Vestibular-Evoked Myogenic Potentials Across a Spectrum of Dizzy Diagnoses

William Schmitt, M.D.1, Matthew Carlson, M.D.1, Scott Eggers, M.D. N2, Neil Shepard, Ph.D.1, Jeffrey Staab, M.D. P3, Brian Neff, M.D.1
Departments of Otorhinolaryngology1, Neurology2, and Psychiatry & Psychology3
Mayo Clinic, Rochester, MN, U.S.A.

Abstract

Objectives
Cervical vestibular-evoked myogenic potentials (cVEMPs) produced by air-conducted sound are thought to interrogate the sacculecollic reflex. The diagnostic role for VEMPs is under investigation, as abnormalities are found in many conditions. We present cVEMP data for patients with Ménière’s disease (MD), vestibular migraine (VM), unrelated headache (HA), chronic subjective dizziness (CSD), and anxiety-spectrum disorders (ASDs). Study design Retrospective chart review.

Methods
Consensus diagnoses for study conditions were rendered by a multidisciplinary team including experts from neurology, psychology, audiology, and neurotology. Patients with comorbid disorders were excluded to decipher effects attributable to individual diseases. Patients >70 years and those with conductive hearing loss were excluded due to confounding effects. cVEMP testing was performed using 500 Hz air-conducted toneburst stimulus.

Results
We compared 25 patients with MD, 28 with VM, 33 with HA, 11 with CSD, and 6 with ASDs. The rate of absent cVEMP responses was 56%, 18%, 24%, 45%, and 66% respectively, with MD and ASDs yielding statistically significant differences when compared with VM (p=0.005 and 0.031). Patients with migraine unrelated to their dizziness had a similar rate of absent VEMP response to their VM and non-migraine HA counterparts (25% versus 24% and 22%, respectively).

Conclusions
Abnormal cVEMP responses are common among patients reporting dizziness, including individuals with traditional neurotologic diagnoses and those with presumed “functional” disorders. These data suggest that patients who were previously considered to have normal labyrinthine function may have either otolithic abnormalities or central nervous system modulation of the sacculecollic reflex.

Objectives
Although VEMPs have been investigated in a number of organic conditions that intuitively perturb the sacculecollic reflex (e.g., endolymphatic hydrops, superior semicircular canal dehiscence, vestibular schwannoma, and spinoocerebellar degeneration), abnormalities have been reported across a wide range of conditions that manifest with dizziness. We sought to characterize our experience with cVEMP testing performed routinely as part of a multidisciplinary dizziness evaluation in an effort to refine its diagnostic utility.

Materials/Methods
Patients were evaluated by a multidisciplinary team including experts in neurology, audiology, neurology, and psychology. Consensus diagnoses were rendered after relevant tests and consultations were completed. Defined and possible MD were diagnosed according to AAO-HNS criteria. VM and unrelated headache conditions (migraine and non-migraine) were diagnosed according to Neuhauser and International Headache Society criteria. CSD was diagnosed according to criteria laid out by Staab and Ruckenstein. Anxiety-spectrum disorders were diagnosed in accordance with DSM-IV criteria. To better identify effects attributable to disease, patients carrying multiple diagnoses (e.g. VM and CSD) were excluded. cVEMP testing was carried out using 500 Hz air-conducted toneburst stimuli with surface electrodes over a tensed sternocleidomastoid muscle. A retrospective chart review was conducted following IRB approval.

Discussion
• All of the conditions included in our study exhibit a higher than anticipated rate of absent cVEMP response. Previously published normative data has found a 7% absent cVEMP rate.
• Our data are counterintuitive; in that conditions traditionally thought to be without neurotologic underpinnings demonstrate an increasing incidence of absent cVEMP responses.
• Although no conclusions can be drawn from the current data, these findings do speak to the body of literature regarding corticovestibular interactions. Efferent signaling from vestibular nuclei to the parietal, somatosensory, and parietoinsular cortex has been clearly demonstrated. Corticofugal pathways involving the vestibular nuclei are an area of growing basic science interest and may be responsible for our findings.
• Alternatively, these data could be taken to suggest that otolithic dysfunction is responsible for some of the symptomatology of “functional” disorders such as CSD and the ASDs.
• This study is limited in its retrospective nature. Although we excluded patients of old age and with conductive hearing loss to minimize confounders, false-positive results (absent cVEMP despite normal sacculecollic reflex) may have resulted from poor compliance with tonic sacculecollicastoid contraction throughout testing.

Results
Demographic and test data are found in Table 1. Of the patients with MD, 14 were diagnosed as “definite” and 11 as “possible”. Of the patients with VM, 17 were diagnosed as “definite” and 11 as “probable”. Twenty-four patients with unrelated headache were migraineurs, while 9 were not. Most (4/6) of the ASD patients had panic disorder. The rate of absent cVEMP responses is reiterated in Figure 1.

Table 1

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Average age, years (range)</th>
<th># Patients (# male)</th>
<th># Absent cVEMP (%)</th>
<th>Mean right p, mV (mV)</th>
<th>Mean left p, mV (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ménière’s disease</td>
<td>53 (18-94)</td>
<td>25 (17)</td>
<td>84 (76)*</td>
<td>15.0, 21.0</td>
<td>14.0, 22.0</td>
</tr>
<tr>
<td>Vestibular migraine</td>
<td>47 (25-71)</td>
<td>18 (8)</td>
<td>51 (28)</td>
<td>55.2, 52.7</td>
<td>54.0, 52.2</td>
</tr>
<tr>
<td>Irritated headache</td>
<td>48 (17-68)</td>
<td>33 (23)</td>
<td>80 (8)</td>
<td>14.9, 22.4</td>
<td>14.3, 22.0</td>
</tr>
<tr>
<td>Migraine</td>
<td>48 (18-46)</td>
<td>14 (7)</td>
<td>82 (22)</td>
<td>23.1, 23.1</td>
<td>21.9, 23.2</td>
</tr>
<tr>
<td>Non-migraine</td>
<td>46 (17-69)</td>
<td>24 (12)</td>
<td>66 (12)</td>
<td>44.9, 22.2</td>
<td>44.3, 22.0</td>
</tr>
<tr>
<td>Chronic subjective dizziness</td>
<td>47 (17-69)</td>
<td>33 (23)</td>
<td>80 (8)</td>
<td>15.1, 23.3</td>
<td>15.2, 23.9</td>
</tr>
<tr>
<td>Anxiety-spectrum disorder</td>
<td>49 (21-66)</td>
<td>6 (4)</td>
<td>68 (87)*</td>
<td>14.0, 21.6</td>
<td>20.2, 23.3</td>
</tr>
</tbody>
</table>

* Indicates statistically significant difference when compared to the VM group, Student’s paired t-test. P=0.005 for MD and 0.031 for ASD.

Figures

Figure 1

Table

References