Cholesterol Granuloma of the Petrous Apex: 
Establishment of a Drainage Route into 
the Superior Tympanic Cavity

—Technical Note—

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Abstract

A 40-year-old male presented with a cholesterol granuloma of the petrous apex manifesting as progressive hearing loss and tinnitus. The lesion was treated via an extradural middle cranial fossa approach employing a new procedure to establish a drainage pathway into the superior tympanic cavity which preserved his hearing. The pathway was formed by a groove 5 mm wide and deep in the anterolateral aspect of the petrous bone, crossing the major petrosal nerve and carotid artery, running around the cochlea, crossing the tensor tympanic muscle, and entering the superior tympanic cavity above the orifice of the eustachian tube. This procedure is easy to perform without special techniques.

Key words: cholesterol granuloma, petrous apex, middle cranial fossa approach, drainage

Introduction

Cholesterol granuloma, first described in 1894, is commonly encountered in the middle ear and mastoid air cells after obstruction of the normally aerated spaces due to associated diseases such as otitis media. Cholesterol granuloma accounts for approximately one in 30 acoustic tumors, significantly less than the incidence of epidermoid cholesteroloma. Cholesterol granuloma is a cystic, expansile lesion, which grows silently, eroding surrounding bone, and eventually exerting pressure on the cranial nerves and brainstem. Surgical treatment is by drainage of the semiliquid content and reestablishment of normal pneumatization. Cholesterol granuloma of the petrous apex is normally treated by forming a permanent fistula for drainage into the mastoid cavity via the transmastoid translabyrinthine or infralabyrinthine approaches.

We describe a case of cholesterol granuloma of the petrous apex successfully treated via an extradural middle cranial fossa approach employing a new procedure to establish a drainage pathway into the superior tympanic cavity with preservation of hearing.

Case Report

A 40-year-old male presented with a 7-month history of progressive hearing difficulty and tinnitus in the right ear. He had no significant medical history. Neurological examination revealed right sensorineural hearing disturbance, but no other neurological deficits. His preoperative hearing level was 45 dB, and speech discrimination score was 28% (100 dB). Computed tomography (CT) demonstrated an isodense, non-enhanced mass lesion in the right petrous apex, markedly eroding the surrounding bone with involvement of the anterior wall of the internal
auditory meatus (Fig. 1 left). Magnetic resonance (MR) imaging showed the mass as a well-defined high-intensity area on the T1-weighted image (Fig. 1 right) and a mixed-intensity area on the T2-weighted image. The high-intensity signal was not changed on fat-suppression images. Cerebral angiography showed nothing remarkable. The preoperative diagnosis was cholesterol granuloma of the petrous apex.

He underwent surgery via an extradural middle cranial fossa approach. A brownish cyst was discovered through the petrous bone defect medial to the major petrosal nerve. The cyst contained golden-brown, viscous liquid with shiny crystals and flakes of crystalline materials. The upper part of the cyst wall was removed. A permanent drainage route was formed by making a groove in the anterolateral aspect of the petrous bone about 5 mm in depth and width to connect the granuloma cavity to the superior tympanic cavity (Fig. 2). The groove crossed between the major petrosal nerve and the carotid artery, ran around the anterolateral margin of the cochlea, transversed above the tensor tympanic muscle, and finally entered the superior tympanic cavity above the orifice of the eustachian tube. The minor petrosal nerve was sacrificed but the major petrosal nerve was preserved. Histological examination of the specimen showed cholesterol clefts surrounded by foreign body giant cells, chronic inflammatory cells, hemosiderin deposits, and fibrosis (Fig. 3). The histological diagnosis was cholesterol granuloma.

The postoperative course was quite uneventful except for a transient conductive hearing disturbance. He sometimes noticed a bitter taste, indicating intermittent spontaneous drainage through the eustachian tube. Postoperative MR imaging revealed that the size of the lesion had decreased markedly, and serial MR imagings showed no sign of recurrence during a 3-year follow-up period (Fig. 4).
Discussion

Cholesterol granuloma and cholesteatoma are two distinctly different clinical entities that may occur in the petrous apex. MR imaging is valuable for the differential diagnosis. Cholesterol granuloma demonstrates a high-signal intensity on both T₁- and T₂-weighted images that is presumably due to cholesterol crystals and chronic hemorrhagic by-products, whereas cholesteatoma demonstrates a low- to iso-signal intensity on T₁-weighted images and a high-signal intensity on T₂-weighted images. Treatment of these lesions differs significantly. Cholesteatoma is best treated by total removal of the matrix. Cholesterol granuloma requires chronic drainage of the cyst into another air-containing cavity, but total excision of the cyst wall is not necessary due to the absence of epithelial lining.

Several surgical approaches to cholesterol granuloma in the petrous apex may be selected, depending on the location of the lesion and the preoperative state of the patient’s hearing. A transmastoid translabyrinthine approach is recommended in patients with no useful hearing, and extradural middle cranial fossa or transsphenoid or transmastoid infralabyrinthine approach may be used when hearing can be preserved. Establishment of a pathway for drainage via the transsphenoidal route is advantageous if the lesion is adjacent to the posterior wall of the sphenoid sinus, or for bilateral lesions in the petrous apices. Several otologists have recommended the translabyrinthine or infralabyrinthine approach as the first choice, since these procedures provide a direct path for aeration of the petrous apex through the mastoid air sinus, and the cyst can be stented open into the mastoid cavity with a silicone elastomer drain tube. The middle fossa approach has not been generally recommended, because a direct drainage route into the mastoid cavity seems impossible to establish resulting in a likelihood of recurrence. However, the middle fossa approach provides the shortest route to the petrous apex and the widest operative view, and bony erosion caused by the lesion favors easier exposure without drilling of the petrous bone. If the preoperative diagnosis of cholesterol granuloma is not definite and the lesion is a solid mass, for example cholesteatoma, the middle fossa approach would allow substantial resection of the internal content. In addition, neurosurgeons are accustomed to the middle fossa approach rather than the translabyrinthine or infralabyrinthine approach. Therefore, we used the middle fossa approach in the present case employing the new procedure to establish a drainage route.

The long-term patency of the drainage route seems to depend on the depth of the groove. In the present case, the groove was about 5 mm in depth, and limited by the carotid artery and the tensor tympanic muscle where the groove crossed just above these structures. A silicone elastomer drain tube may be set along the groove if necessary, but obstruction of this tube with inflammatory tissue has been reported. To avoid cerebrospinal fluid leakage and chemical meningitis induced by the content of cholesterol granuloma, every operative procedure must be done extradurally, and special care should be taken not to lacerate the dura. The cochlea and geniculate ganglion of the facial nerve should not be damaged and the major petrosal nerve can be preserved as in the present case by making a groove under the nerve. It is also important not to injure the auditory ossicles and chorda tympani when opening the roof of the superior tympanic cavity. This novel procedure does not require special surgical technique, and can be performed safely with an adequate knowledge of anatomy.

References

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