CASE REPORT

Detection of Presumed Hemorrhage in the Ampullar Endolymph of the Semicircular Canal: A Case Report

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We examined a 61-year-old woman with sudden left-side hearing loss accompanied by severe vertigo. High signal in the ampullar endolymph of the left semicircular canal on magnetic resonance (MR) fluid attenuated inversion recovery (3D-FLAIR) images suggested labyrinthine hemorrhage. The patient had been treated for chronic heart failure and prescribed 100 mg/day of acetylsalicylic acid (aspirin) for its antiplatelet effect. The 3D-FLAIR images demonstrated a small amount of focal hemorrhage in the labyrinthine fluid that may have been overlooked on T₁-weighted images.

Keywords: *ampulla, endolymphatic hydrops, hemorrhage, labyrinth, magnetic resonance*

Introduction

The sensitivity of 3D-FLAIR (fluid attenuated inversion recovery) to subtle alterations in the composition of labyrinthine lymph fluid in various inner ear disorders has been reported.^{1–6} Combined with intratympanic Gd-DTPA administration, 3D-FLAIR has enabled separate visualization of endo- and perilymph fluid.⁷ In an exceptional case of enlarged endolymphatic duct and sac syndrome, 3D-FLAIR without contrast revealed endolymphatic hydrops by visualizing the reflux of hemorrhagic fluid from the enlarged sac to the cochlea and vestibule.⁸

Although inner ear hemorrhage has been reported in many cases of sudden deafness, such as in patients with leukemia and those receiving anticoagulant therapy,^{9–11} we do not believe that focal inner ear hemorrhage, such as that confined to the ampulla of the semicircular canal, has been reported.

We present the case of a patient receiving antiplatelet therapy who suffered hemorrhage confined primarily to the ampullar endolymph of the semicircular canal that was detected by 3D-FLAIR.

Case Report

A 61-year-old woman with long-term moderate bilateral hearing loss of about 50 dB on average presented with fullness in the left ear and worsening left-side hearing loss accompanied by severe vertigo. Hearing in her left ear worsened to 80 dB on average. She had been treated for chronic heart failure and prescribed 100 mg/day of acetylsalicylic acid (aspirin) for its antiplatelet effect. Otoscopic findings were unremarkable. Bone algorithm, thin-section computed tomographic (CT) images targeting the temporal bone revealed no abnormality. The patient received oral steroid therapy but did not recover her left-ear hearing level. Two months after the onset of her profound left-ear hearing loss and severe vertigo, we obtained pre- and post-contrast MR images on a 3-tesla MR imaging scanner (Trio, Siemens Medical Solutions, Erlangen, Germany) using a 32-channel coil. For the pre-contrast scan, we performed 3D-CISS (constructive interference in the steady state), 3D-FLAIR using SPACE (sampling perfection with application-optimized contrasts by using different flip angle evolutions), and 3D T₁-weighted volume interpolated breath-hold examination with water excitation (3D-VIBE). The scan parameters of 3D-FLAIR were: repetition time, 9000 ms; echo time, 458 ms; inversion time, 2500 ms; 0.8-mm slice thickness; 0.7-mm × 0.7-mm in-plane resolution; and scan time, 5.5 min. A slice thickness of 0.8 mm was used for 3D-CISS and 3D-

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Fig. 1.

VIBE as well. Detailed parameters for 3D-CISS and 3D-VIBE were described previously.¹² Three minutes after intravenous administration of Gd-DTPA, 3D-VIBE and 3D-FLAIR were repeated.

MR images obtained with 3D-CISS showed no vestibular schwannoma and no malformation of the inner ear. High signal in the ampullar endolymph of the left lateral and posterior semicircular canal on 3D-FLAIR suggested endolymphatic hemorrhage in the subacute phase (Fig. 1). On 3D-CISS, these areas showed high signal similar to that of lymph fluid. These areas showed slightly increased signal on T₁-weighted 3D-VIBE images but were difficult to detect prospectively without first examining 3D-FLAIR images. These areas of increased signal in the ampulla corresponded with endolymphatic space in the ampulla visualized on 3D-real inversion recovery (IR) images obtained from another patient with Meniere's disease after intratympanic administration of Gd-DTPA (Fig. 2). The other areas of labyrinthine fluid, including the cochlea of the left ear, showed slightly increased signal on 3D-FLAIR. After intravenous administration of Gd-DTPA, no significant enhancement was noted. No remarkable findings were noted for the inner ear of the other side.

Discussion

The endolymphatic space of the ampulla in the

semicircular canal contains the crista ampullaris, where rich vascular structure has been observed on histological sections.¹³⁻¹⁵ In animals, hemorrhage has been reported to cause temporary and permanent inner ear damage.¹⁶ Hemorrhage in the ampullar endolymph would cause deterioration of the crista ampullaris resulting in severe vertigo.

