Artículo Original

The Precallosal interhemispheric approach for the treatment of osteomeningeal defects in the cribiform area.

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ABSTRACT

The subfrontal approach is the most frequently used cranial route to seal osteomeningeal defects of the anterior cranial fossa. Nevertheless, we have observed difficulties preserving the first cranial nerve and the frontal paranasal sinus when using this corridor – eirther unilateral or bilateral-. For these reasons, we now favor using the interhemispheric precallosal approach to seal leaks in the cribriform area in selected cases. To describe and analyze advantages and disadvantages of precallosal interhemispheric approach as an alternative approach to repair osteomeningeal defects in the cribriform area. Based on previous anatomical studies and surgical experience with other well-known interhemispheric approaches, we have planned a precallosal interhemispheric approach to the ethmoido-fronto-sphenoidal area of the anterior cranial fossa to treat a series of eight patients sustaining post-traumatic or spontaneous CSF-leaks originating in that area. Six patients presented with post-traumatic CSF leaks while in the remaining two they were spontaneous. Immediate sealing of the leak was achieved in seven patients using the proposed approach. One patient with persistent leak after surgery required an additional procedure. The contralateral first cranial nerve was preserved in all cases, while it was not possible to preserve the ipsilateral olfactory nerve by this approach. Unilateral olfactory function was preserved in four cases.

The interhemispheric precallosal approach is an alternative for the repair of osteo-meningeal defects in the cribriform area when olfactory function and frontal paranasal sinus preservation is desirable.

Keyword: Anterior Cranial Fossa, Cerebrospinal Fluid leak, Olfactory Nerve Diseases, Cerebrospinal Fluid Rhinorrhea Surgery..

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BACKGROUND

Traumatic or non-traumatic etiology, are frequently localized in the cribriform plate area, a true funnel in the central anterior skull base[1,18,21,26]. These defects or fistulae, connecting the intracranial subarachnoid space with the respiratory mucosa, may lead to recurrent meningitis[1,5]. Diagnosis is clear when rinorrhea is significant and persistent in the context of cranial trauma[8]. In some cases, rhinitis and nasal discharge of various origins should be ruled out by biochemical analysis of beta-2 transferrine or glucose in the suspected liquid[1,5]. Neuroimaging, and especially cisternography by means of computed tomography (CT) are crucial to establish a diagnosis and to localize the defect for surgical planning. Magnetic resonance imaging (MRI) and particularly MRI-based cisternography is also useful, as sometimes a small encephalocele pointing the site of the osteo-meningeal defect can be observed (figure 1-A)[17]. Diagnosis may be challenging in the case of intermittent leak[22]. Nonetheless, it should be noted that most of these fistulae and CSF-leaks seal spontaneously and that more conservative non-operative therapeutic measures have demonstrated to be effective. These include bed rest, diuretics, repeated spinal taps, continuous spinal drainage and ventricular drainage[3,8,9,15,20,25]. Usually, a direct approach to seal a traumatic fistula is only considered 2 to 4 weeks after trauma. On the other hand, spontaneous fistulae must be sealed without further delay, because spontaneous closure of these type of defects is rare, although it may occur after an episode of meningitis[1, 8,18].

It is still unclear if the use of prophylactic antibiotics reduces the incidence of meningitis in patients with traumatic CSF leaks despite the publication of several studies on this subject[2,8,19]. The objective of surgery, regardless of the approach, is to eliminate the communication between the subarachnoid space and the paranasal mucosa building a permanent barrier between them. A secondary objective may be to preserve function of the first cranial nerve when it is present, and the anatomy of paranasal air spaces, especially the frontal sinus[23]. The aim of this study was to describe and to analyze the advantages and disadvantages of an original transcranial route to approach these lesions.

PATIENTS AND METHODS

Although the endoscopic endonasal approach is usually the preferred approach in our institution to seal the osteo-dural defects of the anterior skull base, some cases still call for the transcranial route. These cases are those in which the endoscopic route is supposed to be difficult because of the location of the fistula or when the herniated sac is considered large to be handled safely by the endoscopic endonasal approach (Figures 1 and 2).

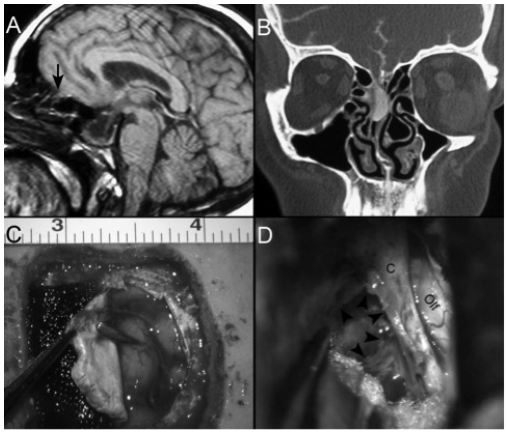

Figure 1. Illustrative case. A 56 years-old woman with history of empty sellar syndrome presented with repeated rinorrhea. MRI showed a large empty sella ocupied by an arachnoidal sac, along with a small etmoidal meningo-cephalocele (arrow). (B) CT cisternography confirmed the CSF-leak through the left cribiform plate. (C) Right parasagital precoronal craneotomy the dura has been opened, the midle frontal vein is strongly attached to the dura and it is locate in the middle of the operative route. In this case the vein was not preserved. (D) Operative image showing the left osteo-meningeal defect (arrows heads), the crista galli (C) and the preserved right olfactory nerve (Olf).

