

Complete Recovery of Sensorineural Hearing Loss Following Endoscopic Transsphenoidal Surgery for a Petrous Apex Cholesterol Granuloma: Case Report

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Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Male, 64
Final Diagnosis: Petrous apex cholesterol granuloma
Symptoms: Right ear sensorineural hearing loss
Medication: —
Clinical Procedure: Endoscopic endonasal transsphenoidal surgery
Specialty: Neurosurgery





Objective: Rare disease
Background: Cholesterol granulomas of the petrous apex may impinge surrounding cranial nerves, leading to neurological impairments such as hearing loss. Less invasive endoscopic techniques are gaining popularity as the mainstay of therapy for this lesion.

Case Report: We present a case of petrous apex cholesterol granuloma causing mild sensorineural hearing loss. An endoscopic endonasal transsphenoidal approach was successfully performed to partially resect and aerate the lesion. The auditory function on the affected side was completely restored after surgery. The patient experienced no post-operative complications.

Conclusions: This case report highlights the advantages of using an endoscopic transsphenoidal surgical approach in cases of petrous apex cholesterol granuloma, including the potential for this less invasive technique to restore sensorineural hearing loss.

MeSH Keywords: Case Reports • Cholesterol • Hearing Loss • Neurosurgery • Recovery of Function • Skull Base

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Background

Cholesterol granulomas are round cysts capable of growth, typically found in middle ear spaces and mastoid air cells although their location varies [1]. These lesions are thought to be the result of a chronic inflammatory response to cholesterol crystals released during the catabolism of stagnant blood in the temporal bone [2]. As the petrous apex is found in an anatomically sensitive site, cholesterol granulomas in this area may cause significant neurological symptoms by impinging nearby cranial nerves [3]. Cysts in the petrous apex also represent a challenge for surgeons as they must diligently navigate around critical structures such as the internal auditory canal, facial nerve, and internal carotid artery [3]. Transcranial procedures have been used for treating petrous apex cholesterol granulomas in the past; however, due to inherent risks such as physical damage to auditory structures as well as difficulty observing the patient's post-operative course, treatment has shifted to an endoscopic approach when possible [4]. This less invasive technique is particularly interesting because of its potential to preserve hearing in patients for whom restoration efforts were previously abandoned, and for those who would

have suffered further auditory damage during a transcranial operation [5]. Here we describe a petrous apex cholesterol granuloma causing mild hearing impairment in the right ear. As the patient already suffered from profound congenital sensorineural hearing loss on the left side, an endoscopic endonasal transsphenoidal surgery (ETSS) was performed to preserve any remaining auditory function. This is a unique case as not only was right-sided hearing preserved, it was completely restored post-operatively.

Case Report

A 64-year-old male presented with acute and progressively worsening right-sided hearing loss of 2 months' duration. Audiology testing showed mild sensorineural hearing loss in the right ear (Figure 1). Past medical history was significant for hyperlipidemia and diabetes, as well as profound sensorineural hearing loss in the left ear since birth.

Physical examination revealed head impulse testing positive on the right side. Computed tomography (CT) demonstrated

