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Guidelines

International guidelines for the clinical application of cervical vestibular evoked myogenic potentials: An expert consensus report

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HIGHLIGHTS

- As more clinical laboratories are publishing data on the cervical vestibular evoked myogenic potential (cVEMP) as a measure of vestibular function, there is a wider range of recording methods and interpretation.
- The variations in methodology and interpretation may be confusing to clinicians and may limit comparisons of cVEMP data across laboratories.
- The purpose of this article is to recommend *minimum requirements* and guidelines for the recording and interpretation of the cVEMP in the clinic and for diagnostic purposes.

ABSTRACT

Background: Cervical vestibular evoked myogenic potentials (cVEMPs) are electromyogram responses evoked by high-level acoustic stimuli recorded from the tonically contracting sternocleidomastoid (SCM) muscle, and have been accepted as a measure of saccular and inferior vestibular nerve function. As more laboratories are publishing cVEMP data, there is a wider range of recording methods and interpretation, which may be confusing and limit comparisons across laboratories.
Objective: To recommend *minimum requirements* and guidelines for the recording and interpretation of cVEMPs in the clinic and for diagnostic purposes.
Material and methods: We have avoided proposing a single methodology, as clinical use of cVEMPs is evolving and questions still exist about its underlying physiology and its measurement. The development of guidelines by a panel of international experts may provide direction for accurate recording and interpretation.
Results: cVEMPs can be evoked using air-conducted (AC) sound or bone conducted (BC) vibration. The technical demands of galvanic stimulation have limited its application. For AC stimulation, the most effective frequencies are between 400 and 800 Hz below safe peak intensity levels (e.g. 140 dB peak SPL). The highpass filter should be between 5 and 30 Hz, the lowpass filter between 1000 and 3000 Hz, and the amplifier gain between 2500 and 5000. The number of sweeps averaged should be between 100 and 250 per run. Raw amplitude correction by the level of background SCM activity narrows the range of normal values. There are few publications in children with consistent results.
Conclusion: The present recommendations outline basic terminology and standard methods. Because research is ongoing, new methodologies may be included in future guidelines.

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Contents

1. Introduction

The cervical vestibular evoked myogenic potential (cVEMP) gained international attention when Colebatch and Halmagyi (1992) described a short latency electromyogram (EMG) response evoked by high-level acoustic stimuli recorded from the tonically contracted sternocleidomastoid (SCM) muscle. The cVEMP has since gained popularity as a clinical test of saccular and inferior vestibular nerve function. In addition to loud (intense) air-conducted sound, cVEMPs can be evoked using bone conducted vibration, head taps, or galvanic stimulation. As more laboratories are publishing data on the cVEMP as a measure of vestibular function, there is a wider range of recording methods and interpretation. The variations in methodology and interpretation may be confusing to clinicians and may limit comparisons of cVEMP data across laboratories. The purpose of this article is to recommend *minimum requirements* and guidelines for the recording and interpretation of the cVEMP in the clinic and for diagnostic purposes. The present recommendations outline basic terminology and standard methods and advocate desirable instrumentation. Because research in this field is ongoing, new methodologies may be included in future guidelines. Therefore, this manuscript will be subject to periodic review.

We have refrained from proposing a single methodology, as clinical use of cVEMPs is evolving and questions still exist about its underlying physiology and its measurement. The development of guidelines by a panel of international experts in the field, however, may provide direction for the accurate and reliable recording and interpretation of cVEMPs.

These recommendations may require revision to keep abreast of the rapid changes in methodology, technology, and knowledge with regards to the neuroanatomy and neurophysiology of cVEMPs.

2. Terminology

To improve communication among scientists and clinicians a standardized nomenclature needs to be adopted (Celesia et al., 1993). The nomenclature in this report is derived from: (1) established use in the last two decades, especially with respect to the development of other vestibular evoked myogenic potentials, and (2) introduction of clarifications in areas where conflicting terms have been used.

Vestibular evoked myogenic potentials are electrical potential differences recorded from muscle in response to vestibular stimulation; they are abbreviated as *VEMPs*. When the VEMP is recorded from the sternocleidomastoid muscle, it is referred to as a *cervical VEMP*, abbreviated to *cVEMP* (Akin et al., 2011; Curthoys, 2010; Rosengren et al., 2011).

Waveform nomenclature is most commonly derived from either of two methods (Chiappa, 1997); (1) the components are numbered in sequence by polarity, for example, N1, N2, N3, and so forth; or (2) the components are labeled according to their polarity and mean latency in normal subjects. Both methods are used in the literature with regards to cVEMPs. Although perhaps the best approach is the use of a method employed by the majority of investigators publishing work in this field, at the moment this does not apply here. Most publications tend to use the second method; however, this committee does not favor either one. With regards to the second method, the response components of cVEMPs are designated with the first major positive peak as p13 and the first major negative peak following p13 as n23 (Fig. 1). The lower case of the letter emphasizes the non-neural origin of the potentials (Yoshie and Okudaira, 1969), as opposed to other neural evoked potentials that usually use an upper case, for example P100 for the visual evoked potential. Of course, the precise peak latency depends on stimulus characteristics. For the purposes of this manuscript, the first major positive peak will be named p13 (P1) and the following major negative peak as n23 (N1). However, laboratories will need to choose either one or the other form of labeling.

3. Neurophysiology

Cervical vestibular evoked myogenic potentials represent a transient alteration of muscle activity. The response likely represents a short period of inhibition on a background of tonic muscle activation (Colebatch and Rothwell, 2004; Wit and Kingma, 2006). cVEMPs are employed routinely in the assessment of the functional