

CASE REPORT

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Significance of an augmented response on cervical vestibular evoked myogenic potential testing in Meniere's disease

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ABSTRACT

The potential mechanism of augmented response on cervical vestibular evoked myogenic potential (cVEMP) testing and its decrease following treatment in a patient with Meniere's disease (MD) are discussed. Changes of static posturography and cVEMP testing before and after a glycerol drip in a 69-year-old man with unilateral MD, in which significant endolymphatic hydrops (EH) was confirmed on magnetic resonance imaging (MRI) on the diseased side, were evaluated. Values of total locus lengths, areas of postural sway, and their Romberg ratios were decreased after the glycerol drip. On cVEMP testing, the diseased ear demonstrated a 375% larger amplitude than the contralateral ear before treatment, but both ears showed almost the same responses after treatment. An augmented response on cVEMP testing and a decrease following treatment for MD reflect the diversity of clinical findings in MD. Responses on cVEMP testing may relate not only to the degree of EH, but also be due to abnormal acoustic energy absorbance transmitted into the saccule.

Keywords: augmented cVEMP, Meniere's disease, static posturography, glycerol drip

Abbreviations:

cVEMP: cervical vestibular evoked myogenic potential

MD: Meniere's disease

EH: endolymphatic hydrops

MRI: magnetic resonance imaging

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INTRODUCTION

Since the first reported visualization of endolymphatic hydrops (EH) on magnetic resonance imaging (MRI) in the living human body,¹ correlations between audio-vestibular functional tests and the degrees of EH on MRI have been demonstrated, including a significant association of

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EH and the disappearance of cervical vestibular evoked myogenic potentials (cVEMPs)² or a higher degree of asymmetry of cVEMP amplitude in Meniere's disease (MD).³ In ears with MD, cVEMP responses are generally weak, but Young et al reported an augmented cVEMP response.⁴ They speculated that augmented cVEMP responses were an indication of distended saccular hydrops, where the distended wall was in contact with the footplate. Since then, a similar finding has not been reported, and the evidence of its existence and the exact mechanisms have not been elucidated.

A case with unilateral MD, which demonstrated an augmented response on cVEMP testing on the diseased side with significant EH confirmed on MRI, is presented. After treatment for MD, the patient showed improvement on static posturography and a decreased cVEMP response. The mechanism of the augmented response on cVEMP in the ear with EH is considered, and its significance for evaluating vestibular function in MD is discussed.

CASE PRESENTATION

A 69-year-old man with MD, who had repeated vertigo and sensorineural hearing loss (SNHL) of the left ear for 9 years, was referred to our hospital due to resistance to conventional therapies. Audiogram, static posturography and cVEMP examinations were performed before and after a 200-ml glycerol drip, and changes in their values were evaluated.

Magnetic resonance imaging examination

MRI examination for EH was performed 4 h after intravenous injection of a standard dose (0.1 ml/kg body weight) of gadolinium hydrate. All scans were performed using a 3-T MRI scanner (Magnetom Verio; Siemens, Erlangen, Germany) equipped with a receive-only, 32-channel, phased-array coil. The details of the parameters of hybrid of reversed image of positive endolymph signal and native image of positive perilymph signal (HYDROPS) sequences detecting EH have been described elsewhere.⁵ Radiologists who did not know the patient's clinical course classified the degree of EH using three grades.⁶ When the ratio of the area of endolymphatic space to the vestibular space (sum of the endolymphatic and perilymphatic spaces) exceeded 1/2 on MRI and the area of the cochlear duct exceeded the area of the scala vestibuli, the case was classified as significant EH.

Static posturography examination

The static posturography evaluation was performed using computer-driven coordination and a balance analysis device. After a sufficient period of adjustment to standing, the subject was instructed to maintain a stable posture for one minute with the eyes opened, followed by another minute with the eyes closed. Total locus length (mm), the area of postural sway (mm²) of the center of gravity movement, and the Romberg ratio of the values when the eyes were closed to those when the eyes were opened were calculated (UM-BAR, Unimec Corporation, Tokyo, Japan).

