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Endoscopic transsphenoidal surgery for cholesterol granulomas involving the petrous apex

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Key points

- Surgery for cholesterol granulomas involving the petrous apex has traditionally been performed via a lateral skull base approach.
- We present a case-series of four cholesterol granulomas treated through the endoscopic–transsphenoid approach over the last 10 years.
- Drainage was successful and symptomatic improvement was obtained in all cases (follow-up 6 months–10 years).
- Primary 'sphenoid' lesions, which can be widely drained and remain marsupialised, should be differentiated from primary 'petrous' lesions that can be removed safely through the sphenoid sinus only in case of extension medial to the internal carotid artery (ICA).
- We feel that the endoscopic transsphenoidal approach is a safe and effective way to access cholesterol granulomas of the petrous apex.

Cholesterol granulomas involving the petrous apex are expansile cystic lesions containing cholesterol crystals in a brown glue-like fluid within the temporal bone. Brackman from the House Ear Clinic summarised the different otological approaches to cholesterol granulomas of the petrous apex, namely the transcanal infracochlear, transmastoid infralabyrinthine, middle fossa and translabyrinthine approaches.¹ With these approaches, the aim was to achieve drainage of the granulomas, with or without complete removal of the lining of the cyst. However, they are associated with significant morbidity and a number of cholesterol granulomas recur after surgery. Montgomery described a transsphenoid approach for lesions sharing a

wall with the sphenoid sinus,² which has since been used in a number of cases.^{3–8}

In this report, we describe our 10-year experience with the transsphenoid endoscopic approach for these rare lesions and attempt to draw some useful conclusions and guiding principles regarding their operative management.

Methods

Type of study

Retrospective case series.

Patients

All patients undergoing endoscopic transsphenoid drainage of petrous apex granulomas over the last 10 years. Image

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guidance (DigiPointeur; COLLIN-ORL SA, Cachan, France) was used for all cases performed after 2002.

Setting

Tertiary academic otolaryngology department.

Results

Case 1

A 30-year-old man presented in 1996 with a history of vertigo, complete facial palsy and sensorineural hearing loss. A computed tomography (CT) scan showed a large, well-defined erosive lesion in the petrous apex, while the magnetic resonance imaging (MRI) confirmed the presence of a large, cystic lesion that was hyperintense in T1 and T2 and was abutting the postero-lateral wall of the sphenoid sinus (Fig. 1). After thorough analysis of the location of the lesion and its relations with the sphenoid sinus, the carotid canal and the optic nerve, a decision was made to drain it via an endoscopic transsphenoid approach. The middle turbinate was resected and following a posterior ethmoidectomy, a wide sphenoidotomy was performed, providing access to a large sinus. After puncture of the wall of the cyst, the bony opening was enlarged and the cyst was marsupialised. Pathologic examination of the cyst wall was consistent with the diagnosis of cholesterol granuloma. Unfortunately the sphenoid

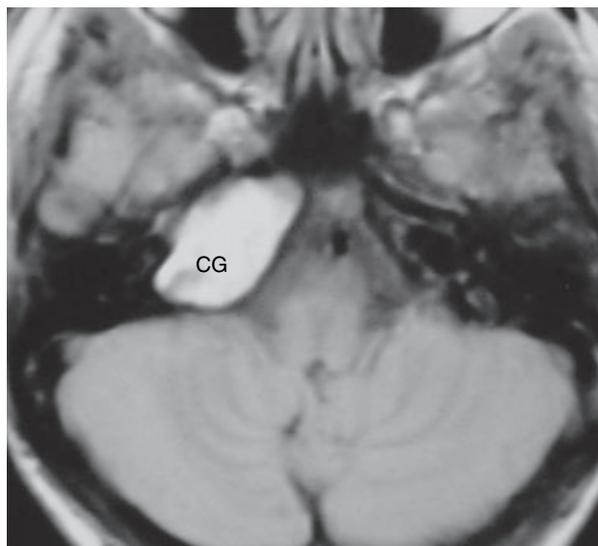


Fig. 1. A petrous apex cholesterol granuloma (case 1). Cholesterol granuloma (CG) of the right petrous apex. Note the strong hyperintense signal on T1-weighted sequence, as well as the displacement of the dura of the posterior fossa. (CG, cholesterol granuloma)

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noid mucosa was stripped at the time of surgery. Following surgery, the facial palsy recovered (albeit a minor residual hemifacial spasm persisted), and hearing returned to normal. Endoscopic examination in outpatients showed that the cyst opening had closed as a result of massive regrowth of sphenoid sinus bone and could not be reopened as an office procedure. As the patient was asymptomatic, a decision was taken not to intervene surgically. An MRI performed 7 years later showed no evidence of cyst recurrence. At 10 years of follow-up the patient remains symptom-free.

