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Auris Nasus Larynx 38 (2011) 551–554

AURIS NASUS LARYNX
INTERNATIONAL JOURNAL OF ORL & HNS

www.elsevier.com/locate/anl

Accuracy of 3.0 Tesla magnetic resonance imaging in the diagnosis of intracochlear schwannoma

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Received 9 October 2010; accepted 13 December 2010
Available online 19 January 2011

Abstract

Intracochlear schwannomas (ICSs) are rare tumors. The diagnosis of ICS is based on high-resolution magnetic resonance imaging (MRI), which should be used for the accurate determination of the location of tumors. Recent advancements in imaging technologies and software enable the precise regional diagnosis of ICS. We experienced a case of intracochlear schwannoma with a diagnosis of progressive hearing loss and tinnitus. Audiometry revealed severe hearing loss in the right ear with remaining low-frequency hearing. MRI showed an abnormal lesion in the cochlea. Three-dimensional real inversion recovery (3D rIR) and constructive interference in steady state (CISS) MRI revealed the size and shape of the tumor via identification of the cochlear nerve and cochlear fluid space. CISS and 3D rIR sequences provide useful information regarding the boundaries of tumors and the tissues that surround them.

Keywords: Intracochlear schwannoma; Magnetic resonance imaging; Constructive interference in steady state; Three-dimensional real inversion recovery

1. Introduction

Intracochlear schwannomas (ICSs) are rare tumors; fewer than 100 cases have been described in previous reports [1,2]. Schwannomas usually involve the vestibular or cochlear nerves within the internal auditory canal (IAC) and cerebellopontine angle (CPA). These tumors develop from perineural schwann cells and are most commonly located at the Schwann–glial cell junction of vestibular nerves in the IAC. However, Schwann cells are also present in the modiolus, near the spiral ganglia. Before the magnetic resonance imaging (MRI) era, the diagnosis of these tumors was usually reached during surgical procedures on the inner ear (for intractable vertigo) or during autopsy. Recent advances in MRI technology allowed the detection of small ICSs and the determination of their precise localization [3].

2. Case report

A 19-year-old woman presented with progressive right-sided hearing loss and tinnitus over a period of two years and absence of any vestibular complaints. Audiometry performed when she first visited our department revealed severe hearing loss in the right ear with remaining low-frequency hearing (Fig. 1). No vestibular or neural symptoms were present. Otoscopic examination of the ear found normal tympanic membranes, and neurological examination revealed the presence of a direction-changing downbeat nystagmus. This nystagmus was thought to be subclinical problem, because caloric tests showed no abnormalities. T1- and T2-weighted images acquired using 3.0 T MRI detected a right-sided intracochlear neoformation. Gadolinium-enhanced MRI revealed a small enhancing lesion in the right cochlea (Fig. 2). Invasion of the IAC was suspected in postcontrast MRI. However, constructive interference in steady state (CISS) analysis showed no invasion of the IAC, and three-dimensional real inversion recovery (3D rIR) showed the fluid space in the apical turn. 3D rIR, which provides high-resolution images

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doi:10.1016/j.anl.2010.12.011