Cervical vestibular-evoked myogenic potential

Surface myogenic potentials in the sternocleidomastoid muscles were added 200 times with a reference electrode over the sternum, while click stimuli of 105 dB sound pressure level in decibels (dB SPL) were presented to the ipsilateral ear being tested, and white noise (75 dB SBL) was presented to the contralateral ear. The stimulation rate of the clicks was 5 Hz, and the electromyogenic signal was amplified through a bandpass filter (20–2000 Hz) (Synax2100, NEC Medical Systems, Tokyo, Japan). Amplitudes between the first positive (p13) and the first

negative peak (n23) of the responses were calculated as parameters of saccular function.

RESULTS

The patient had SNHL of 45 dB on the left side, which was not improved after the drip, in which MRI showed significant EH both in the cochlea and vestibule, nonadjacent to the stapes footplate (Figure 1). On static posturography, the Romberg ratios of total locus length or the area of postural sway were 2.7 or 2.0, respectively, which decreased to 2.0 or 1.3 after the drip (Figure 2). On cVEMP, the amplitude in the left ear with EH was 103.8 μV , which was 375% larger than that in the right ear (27.8 μV). After the drip, the amplitudes in the left and right ears were 35.2 μV and 36.4 μV , respectively, almost the same (Figure 3).

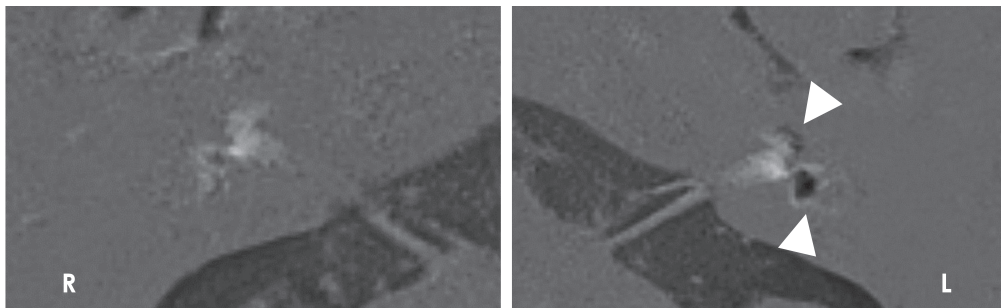


Fig. 1 Magnetic resonance imaging (MRI) performed 4 h after intravenous injection of gadolinium hydrate. A 69-year-old man with left Meniere's disease shows significant endolymphatic hydrops on the left side on MRI (white arrowheads).

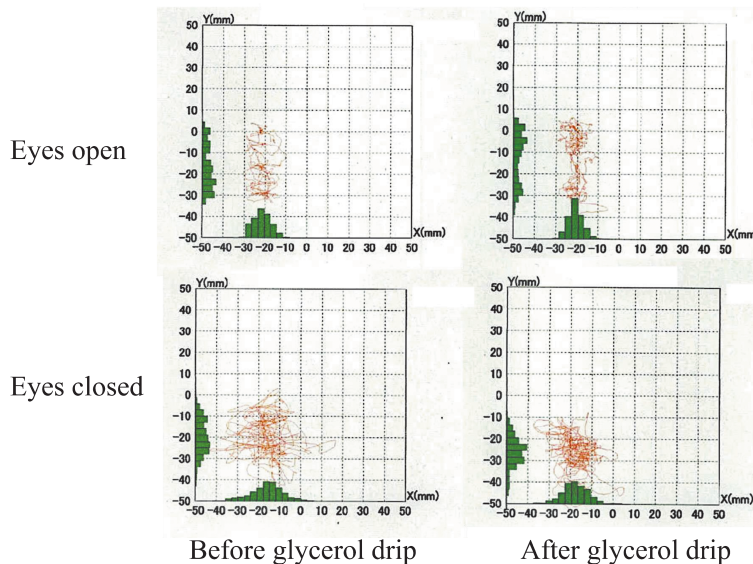


Fig. 2 Posturographic examination before and after the glycerol drip. The Romberg ratios are lower for total locus length and the area of postural sway after the drip.

