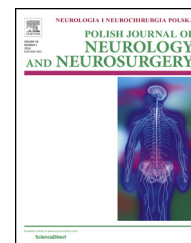


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## Case report

# Repetitive transcranial magnetic stimulation in treatment of post polio syndrome

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## ABSTRACT

**Background:** Post polio syndrome is a rare disease that occurs decades after polio virus infection. Repetitive transcranial magnetic stimulation (rTMS) is a treatment option with proved effectiveness in drug resistant depression. Possibly it can be helpful in therapy of other neurological diseases including post polio syndrome.

**Objective:** To describe a case of patient diagnosed with post polio syndrome who was treated with rTMS stimulation with a good effect.

**Methods:** Patient had rTMS stimulation of left prefrontal cortex twice a week for an eight weeks. Patient's health status was evaluated before treatment, after last rTMS session and after three months from the end of the treatment.

**Results:** Improvement of fatigue score, mood disturbances and motor functions was observed after treatment.

**Conclusion:** rTMS can be an effective method in treatment of post polio syndrome but further studies with larger group need to be done to confirm that data.

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## 1. Background

Post polio syndrome (PPS) can occur even 30–40 years after acute polio virus infection. The most characteristic symptoms are slowly progressive muscle weakness and atrophy that can

be observed in muscles clinically affected and nonaffected during primary polio infection. Patients often claim at muscle and joints pain as well as chronic fatigue, mood disturbances, problems with sleeping, memory and concentration [1]. PPS symptoms can be induced by infectious, injuries, operations or intensive physical activity. Those symptoms have severe impact on daily activity making patients severe disabled [2]. In

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Abbreviations: rTMS, repetitive magnetic stimulation; PPS, post polio syndrome; tDCS, transcranial direct current stimulation.

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differential diagnosis it is important to take into account amyotrophic lateral sclerosis, cervical spondylosis, cord tumors as well as systemic conditions that may be a cause of fatigue. Unfortunately there is no cure for PPS. The most important is rehabilitation because it can improve the quality of life and slow the process of muscles atrophy. Resting affected limb with the orthopedic equipment can be also effective. There were attempts of treatment with pyridostigmine and amantadine or immunoglobulins but their effectiveness in PPS was not confirmed [3]. In presented study we described the case of patient who was treated with repetitive transcranial magnetic stimulation (rTMS) with satisfying effect.

## 2. Method

In presented work we described 58 years old female with hypertension who survived from polio infection at age of 6 years. She complained of progressive general weakness, problems with sleeping and concentration, joints pain accompanied by mood deterioration. Symptoms started five years earlier after respiratory tract infection. Due to polio she had paresis of left leg and walk on crutches since that time. Now she claims that also right limbs seem to be disabled from about four years. In computer tomography (CT) there were no abnormalities. Laboratory tests were also normal. Electro-neurography (ENG) did not reveal any abnormalities. In electromyography (EMG) there were features of chronic denervation in muscle of both arms and right leg. No voluntary activity in left leg muscles was observed. Signs of acute denervation were not noted despite of the fact that her neurological state was deteriorating. Diagnosis of PPS was established based on criteria made by the European Federation of Neurological Societies (EFNS) [4]. Due to the joints pain and sleep disturbances, patient was treated with amitriptyline 25 mg once a day and regular rehabilitation for four years with mild effect.

Patient was treated with the use of repetitive transcranial magnetic stimulation (rTMS, MagPro R20) twice a week for a month (eight sessions). rTMS frequency was 5 Hz and during one session 750 stimuli was given to the left prefrontal cortex. We had chosen that area of brain due to the fact that fatigue, mood deterioration, general weakness were the most troublesome symptoms in case of that patient. Moreover we had made the hypothesis that rTMS stimulation may have impact on that structure in brain and motor function due to the fact that prefrontal cortex is located near to motor cortex area. Parameters of stimulation were determined based on litera-

ture data and were similar to those used in treatment of Parkinson disease as well as brain stroke (due to the fact that there is lack of data evaluating the best parameters of rTMS in PPS) [5,6]. Patient's motor functions were evaluated with 25 foot walk test (25 FWT) [7]. Visuospatial attention and information processing speed were evaluated with the simple digit modality test (SDMT, oral version of the test) [8]. Mood was evaluated with the use of Hamilton and Beck tests [9,10]. Modified fatigue impact scale (MFIS), fatigue severe scale (FSS) and visual analog fatigue scale (VAFS) were used to investigate impact of fatigue on patient's daily activity [11-13]. Tests were made before treatment, after last rTMS session and three months after end of treatment. Pain and sleep were not evaluated with the use of specific tests due to the fact that patient was treated with amitriptylinum because of that symptoms.

## 3. Results

In presented study improvement was observed in all performed tests after rTMS treatment compared to results before that therapy. That positive effect was still present after three months from the end of treatment (Table 1).

