**Appraisal of endolymphatic space 3D-MR-Imaging in view of different gadolinium-based contrast agent applications**

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**Abstract:**

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**Key words:**

X

**Introduction:**

The endolymphatic hydrops (EH) seems to occur in many different disorders of the vestibular system- yet little is known about its pathophysiological mechanism [1]. An important reason might be that until recently changes in the endolymphatic space could only be diagnosed indirectly through the loss of neuro-otologic functions, post mortem on the basis of histological sections of the inner ear or invasively via intratympanic injection gadolinium-based contrast medium (GBCM) in combination with magnetic resonance imaging (MRI). Intravenous contrast agent administration in combination with 3D-MR-Imaging, allow a less invasive in vivo appraisal of the endolymphatic space (Gürkov et al. 2014) (Tanigawa et al. 2011). Aim of this study was to investigate the effect of different intravenous GBCM applications on endolymphatic space 3D-MR-Imaging. (Yamazaki et al. 2012)

**Materials and Methods:**

Four healthy controls (two females, aged 30–36 years) were included in this study. Intravenous gadolinium-based contrast medium (GBCM) application was compared between Dotarem® (=D) vs. Gadovist® (=G) and single dose (=S) vs. Double dose (D). Intravenous gadolinium-based contrast medium (GBCM) was applied at three different time points (T1: after 3½ hours, T2: after 4 hours, T3 after 4½). Magnetic resonance (MR) cisternography with a T2- SPACE sequence was combined with a T2-FLAIR sequence for delimitation of inner ear fluid spaces. Machine learning and automated local thresholding segmentation algorithms were applied for three- dimensional (3D) reconstruction and volumetric quantification of endolymphatic hydrops. Appraisal of endolymphatic space 3D-MR-Imaging was estimated in view of signal-to-noise-ratio and distribution of signal intensity.

**Results:**

Our analyses showed four major results: i) perilymph signal intensity signal-to-noise-ratio were significantly increased in the double dose intravenous gadolinium-based contrast medium (GBCM) applications (DG> DD> SG> SD), ii) in average intravenous GBCM showed best results 4 hours after application, iii) intravenous application showed a particularly homogenous signal distribution when compared to intrarympanal application and iv) 3D-Recontruction of the perilymphatic/endolymphatic space worked best in data with homogenous signal distribution and high signal-to-noise ratio.

**Discussion:**

The data suggest clear methodical advantages when using intravenous double dose gadolinium-based contrast medium (GBCM) applications for endolymphatic space 3D-MR-Imaging, namely due to the combination of high signal-to-noise-ratio and homogeneity of signal intensity. This is in accordance with results of earlier studies (Iida et al. 2013)[4]. However, to the best of our knowledge, this is the first study to supply a structured comparison of application method, type of contrast agent and dosage in view of 3D-MR-Imaging of endolymphatic space. This should prove important in the search for clinical correlates of the endolymphatic space 3D-Imaging.

**Conclusions:**

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**References**

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**Tables:**

**Table 1:**

**X**

**Figures:**

Figure 1:

The IV gadolinium agent injection was administered 4 hours before MR imaging. A 3D-FLAIR images displays contrast agent destribution, with Gadovist SD (a), Dotarem SD (d), Gadovist DD (c), Dotarem SD (b), at the level of the of the mid-modiolar cochlear and the vestibular section.

Figure 2:

Fig.2) A 3D-FLAIR image at the level of the cochlear basal turns after IV Gadovist injection (IV-method) in a 30-year-old healthy woman. The IV gadolinium injection was administered 4 hours before MR imaging, and the cochlear basal turns has higher signal intensity than the Medulla oblongata p<0.01 and temporal bone p<0.001 the gadoliniu is evenly distributed no significant difference between left and right cochlear basal turn. The region of interest (3.) was set on the center of the medulla oblongata, the region of interests (4.)(5.) was set in to temporal bone at the identical section of the basal turn of the cochlea.

Figure 3:

Fig. 3.A) paired *t* test was used to compare the differences in CA signal intensity between the IV-method with Gadovist DD (a), Dotarem SD (d), Gadovist DD (c), Dotarem SD (b). The CA signal intensity was significantly higher between the IV- Dotarem SD (b) and Gadovist DD (c) p<0.05.

Fig. 3.B) paired *t* test was used to compare the differences in CA signal intensity between temporal bone, medulla oblongata and cochlear basal turns of Gadovist DD IV application.

Figure 4:

comparison of the cochlear apical scala tympani vs. cochlear scala tympani basal turn and vestibulum signal **intensity** of GadDD shows nearly homogenous distribution throughout the inner ear, slightly descending across of the apical area.

Figure 5:

Fig. 5 Comparison of different automated local threshold segmentation algorithms applied to the GadDD Flair/T2-SPACE-Temp dataset. The Niblack algorithm was chosen for the segmentation of enolymph from perilymph space. With window radius of r=8 px was chosen (Gürkov et al. 2014).

Figure 6:

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**List of abbreviations:**

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