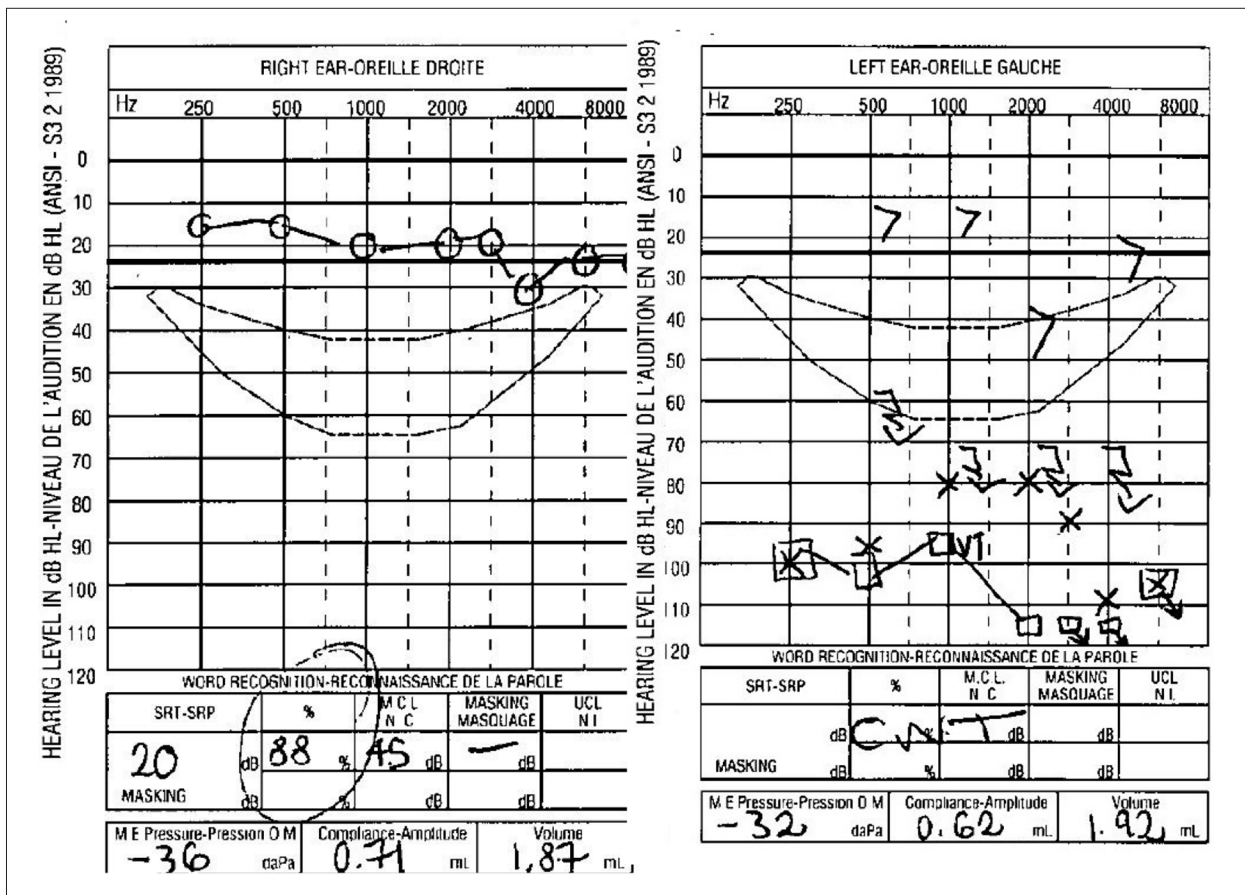


Figure 1. Preoperative audiograms. Right ear audiogram showed mild sensorineural hearing loss in the right ear. Left ear audiogram indicated profound sensorineural hearing loss in the left ear present since birth.

