ELECTROMAGNETIC STIMULATION OF THE BRAIN: FROM PHYSICS AND PHYSIOLOGY TO CLINICAL APPLICATIONS

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The human cortex can be triggered to action or modulated noninvasively by transcranial magnetic stimulation (TMS [1, 2]). The magnetic field itself has no essential effect on tissue; the effect produced is due to the induced electric current in the brain. The induced current depolarizes some of the neuronal membranes, eliciting action potentials. The effect of magnetic brain stimulation is thus to create artificial information pulses into neurons. Although these neuronal signals have been artificially generated, they do not differ from naturally occurring action potentials. Therefore, any physiological consequences of TMS are the result of action potentials affecting cellular activity.

The new method called Navigated Brain Stimulation (NBS) allows targeting TMS pulses very accurately to selected anatomical or functional sites on the basis of MRI. When combined with multichannel EEG, the reaction of the brain to TMS can be measured just milliseconds after the electromagnetic pulse. This allows one to obtain information on the excitability of the cortex as well as on functional connectivity between brain areas. Depending on stimulation parameters and on the evoked response characteristics to be studied, a rich spectrum of information on brain functionality can be obtained [3–6]. Applications of these techniques include basic research, diagnosis, and therapy.

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