## 4. Discussion

PPS is a rare condition with unknown etiology. Effective treatment also remains elusive. rTMS can be a therapeutic option, that may improve patients' quality of life, reduce fatigue symptoms or mood disturbances. Repetitive transcranial magnetic stimulation (rTMS) is a treatment option with proved effectiveness in many neurological and psychiatric disorders especially in drug resistant depression. Magnetic field generated by rTMS penetrate skin of the scalp and infiltrate brain tissues, causing neurons depolarization or hyperpolarization. Depending on the stimulation frequency rTMS can stimuli or inhibit brain cortex [14]. There is no data describing rTMS effectiveness in PPS. Left prefrontal cortex was stimulated with the use of rTMS in many studies with patients suffered from mood disturbances and neuropathic pain. It is also accepted in treatment of drug resistant depression by the Food and Drug Administration (FDA) [14,15]. In study with group of 17 patients with drug resistant depression, improvement of psychiatric condition was seen in case of 11 people after five rTMS sessions with 10 Hz frequency [16]. Herman in his analysis from 2006 year with group of 877 patients with depression, revealed that in group treated with

**Table 1 – rTMS treatment compared to results before that therapy.**

Test	Results before treatment	Results after treatment	Results three months after treatment
25 foot walk test	9.76 s	7.36 s	7.82 s
SDMT test	76 points	88 points	82 points
Hamilton test	4 points	1 point	2 points
Beck test	15 points	4 points	6 points
MFIS scale	39 points	31 points	30 points
FSS scale	49 points	44 points	44 points
VAF scale	4 points	6 points	6 points

rTMS psychiatric condition improvement was seen in case of 33.6% compared to 17.4% in placebo group [17]. In another study, rTMS also improved cognitive and motor function in healthy volunteers. In those patients cerebral blood flow was higher in brain areas connected with attention, motor functions, concentration and ability to learn new tasks [18]. In review of literature, Lefaucheur analyzed effectiveness of rTMS and transcranial direct current stimulation (tDCS) in treatment of fatigue in patients with multiple sclerosis, fibromyalgia, chronic fatigue syndrome, post-polio syndrome, Parkinson's disease and amyotrophic lateral sclerosis. The primary sensorimotor cortex, the dorsolateral prefrontal cortex and the posterior parietal cortex were the areas of stimulation in presented work. Non-invasive brain stimulation seemed to be a promising therapeutic option in those patients but further study with larger groups of patients need to be done [19]. There is also a sufficient body of evidence to accept the analgesic effect of high-frequency rTMS of the primary motor cortex contralateral to the pain [20].

Based on that data we hypothesized that stimulation of left prefrontal cortex may be effective in case of PPS symptoms like depression, chronic fatigue and problems with concentration. Magnetic field infiltrates brain tissues to a depth of 2 cm and causes neurons depolarization. Similar changes were also observed in adjoining areas of the brain probably due to synaptic modulation process. rTMS stimulation increases dopamine secretion in mesolimbic system and stimulates neurogenesis due to release of neuroprotective factors [21]. It also stimulates signal transduction in cortico-subcortical pathways and modulates neurons activity in subcortical areas. In case of PPS patients motoneurons damage in spine frontal horns results in motor problems, limbs paresis and muscle atrophy. Other symptoms like chronic fatigue, mood disturbances, problems with sleeping cognitive performance deterioration, memory and concentration impairment are probably related to reticular activating system (RAS) damage. RAS is connected with regulating wakefulness and sleep-wake transitions. In histopathological examinations severe abnormalities in brainstems of PPS patients were also observed [22].

In presented study after rTMS stimulation great improvement was observed in all performed tests evaluating mood disturbances, visuospatial attention, information processing speed and fatigue syndrome severity. Patient claimed that her daily activity improved, she had better mood and felt less tired during a day. Her family also noticed neurological state improvement. Better result of 25 foot walk test after month of rTMS treatment was surprising. Patient was disabled due to left leg paresis and walk on crutches since childhood. She claimed that also right limb seemed to be disabled from about four years. Her problems with walking were connected to front spine horns damage, that were not stimulated in that study. Improvement of motor function may be a result of less severe fatigue symptoms or rTMS analgesic effects. Prefrontal cortex is located near to motor cortex area and rTMS stimulation may have impact on that structure in brain and motor function. Many studies revealed that chronic fatigue symptoms may fluctuate during a day and that effect can have impact on 25 foot walk test results. That positive effect of rTMS on PPS symptoms severity lasted for three months in presented patient. Further study with larger group of patients and with

sham (placebo) rTMS need to be done to confirm rTMS effectiveness and safety in PPS patients.

## 5. Conclusion

PPS is a rare disease with elusive etiology. There is no effective treatment for PPS symptoms. rTMS can be a treatment option for those patients that can reduce fatigue, improve mood disturbances or even motor functions. Although PPS is a very rare disease, further studies with larger group of patients and with sham rTMS need to be done to evaluate effectiveness and safety of that treatment option in those people.

## Conflict of interest

None declared.

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