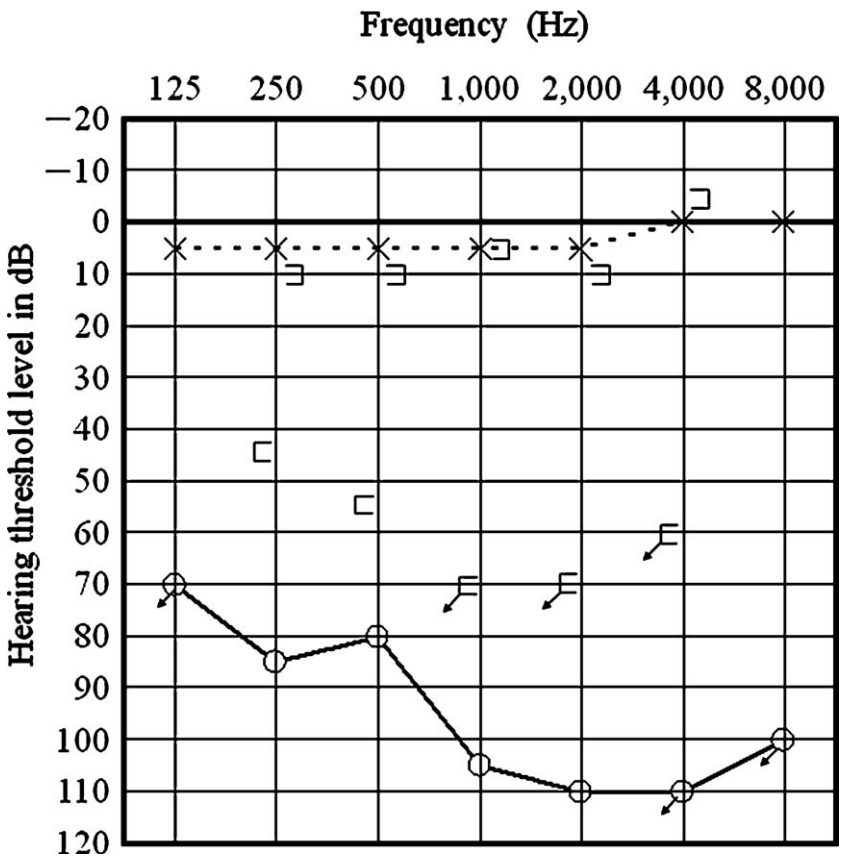

Fig. 1. Pure-tone audiometry performed during the first consultation showed severe hearing loss in the right ear with remaining low-frequency hearing. The arrows at the bottom of the audiogram indicate an absence of response.

with good contrast, showed the size and shape of tumor contrast with fluid space of cochlea (Fig. 3). MRI findings revealed the absence of invasion in the fundus meatus acustici interni and the presence of fluid space in the apical turn. Measurement of the distortion product otoacoustic emission (DPOAE) levels of the right ear revealed an absence of response, at all frequencies. There was also an absence of auditory brainstem response (ABR) in the right ear.

The patient underwent surgical removal of the tumor via the transotic approach. A whitish bouncy mass was found in the cochlea, with a central focus on the second turn. A small lymph fluid space was found at apical and lower basal turns (Fig. 4). Histological examination led to a diagnosis of schwannoma. The pathological type of our case was Antoni A in light microscope. Transmission electron microscopy analysis of our case revealed the presence of a specific finding in the cells of the schwannoma; i.e., extracellular long-spacing collagen (Fig. 5). This type of collagen, which is termed ‘‘Luse body’’, has been reported in pathological Schwann-cell lesions and is considered a marker of degeneration [4]. The postoperative course was uneventful, with the exception of the presence of vertigo. Examination showed horizontal nystagmus directed to the left and vertigo continued 5 days after surgery.

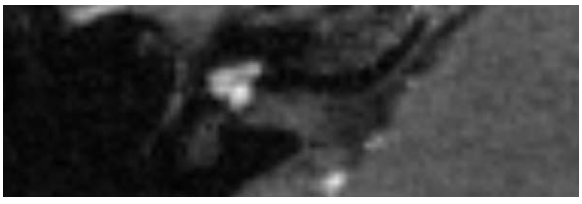

Fig. 2. Axial postcontrast T1-weighted image of the right ear in a patient with ICS.

3. Discussion

Predicting the accurate location of lesions and the nature of the tissue surrounding the tumor represents the most important information for surgery. CISS and 3D rIR may provide precise anatomical details of the inner ear [5]. In our case, CISS and 3D rIR revealed that the tumor did not invade the IAC and the presence of fluid space in the apical turn of the cochlea, which may explain the residual response at lower frequencies on pure-tone audiometry. Detailed information is advantageous (even in the case of advanced tumors), particularly for nerve-sparing surgery.

The CISS sequence is a T2-weighted gradient echo imaging that has a high spatial resolution with good contrast between the cerebrospinal fluid (CSF) and other structures (i.e., bone, nerves, and soft tissues). On CISS images, we