

Transmastoid Infralabyrinthine Approach to Petrous Temporal Bone

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Abstract—The most direct approach to the anterior and inferior regions of the petrous temporal bone skull base is transmastoid infralabyrinthine. This approach provides an exposure for draining and aerating cholesterol granulomas or obtaining tissue for micropathologic diagnosis. It obviates the exposure of the intracranial space, thereby producing minimal care, as in mastoid-type surgical procedures. The procedure is described and illustrated. Two cases with petrous temporal bone cholesterol granulomas demonstrate the definitive effectiveness of this procedure.

Transmastoid infralabyrinthine (TMIL) surgery has been used for drainage, biopsy, and exteriorization of cystic lesions occurring in the apical carotid portion of the petrous pyramid.¹ The cystic lesions occurring in this region with some predilection are cholesterol granulomas²⁻⁴ and giant cholesterol cysts.⁵⁻⁸ Several articles have reported these lesions and described multiple surgical procedures for treatment.⁹⁻¹² The surgical procedures include transsphenoidal,¹³⁻¹⁶ transotic,¹⁷⁻²⁰ middle fossa craniotomy,²¹ posterior fossa craniotomy,¹¹ transinfratemporal fossa,²² translabyrinthine,²³ and TMIL.^{6,9,12}

The TMIL surgery should be considered the procedure of choice for draining and exteriorizing most cholesterol granuloma cysts in the anterior petrous pyramid. The surgical procedure and related anatomic structures are described. Two cases are presented to illustrate the effectiveness of the TMIL approach in these lesions.

SELECTION OF PATIENTS

“Cystic” lesions most commonly seen in the temporal bone petrous apex include cholesterol granuloma and cholesteatoma.^{24,25} Fatty bone marrow in the temporal bone must be differentiated from these lesions. Magnetic resonance imaging (MRI) and high resolution computed tomography (HRCT) are used in the evaluation of these

lesions.^{26,27} MRI is very effective in differentiating these “cysts.”²⁸⁻³⁰ Signal characteristics on T₁- and T₂-weighted sequences can provide an accurate diagnosis in most cases (Table 1). Paramagnetic contrast agents are generally not necessary. High-signal intensity on T₁-weighted images indicates fat or methemoglobin. If the signal intensity lessens on T₂-weighted sequences, fat is present, usually in the bone marrow. Should the signal intensity remain high, then methemoglobin is present, indicating a cholesterol granuloma. The change in signal intensity from T₁- to T₂-weighted images is critical in differentiating a pathologic process, such as cholesterol granuloma, from normal occurring fat and bone marrow. Cholesteatoma characteristically shows medium intensity on T₁ images and brightens on T₂.

HRCT is important during preoperative assessment. It demonstrates the position of the lesion in the temporal bone and its relationship to the normal structures and spaces in the bone: otic capsule, carotid artery, jugular bulb, internal auditory canal, middle ear, and mastoid cavity. The density of the cyst and appearance of its margin also aids in the diagnosis. Postoperative HRCT provides information regarding the effectiveness of the surgery in exteriorizing and aerating the cholesterol granuloma cyst. HRCT is the procedure of choice for periodic future examinations following surgery in the event the exteriorization fails and the cyst enlarges.

Table 1. Imaging Characteristics of Cystic Lesions in the Petrous Apex

	MRI Intensity	
	T ₁	T ₂
Fatty bone marrow	High	Medium
Cholesterol granuloma	High	High
Cholesteatoma	Medium	High

Symptomatic cholesterol granulomas and enlarging cysts are surgical candidates. When the site of the lesion is in the anterior apical carotid portion of the petrous pyramid, exteriorization can be accomplished through the TMIL approach.

SURGICAL ANATOMY

A mastoidectomy is performed, skeletonizing the bony posterior canal wall, middle fossa, and posterior fossa bony dural surfaces, sinodural angle, and sigmoid sinus. The vertical facial nerve and ampullary limb of the posterior semicircular canal are carefully skeletonized. The infralabyrinthine portion of the procedure is approached through the space medial to the facial nerve, inferior to the posterior semicircular canal, superior to the jugular bulb, and anterior to the sigmoid sinus and posterior fossa dura. The line of vision can be improved by removal of bone from the sigmoid sinus and posterior fossa dura to allow retraction posteriorly.

The carotid artery can be identified anterior to the jugular bulb. When necessary, the jugular bulb can be "fractured" inferiorly for wider exposure between the bulb and the internal auditory canal. Beyond the facial nerve and posterior semicircular canal, the infralabyrinthine space is bordered by the jugular bulb below, internal auditory canal above, and carotid artery in front. Continued dissection of this space leads to the petrous pyramid and cyst. The opening into the cyst cavity is accompanied by the appearance of brownish-colored liquid. Widening the cyst opening allows the placement of a ventriculostomy tube or Silastic sheeting from the cyst cavity to the mastoid cavity. Aeration of the cyst cavity is the desired ultimate effect from the surgical procedure.

CASE REPORTS

Two cases of anterior petrous pyramid cholesterol granuloma are presented. Illustrations of the first case demonstrate the lesion, imaging, and treatment.

