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MRI Features of Cholesterol Granuloma of the Petrous Apex: A Diagnostic Review with a Rare Presentation

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Abstract **Case Report**

Cholesterol granuloma of the petrous apex is an uncommon benign lesion characterized by a foreign body reaction to cholesterol crystals within an air cell tract of the temporal bone. It is often mistaken for other petrous apex lesions such as cholesteatoma or petrous apex effusion. We present the MRI findings in a 16-year-old female with a history of left-sided cholesteatoma surgery at age 7, presenting 9 years later with suspected recurrence on CT. MRI revealed a non-enhancing, T1 and T2 hyperintense lesion with restricted diffusion at the left epitympanum and mastoid, consistent with a cholesterol granuloma associated with recurrent cholesteatoma. This article highlights the imaging hallmarks, diagnostic challenges, differential diagnoses, and current literature on petrous apex cholesterol granulomas, with a focus on MRI.

Keywords: Cholesterol Granuloma, Petrous Apex, Temporal Bone Lesion, MRI, T1 Hyperintensity, Differential Diagnosis, Pediatric Recurrent Cholesteatoma.

INTRODUCTION

Cholesterol granuloma (CG) of the petrous apex is a benign, expansile lesion resulting from an inflammatory response to cholesterol crystals, typically occurring within pneumatized areas of the temporal bone. Though benign, CGs can present with cranial nerve symptoms, hearing loss, and mimic other pathologies. Accurate diagnosis using MRI is critical for appropriate management and to avoid unnecessary surgery.

CASE PRESENTATION

A 16-year-old female with a history of left-sided cholesteatoma surgery at the age of 7 was referred for imaging due to recent left-sided otologic symptoms and suspicion of recurrence on temporal bone CT.

MRI Findings:

MRI of the temporal bones was performed using sagittal T1, axial T2, FLAIR, coronal T2, diffusion-weighted imaging (DWI with ADC map), and post-contrast sequences.

- A soft tissue filling of the left mastoid and epitympanic cavity was observed, showing:
- High signal intensity on T1- and T2-weighted images
- A marked hyperintensity on diffusion-weighted imaging (DWI) with corresponding ADC restriction
- No enhancement after gadolinium administration
- The findings are suggestive of a cholesterol granuloma, potentially associated with a recurrent cholesteatoma focus.
- The cochlea, vestibule, and semicircular canals were normal on both sides.
- The right middle ear and mastoid appeared normal.
- The cerebellopontine angles and the acoustic-facial nerve complex showed no abnormalities.