Case 2

A 13-year-old boy presented to another hospital with headache and progressive diplopia. MRI showed a cystic lesion of the lateral sphenoid region abutting the cavernous sinus and the middle cranial fossa, displacing medially the posterolateral sphenoid sinus wall and almost completely obliterating the left sphenoid sinus. It was hyperintense on T1 and T2-weighted sequences. The patient was operated in a paediatric neurosurgical department via a middle fossa approach with good results. However, his symptoms recurred and he was referred to our department. After middle turbinectomy and posterior ethmoidectomy, a large sphenoidotomy was performed which included the medial pterygoid ala. The cyst was marsupialised, taking care to preserve the sphenoid mucosa as much as possible to avoid scarring and subsequent restenosis (Fig. 2). His diplopia and headache resolved following surgery. Six years later he remained clinically asymptomatic, but refused any further imaging.

Case 3

A cholesterol granuloma of the petrous apex was an incidental finding of a brain MRI performed for another reason in a 34-year-old woman in 2002. As she was asymptomatic, a decision was made to avoid any intervention and to just follow-up the lesion. Ten years later however, she started developing headaches that were attributed to this lesion, possibly due to contact with the Gasser ganglion. A CT demonstrated that the lesion had developed anterior to the internal auditory meatus. Medially however, the tumour was encasing and displacing the vertical part of the internal carotid artery, displacing anteriorly the posterior wall of the small right sphenoid sinus, eroding the sphenoid sinus septum and entering the left sphenoid sinus (Fig. 3). After removal of the middle turbinate, the posterior part of the vomer was drilled and the perpendicular plate of the ethmoid was removed with bone cutting forceps, providing a wide exposure to the

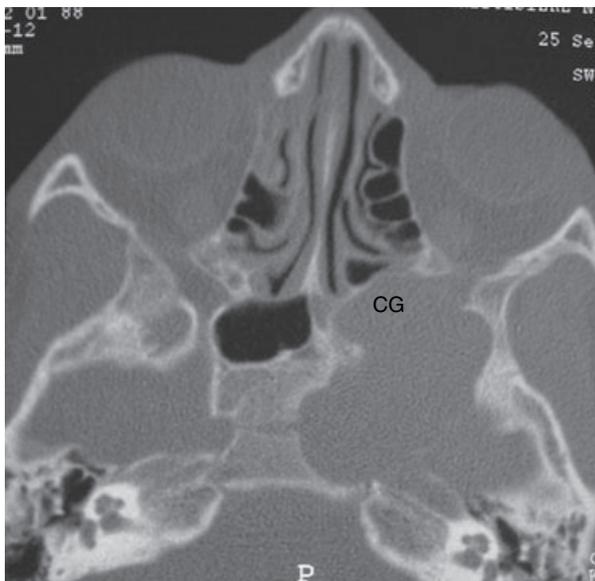


Fig. 2. Computed tomography of a left sphenopetrous cholesterol granuloma (case 2). (CG, cholesterol granuloma)

sphenoid sinus. A wide sphenoidotomy that included removal of the sinus septum as well as extensive drilling down to the floor of the sphenoid sinus was fashioned. In this way adequate access to both sphenoid sinuses was achieved with exposure of both optic nerves and carotid arteries. The anterior wall of the cyst was opened and removed with the use of a diode laser allowing for a wide marsupialisation. Repeated lavage of the cyst was performed and the granulation tissue inside the cyst was removed with curette under direct vision. The carotid as

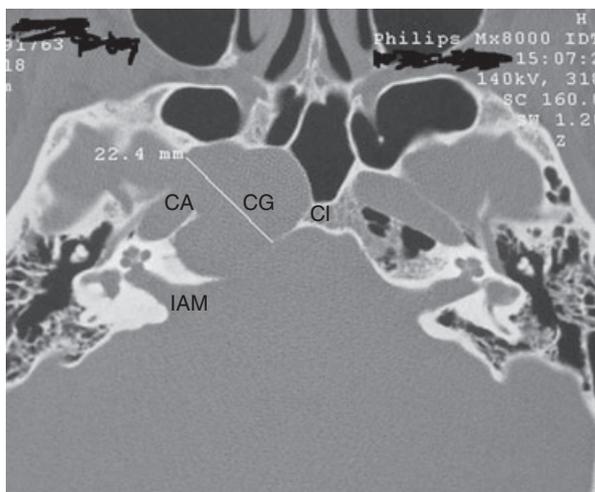


Fig. 3. Cholesterol granuloma of the right petrous apex (case 3) Computed tomography of skull base: Note the displacement of the ICA anteriorly and of the posterior cranial fossa dura posteriorly. (CG, cholesterol granuloma; CA, internal carotid artery; Cl, Clivus; IAM, internal auditory meatus).

well as the dura of the posterior fossa were clearly visible inside the cavity. Outpatient endoscopy performed 3 months after the surgery revealed a well-epithelialised sphenoid cavity with healthy mucosa. In spite of a minimally invasive approach, the opening of the cyst has closed at 2 years. However, the patient has no clinical signs of recurrence and remains symptom-free.

