SHORT REPORT

Transcranial magnetic stimulation as an efficient treatment for psychogenic movement disorders

Béatrice García,1,2,3 Emmanuel Roze,1,3 Francine Mesrati,4 Emmanuel Cognat,1 Emmanuel Fournier,4 Marie Vidailhet,1,3 Bertrand Degos1,5

ABSTRACT

Background Management of psychogenic movement disorders (PMDs) is challenging for neurologists and, to date, there is no consensus about their treatment. Recent studies suggested a possible therapeutic effect of repeated transcranial magnetic stimulation (TMS) in psychogenic paralysis and tremor.

Objective To document the clinical impact of TMS in PMDs.

Methods We blindly video scored symptoms of consecutive patients with PMD who were recorded before and after TMS. TMS was delivered at low frequency (0.25 Hz) over the motor cortex contralateral to symptoms.

Results Twenty-four patients were included. They presented with dystonia, myoclonus, tremor, Parkinsonism or stereotypies. The median duration of symptoms before TMS was 2.8 years (6 months to 30 years). The overall score of 75% of patients improved by >50% and, furthermore, the clinical benefits were sustained upon protracted follow-up (median 19.8 months). There was no correlation between improvement and duration of symptoms before TMS.

Conclusions TMS is a therapeutic option for PMDs, including chronic PMDs.

INTRODUCTION

Psychogenic movement disorders (PMDs)1 account for about 0.3% of all patients seen in neurology clinics and 3% of those seen in movement disorder clinics.2–3 Diagnosis and management of PMDs remains challenging. Symptoms can mimic the full range of organic abnormal involuntary movements—psychological or psychiatric disturbances being not always obvious. The outcome is often poor, since only half of the patients improve after 3 years of follow-up,4 with a significant related disability, similar to that seen in neurodegenerative conditions.5 Multidisciplinary care is often proposed for these patients but there is an overall lack of data, recommendations and consensus about the management of PMDs.6

Low-frequency repeated transcranial magnetic stimulation (TMS) was recently proposed to treat psychogenic paralysis, showing encouraging results.7 A preliminary study also suggested its efficiency in psychogenic tremor.8 However, a recent study showed no efficacy of repetitive TMS using stimulation under motor threshold in five patients with chronic PMDs.9 Therefore, in view of these conflicting results, we conducted a prospective pilot study to test its effect in patients with PMD.

PATIENTS AND METHOD

The study was approved by the local ethics committee. We included 24 consecutive inpatients with PMD admitted between December 2010 and October 2011 to the movement disorders unit of Salpêtrière Hospital for investigation and/or treatment of abnormal movements. All patients fulfilled the criteria for clinically established PMD, as defined by Fahn and Williams.1 The diagnosis was made by one movement disorder expert and confirmed by at least one other movement disorder expert from our centre. Except for one Italian patient (case no 22), all the other patients were seen at least once (mean 2.2±2 times, range 1–10; median 1, IQR 1–3) by a movement disorder specialist from our unit at least 1 month before low-frequency repeated TMS. All were followed up for a median duration of 6 months before the TMS session (IQR 3–10; mean 10.9±13, range 1–40). All patients gave written informed consent for a video and the TMS.

The patients were given information about the three following aspects of the procedure. First, their symptoms were explained as being a consequence of brain dysfunction in the absence of lesion of the motor system and that, although unconscious, it was often linked to a psychological difficulty. Second, they were informed that the integrity of the motor system would be assessed and confirmed with motor evoked potentials, resulting in reduced and/or disappearance of symptoms upon repeated TMS. Third, TMS was described to the patients as a very efficient treatment with excellent results. Patients were videotaped the day before and the day after the TMS session. After treatment and putative recovery, we recommended the patients to undergo physiotherapy. We further advised them to be followed up by a psychologist or a psychiatrist to identify the origin of the trouble and/or to discuss the physical, psychological, social and professional impacts of the motor benefits induced by the TMS. No drugs were added to this care management. We made it clear before the therapeutic TMS session that the neurological follow-up by a neurologist would not be interrupted, even after putative disappearance of the symptoms.

Somatosensory and motor evoked potentials were performed before TMS treatment, ensuring the sensory and motor tract integrity in all cases. Then, an average of 20 stimuli (120% of the resting motor threshold; each stimulus lasted for 50 ms) were delivered at low frequency (0.25 Hz).
with a circular coil (9 cm diameter, Magstim device) over the motor cortex either contralaterally to symptoms—or bilaterally, if movement disorders were bilateral. The stimulation intensity was sufficient to induce a motor response. To evaluate the severity of the wide range of movement disorders seen, we designed a rating scale based first, upon a modified version of the Abnormal Involuntary Movement Scale, and second, upon the walking subscore of the disability score from the Burke–Fahn–Marsden Scale (see online supplementary material). Overall scores on our scale ranged from 7 (normal) to 41 (worst score).

