

REPETITIVE TRANS-CRANIAL MAGNETIC STIMULATION: EFFECTS ON LOWER URINARY TRACT FUNCTION IN MULTIPLE SCLEROSIS PATIENTS

Hypothesis / aims of study

Transcranial magnetic stimulation (TMS) is a non invasive method of brain stimulation frequently used as a diagnostic and research tool since its introduction in 1985 (1). TMS uses magnetic fields to induce electric currents that cross the nervous tissue, producing neuronal depolarization. It is performed positioning an electromagnetic coil on the skull over the cerebral motor area (motor hot spot). The evoked motor responses are recorded as electromyographic potentials from the muscles. The repetitive transcranial magnetic stimulation (rTMS) is the application of magnetic stimuli at frequencies of 1 Hz (low frequency) or higher (high frequency). It is frequently used for the explorations of cortical functions, for the modulation of the intrinsic cortical plasticity, and for therapeutic applications in a variety of neuropsychiatric disorders (2). When applied over the motor cortex, high frequency rTMS is able to induce facilitatory effects on cortico-spinal excitability, while low frequency stimulation rather induces inhibitory effects (2). Reduced corticospinal transmission is frequently observed in multiple sclerosis (MS) patients with urinary dysfunctions. The present study was aimed to explore the effects of high frequency (5 Hz), excitatory rTMS over the motor cortex on lower urinary tract (LUT) function in MS patients complaining urinary disturbances.

Study design, materials and methods

10 MS patients (8 females and 2 males) were included in this study. Mean age was 38 (18-50) years. All patients had indication to rTMS for lower limb spasticity, but complained LUT symptoms either of the filling or of the voiding phase. Each patient was submitted to 10 5 Hz rTMS sessions in two consecutive weeks. rTMS was applied over the primary motor cortex (lower limb hot spot) of the dominant hemisphere at 100% resting motor threshold intensity. Every session was composed from 20 trains of 10 seconds (50 stimuli each train) with intervals of 30 seconds. 1 to 5 days before, and 1 to 3 days after rTMS treatment, a urodynamic evaluation was performed. Results obtained were statistically compared. A subjective impression on LUT symptoms modification was obtained from patients at the end of treatment.

Results

One patient dropped out the rTMS protocol because of adverse events (headache) and was excluded from the evaluation. Before rTMS, 2/9 patients showed a urodynamic pattern of neurogenic detrusor overactivity (DO) with detrusor-sphincter dyssynergia (DSD); one patient showed DO with detrusor underactivity during the voiding phase (DO/DU). The remaining 6 showed a pure pattern of detrusor underactivity (DU). The DO patients reported LUT symptoms of the filling and of the voiding phase; in the two patients with DSD a significant amount of post-void residual (PVR) was present (mean 155 ml). The patient with DO/DU showed a PVR of 250 ml. The DU patients reported symptoms of the voiding phase; a large PVR was present as well (mean 200 ml). After rTMS, the three patients with detrusor overactivity showed no significant changes in urodynamic parameters of the filling phase; the two patients with DSD showed a better bladder voiding with (non significant) decrease in detrusor pressure at maximum flow (Pdet@Qmax, 25 vs. 41 cmH₂O) and significant reduction of PVR (25 vs 155 ml, p=0,048). A reduction in PVR was seen in DO/DU patient as well (100 vs 250 ml, p=0,041). Five out of six patient with DU showed a significant reduction of PVR (88 vs 200 ml, p=0,02) and a slight increase of the maximum flow (Qmax, 14 vs. 11 ml/s, p=0,02) and a slight increase of Pdet@Qmax (17 vs 13 cmH₂O, p=0,09). With the exception of one patient with pure DU (who did not show any urodynamic modification), all other

patients reported a subjective improvement of LUT symptoms of the voiding phase. The three patients with DO did not report any improvement in filling phase LUT symptoms.

Interpretation of results

High frequency rTMS seems to produce effects on the voiding phase of the micturition cycle. In our series, all but one patients reported an improvement of voiding phase LUT symptoms and a significant reduction of PVR. In patients with pure DU this finding seems to be produced by a better contraction of the detrusor muscle, with consequent increase of Pdet@Qmax and Q max: a similar finding was reported in female Fowler's syndrome patients (3) after sacral neuromodulation. In patients with DSD, on the other hand, this condition persists after treatment, but the observation of a reduction of Pdet@Qmax seems to suggest a better relaxation of urethral sphincter. No clear effect was observed on the filling phase parameters. It can be hypothesised that a different type of rTMS (low frequency, different site of stimulation) could produce different results: further studies are needed.

Concluding message

In MS patients, 5 Hz rTMS seems to produce effects on the voiding phase of the micturition cycle, with improvement of voiding and a significant reduction of PVR.

References

- 1) Electroencephalogr. Clin. Neurophysiol. 1994; 91: 79-82.
- 2) Exp Brain Res. 2003;148: 1-16.
- 3) J Urol. 2004;171: 1161-1164.