Visualization of Endolymphatic Hydrops in Ménière’s Disease after Intravenous Administration of Single-dose Gadodiamide at 1.5T

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Endolymphatic hydrops (EH) was first visualized in patients with Ménière’s disease by magnetic resonance (MR) imaging using 3-dimensional (3D) fluid-attenuated inversion recovery (FLAIR) after intratympanic administration (IT) of gadolinium-based contrast material (GBCM) at 3 tesla.1 Visualization of EH in these patients is also reported using heavily T2-weighted 3D-FLAIR (hT2W-3D-FLAIR) and imaging 4 hours after intravenous administration of single-dose GBCM (IV-SD-GBCM) at 3T.2 On hT2W-3D-FLAIR images, the perilymph is bright and endolymph is dark (PPI; positive perilymph image). Shortening inversion time (TI) of hT2W-3D-FLAIR suppresses the signal of perilymph and brightens the signal of endolymph (PEI; positive endolymph image),3 and subtraction of PEI from PPI further clarifies the anatomical details of EH.4 In clinical practice, we now image EH by IV-SD-GBCM using this subtraction image, called HYDROPS (HYbrid of Reversed image Of Positive endolymph signal and native image of positive perilymph Signal). Though previous reports of EH imaging by IV-SD-GBCM have been performed at 3T, the longer wait to schedule 3T than 1.5T examination at our hospital has led to our undertaking EH imaging at 1.5T after optimizing inversion time in volunteers.

We examined 20 patients with clinically suspected Ménière’s disease at 1.5T (AVANTO, Siemens Medical Solutions, Erlangen, Germany) using a 32-channel head coil. We obtained MR cisternography (MRC), PPI, and PEI using similar techniques to those previously reported 4 hours after IV-SD-GBCM (gadodiamide: Gd-DTPA-BMA; Omniscan, Daiichi-Sankyo Co. Ltd., Tokyo, Japan) at 3T.3,4 Pixel size at 1.5T was enlarged from 0.5 mm × 0.5 mm at 3T to 0.7 mm × 0.7 mm to compensate for decreased signal-to-noise ratio. Parameters for PPI and PEI were: repetition time/echo time/inversion time, 9000/546/2250 ms for PPI and 9000/546/2050 ms for PEI; variable flip angle 3D turbo spin echo technique; 180-mm square field of view; 1.0-mm slice thickness; 256 × 256 × 144 matrix; 141 echo train length; and GRAPPA factor of 2. Scan time was 3.5 min for MRC, 14.3 min for PPI, and 14.3 min for PEI. We generated HYDROPS images by subtracting PEI from PPI, and an experienced neuroradiologist evaluated those images using MRC as the reference for total lymph fluid anatomy according to the previously proposed guideline.5 In all 40 ears in 20 patients, we could recognize and grade the cochlear and vestibular endolymphatic space (Figs. 1, 2). Endolymphatic hydrops was significant in 15 cochleae and 31 vestibules, mild in 17 cochleae and 6 vestibules, and absent in 8 cochleae and 3 vestibules. Significant or mild EH was seen in either the cochlea or vestibule in all ears.

Our study is limited because we did not directly compare 1.5 and 3T. Firm validation of the results of EH imaging at 1.5T requires further clinical study.

In conclusion, EH imaging by IV-SD-GBCM might be feasible even at 1.5T. The wider availability of 1.5T MR imaging is expected to lead to its broader clinical use for EH imaging.

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Fig. 1. A 46-year-old woman with Ménière’s disease, images obtained 4 hours after single-dose intravenous administration of gadolinium-based contrast material (GBCM). (a) Heavily T₂-weighted magnetic resonance (MR) cisternography shows the anatomy of total lymph fluid for the right inner ear. (b) HYDROPS (HYbrid Of Reversed image Of Positive endolymph signal and native image of positive perilymph Signal) image of corresponding location. Short arrows indicate significantly enlarged cochlear endolymphatic space visualized as black areas.

Fig. 2. A 76-year-old man with Ménière’s disease, images obtained 4 hours after single-dose intravenous administration of gadolinium-based contrast material (GBCM). (a) Heavily T₂-weighted magnetic resonance (MR) cisternography of left inner ear. (b) HYDROPS (HYbrid Of Reversed image Of Positive endolymph signal and native image of positive perilymph Signal) image of corresponding location. Long arrows indicate significantly enlarged vestibular endolymphatic space visualized as black area.

References