To objectively assess the efficiency of TMS, two movement disorder specialists (BD and EF-R) blindly rated the patients recorded before and after repetitive TMS. Three cases required an additional evaluation (by MV) owing to a scoring discrepancy >10%. Scores were then averaged to compare scores before and after TMS. Furthermore, to assess the continuing effectiveness of TMS a self-evaluation of the clinical status was conducted by telephone 1 year after the end of the inclusion period (November 2012) using the Clinical Global Impression—Improvement Scale (CGI-I Scale); this scale ranges from 1 (very much improved) to 7 (very much worse) and includes 0 (not assessed).

All statistical analyses were performed with GraphPad Prism software, with a threshold set at p<0.05 for significance. Spearman’s rank correlation test was used for correlation analyses. A Student t test was used for comparison of two groups, after checking for variance similarity with Fisher’s test, and an analysis of variance was performed to compare scores across more than two groups. Results are expressed as percentage and as mean±SD.

**RESULTS**

Twenty-four patients (16F/8M) were included in the cohort. The main characteristics of the population are displayed in table 1. The mean age of patients was 44.5±13.2 years (range 22–76 years). They had fixed dystonia (46%, N=11), myoclonus (21%, N=5), tremor (12.5%, N=3), jerky dystonia (12.5%, N=3), Parkinsonism (4%, N=1), or stereotypes (4%, N=1). The median duration of the symptoms was 2.8 years (mean duration 6.8 years±8.9; range 0.5–30 years). Seven patients (29%) had psychiatric comorbidities, which were chronic depression (N=4), bipolar disorder (N=2) or addiction to drug of abuse (N=1). At the time of TMS treatment, 14 patients were taking no specific medication, while the 10 remaining patients were

### Table 1  Main clinical characteristics of the 24 patients included in the study

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Gender</th>
<th>Age at treatment (years)</th>
<th>Psychiatric comorbidities</th>
<th>Movement disorder</th>
<th>Body region</th>
<th>Onset</th>
<th>Duration before repeated TMS treatment (years)</th>
<th>Efficiency on total score (%)</th>
<th>Duration of follow-up (months)/CGI score</th>
<th>Number of relapses (efficiency of following repeated TMS)</th>
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<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>60.0</td>
<td>Bipolar</td>
<td>Jerky dystonia</td>
<td>UL</td>
<td>Sudden</td>
<td>0.5</td>
<td>72.2</td>
<td>10.1/0</td>
<td>3 (+)</td>
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<tr>
<td>2</td>
<td>F</td>
<td>30.6</td>
<td>Depression</td>
<td>Dystonia</td>
<td>Left side</td>
<td>Sudden</td>
<td>9.9</td>
<td>96.3</td>
<td>21.7/1</td>
<td>0</td>
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<tr>
<td>3</td>
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<td>49.8</td>
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<td>Myoclonus</td>
<td>Neck+UL</td>
<td>Progressive</td>
<td>4</td>
<td>100.0</td>
<td>22/5</td>
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<td>Sudden</td>
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<td>22</td>
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</table>

Sudden, in <24 h; subacute, 24 h–1 month; progressive, >1 month.

+, positive effect of the low-frequency repeated TMS.

*CGI score performed at the end of follow-up. CGI-I=1, very much improved; CGI-I=2, much improved; CGI-I=3, minimally improved; CGI-I=4, no change; CGI-I=5, minimally worse; CGI-I=6, much worse; CGI-I=7, very much worse.

CGI, Clinical Global Impression; LL, lower limbs; TMS, transcranial magnetic stimulation; UL, upper limbs.
receiving various treatments for their movement disorder, including antidepressant agents (N=6), clonazepam (N=5), antiepileptic medication (N=2) and/or baclofen (N=2).

The clinical score of all patients improved upon TMS treatment. After low-frequency repeated TMS, 75% of the patients (N=18) improved by >50% and, among them, one-third (N=6) had a complete resolution of motor symptoms (figure 1). The improvement occurred immediately after the session in all cases. No side effects were seen. We observed no correlation between TMS efficiency and subsequent duration of symptoms (r=0.0004, p value (two-tailed)=0.99), gender (t=0.24, df=22; p value (two-tailed)=0.81), age (t=0.21, p value (two-tailed)=0.32), clinical presentation (F=0.65, p value (two-tailed)=0.63), use of medication (t=0.7, df=22; p value (two-tailed)=0.49) or psychiatric comorbidities (t=0.31, df=22; p value (two-tailed)=0.76).

