ROLE OF COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING IN EVALUATION OF TINNITUS

An Essay
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Abstract

Role of CT and MRI in evaluation of tinnitus

Tinnitus can be subdivided into subjective and objective types. Subjective tinnitus is sound that is audible only to the affected person, objective tinnitus is sound that is produced within the ear or adjacent structures that can be heard by the examining physician.

Recently, 3D multi-planar reformatted CT images can aid in understanding the temporal bone, a region of complex anatomy containing multiple small structures within a relatively compact area, which makes evaluation of this region difficult.

Contrast enhancement is not essential for evaluation of pathology isolated to bone or air spaces. Intravenous contrast material is often used to assess vascular lesions, areas of break down in the blood-brain barrier, or soft tissue changes.

CT has its greatest advantage in the detection of the early bone erosion of the lateral and anterior bony walls of the jugular fossa in cases of glomus jugular tumors which differentiates glomus tumor from other jugular fosssa lesions; while, high resolution CT of the temporal bone is the examination of choice of glomus tympanicum.

MRI is then used for detection of such tumor with gadolinium enhancement.

Both high resolution CT and MRI provide definitive diagnosis of schwannomas and cerebellopontine angle meningioma.

CT is superior to MRI in detecting calcifications& bone invasion with hyperostosis and CT is the imaging modality of choice in cholesteatima.

MRI is outstanding for its ability to evaluate blood vesselrelated disorders of the temporal bone with many gradient-echo techniques. MRI studies, compared with CT, have higher resolution and are more sensitive to alteration in the fluid spaces of the inner ear and the cerebellopontine angle.

Key words: Tinnitus causes, imaging of tinnitus-CT and MRI, CT and findings of tinnitus.

Introduction

Tinnitus is the perceived sensation of sound in the absence of acoustic stimulation. It may be unilateral or bilateral (*Heller JA*, 2003).

Tinnitus is a symptom, not a disease, and as such has many different causes. It may be the first or the only symptom of a disease which threatens the patient's health (*Noel CA and Meyerhoff WL*, 2003).

Tinnitus has been divided according to the characteristics of the sound. The sound may be pulsatile (coinciding with the patient's heartbeat) or continuous (non pulsatile) (*Weissman JL and Hirsch BE*, 2000).

Pulsatile tinnitus is less common, but more difficult to diagnose. This symptom always deserves a thorough evaluation to avoid disastrous consequences from potentially life-threatening associated pathology. In many pulsatile tinnitus patients a treatable underlying etiology can be identified (*Sismanis A*, 1998).

The evaluation of a patient with pulsatile tinnitus requires a detailed history taking, complete medical examination, otoscopy, and audiological evaluation. Imaging studies are almost always required in the evaluation of tinnitus (*Noujaim SE*, *Pattekar MA*, *Cacciarelli*, *et al.*, 2000).

Computed Tomography and Magnetic Resonance imaging are the studies of choice in diagnosing most of the causes of tinnitus. History taking and clinical examination should precede the imaging studies to ensure the best results (*Jane L. Weissman*, 2000).

MRI is used for detection of the most important tumor (glomus jugular) that causes tinnitus. On Gadolinium enhanced MRI images, the tumor enhances intensely. The characteristic MR pattern is salt and pepper. That salt is the enhancing tumor stroma (on T1 weighted images after

☐ Introduction

contrast material enhancement and on T2-weighted images). The pepper is signal voids of tumor vessels (*Jane L. Weissman*, 2000).

The most important inflammatory cause of tinnitus is cholesteatoma generally; two separate types of cholesteatomas are identified based on different etiologies: congenital and acquired types.

CT scanning is the imaging modality of choice in cases of cholesteatoma. CT scanning can detect the bony defects which may include scutal erosion, Labyrinthine fistula, Defects in the tegmen, and give us details about the ossicular involvement either erosion or discontinuity (*Lo WW and Maya MM*, 2003).

Aim of the work

This work was conducted to discuss the role of CT and MRI in the evaluation of tinnitus.

ANATOMY OF THE TEMPORAL BONE

The temporal bones are situated at the sides and base of the skull. Each consists of the following five parts: squamous, petrous, mastoid, tympanic, and styloid process (*Soames RW*, 1995).

1. Squamous part:

The squamous part forms the anterior and upper part of the bone. The external surface is smooth, convex, and forms part of the temporal fossa. The zygomatic process projects from its lower part, and is directed anteriorly. Its lateral surface is subcutaneous and its medial surface gives origin to the masseter muscle. The internal surface is concave and irregular matching the cerebral sulci and gyri (*Curtin HD*, *et al.*, 2003).

