Endoscopic Transsphenoidal Approach to Petrous Apex Cholesteatoma

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ABSTRACT

The purpose of this report is to present indications and risks of endoscopic transsphenoidal approach to treat petrous apex cholesteatoma. This is a retrospective analysis of two cases of petrous apex cholesteatoma presenting with double vision who underwent an endoscopic transsphenoidal approach at Lariboisiere Hospital, Paris, France. Control of the lesion was satisfactory in both cases. However, a minor pontic stroke resulted in transient hemiparesis in the case with dehiscent dura around the petrous apex cholesteatoma. To our knowledge, there are the first cases of petrous apex cholesteatoma reported to be removed by an endoscopic transsphenoidal approach, using image guidance system, with minimal morbidity.

KEYWORDS: Petrous bone cholesteatoma, petrous apex, endoscopic transsphenoidal approach

Petrous apex cholesteatoma (PAC) is an epidermoid cyst developed in the petrous apex portion of the temporal bone. PAC can be a recurrence of acquired cholesteatoma, but it is mainly congenital. The petrous apex is a complex region due to its close proximity to vital structures. In fact, it is bounded by the bony labyrinth and the internal carotid artery (ICA) anteriorly, the posterior cranial fossa and Dorello's canal (VI nerve) posteriorly, the middle cranial fossa and Meckel's cave superiorly, and the jugular bulb and inferior petrosal sinus inferiorly. PAC surgery is challenging because the thin matrix membrane of cholesteatoma often adheres tightly to the dura, the ICA, or the jugular bulb. Classical surgical approaches to the petrous apex include lateral transtemporal (translabyrinthine, transcochlear, infralabyrinthine, infracochlear) and middle fossa approaches.^{1,2} Improvements in skull-base surgery and recent advances in radiologic imaging

allow refining the management of PAC, especially by an endoscopic transsphenoidal approach. On the basis of two reported cases of PAC, the aim of this work is (i) to define the indications for an endoscopic transsphenoidal approach; (ii) to stress the benefits of this approach as compared with the lateral approach; and (iii) to underline the specific difficulties and risks of this approach.

CASE 1

A 70-year-old woman presented with a right trigeminal dysesthesia for several years and recent double vision. She had no history of otitis. The right eardrum was intact. Hearing test was normal. Clinical examination found anesthesia in the right V2 territory, and limited adduction of the right eye, suggestive of VI nerve palsy. The computed tomography (CT) examination revealed a low-density lesion (dimensions 1.8×3 cm) with bony

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Figure 1 Case 1: (A) CT-scan, axial section: low-density lesion with bony destruction in the right petrous apex region, involving the external wall of the right sphenoidal sinus and displacing medially the vertical part of the ICA. (B) Endoscopic transsphenoidal approach with guidance (DigiPointer[®], Collin-ORL, France).

destruction in the petrous apex region (Fig. 1). This lesion involved the external wall of the right sphenoidal sinus, displaced medially the vertical part of the ICA, and displaced laterally the cavernous sinus. Magnetic resonance imaging (MRI) signal of the lesion was hypointense in T1, hyperintense in T2, and without enhancement after Gadolinium injection. As the patient's hearing capacity was normal, we decided to remove the lesion by an endoscopic transsphenoidal approach with guidance (DigiPointer, Collin-ORL, France) (Fig. 1); 4-mm sinus endoscopes with 0°, 30°, 70° lenses were used. A wide sphenoidotomy that included removal of the vomer, sinus septum, medial pterygoid ala, as well as extensive drilling down to the

floor of the sphenoid sinus, was performed. The matrix was dissected from the ICA and dura. As the cyst was found to have a spontaneous communication with the cisterna, a high-pressure cerebrospinal fluid (CSF) leak was observed. Tight closure of the wound was obtained with fascia lata, Surgicel, fibrin-glue, and a CSF derivation with lumbar drain during 5 days. Postoperatively, a right hemiparesis was observed, which recovered within few weeks. Immediate postoperative angioscan was normal. Postoperative analysis of the MRI data demonstrated a discontinuous dura in the posterior cranial fossa that had not been noticed before surgery. Postoperative MRI revealed a minor pontic infarctus probably due to inadvertent and unnoticed tearing of a minute pontic

Figure 2 Case 1: (A) MRI, axial section, T1-weighted image after gadolinium injection: low-density lesion on the right petrous apex region, with discontinuous dura in the middle-cranial fossa; presence of a small, pontic artery on the medial part of the lesion. (B) MRI, axial section, T2-weighted image, after surgery: minor pontic infarctus.

artery during matrix dissection (Fig. 2). VI nerve recovered and follow-up remained uneventful. The patient had no clinical sign of recurrence and remained symptom free during all 4 years of follow-up.