Case 1

A 45-year-old man presented with severe left-sided headaches associated with nausea and a plugged sensation

in his left ear. Occasional left facial twitching, without weakness, was observed. He had neither hearing loss nor vertigo. MRI and HRCT demonstrated a cholesterol granuloma in his left anterior petrous pyramid (Fig. 1). A TMIL approach was used to drain the cyst cavity. Aeration was accomplished by connecting the cyst area and mastoid antral cavity with a ventriculostomy tube (Fig. 2). HRCT 6 months after surgery shows the tube placement (Fig. 3).

Case 2

A 28-year-old woman presented initially with right-sided throbbing headaches and a subjective sense of right-

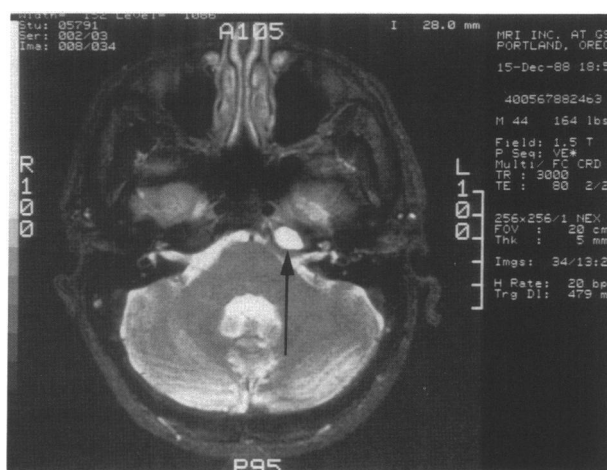


Figure 1. Magnetic resonance image, T₂-weighted. Arrow indicates enhanced cholesterol granuloma in anterior petrous pyramid. Note absent enhancement on the left.

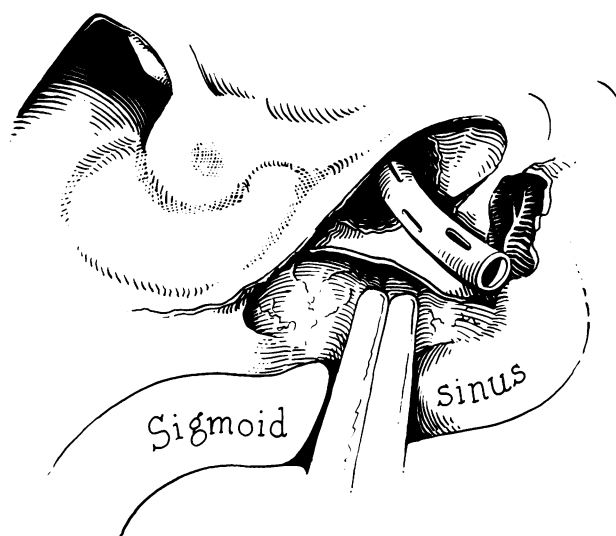


Figure 2. Artist's drawing of surgeon's view demonstrating the transmastoid infralabyrinthine approach and tube placement. Jugular bulb is collapsed.

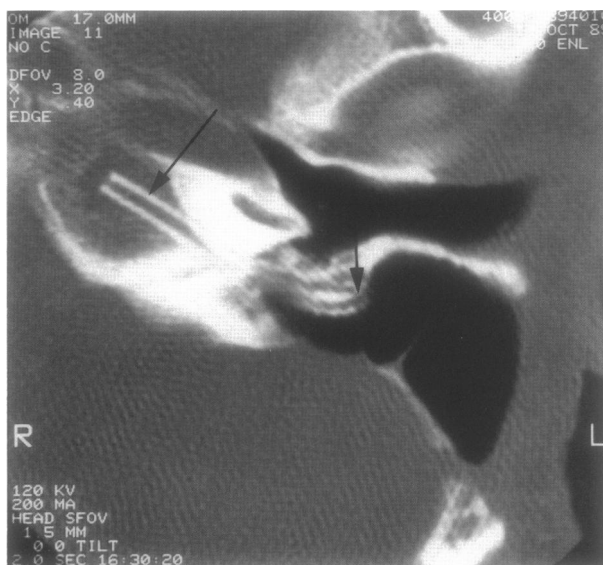


Figure 3. Postoperative high resolution computed tomography scan with tube extending from cyst to mastoid (arrows).

sided hearing loss associated with fullness in this ear. Audiometry revealed only a mild low-frequency sensorineural hearing loss. MRI and HRCT demonstrated the presence of a significant cystic lesion with characteristics of a cholesterol granuloma. A small identical asymptomatic cyst was also seen in her left anterior petrous pyramid. A right transmastoid infralabyrinthine exteriorization procedure with insertion of a Silastic tube was performed. HRCT and MRI 8 months after surgery showed aeration of the cyst and no evidence of methemoglobin containing fluid reaccumulation. Her right-sided headaches have improved, although the sensation of fullness has persisted.

COMMENT

MRI is a diagnostic procedure for cystic lesions in the temporal bone. Cholesterol granulomas can be distinguished from cholesteatomas and bone marrow.

The TMIL procedure is a direct approach for aeration when cholesterol granulomas are expansile and symptomatic lesions in the apical carotid region of the petrous pyramids.

HRCT provides preoperative anatomic information for surgical planning and determination of postoperative aeration of the cystic cavity.

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