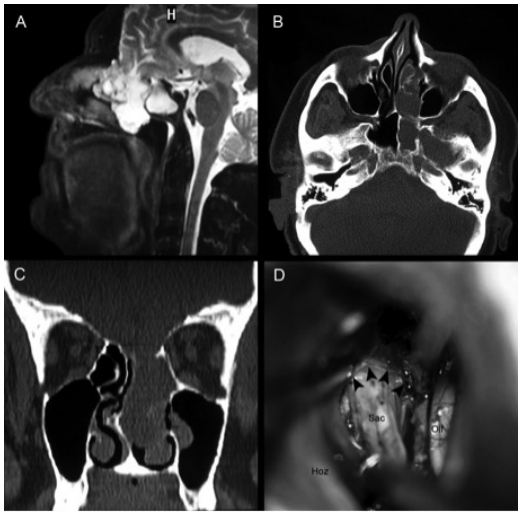

Figure 2. Illustrative case. A 72 years-old man with history of meningitis and left frontal brain abscess presented basilar encephalocele. Rinoscopy showed a large polypoid mass in the left nasal fossa. (A) MRI showed the girus rectus of the frontal lobe herniating in the nasal cavity through left cribriform plate. The encephalomeningeal sac protruded to the ethmoidal sinus, nasal fossa, and sphenoid sinus. (B) CT-scan showing complete obliteration of the left paranasal spaces. (C) CT-scan coronal projection showed the lack of cribriform plate in the left side. (D) operative view of the right interhemispheric precallosal approach showing the osteomeningeal defect (arrows heads), the falx cerebri (Hoz) and the right olfactory (Olf) nerve which is preserve.

The transcranial route is also preferred when a free tissue transfer is required or in cases where there is a comminuted fracture or multiple points of leaks affecting the anterior cranial base. We reviewed the surgical videos and medical charts of patient who were operated on using the precallosal interhemispheric approach to seal osteo-meningeal defects of the anterior cranial base.

The interhemispheric precallosal approach is performed with the patient in the supine position with the torso bent forward in a 40-degree angle and

the head-holder placed as usual. The head is not rotated and the neck is maintained in a neutral position. Once the patient is in this position, anatomical landmarks are identified and marked in the scalp (i.e. the midline, the coronal suture, and the bregma). Neuronavigation may be used in this stage of the surgery and/or later to identify the most convenient gap between bridging veins, but it is not essential. The scalp incision is tailored to be hidden by the hair which is minimally shaven and the scalp is generously infiltrated with local anesthesia. A subgaleal flap is elevated carefully preserving the periosteum.

The craniotomy may be either right or left-sided; we prefer the non-dominant side in spite of the location of the targeted defect. A single burr-hole is performed in the midline over the superior sagittal sinus two centimeters in front of the bregma and a paramedial craniotomy is elevated following the midline and a lateral semilunar curve (Figure 1-C). The most lateral point of the craniotomy must be 3 cm away from the midline, and the most rostral at 5 cm in front of the bregma. The dura is then opened under the microscope so the bridging veins (one or more middle frontal veins) are identified and preserved. There are several strategies to preserve these veins. First, the vein may be identified preoperatively and its preservation planned. Second, since preservation of these vessels may determine the result of surgery, the craniotomy and the approach can be slightly moved backward of forward to preserve these veins[11]. Neuronavigation may be useful to accurately identify these veins. If veins are in the way of the approach (usually the middle frontal vein), they should be dissected free from the arachnoid to allow some degree of mobilization[27]. Nonetheless, in some instances one of these bridging veins needs to be sacrificed and clinical consequences are expected to be rare when these vessels are rostral to the coronal suture. Once the dura is opened towards the sagittal sinus, the falx cerebri is identified and followed downward. Then, the medial surface of both frontal lobes below the falx cerebri are identified and separated. At this point, arachnoidal dissection must be meticulous because both frontal lobes are usually imbricated, and may also be strongly adherent to each other in patients with previous episodes of meningitis. The anterior cerebral arteries, and the pericallosal artery falls behind this approach so they are not usually exposed. Olfactory nerves are then identified, and the insertion of the falx into the crista galli. The first cranial nerve may be separated from the frontal lobe if necessary, but it should not be separated from the cribriform plate whenever possible, because this maneuver assures loss of olfactory function. The cribriform plate is pierced by the filaments of the first nerve, so any traction either upward or lateral may transect these tiny filaments. By contrast, the olfactory nerve does tolerate some degree of downward

mobilization. In order to expose the defect, elevation of the falx from the crista galli may be necessary, especially when the approach is contralateral to the defect. Once the osteo-meningeal defect is identified it is cleaned up of its surroundings and sealed with pericranium, muscle, fascia lata, fibrin glue and/or cranial bone as necessary. Cranial bone may be harvested from the inner surface of the cranial flap.