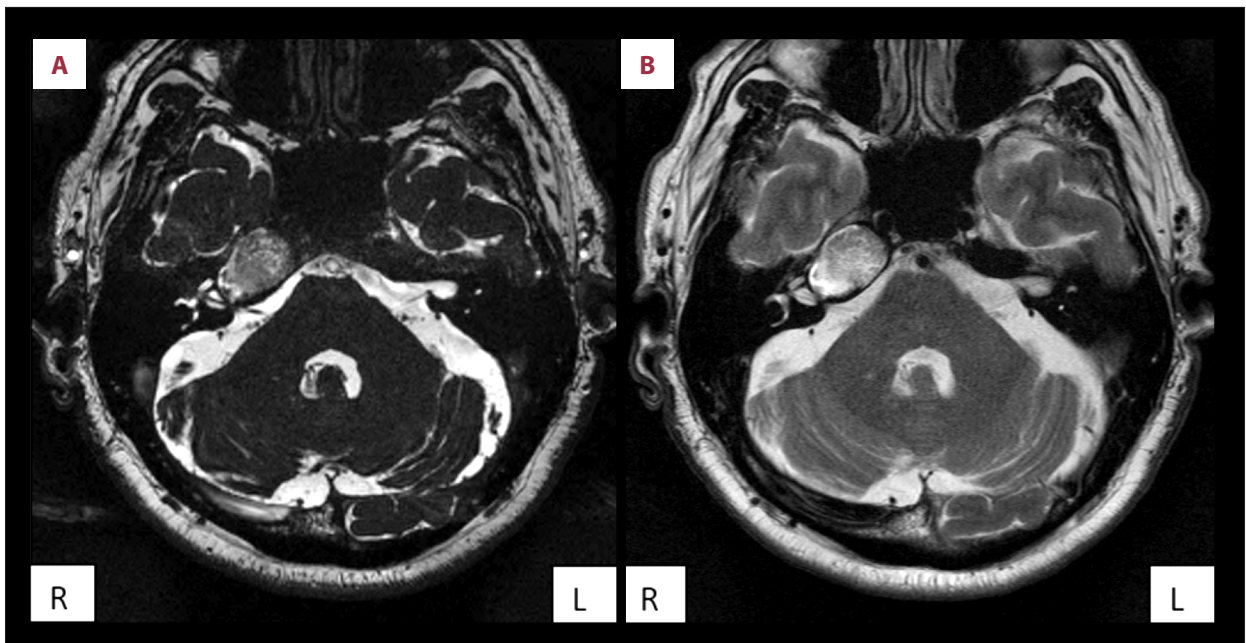


Figure 2. (A, B) Preoperative axial magnetic resonance imaging revealed a well-circumscribed, expansile lesion within the right petrous apex measuring 23×17×23 mm. The lateral margin of the lesion protruded into the right petrous canal.

an osteolytic lesion closely opposed to the right petrous internal carotid artery (ICA). Magnetic resonance imaging (MRI) revealed a well-circumscribed, expansile lesion within the right petrous apex measuring 23×17×23 mm. The lateral margin of the lesion protruded into the right petrous canal and, further, the petrous segment of the right ICA was bowed anteriorly (Figure 2). The lesion was hyperintense on both T1- and T2-weighted MRI scans.

Clinical suspicion of a cholesterol granuloma led us to perform an endoscopic endonasal transsphenoidal surgery to the right petrous apex using an image-guidance system. The right sphenoid was opened and a type 3 sphenoidotomy was performed. The sphenoid was first opened at the level of its os and then superiorly to the skull base. After sphenoidectomy, the septum was drilled at the middle of the sphenoid sinus down to the floor of the sphenoid, and the mucosa was removed. The neuro-navigation system identified the lesion posterior to the internal carotid artery. The bone at the petrous apex was thinned using a high-speed drill, leading us to the encapsulated, fluid-rich lesion. It was decompressed using a suction and the endoscope. Once adequate decompression and partial resection of the capsule was achieved, we widened the opening into the sphenoid sinus. A T-tube was also inserted into the cavity to ensure that re-accumulation of the lesion would drain through the sphenoid sinus. A Kennedy sinus stent that extended into the neo posterior ethmoid/nasal cavity was also placed into the petrous apex. No complications were encountered.

