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Rate-dependent depression of the H-reflex during Galvanic Vestibular Stimulation: a case study

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***Abstract*— The amplitude of the rate-dependent depression (RDD) of the H-reflex was evaluated at 0.1, 1, 5 and 10 Hz in a 10 consecutive pulse protocol recorded in the soleus muscle, before, during and after cathodal and anodal Galvanic Vestibular Stimulation (GVS) in a single subject in a prone position. Although, RDD slightly decreased during and after GVS compared to before (no GVS), this spinal mechanism was preserved in all stimulation frequencies and GVS polarity.**

***Clinical Relevance*— Rate-dependent depression (RDD) of the H-Reflex in combination with GVS could be used to explore the vestibulospinal pathway excitability in healthy subjects and in motor dysfunction.**

I. INTRODUCTION

The integrity of the vestibulospinal pathway is essential for adequate postural control and motor function. H-reflex is a motor output produced when a peripheral nerve is stimulated, and it is highly modulated by spinal and supraspinal circuits. When the H-reflex is evoked by pulse-paired stimulation at frequencies >1 Hz, RDD occurs. [1]. Galvanic vestibular stimulation (GVS) is a noninvasive method that activates the vestibular system without interfering with other sensory input. The effect that GVS has on H-reflex amplitude has been previously described: cathodal GVS increases the amplitude, while anodal stimulation produces a decrease [2]. However, no previous work has evaluated the RDD during GVS. This case study, we explored if GVS and its polarity modifies RDD evoked at 1,2,5 and 10 Hz.

II. METHODS

A healthy male subject, aged 22, signed informed consent. All experimental trials were performed according to the Helsinki Declaration and Mexican Normativity on research in human subjects (NOM-012-SSA3-2012).

A. *H-reflex*. Standard procedures were followed to record the H-reflex in the left soleus muscle. H-reflex was recorded at 10 kHz sample frequency (LabChart ADInstruments). A stimulation intensity between 35-50% of the maximal amplitude of the H-reflex at 0.1 Hz was used for the rest of the protocol. Ten monophasic square pulses (1 ms) were delivered at 0.1, 1, 5 and 10 Hz using a constant current stimulator (Digitimer DS8R).

B. *Galvanic vestibular stimulation*. Two surface electrodes (3M Red Dot, 6 cm diameter) were placed over the subject's mastoid process. Stimulation intensity was set to maximal tolerance threshold (2.2 mA).

C. *Experimental procedure*. The experiment was conducted with the subject in a prone position. The RDD was evaluated in 3 conditions: 1) before (no GVS), 2) during and 3) after GVS. Stimulation frequencies were randomized. Intervals between trials were > 1 min. The subject did not report pain or discomfort due to the H-reflex RDD protocol or GVS.

III. RESULTS

H-reflex amplitude from 2nd to10th pulse was normalized to the amplitude of the 1st pulse for each stimulation frequency. The RDD phenomenon is present during cathodal and anodal GVS. The effect persisted even after GVS. Amplitudes from 2nd to 10th pulses, were used to construct bar plots in Fig. 1. The "average RDD" for each frequency and GVS polarity, the mean (±SD) of the H-reflex RDD (%) were determined before, during and after GVS. RDD was lower before GVS and in all tested frequencies, in comparison to during and after GVS.

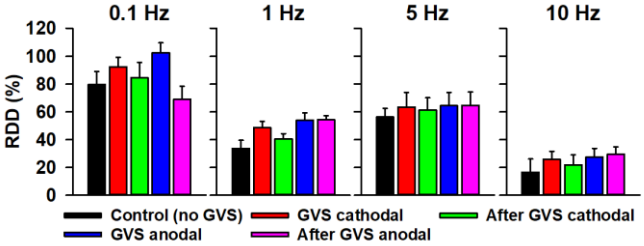

Figure. 1. RDD of the H-reflex (%) for each stimulation frequency before (no-GVS), during and after anodal and cathodal GVS.

IV. DISCUSSION & CONCLUSION

For the first time, RDD of the H-reflex phenomenon was evaluated before (no GVS), during and after anodal and cathodal GVS. A 10 consecutive pulses protocol for each frequency was implemented to characterize the "average RDD". We describe RDD considering 10 consecutive stimulation pulses, as it has been reported that the amplitude of the 2nd pulse may not represent RDD accurately enough during paired-pulse stimulation. Although a trend to a RDD decrease was observed, this mechanism was preserved during GVS. These results encourage further exploration in a larger sample.

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