CASE 2

A 60-year-old woman had a longstanding history of left-ear surgery: four surgeries for cholesteatoma (via trans-labyrinthine and middle fossa approaches) followed by facial rehabilitation with hypoglossal-facial anastomosis. In May 2005, she presented double vision (left VI nerve palsy) with headaches. The audiogram revealed deafness in the left ear. The CT scan showed an extensive petroclival lesion. A translabyrinthine approach with endoscopic assistance was performed, but the control of the apex and clivus was uneasy, particularly because they were too close to the ICA. One year later, MRI showed residual disease anterior to the jugular bulb and ICA (Fig. 3). The lesion was developed around the horizontal and vertical parts of the left ICA and invaded the petrous bone reaching the foramen magnum and the condylar canal. Because of the medial location of this recurrence, an endoscopic transsphenoidal approach with guidance (DigiPointer, Collin-ORL, France) was decided. The sphenoid was drilled providing a wide exposure to the sphenoid sinus. The matrix of the cholesteatoma was peeled off from the adjacent structures: dura of the posterior cerebral fossa, horizontal and vertical parts of the left ICA, VI nerve, jugular foramen, and lower nerves. CSF leak was not observed. Fascia lata and abdominal fat were used to obliterate the cavity. The patient was discharged after 2 days. MRI control showed no recurrence 1 year later (Fig. 3).

DISCUSSION

The goal of the PAC surgery is to remove it completely, a challenging issue when dealing with soft tissues as dura, ICA, jugular bulb, and nerves.³⁻⁹ Using high-resolution CT and MRI allows for determining its size and its anatomical site of development preoperatively. Choice of approach is based on the location and extent of the lesion, anatomic position of the ICA and the jugular bulb, and hearing on the affected side. By lateral trans-temporal approaches, direct exposure of PAC is difficult due to overlying structures, including the facial nerve, ICA, jugular bulb, and otic capsule. Furthermore, these approaches to petrous apex may not be possible when there is poor pneumatization of the temporal bone.¹⁰ On the other hand, the middle-fossa approach is technically difficult. The transsphenoidal approach to petrous apex was first described by Montgomery in 1977.¹¹ Recent advances in minimally invasive surgery, combined with the use of intraoperative navigational systems, allow transnasal endoscopic access to petrous apex lesions such as cholesterol granuloma, petrous apicitis, and chondrosarcoma, with minimal morbidity.^{10,12-14} The originality of our reported cases is that they are the first cases published of PAC treated by an endoscopic transsphenoidal approach. As described by Zanation et al,¹⁰ endoscopic approaches to the petrous apex include medial approach, medial approach with ICA lateralization, and transpterygoid infrapetrous approach; however, the decision to use an endoscopic approach depends on lesion's proximity to the ICA and the degree of medial expansion. These endoscopic approaches can also be proposed even if there is no expansion of the lesion into the sphenoid sinus. Technically, the middle turbinate and the posterior nasal septum are removed. A wide

Figure 3 Case 2: (A) MRI, axial section, T2-weighted image, before surgery: residual disease on the left petrous apex. (B) MRI, axial section, T2-weighted image, 1 year after surgery: no recurrence.

bilateral sphenoidotomy with removal of the rostrum and the intersinus septum provides a wide access for instrumentation even from the opposite side of the lesion, improves angle for drilling laterally, and allows four-hands surgery. Optic and carotid canals and medial and lateral optic-carotid recesses within the sphenoid sinus are identified. When the PAC expands into the sinus, the overlying mucosa is stripped and the bone overlying the cholesteatoma is thinned with a 3-mm coarse-diamond burr. Drilling starts on the medial surface of the bony deformity and runs along a vertical plane to avoid injury to the ICA. When the contour either of the ICA or of the PAC cannot be distinguished due to poor pneumatization of the sphenoid sinus, minimal medial expansion, or a more posterolateral location of the cholesteatoma, additional bone removal is necessary with decompression and lateral displacement of the ICA that creates a larger medial window. In the cases where the petrous apex lesion is not accessible via the sphenoid sinus, a transpterygoid infrapetrous approach is required. The petrous apex is reached after decompression of the ICA genu following the vidian canal, by drilling the bone between the horizontal segment of the petrous ICA and the Eustachian tube, medial to the third division of the trigeminal nerve.

Potential advantages of endoscopic approaches include avoidance of a craniotomy, faster recovery, and shorter hospitalization. Furthermore, facial weakness and hearing-vestibular loss, which are common complications of the transtemporal and middle-fossa approaches, are not described in the endoscopic transsphenoidal approach. As in the other approaches, CSF leakages may occur; they are usually related to matrix dissection rather than to the disease, and our first case is unusual. A small dural tear can be sealed by a fascia lata tobacco pouch or a nasoseptal flap introduced through the defect in the subarachnoid space. When tight closure of the dural defect cannot be achieved, a CSF lumbar drainage can be carried out as an additional measure. Potential major complications of this surgery include nerve and vascular injuries that can be avoided by knowledge of anatomic relationships, recognition of anatomic variations, use of image guidance system, and experience of endoscopic skull base surgeons. The postoperative treatment only consists on nasal and saline irrigations. Long-term follow-up on the basis of long-term MRI assessment is recommended to be carried out at least for 5 years after the procedure.¹

CONCLUSION

Recent progresses demonstrate that endoscopic surgery, with the use of image guidance system, facilitates better

access to PAC, particularly when using endoscopic transsphenoidal approach. In addition to recent publications,^{10,12} our two cases confirmed that endoscopic transsphenoidal approach is a safe and effective approach to the petrous apex, when carried out by experienced, endoscopic, skull-base surgeons. The purpose this paper is to emphasize/report on the originality of its findings that demonstrated the effectiveness of transsphenoidal approach as a method used for removing either congenital or recurrence of acquired PAC with minimal morbidity, particularly in absence of preoperative dehiscent dura.

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