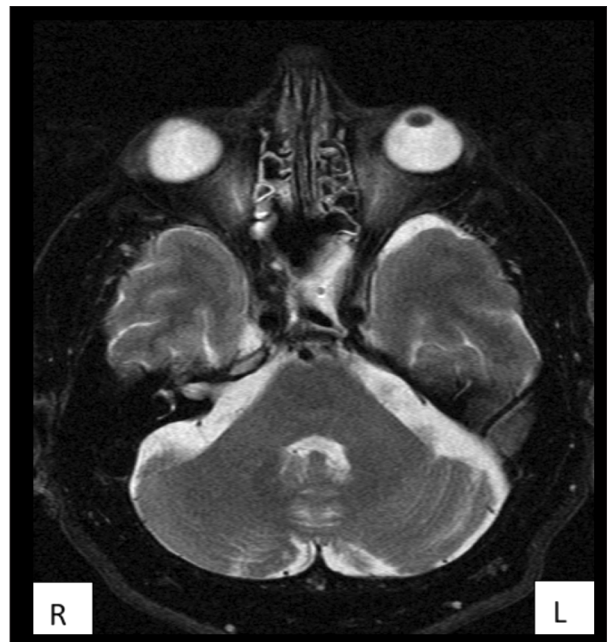


Figure 3. Post-operative axial T2 magnetic resonance imaging showed resolution of the right petrous apex lesion. The slightly hyperintense peripherally enhancing material represents surgical packing.

Histopathology confirmed the diagnosis of cholesterol granuloma. Post-operative MRI showed resolution of the lesion (Figure 3). A post-operative audiogram demonstrated right-sided auditory improvement back to normal limits, representing total restoration of hearing loss unilaterally (Figure 4).

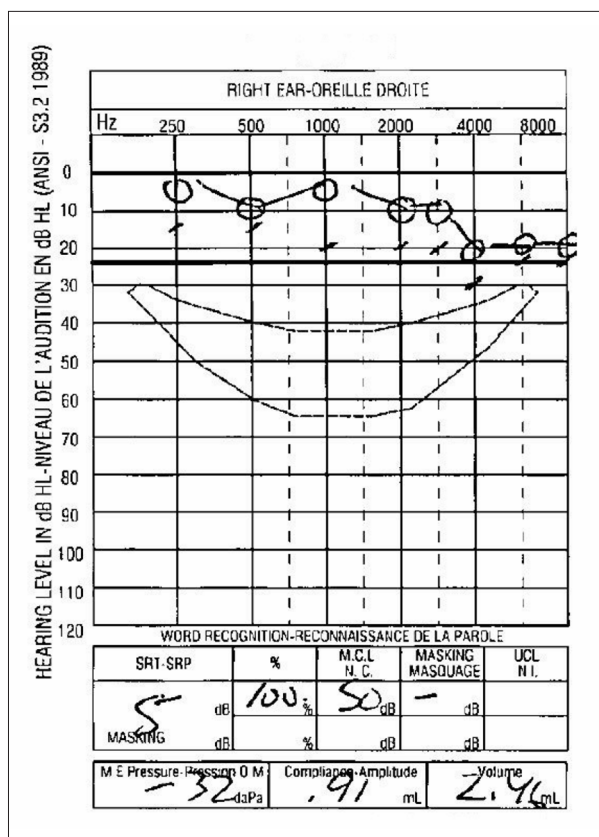


Figure 4. Post-operative audiogram. Right ear audiogram showed total restoration of hearing.

Discussion

Although relatively rare, cholesterol granulomas are the most common primary lesions of the petrous apex [3]. The walls of these expansile, cystic growths are composed of fibrous connective tissue, housing fluids, lipids, chronic inflammatory cells and cholesterol crystals within [6,7]. The exact etiology of this lesion remains unclear; some postulate that trapping of air spaces in the petrous apex forms a vacuum whereby stagnant blood degrades, leading to a chronic inflammatory reaction [2]. Others propose that abnormal, aggressive pneumatization in the temporal bone exposes bone marrow-filled spaces in the petrous apex, which then leads to hemorrhage, clotting, and chronic inflammation [2]. In either case, a cholesterol granuloma is made as anaerobic blood degradation forms cholesterol crystals and triggers an inflammatory reaction by foreign body giant cells [8].

