Dryden reported a case with prior posttraumatic orbito-naso-ethmoidal disjunction [3]. Bagheri et al. [6] described another case with a meningoencephalocele. In both cases, the frontal part of the brain was in direct contact with the nasal bone (major meningeal prolapse).

Indirect damage during external DCR was first suggested by Neuhaus...
and Bayliss [5]. A twisting movement of the bone rongeur applied to the maxillary bone during the osteotomy may cause a spiroid fracture that can further spread to the base of the skull. However, this hypothesis has not been confirmed by any imagery technique to date.

However, indirect damage is more widely established in CSF leakage occurring after endoscopic sinus surgery (FESS) [7]. In this technique, the defect originates from an excessive displacement of either the middle turbinate or the perpendicular plate of the ethmoid. These two structures, which are inserted onto the cribriform plate of the ethmoid, may also be adjacent to the lacrimal fossa [13].

We report a documented case of CSF leakage induced by the forced reclining of the nasal septum during endonasal DCR. We further describe an endonasal endoscopic repair method for this rare complication.

**CASE REPORT**

**Preoperative data**

An 80-year-old female patient, in good general health and with no specific history, presented with permanent chronic epiphora with secretions that had been increasing for the previous year.

Examination revealed a mucocele of the right lacrimal sac, with bone contact and negative irrigation. The lacrimal-nasal stenosis was incomplete on the left side. Endoscopic examination of the middle meatus was difficult because of a major deviation of the nasal septum, causing an extreme narrowing of the right nasal fossa. Preoperative CT scan revealed a complex deviation of the nasal septum (fig. 1a) involving both the cartilaginous (septum) and bony (perpendicular plate of the ethmoid) sections. A meningeal prolapse and marked osteoporosis of the skull base was also noted (fig. 1b). The right middle turbinate was atrophic and distant from the lacrimal duct.

**Endonasal DCR method**

A right dacryocystorhinostomy (DCR) was performed from an endonasal approach. A three stage enlargement of the nasal fossa was initially achieved. The anterior nasal fossa was first packed with 5% naphazoline Xylocaine. The septum was then medialized using a Killian speculum. The resulting enlargement allowed inserting a second packing up to the middle meatus. A few minutes later, the nasal mucosa over the frontal process of the maxillary was infiltrated with 1% Xylocaine and adrenalin (1ml).

The endonasal DCR was then performed as previously described [14]. A mucosal-periosteal flap incorporating the anterior part of the uncinate process was resected. This was followed by maxillary osteotomy with a protected microdrill without using any bone rongeur. The lacrimal sac was freed from all bony obstruction. The sac was then cut open and its medial wall was removed. Finally, the two lacrimonasal canaliculi were catheterized with silicone tubing. Mucosal bleeding required permanent irrigation/aspiration. Neither turbinectomy nor anterior ethmoidectomy (other than unciformectomy) was required.
Diagnosis of immediate postoperative CSF leakage

Upon recovery from the anesthetics, the patient complained of headache that became more severe with time. A discharge of a clear liquid from her right nostril was noted when she was seated. A CT scan showed a breach in the roof of the right ethmoid, producing a massive pneumoencephalocele (fig. 2).

Medical and surgical management of the CSF leakage

Immediate management included immunization against meningococcus and pneumococcus, without antibiotic prophylaxis to avoid masking the initial signs of meningitis.

Because of the advanced age of the patient, the conventional neurosurgical repair of the meningeal defect from a coronal approach with a frontal bone flap and direct surgery of the anterior skull base was not elicited. Instead, an endonasal endoscopic repair of the ethmoidal bone and meningeal defect was performed on the same day by the authors (ER and BF), using a technique similar to that of Wormald and McDonogh [15, 16] with some modifications (fig. 3).

Endoscopy confirmed an opening 1 cm in diameter in the roof of the ethmoid. This defect was plugged by a multilayered composite patch of cartilage, fat, Surgicel®, and mucosal graft. A total of 4 cm³ of autologous fat was harvested from the patient’s abdomen. In addition, a subtotal sampling of a 2-cm-diameter graft of cartilage was obtained from the right inferior turbinate. These tissues were placed in isotonic saline with aqueous povidone iodine 10% (Betadine, Houdan, France) for 10 min.

The septal cartilage was then threaded onto a line of 4/0 absorbable polysorbate monofilament (Monocryl, Johnson & Johnson, Paris, France) with a stopping knot. This cartilage patch was inserted obliquely into the skull cavity and then held in place by tightening the Monocryl suture.

Five spheres of abdominal fat, each 5 mm in diameter, were threaded onto the filament and slid up onto the cartilage graft. The first two fat grafts were placed intracranially to improve the sealing effect of the cartilage plate. Three more fat grafts were placed beneath the ethmoidal roof.

