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Editorial

# Standardizing the way we perform and apply vestibular evoked myogenic potentials (VEMPs)

Vestibular evoked myogenic potentials are an exciting and relatively new way to record function and dysfunction from the peripheral and central vestibular nervous system, and more and more laboratories are including it in their diagnostic and prognostic arsenal of paramedical examinations (Halmagyi and Carey, 2010). Compared to how it was performed and interpreted in the 1990s, things have improved significantly and are now less confusing. Many guidelines and reviews have been written over the years to try and help the medical community to understand what VEMPs are and how to start applying them to their own environment. These continuous updates are necessary as new information is continuously being created and more is discovered with regards to what VEMPs represent not only clinically, physiologically, but also their appearance in different age groups (Welgampola and Colebatch, 2005; Brantberg 2009; Rosengren et al., 2010; Curthoys et al., 2014; Papathanasiou et al., 2014; Murofushi 2016). The take home message in all these publications (taken from something similar in the children's cartoon film "Ratatouille") should be "Anyone can perform VEMPs".

We therefore have a new update for the year 2019 published in this issue (Rosengren et al., 2019) which attempts to include the most recent developments in this field. In this editorial, I would like to bring out the main features of this review.

Monitoring of background electromyography (EMG) of the sternocleidomastoid muscle (with respect to cVEMPs) cannot be more emphasized and is of the utmost importance. As has been explained on numerous occasions in the past, the amplitude of the cVEMP response is heavily dependent on the level of EMG: the stronger the contraction, the larger the cVEMP response (Welgampola and Colebatch, 2001; Papathanasiou et al., 2014). Unfortunately, many papers continue to be published without taking this into consideration, and even avoid publishing data on amplitude altogether. As stated in the feature review, the best method of doing this is to record rectified EMG at (or around) the same time as the cVEMP response. Initial publications showed the recording of rectified EMG prior to stimulus onset, and following onset the unrectified cVEMP response is shown, frequently on the same screen. Most (if not all) commercial systems dedicated to cVEMP recordings tend to have a colored indicator on the monitor, asking the tester to obtain a minimum level of contraction before the cVEMP can be recorded. In my opinion, this latter method has a significant disadvantage. Not all patients, especially the elderly, are able to achieve this minimum level of muscle contraction. This does not mean that there will not be a cVEMP response. In fact, recent publications have shown that a minimal level of contraction is enough to get a good cVEMP response, and that most likely too much contraction may prevent the appearance of this waveform (Akin et al., 2004). However, even though the contraction may be low in intensity, the ability to record rectified EMG amplitude, and to obtain a ratio of cVEMP amplitude to rectified EMG amplitude, does not allow this to be a problem. But a system that demands a minimum level of contraction will not allow this specific recording to take place. We should therefore go back to the earlier publications where the above parallel recordings took place, and try to reproduce this in the dedicated VEMP systems available today. There is also another disadvantage to the above systems. If one were to decide to take the cVEMP program to do oVEMPs (something that should be easy to do), such dedicated software will not allow one to do so as the EMG of the inferior oblique muscle is significantly less than the cVEMP amplitude. This requires the user to purchase different software (or even a different recording system!) to record oVEMPs, which is something that should not have to exist.

The detailed analysis with respect to acute vestibular syndrome, especially with regards to the possibility of rostral brainstem lesions having an influence on cVEMP responses, is an interesting phenomenon to report. Although the report emphasizes the ability to locate lesions with VEMPs in such cases, there are publications that exist that try to use VEMPs to *predict* the outcome after the symptoms first appear. For example, a prolonged oVEMP response in cases of superior vestibular neuritis has been shown to be predictive of a good outcome (Adamec et al., 2014).

With regards to benign paroxysmal positional vertigo, or benign positional vertigo as called in the featured paper, it is true that the diagnosis of this disorder does not require VEMPs as it is easy to do so clinically. The possibility that abnormal VEMP findings may be attributable secondarily to an underlying vestibular disorder is noted by this publication. However, it is also feasible that pathophysiological alterations of the macula of the utricle and saccule may contribute to the above abnormalities (Parnes and McClure, 1992; Welling et al., 1997; Akkuzu et al., 2006; Hong et al., 2008). The possibility for VEMPs to predict resistance to canalith repositioning manoeuvres has also been investigated (Chang et al., 2017).

This review paper has focused on the use of VEMPs in Superior Semicircular Canal Dehisence, bilateral vestibulopathies, vestibular neuritis and benign paroxysmal positional vertigo, Meniere's disease and Vestibular Migraine, which no doubt make up the majority of the literature with regards to investigating the clinical applications of VEMPs. Of course, other disease entities have been researched, including the possible existence of endolymphatic hydrops of the vestibular end organs alone (Recurrent Peripheral

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Vestibulopathy). This latter disorder, if proven beyond doubt to exist (although further studies are needed) will be picked up electrophysiologically only with VEMPs and caloric responses (if the semicircular canals are also involved (Attye et al., 2015; Murofushi et al., 2017). These patients present with episodic vertigo without migraine or hearing loss. Isolated otolith dysfunction is also feasible apparently (Murofushi et al., 2013; Pelosi et al., 2013). Patients exist here that present with episodic tilting or translational sensations in the pitch plane, without any other vestibular symptoms.

Truly, there is still much to do in this field with respect to VEMPs, and no doubt other reviews/guidelines will appear in the future. Following on from the publication now recognized by the International Federation of Clinical Neurophysiology as an international guideline with respect to cVEMPs (Papathanasiou et al., 2014), a similar guideline should be done for oVEMPs. The time is ripe for this to be done.

## Conflict of interest

None.

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