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Threshold properties of VEMPs to impulsive head acceleration

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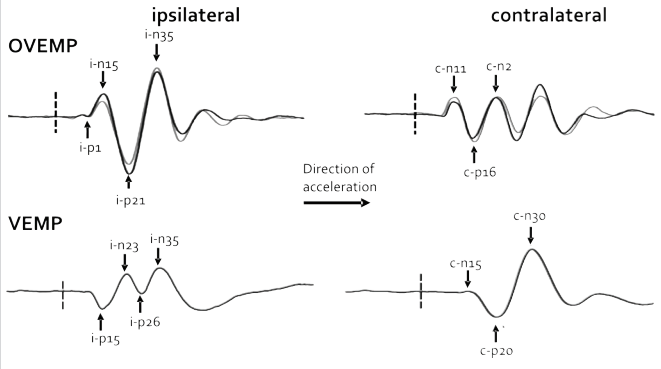
Introduction



Vestibular evoked myogenic potentials (VEMPs) and ocular VEMPs (OVEMPs) produced by air-conducted (AC) sound and vibration have become established as important clinical tests [1]. VEMPs/OVEMPs may also be evoked by impulsive head acceleration (IA) which are characterised by bilateral responses composed of a sequence of –ve and +ve waves [2,3; Figure 1]. However, whereas the threshold properties of VEMPs/OVEMPs produced by AC sound are well defined in the literature [4,5], there is no threshold data for VEMPs/OVEMPs produced by IA and we aimed to fill this gap in our knowledge with the present study.

Figure 1. VEMPs and OVEMPs produced by impulsive acceleration (IA) applied at the mastoid, from [2,3]

Methods

VEMPs, from the sternocleidomastoid muscles, and ocular VEMPs (OVEMPs), from infra-ocular electrodes, were recorded in twelve healthy subjects in response to AC sound and IA. The AC stimuli were 2 ms, 500 Hz pips delivered by headphones and the IAs were third order gamma distribution pulses with 4 ms rise-time delivered at the mastoid by a mini-shaker. VEMP/OVEMP thresholds were obtained for intensities in the range 0 to -35 dB re 135 dB LLpk for sound and re 0.2 g for IA. IA-thresholds were measured by a number of methods using (i) the first bilateral components (ii) the first two bilateral components (iii) all bilateral components and (iv) the first two ipsilateral VEMP and contralateral OVEMP components, as in the case for AC. Somatosensory thresholds for IA stimulation were also assessed. OVEMP-VEMP threshold differences, an "eye-neck gap" (ENG),were calculated.

Results

For IA, the mean VEMP thresholds were (i) -17.29 (± 6.56), (ii) -23.54 (± 3.75), (iii) -25.20 (± 4.01), and (iv) -19.16 (± 5.94) re 0.2 g and (i) 12.29 (± 6.13), (ii) 6.04 (± 5.82), (iii) 4.37(± 5.65), and (iv) 10.41 (± 5.80) sensation level (defined from the somatosensory threshold). Our results are consistent with the earlier literature in showing that AC-VEMP thresholds are lower than AC-OVEMP thresholds, i.e. there is an ENG of about 5 dB. There is also an ENG for IA, but the value differs depending on the method used (Figure 1). If defined using the same method as for AC the IA-ENG is smaller than for AC, i.e. about 3 - 4 dB, but not significantly so in our sample.

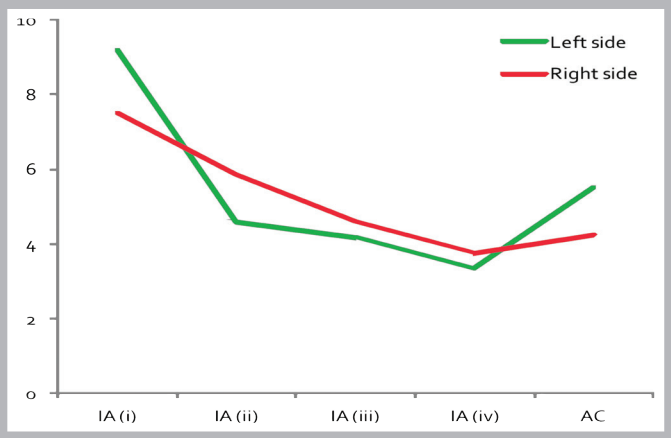


Figure 2. ENGs for Left and Right side IA compared with the ENG for AC. IA ENGs estimated using (i) the first components, (ii) the first two components, (iii) all components and (iv) as for AC

Conclusion

As for 500 Hz AC stimulation, IA stimulation is less effective in evoking OVEMPs than VEMPs, but if thresholds are defined by the same method the ENG is smaller for IA. VEMPs/OVEMPs produced by IA stimulation (and low frequency vibration) have been interpreted was being the result of utricular afferent activation, in contrast to 500 Hz AC responses which are thought to be saccular in origin [6]. The smaller IA-ENG compared with the AC-ENG may be due to differences in utricular-ocular vs saccular-occular projections but further work will be required to substantiate this. The relatively high thresholds for OVEMPs here, about + 8 dB SL, compared with previous estimates with 100 Hz vibration [6], about – 15 dB SL, may be due to additional central mechanisms being recruited in the 100 Hz case.

Reference

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Acknowledgement

Work supported by a grant from the Wellcome Trust, WT-091961MA.

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