Case 4

A 58-year-old man presented to his ophthalmologist in 2006 with a 2-month history of progressive deterioration of visual acuity on the right (2/10). An MRI showed a very large cystic lesion filling the whole sphenoid, extending anteriorly in the ethmoid and inferiorly on the roof of the rhinopharynx, that was hyperintense in T1 and isointense on T2 (Fig. 4). During surgery, it was noted that the anterior wall of the sphenoid was displaced anteriorly and the sphenothmoidal recess obliterated. After sphenoidotomy, drainage of a characteristic oily material was obtained. The cavity of the cyst was explored and the access improved by posterior ethmoidectomy. The cavity was lined with granulomatous tissue that was gently excised from the sella turcica, from the dura of the

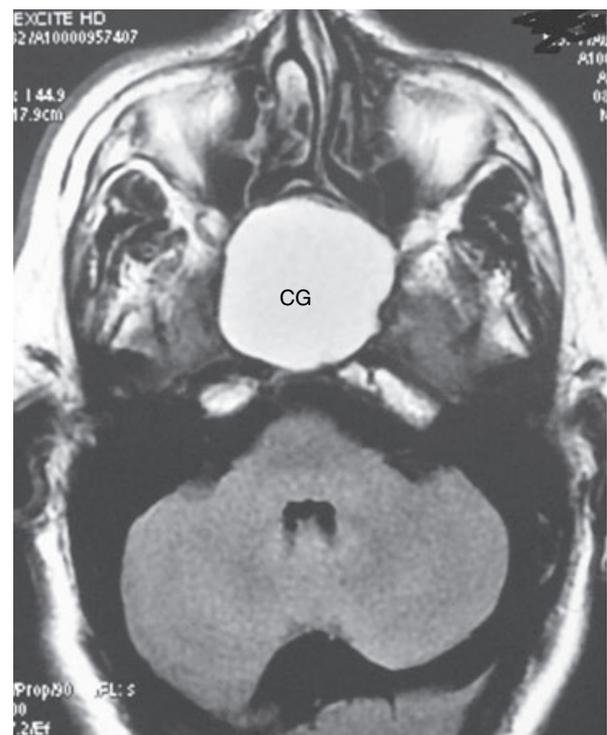


Fig. 4. Sphenopetrous cholesterol granuloma presenting with decreased visual acuity on the right (case 4) T1-weighted sequence of a massive cholesterol granuloma of the sphenoid bone abutting both petrous apices. (CG, cholesterol granuloma).

posterior cranial fossa and from the underlying carotid arteries and optic nerves. Histology confirmed a cholesterol granuloma of the petrous apex. Four months later, on outpatient endoscopy the cyst was wide open, and there was no evidence of recurrence or reaccumulation of liquid in the cyst. His visual acuity improved progressively to 8/10 after surgery and has since remained stable.

Discussion

Cholesterol granulomas can be managed through a transphenoid, a middle cranial fossa, or a lateral–transtemporal approach (further subdivided in infralabyrinthine, infracochlear, transcochlear and translabyrinthine).

The transphenoidal approach was first described in 1977 by Montgomery, as an external procedure performed via an incision near the medial canthus. Fucci in 1994 adapted this approach to the use of the nasal endoscope and gained access to the petrous apex via a transnasal–transphenoid approach.⁹ We present the largest case series of cholesterol granulomas involving the petrous apex treated via the endoscopic–transphenoid approach. The advantages of this route are obvious: avoiding the lateral temporal bone, the procedure is technically less challenging and significantly shorter – between 1 and 2 h in this series. Consequently, morbidity is reduced while hospitalisation time is decreased. In our series, hospital stay ranged from 2 to 4 days. Facial weakness (temporary or permanent) is a well-described complication of the lateral temporal as well as of the middle fossa approach, but highly unlikely in the transsphenoid approach. Similarly, hearing is not at risk with the endonasal approach. Although there is a theoretical risk of injury to the optic nerves or to the ICA, as well as the possibility of CSF leak, the wide field of vision of the endoscope, as well as the use of an image guidance system and the performance of a conservative and minimally invasive dissection can help to avoid these complications. Besides, the petrous apex stands at the level of the floor of the sphenoid sinus, far from the optic nerves.