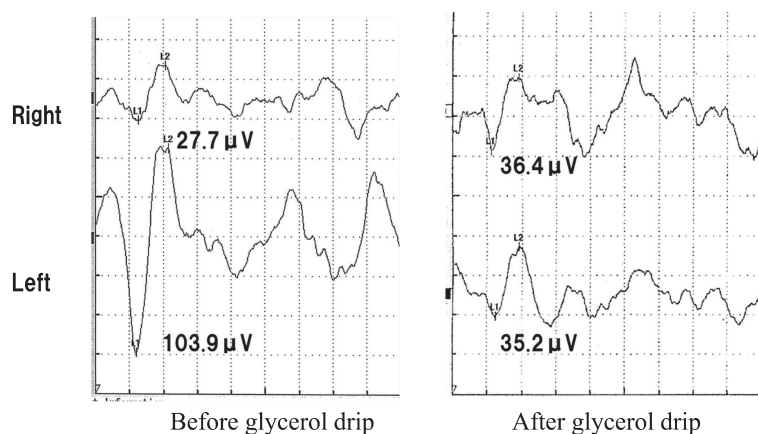


Fig. 3 Cervical vestibular-evoked myogenic potential testing before and after the glycerol drip. On cervical vestibular-evoked myogenic potential testing, an augmented response on the affected side appears before the glycerol drip, and a decrease in amplitude is seen after the drip.

DISCUSSION

Saccular dysfunction is more common than utricular dysfunction in MD, and cVEMP testing is suitable for evaluation of vestibular function in ears with MD. Interaural asymmetry of amplitudes on cVEMP is a frequently observed finding in cases with unilateral MD. Amplitudes in diseased ears are usually small or absent, but augmentation of the cVEMP response has been reported by Young et al.⁴ They suggested that an augmented response would appear in ears that had a distended saccule, contacting the stapes footplate due to EH, and result in enhancement of sensitivity to acoustic stimulation in the saccular macula. Their conclusion was that an augmented cVEMP response would correlate with the severity of EH in the saccule.

Advanced MRI technology has enabled effective visualization of significant EH in the vestibule adjacent to the stapes footplate.⁷ The present case showed an augmented cVEMP response in the ear with vestibular EH nonadjacent to the stapes footplate, but its amplitude was much larger than the amplitudes reported by Young et al.⁴ We have evaluated responses on cVEMP in many cases with significant EH adjacent to the stapes footplate, but we have not encountered such an augmented response.² Since the paper by Young et al, no similar cVEMP finding has been reported.

Occasionally, significant EH adjacent to the stapes footplate could induce air-bone gaps (ABGs) at low frequencies, which have been demonstrated to be evidence supported by findings on MRI.⁷ A previously proposed mechanism included that increased perilymphatic pressure or saccular dilatation caused by EH might decrease the mobility of the stapes^{8,9}; however, a recent study showed that significantly higher absorbance of acoustic energy was observed in ears with significant vestibular EH at low frequencies.¹⁰ Though absorbed acoustic energy is high, the presence of EH in the vestibule might cause an obstacle to the transmission of energy to the inner ear. The increased amplitude observed in the present case may reflect more strongly transmitted acoustic energy to the saccule than usual, even in a case with vestibular EH nonadjacent to the stapes footplate. The characteristic augmented response on cVEMP could be observed in ears with saccular EH nonadjacent to the stapes footplate, too. Responses on cVEMP testing may relate not only to the degree of EH, but also to the transmission of acoustic energy absorbed into the saccule.

The improvement on static posturography indicated the effect of the treatment for MD. The decrease of cVEMP amplitude may also demonstrate functional improvement of the saccule according to the previous report.¹¹ A phenomenon of augmented cVEMP responses is rarely observed in cases with MD, but such a finding might show the diversity of clinical findings in MD.

CONCLUSION

MD patient who showed an augmented cVEMP amplitude and its reduction after drip treatment, demonstrating functional improvement in the vestibule, was reported. Responses on cVEMP testing may relate not only to the degree of EH, but also be due to abnormal acoustic energy absorption transmitted into the saccule.

DISCLOSURE STATEMENT

The authors have no conflict of interest.

ETHICAL CONSIDERATIONS

Written informed consent was obtained from the patient for the publication.

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