Tissue glue was then used to seal a piece of Surgicel® over this composite fat/cartilage graft. The right inferior turbinate, from which the cartilage patch had been
harvested, was then glued into place as an outer cover on the composite graft and held in place using a pressure packing of reinforced silastic tubing and Merocel™.

**Follow-up and outcome at 34 months**

Postoperative follow-up was unremarkable. No further signs of CSF leakage, neurological damage, or infection were observed. The headache resolved completely within 8 days. A follow-up CT scan at 1 month (fig. 2d) confirmed that the pneumoencephalocele had completely disappeared. Rhinoscopic examination performed 16 months later (fig. 4) showed complete healing of the ethmoidal defect and a permeable DCR.

There was no residual epiphora 2.5 years after surgery.
DISCUSSION

What is the most probable mechanism for CSF leakage after endonasal DCR?

Direct accidental and unnoticed damage resulting from an uncontrolled move or an excessive osteotomy cannot be excluded in this case, since intraoperative visual access was poor. However, the postoperative review of serial CT scan sections confirmed that the anterior ethmoid was intact and that the upper edge of the osteotomy remained at a significant distance from the base of the skull despite the meningeal prolapse.

Indirect damage transmitted from the middle turbinate (MT) was also unlikely since the MT was atrophic and distant from the surgical area. In fact, no middle turbinectomy was required to perform the DCR.

Force reclining of the nasal septum therefore appears to be the most probable cause of the damage to the roof of the ethmoid and subsequent CFS leakage. The separation forces applied from the valves of the Killian speculum onto the nasal septum cause a forced medial movement of the septum and are also responsible for a distal mechanical action onto its insertions. Because the caudal insertion of the nasal septum onto the base of the nasal fossa may be more solid than its weaker cranial insertion onto the cribriform plate, an excessive pressure from the Killian speculum may cause an elective fracture of the roof of the ethmoid.

In this specific case, the rare simultaneous occurrence of four independent factors contributed to this mechanism:

– the unusual extent of the septal deviation (fig. 1a) required a significant amount of pressure from the Killian speculum against the septum to gain visual access for the DCR;
– the cranial insertion of the perpendicular plate of the ethmoid directly onto the cribriform plate (fig. 1b) is quite uncommon and may favor the transmission of mechanical forces applied to the septum. The usual insertion of the nasal septum onto the crista galli apophysis is much more frequent and also more robust;
– the meningeal prolapse reduced the path length of the fracture required to cause a CFS leakage (fig. 1b);
– the extensive osteoporosis involving the anterior part of the skull base, related to the age of the patient, contributed to reducing the resistance to the propagation of the fracture to the base of the skull.

Intraoperative diagnosis of the fracture may be precluded by local factors. The ethmoidal breach is too distant from the area of lacrimal surgery to be readily visible. The CSF leakage is not detected during surgery because of the poor visibility and the reclining position (dorsal decubitus) that allowed the mixture of blood, CSF, and irrigation fluid to flow backwards.

Should forced reclining of the nasal septum be avoided in endonasal DCR?

The use of an orthostatic Killian-type speculum may carry unexpected risks for complications. Killian valve orthostatic spreaders are widely used in microscopic surgery of the ethmoid and for endonasal DCR [17-20]. This speculum can be used for partial dislocation of the middle turbinate or the septum.

There is currently no published report of problems encountered with the use of the Killian valve speculum. We have used this device to recline the septum on many occasions during endonasal DCRs with no complication identified.

While the published cases of CSF leakage after DCR are exceptional, the fracture of the cribiform plate may be underestimated. Such a fracture does not always cause a meningeal opening and CSF leakage. This is especially relevant in young subjects with thicker, stronger meningeal walls, which in addition do not adhere to the bone of the skull. It may also be difficult to diagnose CSF leakage, particularly in minor forms with little clinical effect that heal spontaneously.

Are very narrow nasal fossa a contraindication to endonasal DCR?

A nasal fossa greatly narrowed by a major deviation of the septum may create additional difficulties for endonasal DCR. In light of this case, we no longer try to forcibly dislocate the septum, especially in older subjects.

There is no satisfactory method (CT scan, rhinoscopy) to predict the mechanical strength of the junction between the perpendicular plate of the ethmoid (which forms a prolongation of the ethmoid to the skull) and the ethmoid cribiform plate. The meningeal sheets become thinner with age and adhere to the cribiform plate. Thus a simple fracture is quite likely to tear the meningeal sheet, leading to CSF leakage. We therefore consider an external DCR or an enlargement of the nasal fossa by endoscopic septoplasty (ES) when the fossa is very narrow. The ES is restricted to providing good access to the nasolacrimal duct, since it adds at least 10 min to the surgical procedure.

In the past 2 years, we have performed 29 ES procedures during endonasal DCR and have had no major postoperative complications when DCR is combined with ES.

REFERENCES