Vestibular evoked myogenic potentials (VEMPs)

Vestibular-evoked myogenic potentials (VEMP) are electromyographic potential reflex tests that reflect the function of the saccule in cervical VEMP and the utricle in ocular VEMP. In the cervical VEMP an inhibitory reflex is evoked from the saccule to the sternocleidomastoid ipsilateral to the stimulus. The most common stimulus is a sound (either a 500 Hz tone burst or a broad-band click) played to the ear on the side being tested. The patient is instructed to contract their sternocleidomastoid muscle while the stimulus is played, and an average of a series of responses is recorded using surface electrodes on the neck. A characteristic biphasic waveform is assessed with a latency of the peaks at 13 and 23 milliseconds. Typically a threshold of sound intensity is obtained at which the characteristic waveform is observed. The saccule functions similar to a hearing organ in fish, responding to lower frequency stimuli and the cervical VEMP may be a vestigial reflex. An absent response at the loudest stimulus level can reflect impairment of the saccule or the inferior vestibular nerve; however, an absent response can also reflect inadequate activity of the sternocleidomastoid muscle, middle ear disease, or a lesion along the pathway from the saccule to the central vestibulospinal pathways. An especially large response at a low threshold (i.e., a present waveform at a much weaker stimulus intensity) is typical of superior semicircular canal dehiscence syndrome, in which a hole in the bony superior semicircular canal creates a new low impedance pathway in the ear.

The ocular VEMP is a crossed response involving a pathway from the utricle to the contralateral inferior oblique muscle that is excitatory. This can be evoked using either a 500 Hz tone burst or with a tap to the forehead (via a reflex hammer or a minishaker). The output is recorded via surface electrodes beneath the eye and is an average response over a series of stimuli. The first negative waveform occurs at 10 ms. The amplitude of the response is commonly used as the relevant output (either the amplitude of the first waveform or the peak-to-peak amplitude). To maximize the response, the patient is instructed to look upward during testing in order to bring the target muscle closer to the surface electrodes placed beneath the eye. An absent response to the ocular VEMP is less common than the cervical VEMP and reflects impairment of the utricle, superior vestibular nerve, or the pathway to the contralateral inferior oblique muscle. Patients with superior canal dehiscence syndrome have enhanced ocular VEMP responses, showing large amplitudes, suggesting pressure transmission through the dehiscent superior semicircular canal.
Figure 1. Picture showing the location of electrodes on the ipsilateral sternocleidomastoid muscle (cervical VEMP) and the contralateral inferior oblique muscle (ocular VEMP). In this image the stimulus is auditory and played via an insert ear phone in the right ear.
Figure 2. Outputs for electromyographic (EMG) responses to stimuli in the left ear. A) Cervical VEMP records an ipsilateral inhibitor biphasic wave from the sternocleidomastoid muscle, in this case in response to a broad-frequency click. A wave is sought at 13 and 23 milliseconds. A threshold is commonly obtained at which point the characteristic responses first appear. B) Ocular VEMP records a crossed excitatory response to the contralateral inferior oblique muscle. The amplitude of the n1 or peak-to-peak amplitude is recorded as the output.


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