2. Mastoid part:

The mastoid part forms the posterior part of the bone and shares in the formation of the external acoustic meatus and the tympanic cavity (*Rhoton AL*, 2000). Its outer surface is rough for muscles attachment. It is perforated by one or more foramina for transmission of the mastoid emissary vein and a branch of the occipital artery (*Soames RW*, 1995). The inner surface of the mastoid portion presents a deep, curved groove, the sigmoid sinus, which lodges part of the transverse sinus (*Rhoton AL*, 2000).

The mastoid process is a thick conical inferior projection. It gives attachment to muscles of the shoulder girdle and of the back. The mastoid process is hollowed to form a number of spaces, the mastoid air cells. In addition to these a large irregular cavity, the tympanic antrum, is situated at the upper and anterior part of the bone, it communicates with the

epitympanum by way of a narrow channel called the additus ad antrum (Soames RW, 1995).

3. Tympanic part:

The tympanic part is a thin curved plate of bone. It forms the anterior wall, the floor, and part of the posterior wall of the bony external auditory canal (*Rhoton AL*, 2000).

4. Petrous part:

The petrous part contains the structures of the inner ear. It resembles a pyramid having a base, an apex and three surfaces (*Rao KC and Robles H*, 1999).

The base is laterally placed and fused with the internal surfaces of the squamous and mastoid parts (*Soames RW*, 1995).

The apex points medially and forward at approximately 45 degree angle with the coronal and sagital planes, and inserted into the angular interval between the greater wing of the sphenoid and the basilar part of the occipital bone (*Rhoton AL*, 2000).

The anterior surface forms the posterior limit of the middle cranial fossa. Near its center is the arcuate eminence which indicated the site of the superior semicircular canal. In front of this eminence a thin smooth layer of bone, the tegmen tympani forms a roof for the tympanic cavity. The posterior surface forms the anterior limit of the posterior cranial fossa. Near the center there is an opening, the porus acousticus, leading to a short canal, the internal auditory canal that transmits the facial and the vestibule cochlear nerves. The lateral end of the canal is closed by a vertical plate of bone that separates the fundus of the canal from the vestibule. The fundus

is divided by a horizontal crest, the crista falciformis, into two compartments. The smaller upper compartment contains the facial nerve anteriorly, and the superior vestibular nerve posteriorly. The larger lower compartment contains the cochlear nerve, the inferior vestibular nerve, and the nerve to the posterior semicircular canal (*Soames RW*, 1995).

The inferior surface is rough and irregular for muscle attachment, and forms part of the exterior of the base of the skull. It is pierced anteriorly by the larger circular aperture of the carotid canal, more posteriorly there is the jugular foramen. The cochlear aqueduct which communicates with the basal turn of the cochlea lies just above the anteromedial portion of the jugular foramen. Between the carotid canal and the jugular fossa is a small canal, the inferior tympanic canaliculus. In the lateral part of the jugular fossa is the mastoid canaliculus. Between the styloid and mastoid processes is the stylo-mastoid foramen (*Curtin HD*, *et al.*, 2003).

5. Styloid process:

A thin pointed downward projection from the under surface of the temporal bone for the attachment of ligaments and muscles (*Rhoton AL*, 2000).

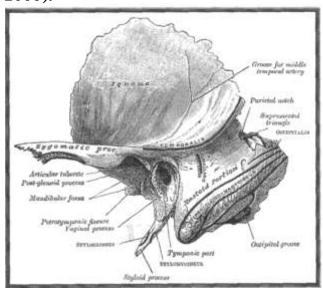


Fig. (1): The temporal bone. Lateral surface (Soames RW, 1995).

Anatomy

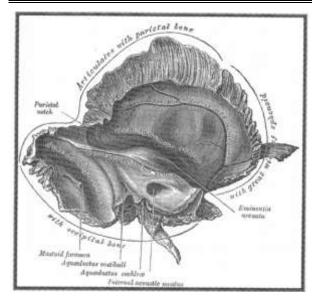


Fig. (2): The temporal bone. Inner surface (Soames RW, 1995).

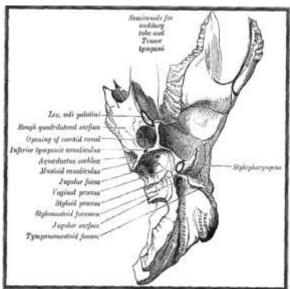


Fig. (3): The temporal bone. Inferior surface (Soames RW, 1995).