



ORIGINAL ARTICLE / *Head and neck imaging*

Endolymphatic hydrops imaging: Differential diagnosis in patients with Meniere disease symptoms

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KEYWORDS

Differential diagnosis;
Endolymphatic
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Abstract

Purpose: The goal of this retrospective study was to investigate the differential diagnosis of endolymphatic hydrops in patients with Meniere's disease (MD) symptoms by using magnetic resonance imaging (MRI) with intravenous injection of gadolinium chelate and delayed acquisition.

Material and method: Two hundred patients (133 women, 67 men; mean age = 67.2 ± 11 [SD] years) with unilateral MD underwent MRI at 3-T, between 4.5 and 5.5 hours after intravenous administration of gadoterate meglumine at a dose of 0.1 mmol/kg. MR images were analyzed for the presence of saccular hydrops, perilymphatic fistulae, inner ear malformations, semicircular canal (SCC) abnormal enhancement and brain lesions. We also tested the potential relationship between past history of gentamicin intratympanic administration and perilymphatic fistula presence and SCC aspect.

Results: Saccular hydrops were found in 96/200 patients with MD (48%). Three patients (1.5%) had perilymphatic fistulas associated with saccular hydrops, as confirmed by surgery. There was a correlation between the presence of perilymphatic fistula and past history of intratympanic gentamicin administration ($P=0.02$). We detected inner ear malformations in 5 patients (2.5%),

Abbreviations: EH, endolymphatic hydrops; MD, Meniere's disease; IT, intratympanic; SURI, saccule to utricle ratio inversion; SCC, semicircular canal; SH, saccular hydrops.

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SCC local enhancement in 15 patients (7.5%) always on the same side than the clinical symptoms of MD. There was a correlation between the presence of SCC abnormal enhancement and past intratympanic gentamicin administration ($P=0.001$). Five patients (2.5%) had brain lesions along central cochleovestibular pathways.

Conclusion: MRI may reveal brain lesions, SCC abnormalities and perilymphatic fistulae in patients with clinical MD.

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Magnetic resonance imaging (MRI) obtained after intravenous administration of a gadolinium chelate with delayed acquisition allows detecting endolymphatic hydrops (EH) in patients with audio-vestibular symptoms, offering new insights into these inner ear disorders [1]. The method of contrast enhanced-MRI with delayed acquisition can reveal EH in patients with Meniere disease (MD), recurrent peripheral vestibulopathy [2], acute low-tone sensorineural hearing loss [3] and atypical MD [4]. More recently, researchers have found that MRI reveals EH in patients with otosclerosis [5]. Various methods have been proposed for the grading of the degree of EH. The first grading system, proposed by Nakashima et al. [6], divided EH grades into three categories: none, mild and significant, both in the cochlea and the vestibule. However, in a recent case-controlled imaging study, this grading system did not allow discriminating between symptomatic subjects and healthy volunteers [7]. Consequently, the saccule to utricle ratio inversion (SURI) was proposed as a specific criterion for the diagnosis of EH, which should be further investigated in other imaging studies.

Since classical MD symptoms include episodic vertigo, fluctuant hearing loss, aural pressure and tinnitus [8], investigating EH could lead to the misdiagnosis of inner ear malformation or perilymphatic fistulae [9]. Studies also revealed abnormal high volumes of endolymph liquid in patients with semicircular canal (SCC) dysplasia [10], large vestibular aqueduct or SCC dehiscence [11]. Other auditory or vestibular central pathway lesions may mimic MD symptoms. The specific contrast of inner ear liquid enabled by three-dimension-FLAIR imaging also provides new insight into brain lesions, which may mimic MD symptoms, and lead to incidental findings such as echordosis physaliphora or Meckel cave cysts.

The goal of this retrospective study was to evaluate differential diagnosis of endolymphatic hydrops in patients with MD symptoms by using MRI with intravenous injection of contrast media and delayed acquisition in a large patient population outlining pitfalls and incidental findings.

Material and methods

Patients

An ethics approval was obtained for a retrospective study (IRB 6705/CPP 15-CHUG-02) including 200 patients presenting with MD symptoms, recruited consecutively between

January 2012 and October 2016. Only patients of 18 years or more were enrolled, with the following inclusion criteria:

- a history of clinically diagnosed definite MD with unilateral sensorineural hearing loss;
- a successfully completed MRI examination with delayed acquisition at least 4.5 hours after intravenous administration of gadolinium chelate.

A definite diagnosis of MD was achieved by two otolaryngologists with 20 years of experience for all patients. Only patients with a definite diagnosis of MD according to the last AAO-HNS guidelines were included [12].

The MRI examinations of 400 inner ears were subsequently analyzed. All patients within this group reported unilateral sensorineural hearing loss, allowing a precise characterization of the disease site. Previous treatment with intratympanic gentamicin administration was also recorded.

For healthy subjects, this was an imaging study registered with the ClinicalTrials.gov registry (identifier: 38RC14.428). Thirty healthy volunteers were recruited between August 2015 and September 2016 and had MRI examination with the same protocol than that of patients.

MRI protocol

Acquisition from 2012 to 2015

MRI examinations were performed at 3 Tesla using an Achieva[®] TX MRI scanner (Philips Healthcare, Best, The Netherlands) with a 32-channel sensitivity encoding (SENSE) head coil. We performed three-dimensional (3D)-fluid attenuation inversion recovery (FLAIR) MRI between 4.5 and 5.5 hours after a single intravenous dose of gadoterate meglumine (Dotarem[®], Guerbet, Roissy Charles de Gaulle, France, at a dose of 0.1 mmol/kg. The 3D-FLAIR sequence was performed with volume isotropic turbo spin echo (TSE) acquisition (Vista[®]) parameters as detailed in Table 1. FLAIR sequence was added to balanced fast field echo (bFFE) imaging (TR: 5.4 ms, TE: 2.2 ms; acquisition voxel size: 0.45 mm isotropic) or Drive acquisition (TR: 1500 ms, TE: 200 ms; acquisition voxel size: 0.43 mm × 0.70 × 0.60), 3D phase-contrast angiography (PCA), and T2 spin echo with whole brain coverage.

Acquisition since January 2016

The Vista[®] technique was replaced with the Brainview[®] technique. The full parameters of the 3D-FLAIR sequence are detailed in Table 1.

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