How should one approach a cholesterol granuloma – is removal always necessary or is marsupialisation an adequate treatment? This is a matter of controversy: recurrences are not uncommon, irrespective of the approach used at the time of surgery. The natural history of cholesterol granulomas of petrous apex is unpredictable: Multiple approaches and different degrees of completeness of removal have failed to show a consistent association with the risk of recurrence: One would tend to expect that in patients 1 and 3, post-operative stenosis would lead to recurrence – it appears however that complete removal prevented the recurrence in patient 1, as proved by imaging. Patient 3 refused imaging, and as a result we can

only speculate on his status regarding recurrence – however he does remain symptom-free. The alternative option is to drain the cyst into ventilated cavities. As a result of the structures surrounding the cyst, the drainage pathway is often narrow, and may further stenose with time. Attempts have been made to use various materials such as silastic stents to prevent this from happening, with debatable success. The feeling of the authors is that marsupialisation of the cyst is likely to be more successful in the case of lateral lesions that can be drained to large cavities like the antrum, or for medial lesions with a wide face abutting the sphenoid sinus. On the contrary, lesions localised in the petrous apex cannot be marsupialised widely due to the anatomy of the region, the surrounding structures, and also because of the displacement of the ICA or the dura that follows cyst drainage. Indeed, this series emphasizes that the outcome is linked to the location of the cholesterol granuloma: closure of the cyst opening was observed in the two cases of primarily petrous lesions (cases 1 and 3), which had a narrow connection with the sphenoid sinus, in spite of a conservative procedure and careful postoperative endoscopic procedures. In the contrary, sphenoid–petrous lesions could be widely marsupialised by removal of the anterior wall of the sphenoid sinus, which subsequently remained patent (cases 2 and 4). Therefore, two categories should be considered: primarily petrous apex or sphenoid lesions. These two categories do not refer to the origin of cholesterol granulomas, which of course is always the petrous apex, but to their localisation, which is commonly a ‘by product’ of the pneumatization of sphenoid sinus and can assist in planning a treatment algorithm: First of all, a well pneumatized, wide sphenoid sinus is a pre-requisite for a successful approach while a small, diploic sphenoid sinus is usually prohibitive for a transnasal, endoscopic approach.¹⁰ Secondly, primary ‘sphenoid’ lesions which extend to the whole sphenoid sinus, can be widely drained and will usually remain marsupialised. On the other hand primarily petrous lesions which have a narrow connection with the sphenoid sinus, can only be successfully drained and if they extend medially to vertical part of the ICA and present a wide front in the sphenoid sinus. In every case, adequate preoperative imaging with a combination of CT and MRI is mandatory to confirm adequate access.

Removal of the middle turbinate and a posterior ethmoidectomy may significantly improve access. A wide sphenoidotomy, with removal of the rostrum and the intersinus septum is required. Identification of the carotid artery and optic nerve is mandatory to safely enter the cyst, a step which is further facilitated with the use of an image guidance system. After entering the cyst and suc-

tioning the oily material, the inflammatory matrix is removed gently taking care not to injure major underlying landmarks. We aim to be as conservative as possible in preserving the mucosa of the sphenoid sinus, as we feel that it may speed the healing process. In the literature, follow-up is reported to be easy after transsphenoidal surgery in the outpatients, allowing for reopening of the cavity if needed. In the light of our experience, this may not be always feasible, because of bone thickening and the close proximity of the ICA.

Conflict of interest

None to declare.

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Endoscopic minimal access surgery in nasal and sinus tumours: lessons from initial experience

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Keypoints

- The role of endoscopic techniques in the treatment of Nose and Para-Nasal Sinus tumours is the subject of wide debate.
- Technical advances in skills, imaging and instrumentation have resulted in Endoscopic Minimal Access Surgery gaining wide acceptance in the treatment of benign tumours. The place of endoscopes in malignant disease is more controversial.
- Defining the aims of endoscopic surgery is key to achieving a successful outcome.
- Experience with these new technologies and strategies should be gathered in a Clinical Network and Multi-Disciplinary Team setting, with planned long-term follow up.
- We report our initial experience of 33 patients managed with EMAS (27 curative, six debulking/palliative cases).
- Initial experience of the transition from the benign to malignant arenas supports a continued, cautious, structured evaluation of the endoscopic approach.

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