Imaging Innovations in Temporal Bone Disorders

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KEYWORDS

• Cholesteatoma • Diffusion-weighted imaging • Paraganglioma
• Whole-body molecular imaging • Dural arteriovenous fistula
• Arteriovenous malformation • Arterial spin labeling

KEY POINTS

- High-resolution computed tomography is a fast and dependable method for assessing temporal bone anatomy and planning surgical approach in cases of cholesteatoma.
- Diffusion-weighted MRI is likely to decrease the number of second-look surgeries, decreasing patient morbidity and surgical costs.
- Contrast-enhanced computed tomography of the skull base, MRI of the skull base and neck, and catheter angiography and embolization in the preoperative period are recommended for evaluation and management of jugular foramen paragangliomas.
- Arterial spin labeling (ASL) is an emerging noninvasive MRI procedure that does not require gadolinium-based contrast administration and is a useful diagnostic test for dural arteriovenous fistulas (DAVFs) and small arteriovenous malformations (AVMs) less than 2 cm.
- The absence of venous signal on ASL is a helpful predictor of the presence or absence of DAVF or AVM in patients with pulsatile tinnitus and no obvious vascular malformation on routine imaging studies.

INTRODUCTION

Important advances in diagnostic imaging of the temporal bone have been made in the past decade. The development of new imaging techniques coupled with new treatment algorithms has created new possibilities in treating temporal bone diseases. This article provides an overview of recent imaging innovations that can be applied to temporal bone diseases; it does not provide a comprehensive review of temporal

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Abbreviations

ASL	Arterial spin labeling
AVMs	Arteriovenous malformations
CBCT	Cone beam computed tomography
CT	Computed tomography
CTA	Computed tomography angiography
DAVFs	Dural arteriovenous fistulas
DOPA	Dihydroxyphenylalanine
DOTATATE	Tetraazacyclododecane tetraacetic acid-octreotate
DSA	Digital subtraction angiography
DTPA	Diethylenetriaminepentaacetic acid
DWI	Diffusion-weighted imaging
EPI	Echo-planar imaging
^{18}F-FDG	^{18}F-fluorodeoxyglucose
HRCT	High-resolution computed tomography
IV	Intravenous
MIBG	Metaiodobenzylguanidine
MR	Magnetic resonance
MRA	Magnetic resonance angiography
MRV	Magnetic resonance venography
NET	Neuroendocrine tumors
PGL-1	Paraganglioma syndrome 1

bone disorders and their imaging characteristics, because numerous excellent references already exist in textbooks and review articles.[1–4]

Topics covered in this article include imaging techniques for evaluation of cholesteatoma and epidermoids, with emphasis on the role of magnetic resonance (MR) diffusion-weighted imaging (DWI); imaging techniques for evaluation of skull base neuroendocrine tumors, including paragangliomas, with emphasis on whole-body molecular imaging; and MR arterial spin labeling (ASL) perfusion for dural arteriovenous fistulas (DAVFs) and arteriovenous malformations (AVMs).

Imaging Techniques for Evaluation of Cholesteatoma and Epidermoids

Since its introduction in the early 1980s, high-resolution computed tomography (HRCT) of the temporal bone has been the gold standard for imaging cholesteatoma.[5–7] HRCT now represents the preeminent modality for defining the bony anatomy of the temporal bone, as well as pathologic alterations in that anatomy caused by cholesteatoma. Although cholesteatoma is usually readily identified based on history and otoscopic examination, its presence and extent may not always be clear. This considerable unpredictability in size and extent of cholesteatoma can substantially affect surgical approach, expectations, and risk, as can the possible involvement of critical adjacent structures. Despite these strengths of HRCT, in postoperative ears, residual or recurrent cholesteatoma may be in areas concealed from direct inspection, leading to the necessity of second-look surgeries for complete evaluation, because HRCT cannot conclusively distinguish residual or recurrent disease from fluid and granulation tissue, which have similar density.

Because HRCT is limited in its ability to differentiate among soft tissue densities in the temporal bone, the addition of MRI, with its superior soft tissue contrast, has been valuable in the temporal bone. The recent development and refinements of diffusion-weighted MRI (DW-MRI) have contributed significantly in this regard, allowing accurate identification of the presence of small foci of keratin debris that would otherwise be impossible to differentiate from fluid, edematous mucosa, and/or granulation tissue