Transcranial magnetic stimulation with a half-sine wave pulse elicits direction-specific effects in human motor cortex.

Abstract:
Transcranial magnetic stimulation (TMS) commonly uses so-called monophasic pulses where the initial rapidly changing current flow is followed by a critically damped return current. It has been shown that a monophasic TMS pulse preferentially excites different cortical circuits in the human motor hand area (M1-HAND), if the induced tissue current has a posterior-to-anterior (PA) or anterior-to-posterior (AP) direction. Here we tested whether similar direction-specific effects could be elicited in M1-HAND using TMS pulses with a half-sine wave configuration. In 10 young participants, we applied half-sine pulses to the right M1-HAND which elicited PA or AP currents with respect to the orientation of the central sulcus. Measurements of the motor evoked potential (MEP) revealed that PA half-sine stimulation resulted in lower resting motor threshold (RMT) than AP stimulation. When stimulus intensity (SI) was gradually increased as percentage of maximal stimulator output, the stimulus-response curve (SRC) of MEP amplitude showed a leftward shift for PA as opposed to AP half-sine stimulation. Further, MEP latencies were approximately 1 ms shorter for PA relative to AP half-sine stimulation across the entire SI range tested. When adjusting SI to the respective RMT of PA and AP stimulation, the direction-specific differences in MEP latencies persisted, while the gain
function of MEP amplitudes was comparable for PA and AP stimulation. Using half-sine pulse configuration, single-pulse TMS elicits consistent direction-specific effects in M1-HAND that are similar to TMS with monophasic pulses. The longer MEP latency for AP half-sine stimulation suggests that PA and AP half-sine stimulation preferentially activates different sets of cortical neurons that are involved in the generation of different corticospinal descending volleys.