Crosstalk in motor evoked potentials recorded from resting and active vastus medialis in response to transcranial magnetic stimulation

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Transcranial magnetic stimulation can be used to stimulate the corticospinal pathway to lower limb muscles. Motor evoked potentials (MEPs) are commonly used to evaluate the responsiveness of the pathway. Although it has been shown that MEPs recorded from forearm muscles may contain crosstalk from non-target muscles, the extent to which crosstalk is present in MEPs recorded from lower-limb muscles has not been investigated. The purpose of this study was to quantify the occurrence of cross-talk in MEPs recorded from the vastus medialis (VM) muscle.

Transcranial magnetic stimulation was delivered over the motor cortex of 10 young healthy participants (nine female, one male; age range 18–27 years) using a double-cone coil. Responses were recorded from the VM using conventional bipolar surface electrodes and a high-density electrode array (4 x 8 electrodes; 10-mm interelectrode distance) placed along the expected fibre orientation. Suprathreshold stimuli were delivered while VM was resting and while active at 10% maximum performing isometric knee extension. An MEP was identified if the EMG signal in the MEP window (15–70 ms post stimulus) exceeded a threshold defined using pre-stimulus EMG amplitude. MEP amplitude was quantified as peak-to-peak EMG amplitude in this window. Conduction velocity (CV) was estimated for the maximal voluntary contraction (MVC) and for each MEP from the high-density EMG data using maximum likelihood estimation. MEP propagation was defined as physiological if r >0.7, CV >3 m/s, and CV < upper bound (the highest value between 6 m/s or 105% of the value measured during MVC). MEPs without physiological propagation were considered to be influenced by crosstalk. The proportion of MEPs with crosstalk was compared between resting and active conditions using a paired t-test. For each condition, MEP amplitude was compared across trials with and without crosstalk using a paired t-test.

At rest, a large proportion of MEPs recorded from the VM muscle contained crosstalk (range across participants 18–100%, mean (SD) 77 (28)%). The prevalence of crosstalk reduced when the VM was active (33 (36)%, range 0–86%; p = 0.017). In the resting condition, MEP amplitude was smaller for trials with crosstalk than for trials without crosstalk (n = 8; p = 0.036 and 0.030 for high-density and conventional EMG, respectively). In the active condition, the MEP amplitude was smaller for trials with crosstalk than for trials without crosstalk for high-density EMG (n = 7; p = 0.008) but not conventional EMG (p = 0.34).

These results suggest that MEPs recorded over the VM muscle are not always specific to the VM, especially when elicited at rest. Smaller MEP amplitude in trials with non-physiological propagation, identified as containing crosstalk, was observed for high-density EMG, but not always for conventional bipolar EMG. This suggests that MEPs recorded with high-density EMG are less affected by crosstalk than MEPs recorded with conventional bipolar EMG, and better reflect the response in the underlying VM muscle.