It is not clear why our patient's hemorrhage was limited mostly to the ampullar endolymph. The cupula on the crista ampullaris may be vulnerable to mechanical stress,¹⁷ but hemorrhage in the ampulla of the semicircular canal is rare and not reported.

Our patient underwent MR imaging 2 months after the onset of symptoms. If the symptoms were caused by hemorrhage from vascular structures in the crista ampullaris, it is unclear why hemorrhage remained there for about 2 months. Small amounts of continuous bleeding may have been present, although such hemorrhage would likely be visible even on 3D-VIBE, and Gd-DTPA might enhance signal on post-contrast 3D-FLAIR.

In the present case, hemorrhage was not dense enough to be detected on T₁-weighted 3D-VIBE images. We speculate that the methohemoglobin concentration of this subacute hemorrhage was too low to be detected on 3D-VIBE. The possibility remains that a T₁-shortening pathology other than methohemoglobin, such as increased protein concentration, may have been present. However, our patient's middle ear and mastoid air cells were clear,

Fig. 1. A 61-year-old woman with long-term moderate bilateral hearing loss presented with left ear fullness and additional left-side hearing loss accompanied by severe vertigo (**a-f**; slices at the posterior ampulla level, **g-l**; slices at the lateral ampulla level).

- a)** 3D-CISS (constructive interference in the steady state) image of the left ear shows that the ampulla of the posterior semicircular canal (arrow) is filled with high signal similar to cerebrospinal fluid.
- b)** 3D-FLAIR (fluid attenuated inversion recovery) image of the left ear shows remarkably high signal in the posterior ampulla (arrow) and slightly increased signal in the cochlea (short arrow).
- c)** 3D-FLAIR image of the right ear shows no signal increase in the posterior ampulla (arrow) and cochlea (short arrow).
- d)** 3D T₁-weighted VIBE (volume interpolated breath-hold examination with water excitation) image of the left ear shows slightly elevated signal in the posterior ampulla (arrow), but this might be difficult to notice without 3D-FLAIR.
- e)** Post-contrast 3D-FLAIR image of the left ear shows no signal enhancement by Gd-DTPA in the posterior ampulla (arrow) compared to pre-contrast 3D-FLAIR (**b**).
- f)** Computed tomographic (CT) image of the left ear shows no abnormal finding around the posterior ampulla (arrow).
- g)** 3D-CISS image of the left ear shows that the ampulla of the lateral semicircular canal (arrow) is filled with high signal similar to that of cerebrospinal fluid.
- h)** 3D-FLAIR image of the left ear shows remarkably high signal in the lateral ampulla (arrow).
- i)** 3D-FLAIR image of the right ear shows no signal increase in the lateral ampulla (arrow).
- j)** 3D T₁-weighted VIBE image of the left ear shows slightly elevated signal in the lateral ampulla (arrow); however, this high signal might be difficult to notice without 3D-FLAIR.
- k)** Post-contrast 3D-FLAIR image of the left ear shows no signal enhancement with Gd-DTPA in the lateral ampulla (arrow) compared to pre-contrast 3D-FLAIR (**b**).
- l)** CT image of the left ear shows no abnormal finding around the lateral ampulla (arrow).

Fig. 2. Reference images from a different patient with Meniere's disease. This 3D real-inversion recovery (IR) image was obtained after intratympanic injection of Gd-DTPA.

a) A negative signal area indicating endolymph space in the posterior ampulla (arrow) seems to correspond to the area of high signal on 3D-FLAIR (fluid attenuated inversion recovery) (Fig. 1b) in the present case.

b) A negative signal area indicating endolymph space in the lateral ampulla (arrow) seems to correspond to the area of high signal on 3D-FLAIR (Fig. 1h) in the present case.

and there was no sign of meningitis. Thus, we believe that methohemoglobin caused the high ampullar signal on 3D-FLAIR.

Labyrinthine hemorrhage has been attributed to coagulopathy, tumor, trauma, viral labyrinthitis, serofibrinoid labyrinthitis after stapes surgery, cholesterol granuloma, lupus erythematosus, and other causes.^{5,18}

3D-FLAIR is more sensitive than T₁-weighted imaging in detecting subtle compositional changes of lymph fluid.⁴ In the present case, focal hemorrhage of the inner ear, which might have been overlooked on T₁-weighted images, could be detected by adding 3D-FLAIR. Precontrast T₁-weighted imaging has been included in the MR imaging protocol for inner ear diseases to detect inner ear hemorrhage¹⁸ such as that in the present case, but the more sensitive 3D-FLAIR sequence should be included to detect subtle pathologies.

To our knowledge, hemorrhage limited to the ampullar endolymph has not been reported. It might be speculated that it has long been overlooked by MR imaging without 3D-FLAIR images.

In patients with acute vertigo undergoing anticoagulant therapy, 3D-FLAIR may impact clinical management, although further accumulation of such cases is necessary before general conclusions can be drawn. Thus, radiologists should at least be aware of this finding.

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