

Successful emergency Lichtenberger lateralisation for immediate bilateral laryngeal immobility after total thyroidectomy: a CARE case report

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**Surgical Considerations in Addressing Cholesterol Granuloma of the Petrous Apex
Through an Infracochlear Approach**

Running title: The Petrous Apex – A Narrow Keyhole to Unlock

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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 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. Multi-slice 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 patients was surgically treated through a transcanal infracohlear approach, since preserving the external and middle ear conduction mechanisms were paramount for the patient. The patient was discharged on the second postoperative day and diplopia resolved within five 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.

Keywords: infracochlear approach; cholesterol granuloma; temporal bone; petrous apex; anatomy

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, 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 result of cystic mass compression, but surgical treatment is often difficult to plan due to limited access to the lesion 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. MSCT and MRI 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. The lesion was hyperintense on both T1 and T2 weighed images, consistent with lipid-containing cholesterol granuloma. (Figures 1 and 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 re-exploration through an inferior myringotomy, provided there is a minimum of 4 millimeters between the jugular bulb and the cochlea. (Figure 3) [6]

The procedure was completed through a standard postauricular incision and transcanal approach. The infracochlear corridor is defined by the cochlea or round window superiorly, internal carotid artery anteriorly and jugular bulb inferiorly and the mastoid portion of the facial nerve 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. (Figure 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 five 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 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 tranlabrynthine 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 re-exploration 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 Brackman et al, out of 18 patients that underwent this procedure, only one patient had a post-op 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 is relatively high, from 12 to 14.7%. [2] In a study by Grinblat et al, 24/31 surgically treated patients experienced symptomatic improvement. Brackmann et al. listed immediate symptomatic relief in 28/34 cases. [8]

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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Data Availability Statement: All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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Figures and Legends

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

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

Figure 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 internal carotid artery (ICA) visible anteriorly and the jugular bulb (JB) inferiorly in the infracochlear drainage tunnel.

Figure 4. Using a 4-millimeter diamond burr, the entrance into the granuloma cavity (CH) was dilated to prevent closure and obstruction.