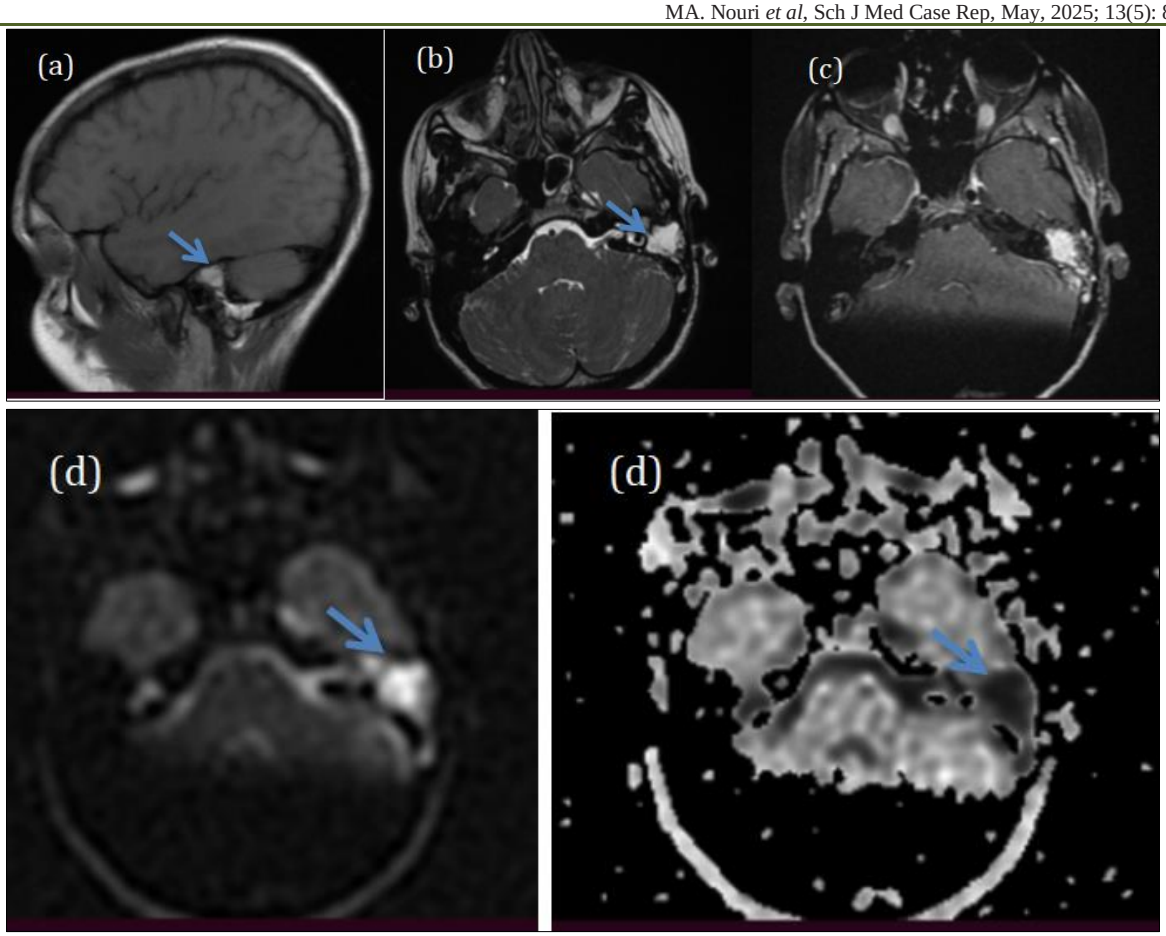

Figure 1: Sagittal T1-weighted MRI showing a hyperintense petrous apex lesion (arrow) (a). Axial T2-weighted image showing matching hyperintensity without enhancement (b,c). A marked hyperintensity on diffusion-weighted imaging (DWI) with corresponding ADC restriction (d,e) blue arrows

DISCUSSION

Cholesterol granulomas form due to obstruction of air cell tracts, leading to repeated hemorrhage and breakdown of blood products, with subsequent cholesterol crystal deposition. The resulting foreign body reaction leads to granuloma formation.

MRI is the imaging modality of choice. The classic signal profile is:

- T1 hyperintensity due to methemoglobin
- T2 hyperintensity due to fluid and breakdown products
- Lack of contrast enhancement
- Absence of diffusion restriction (although atypical in this case due to recurrence overlap)

This signal combination helps differentiate CG from other lesions.

Differential Diagnoses

1. Cholesteatoma – typically hypointense on T1, hyperintense on T2, with diffusion restriction
2. Petrous apex effusion – fluid signal on T2 but not hyperintense on T1, may enhance
3. Petrous apex cephalocele – communicates with subarachnoid space; CSF signal intensity on all sequences
4. Petrous apex mucocele – T1 variable, often enhances
5. Epidermoid cyst – shows restricted diffusion and lower T1 signal

CONCLUSION

Cholesterol granuloma of the petrous apex is a rare but classic lesion with a well-defined MRI signature. In this case, overlapping findings with recurrent cholesteatoma emphasize the value of diffusion-weighted imaging and clinical correlation. Recognizing these features is essential to avoid unnecessary intervention and to guide conservative versus surgical management.

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