RESULTS

We identified eight patients presenting with CSF leaks through the cribriform area that underwent repair using the precallosal interhemispheric transcranial approach. Six patient had post-traumatic leaks while in two patients the fistulaes were spontaneous. Immediate and permanent sealing of the leak was achieved in seven (87.5%) patients. One patient had a persistent leak after surgery requiring an additional endoscopic approach with continuous lumbar drainage (Figure 2). The contralateral first cranial nerve was preserved in all cases. However, it was not possible to preserve the ipsilateral olfactory nerve when using this approach. Interestingly, the olfactory nerve ipsilateral to the CSF fistula was absent in the two cases of non-traumatic etiology. After one year of follow-up there was no olfactory function in four out of six traumatic cases, while first nerve contralateral function was preserved in the two spontaneous cases.

DISCUSSION

Although the endonasal endoscopic approach is preferred in most cases of persistent CSF leak due to osteo-meningeal defects of the anterior central cranial base, transcranial approaches are still needed in many patients. Reason to prefer a transcranial approach include the anatomy of the defect (i.e. multiple or large defects, comminuted fractures), comorbidities, availability of endoscopic surgery, and surgeon preference[1,8,10,13,15,16,24]. We have observed that the classic subfrontal route either unilateral, and especially the bilateral, may be the cause of first nerve injury and frontal paranasal sinus violation. Also, we adhere to this few well-described principles of microneurosurgery: surgery must be simple, must be fast, and must preserve the normal anatomy[12]. Nevertheless, we recognize that preservation of olfactory function is difficult to prove in traumatic cases because its function is not easily evaluated before surgery and because trauma itself may be the cause of loss of olfactory function. For these reasons we have been using the precallosal interhemispheric approach as described in this study, which seems to be faster and to be associated with less morbidity as compared with the subfrontal routes. The interhemispheric approach may also probably reduce the risk of osteomielitis of the cranial flap, although this complication is rare. Still, the subfrontal route is recommended for all defects localized or extending

laterally out of the scope of this approach (Figure 3) or when a wider microsurgical exploration of the anterior cranial fossa is expected to be needed.

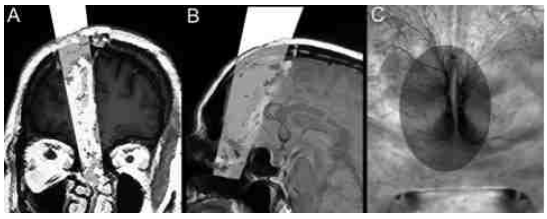

Figure 3. Direction and scope of the interhemispheric precallosal approach to the cribriform plate and its surroundings. (A) and (B) are collages in coronal and sagittal projections depicting the trajectory of the approach. (C) The central anterior skull-base in a dry anterior fossa specimen. The main area overlooked by this approach has been shadowed.

Although our series is too small to raise general conclusions, it is worth stressing the fact that olfactory function was preserved in two out of six traumatic cases. Piek et. al. reported a series of 74 patients operated on by the subfrontal bilateral approach in whom olfactory function was preserved in only five patients[18].

The drawbacks of this approach are associated with the need for exposure of the bridging veins; however, the section of these vessels is seldom needed when using the surgical strategies described above. On the contrary, in cases with a history of meningitis, both frontal lobes middle surfaces are usually strongly adhered to each other and some degree of cortical damage is unavoidable in spite of a meticulous microsurgical dissection. The same may be argued for the orbital surface of the frontal lobes during the subfrontal approach. The described approach is also limited when there is history of previous radiation therapy and when free tissue transfers are need to reconstruct the anterior cranial base[4,14,28,29,30]. Nevertheless, this type of reconstruction is seldom needed and in most cases a patch of fascia, pericranium or fat, with or without cranial bone and fibrin glue are sufficient to seal the defect[6,7,8,20,26]. Another possible drawback of this approach as compared with the subfrontal approach is that, it is easier to harvest an effective pericranial vascularized flap in the latter[5].

CONCLUSION

The interhemispheric precallosal approach to osteo-meningeal defects in the cribriform area may be an alternative when olfactory function and frontal paranasal sinus preservation is desirable.

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CONFLICT OF INTERESTS

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this paper that might lead to a conflict of interests for any of the authors.