A cholesterol granuloma in the petrous apex is not necessarily a dangerous finding. In fact, this lesion is benign by nature, asymptomatic when small, and often found incidentally on radiographic imaging [9]. However, due to the close proximity of sensitive structures near the petrous apex, larger cholesterol granulomas in this location may compress or irritate adjacent

cranial nerves, causing significant neurologic symptoms [10]. Common presenting complaints include headaches, ear pressure, diplopia, dizziness, vertigo, tinnitus and hearing loss, related directly by pressure to one or more of cranial nerves V, VI, VII, or VIII [3]. Pressure to the VIII nerve was most likely the cause of acute hearing impairment in our case. Unilateral hearing loss may also be a result of arterial compression causing transient ischemia and, speculatively, toxins originating from the cholesterol granuloma [5].

Surgical treatment of petrous apex lesions is anatomically challenging due to its proximity to critical structures such as the cranial nerves, internal auditory canal, jugular foramen, inferior petrosal sinus, and internal carotid artery. Due to this risk, as well as the fact that cholesterol granulomas are generally asymptomatic, standard management is to observe with serial imaging [11,12]. MRI is typically the modality of choice for imaging petrous apex lesions and is particularly useful in cases of cholesterol granuloma as this lesion is hyperintense on both T1- and T2-weighted images [13]. Most other petrous apex lesions do not follow this pattern, and thus obtaining tissue once this radiological finding is noted is generally unnecessary [3]. CT can also be used in combination with MRI, on which cholesterol granulomas appear expansile, sharply marginated and occasionally erosive [13]. The decision to “watch and wait” changes when patients are symptomatic or may lose neurological function. In our case, although hearing loss on the affected right side was only mild, a history of profound deafness in the left ear led us to perform surgery in an effort to preserve any of the patient’s remaining auditory function.

As cholesterol granulomas lack an epithelial lining, surgery does not aim to remove the entire cyst. Rather, the goal is to drain it and aerate petrous air cells to prevent recurrence [7,14]. This was traditionally done by transcranial techniques such as middle fossa, infralabyrinthine, translabyrinthine, transcanal, infracochlear, and other approaches [4]. Many of these surgical interventions operated laterally through the skull base and thus exposed delicate auditory structures to damage, making unilateral hearing loss a common complication of transcranial procedures [15]. Further, certain transcranial approaches unescapably destroyed hearing function, such as the wide translabyrinthine technique. This specific procedure was recommended for use when hearing was considered to be absent or severely lost on preoperative audiograms [1]. Later, however, it was found that a partial labyrinthectomy was compatible with hearing preservation and certain reports even demonstrated improvements following this procedure [5]. Thus, not only could hearing loss, while resecting a petrous apex cholesterol granuloma, be avoided but evidence existed that sensory ability could be partially restored as well. Some speculated this recovery of the preoperative state is due to the reversal of neurovascular compression as well as the elimination of

cholesterol granuloma toxins [5]. Nevertheless, given the transcranial nature of a partial labyrinthectomy, this approach still faces challenges related to perioperative complications and finding a more accessible route to the lesion for follow-up [8].

Our case demonstrated that total restoration of auditory function following unilateral hearing loss from a petrous apex cholesterol granuloma can be established endoscopically. Although auditory improvement has previously been demonstrated with partial labyrinthectomies, this case showed the same can be done endoscopically, thus using less operating time, reducing the risk of structural and nervous damage, speeding recovery, shortening hospital stay, and having more cosmetic appeal [8,16,17]. Also, the ease of follow-up is greatly enhanced; patients can be seen in an office using a fiberscope, and if necessary, the cyst

can be re-drained on-site [1]. This technique only applies to lesions accessible by a transsphenoidal approach [18].

Our reported case did not encounter any post-operative complications although transient or delayed epistaxis is common with endoscopic procedures [6].

Conclusions

We reported a unique case with complete recovery of mild unilateral hearing loss after an endoscopic endonasal transsphenoidal procedure performed for a petrous apex cholesterol granuloma. Preoperative and post-operative audiograms demonstrate this change eloquently.

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