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# Surgical Considerations in Addressing Cholesterol Granuloma of the Petrous Apex through an Infracochlear Approach

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## Keywords

Infracochlear approach · Cholesterol granuloma · Temporal bone · Petrous apex · Anatomy

## Abstract

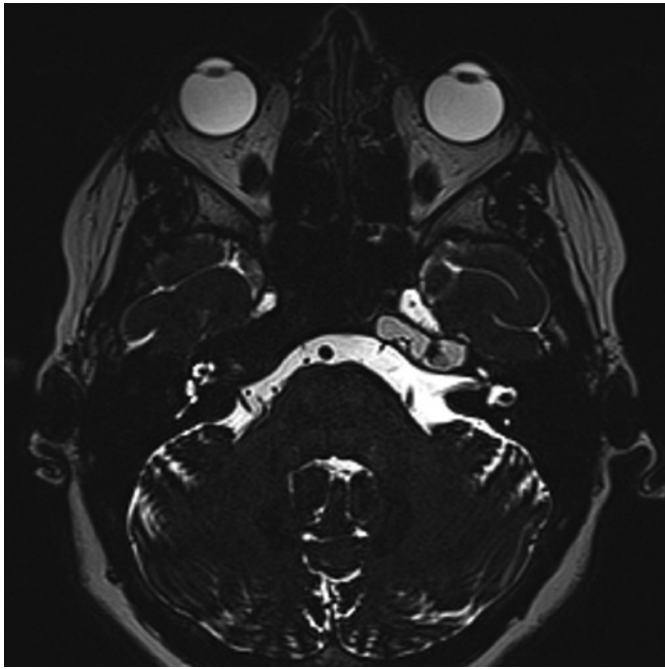
Cholesterol granuloma of the petrous bone is a foreign body giant cell reaction to cholesterol deposits with symptoms including hearing loss, vestibular dysfunction, and cranial nerve deficit as a result of cystic mass compression. Surgical treatment is often difficult to plan due to limited access to the lesion and possible injury to surrounding structures. We report on a case of petrous apex cholesterol granuloma drainage through an infracochlear approach. A 27-year-old female patient presented with acute diplopia due to left-sided abducens paralysis. Multislice computed tomography (MSCT) and magnetic resonance (MR) imaging described a 3.5-cm well-marginated lesion in petrous bone apex, compressing the left abducens nerve at the point of entry into the cavernous sinus, corresponding to cholesterol granuloma. The patient was surgically treated through a transcanal infracochlear approach, since preserving the external and middle ear conduction mechanisms was paramount for the patient. The patient was discharged on the second postoperative day and diplopia resolved within 5 days postoperatively. Six months after the surgery, her hearing on the left side is normal, and she remains symptom-free. This

case underpins the value of preoperative planning when approaching the petrous apex, an anatomically complex area due to abundance of important neurovascular structures crowded in a narrow and confined region.

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## Introduction

Cholesterol granuloma of the petrous bone is a foreign body giant cell reaction to cholesterol deposits, exceedingly rare with incidence estimated at 0.6 cases per 1 million [1, 2]. The exact etiology of cholesterol granulomas is unknown, with two hypothetical etiopathogenetic pathways proposed: (1) impaired ventilation pathways within the petrous apex causing vacuum-induced hemorrhage into this space, and (2) exposure of bone marrow by an overly pneumatized petrous apex resulting in hemorrhage, foreign-body reaction, and obstruction of air cell outflow [3, 4]. These lesions are usually silent but may cause damage due to erosion and expansion, which typically occurs gradually over years. Presenting symptoms commonly include hearing loss, vestibular dysfunction, and cranial nerve deficits as a result of cystic mass compression, but surgical treatment is often difficult to plan due to limited access to the lesion



**Fig. 1.** Axial T2-weighted MRI scan showing cholesterol granuloma compressing the left abducens nerve at its exit from the brainstem.

and possible injury to surrounding structures [5]. We would like to report on a case of petrous apex cholesterol granuloma drainage through an infracochlear approach.

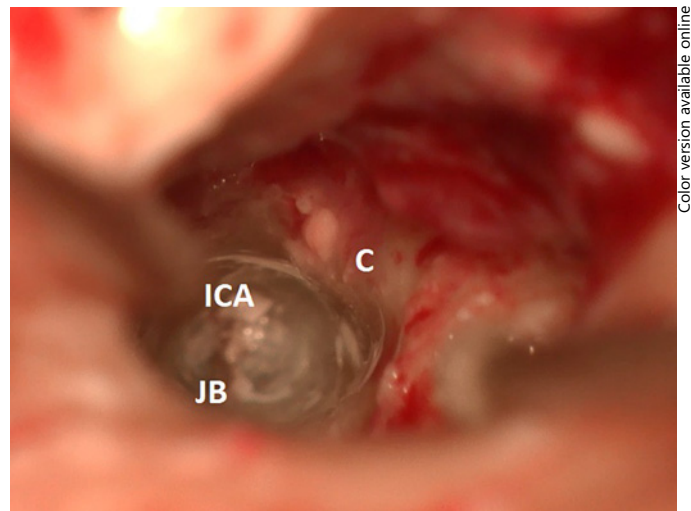
### Case Report

A 27-year-old female patient presented with acute onset diplopia due to left-sided abducens paralysis. Multislice computed tomography and magnetic resonance imaging described a 3.5-cm well-margined lesion in petrous bone apex, compressing the left abducens nerve at the point of entry into the cavernous sinus. The lesion was hyperintense on both T1- and T2-weighted images, consistent with lipid-containing cholesterol granuloma (Fig. 1, 2). Our choice for surgical approach was limited by the fact that the patient is a voice professional, and had normal hearing on the side of the lesion. She had a high jugular bulb (JB) on the left side, and the internal carotid artery (ICA) was positioned immediately anterior to the granuloma in the sphenoid sinus [6]. We decided to use the transcanal infracochlear approach because it offers the advantages of preservation of normal external and middle ear conduction mechanism and reexploration through an inferior myringotomy, provided there is a minimum of 4 mm between the JB and the cochlea (Fig. 3) [6].