There was a high rate of concordance between raters on ranking patients’ overall PMD burden. The Spearman correlation for the total PMD scores between the two raters was 0.93. Kendall’s concordance coefficient for the total PMD rating score was 0.83 and the intraclass correlation coefficient was 0.93.

The median duration of follow-up was 19.8 months (N=24; IQR 18.5–22.3). At the last follow-up, 17 patients (71%) felt improved (ie, CGI-I<4). Of these, 12 were much improved or very much improved (ie, CGI-I=1 or 2). Three patients were stable in comparison with baseline (ie, CGI-I=4), two patients felt worse (ie, CGI=5 or 6), and two patients were lost to follow-up (ie, CGI-I=0, case nos 1 and 23). The median CGI score was two (N=22; range 1–6). Ten patients (42%) relapsed during the follow-up period but after new TMS sessions they had all improved as much as after the first session. Finally, 12 of the patients among those whose score had improved by >50% (N=18) still displayed remarkable improvement at the end of follow-up, as assessed by a score of 1 or 2 on the CGI-I scale. Four of them (case nos 5, 10, 18 and 19) even returned to work after TMS treatment.

**DISCUSSION**

TMS should be considered as a therapeutic option for chronic PMDs, in addition to the standard clinical care. This is important for clinical practice since management of PMDs is difficult, time-consuming and often costly for society. Of 24 consecutive patients with various PMDs, 75% (N=18) halved their severity score immediately after the application of low-frequency repeated TMS over the motor cortex. Of these, one-third (N=6) had a complete resolution of motor symptoms. After a median follow-up of 19.8 months, 17 patients were still improved and the effect was sustained in half of the cases (N=12; CGI-I=1 or 2). The rate of post-TMS improvement could not be significantly correlated with any prior clinical parameter (including symptom duration).

Our 24 patients share common characteristics with previous cohorts reported in the literature: (i) a mean age at onset of 40–50 years, (ii) a clear female predominance, (iii) dystonia, myoclonus and tremor were the most common movement disorders. It is noteworthy that all the PMDs of our study were defined as chronic because abnormal movements lasted for at least 6 months (median duration 2.8 years, range from 6 months to 30 years). A negative prognostic value is usually assigned to long-lasting symptoms (>6 months). By contrast, our patients improved after TMS sessions despite long lasting symptoms, and the influence of symptom duration could be further ruled out.

Recent studies reported a possible beneficial effect of low-frequency TMS in psychogenic paralysis and in psychogenic dystonia. Accordingly, our data support the suggestion that TMS may be a valuable therapeutic option in a wide range of PMDs, even in patients with chronic symptoms. The pathophysiology of PMDs and the mechanisms by which TMS may improve the symptoms remain unclear. Recent neurophysiological studies suggest that somatosensory inputs are altered in psychogenic dystonia. While the beneficial effect of TMS might be due to the combination of suggestion/placebo and unknown cortical functioning effects, we consider that the repeated low-frequency TMS (below 1 Hz) used in this study could not be responsible for stimulation-induced after-effects because (i) stimulation of the motor cortex at 0.1 Hz for 1 h did not change cortical excitability, (ii) at 1 Hz, a minimum of 750 TMS pulses was needed to modulate motor-evoked potential amplitude from 0 to 15 min after the intervention, whereas 600 TMS stimuli at 1 Hz failed to modulate flexor carpi radialis H-reflex, which is well above the total number of pulses we delivered to our patients. All stimuli were above motor threshold.

Movements induced by TMS altered PMD for a few seconds. Thereby, the patients could discover for themselves the possibility of transiently modifying the abnormal movement/posture. During the TMS session, FM discussed this positive motor phenomenon and thereby provided synergistic psychological reinforcement. There might be a cognitive-behavioral, rather than placebo, effect when patients see an unexpected alteration of their movement disorder. This, combined with suggestion, could be a powerful stimulus inducing change in belief about symptoms and could trigger or help recovery.

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**Contributors** BG, BD, EC and ER were involved in conception, organisation and supervision of the project and writing of the first draft of the manuscript. In addition, BD was involved in the coordination and supervision of the project and manuscript. FM was involved in execution of the research project (electrophysiological explorations), and manuscript review and critique. EF and MV were also involved in manuscript review and critique.

**Funding** The research leading to these results received funding from the programme ‘Investissements d’avenir’ ANR-10-IAIHU-06.

**Competing interests** None.

**Patient consent** Obtained.

**Ethics approval** Local ethic committee: comité de protection des personnes de l’hôpital Pitot Salpêtrière.

**Provenance and peer review** Not commissioned; externally peer reviewed.

![Figure 1](http://jnnp.bmj.com/)

**Figure 1** Improvement of patients with transcranial magnetic stimulation (TMS). The chart represents the percentage of patients who were improved by ≥75%, 50–75%, 25–50% and <25%.
REFERENCES

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