The growing enthusiasm for transcranial magnetic stimulation (TMS)

Benoit Trojak, Stéphanie Leclercq, Bernard Bonin, André Gisselmann

Service de psychiatrie et d’addictologie, centre hospitalier universitaire de Dijon, 21033 Dijon cedex, France

Correspondence:
Benoit Trojak, service de psychiatrie et d’addictologie, centre hospitalier universitaire de Dijon, 3, rue du Faubourg-Raines, BP 1519, 21033 Dijon cedex, France.
benoit.trojak@chu-dijon.fr

Available online 4 March 2010

Is it possible to treat illness by stimulating the cerebral cortex of patients’ brains? Since Barker et al. proposed the therapeutic use of magnetic fields in 1985, the idea of transcranial magnetic stimulation (TMS) has generated enormous interest in various medical fields [1]: the number of articles for this keyword in the Medline database has more than doubled over the past 5 years, and has increased by a factor of 5 in 10 years. Pain, depression, Parkinson disease, dementia... doctors are interested in this new technique for all these disorders, and consider it a very promising tool. Why has transcranial magnetic cortical stimulation generated so much enthusiasm?

The principle of TMS is simple. A stimulator transmits a magnetic field via a metallic coil placed against the patient’s scalp. This magnetic field, which has a range of about 2 cm, traverses the patient’s cranium, and causes focal modification of the neuronal excitability of the underlying region of the brain. Standard coils can cover an area of approximately 2 cm² of the cortex [2]. The magnetic stimulation is delivered in repeated pulses (rTMS) to modify the excitability of the target zone. The literature on the motor cortex suggests that high frequency enhances the excitability of the portion of the brain that is directly stimulated, and that low frequency should have the opposite effect [3].

Thanks to rTMS, functional cerebral imaging now has therapeutic prospects, because new imaging techniques, principally designed to investigate cerebral function, are revealing therapeutic targets for many diseases in different regions of the cortex. Stimulation of the auditory cortex, for example, is showing promise in the treatment of tinnitus [4]. Stimulation of the dorsolateral prefrontal cortex (DLPFC) is being used in the treatment of depression that does not respond to antidepressants [2], and stimulation of the left temporoparietal cortex (TPC) to treat auditory
hallucinations [5,6]. It has been suggested that the stimulation of the DLPFC could be used in other psychiatric indications, including mania, obsessive-compulsive disorder, post-traumatic stress disorder, and some negative symptoms of schizophrenia [5]. Studies on other potential indications, including autistic, and eating disorders, are under way [7]. The DLPFC may also be a target in the treatment of dementia, for rTMS appears to improve certain cognitive skills in patients with Alzheimer disease [8]. Moreover, stimulation of the DLPFC may have indications in the treatment of addiction, by diminishing the craving for tobacco, and cocaine [9]. Finally, stimulation of the primary motor cortex, and supplementary motor area is being considered for the treatment of Parkinson disease, dystonia, and even Huntington disease [10,11]. This procedure also seems to have useful antalgic properties, in particular in the treatment of chronic neuropathic pain, fibromyalgia, and migraine headaches [12]. Low frequency stimulation of the motor cortex may reduce the number of seizures in patients with focal epilepsy [3]. Electroencephalographic monitoring, and electromyographic monitoring are required for the latter indication, as rTMS is known to increase the risk of inducing epileptic seizure [13].

The therapeutic use of rTMS does, however, have a number of limitations. There are many exact stimulation parameters (intensity, frequency, duration of sessions, number of stimulations to deliver at each session, number of sessions), and for the moment, these have not been determined with any precision [14]. The rhythm of the rTMS sessions is intense: often daily stimulations (10 to 30 minutes) lasting for several weeks. The position of the coil, though essential, is often intuitive, and imprecise. The targeted areas of the cortex are often established manually, and based on the location of the motor cortex. Neuronavigation systems would probably remedy these problems, but they are rarely used because they are expensive. On the other hand, rTMS has a number of advantages: it is non-invasive, no premedication is required, there is no need for hospitalization, and side effects are rare [13]. The only absolute contraindication to rTMS is the presence of metallic hardware in close contact to the discharging coil [13]. A recent publication, based on a consensus conference, provides important updated guidelines for the use of rTMS, including stimulation parameters, and safety considerations [13].

The innovative nature of this therapy, and the need to optimize the stimulations make it a fabulous subject of research, which may explain why it generates such enthusiasm. But above all, what accounts for it, is therapeutic hope stimulated by rTMS especially for indications in which the standard treatment is limited or insufficient.

Conflicts of interest statement: none.

References