The procedure was completed through a standard postauricular incision and a transcanal approach. The infracochlear corridor is defined by the cochlea or round window superiorly, ICA anteriorly, and JB inferiorly and the mastoid portion of the facial nerve



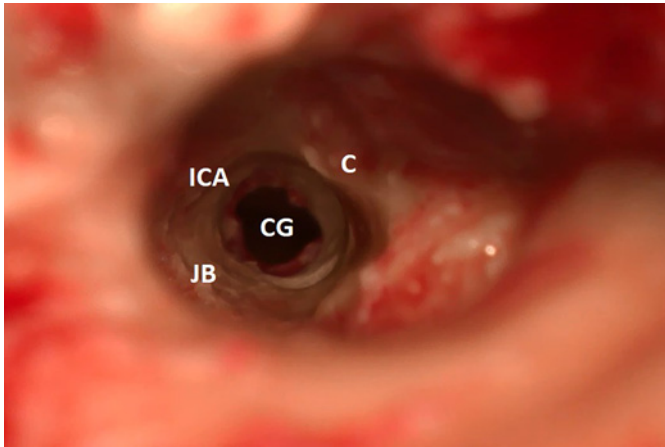
**Fig. 2.** Coronal MSCT scan showing the left temporal bone anatomy and a possible drainage approach through the infracochlear tunnel.



**Fig. 3.** Transmeatal approach to the infracochlear tunnel, dilation of the inferior border of the ear canal, drilling below the basal turn of the cochlea (C), with adventitia of the ICA visible anteriorly and the JB inferiorly in the infracochlear drainage tunnel.

posteriorly [6]. Using a small diamond burr, the air cells below the cochlea were removed to expose the ICA and the JB. The bony dissection was continued in an anteromedial direction, using the round window, ICA, and JB as superior, anterior, and posterior margins, respectively. When the granuloma cavity was entered and drained, a wide opening was created to prevent recurrence (Fig. 4). The tympanomeatal flap was then repositioned and the tympanic membrane was reconstructed using tragal cartilage. Postoperative recovery was uneventful, the patient was discharged on the second postoperative day, and diplopia resolved within 5 days postoperatively. Six months after the surgery, her hearing on the left side is normal, and she remains symptom-free.

Written informed consent was obtained from the patient and this submission was waived consent by our institutional bioethical board adhering to the Ethical Principles for Medical Research Involving “Human Subjects,” adopted by the 18th World Medical



Color version available online

**Fig. 4.** Using a 4-mm diamond burr, the entrance into the granuloma cavity (CG) was dilated to prevent closure and obstruction. The internal carotid artery canal (ICA) is visible anteriorly, the cochlea (C) superiorly and the jugular bulb (JB) inferiorly to the canal.

Assembly, Helsinki, Finland, June 1964, and as amended most recently by the 64th World Medical Assembly, Fortaleza, Brazil, October 2013.

## Discussion

In cases of petrous apex cholesterol granuloma with serviceable hearing, a variety of surgical approaches have been described, including infralabyrinthine and endoscopic-endonasal approaches [2, 7, 8]. They are limited by a high JB and better suited for more medially placed lesions in superior and anterior-inferior petrous apex since anterior approaches may require paraclival ICA lateralization [6, 9, 10]. The middle fossa approach is no longer recommended due to limited drainage and aeration ability, the necessity of a craniotomy and temporal lobe retraction [7, 8]. Infratemporal type B and translabyrinthine approaches should only be considered in cases of profound hearing loss, involvement of critical neurovascular structures, or recurrent lesions [4, 6].

The transcanal infracochlear approach offers drainage to the well-aerated area near the opening of the Eustachian tube, fast postoperative recovery, and the possibility of reexploration through a simple inferior myringotomy [9]. Risks associated with this procedure include intraoperative damage to the tympanic membrane, ICA, JB, cochlea, facial nerve, chorda tympani, and Jacobson's nerve due to the narrow field of dissection. In a study by Brackmann and Toh [2], out of 18 patients that underwent this procedure, only 1 patient

had a postoperative complication, a tympanic membrane rupture that was treated conservatively, while there are very few published case series to analyze [2, 3, 8, 10].

Postoperative symptom relief is reported to be anywhere from 45.5% to 100%, with a recurrence rate for cholesterol granulomas, which is relatively high, from 12% to 14.7% [2]. In a study by Grinblat et al. [8], 24/31 surgically treated patients experienced symptomatic improvement. Brackmann and Toh [2] listed immediate symptomatic relief in 28/34 cases.

Our case underpins the value of preoperative planning when attempting to access the petrous apex, an anatomically complex area due to abundance of important neurovascular structures crowded in a narrow and confined region. A detailed discussion on anatomic landmarks is the most important factor in the decision-making process and could be of interest to the otologic readership, since the approach is difficult, published cases are few, but the results in appropriately selected patients are excellent.

## Statement of Ethics

Ethical approval is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, and writing – review and editing: Andro Košec, Josip Prnjak, Robert Tomljenović, and Mihael Ries. Funding acquisition: none. Approval of final manuscript: all authors.

## Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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