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Letter to the editor

Transcranial direct current stimulation in the neuromodulation of pain in fibromyalgia: A case study

Fibromyalgia is a prevalent chronic pain syndrome that can occur in women with widespread pain, fatigue, muscle stiffness, depression, poor quality of life and anxiety. It might also be associated with exacerbated psychological factors such as somatization, helplessness and catastrophic thinking related to pain [1,2].

The accurate pathophysiology of this syndrome is not completely known; however, some evidence shows that both peripheral and central sensitization may affect the functioning of descending inhibitory mechanisms and facilitatory pathways. These impairments, in turn, can modify the pain perception and sensory processing in the neurosystem and lead to emotional behavior in a person experiencing pain [3]. We lack effective approaches to the management of long-lasting pain symptoms, and the pain experiences might affect sleep quality, physical functioning and quality of life, which can maintain a continuous cycle and sustain the experience of a chronic condition [4].

Brain neuromodulation therapies such as transcranial direct current stimulation (tDCS) can decrease pain in fibromyalgia. tDCS might induce significant analgesic effects when applied to the primary motor cortex (M1) [5] and also a significant antidepressant effect when applied over the dorsolateral prefrontal cortex (DLPFC) [6], but its benefit for alleviating catastrophic thinking related to pain in fibromyalgia has never been investigated.

A decrease in pain might have a considerable impact on the functional physical rehabilitation of patients with fibromyalgia. We describe our study in a female patient with fibromyalgia for 21 years, diagnosed according to 1990 American College of Rheumatology criteria, which was refractory to various therapeutic interventions. Our application of active stimulation of the M1 and DLPFC was associated with a decrease in pain, anxiety and level of catastrophic thinking related to pain.

Our 52-year-old patient had postpartum depression associated with a severe and long-lasting cold after her first child was born 22 years ago, 10 months after she was married. She experienced multiple muscle spasms and felt intense and diffuse pain progressing over time. She also reported that household tasks (household chores plus care for her son and husband), associated with professional commitments, became troublesome. She considered that these burdens resulted from her perfectionist psychological profile. The patient began to experience sleep disorders, together with uncomfortable morning stiffness. She consulted a rheumatologist and the clinical diagnosis was fibromyalgia.

At this time, she started using antidepressants and received psychological therapy and rheumatology monitoring for a long period. She experienced periods of decreased pain but periodically began to feel widespread and intense pain symptoms, even without plausible external triggers. She reported that when her first child was 2 years old, her mother died, and then her painful condition worsened considerably. At that time, she was receiving an anxiolytic associated with an antidepressant and started shiatsu therapy associated with psychotherapy, together with rheumatologist monitoring. She confirmed that the pain decreased after this therapeutic approach, but in situations of emotional instability, the pain symptoms returned and were intense. She replaced the shiatsu therapy with global posture re-education, with good results in controlling pain, but manifestations of painful crises became a constant in her life.

Five years before the study, the patient began to feel an intense pain in the right shoulder, cervical spine, right and left hips and right knee, with multiple diagnoses after MRI and CT. Continuous medication prescription was revised (i.e., the anxiolytic was replaced by an anticonvulsant plus antidepressant); in addition, she received an anti-inflammatory agent for 1 month. Symptoms were relieved after this approach, but 1 year later, at menopause onset, she had a very sharp worsening of pain, together with emotional instability.

After signing informed consent, the patient was randomized to receive 3 treatments (10 sessions of 20 min each for each treatment, 30 sessions total, with an interval of 1 week between treatment types: (1) active tDCS (2 mA) over M1, (2) sham tDCS stimulation and (3) active tDCS (2 mA) over DLPFC. Adverse effects were minor and not common (skin redness and tingling). With DLPFC stimulation, pain score decreased 50%, trait-anxiety score 20% and ruminative catastrophism score related to pain 28.6% (Table 1). With M1 stimulation, pain score decreased 46.7%, state-anxiety score 33.3%, and depressive symptom score 11.8%. With sham stimulation, pain score decreased 6.3% and state-anxiety score 4% and ruminative catastrophism score increased 6.7%.

The relationship between pain and behavior is a consistent aspect in the context of fibromyalgia and other pain disorders. As well, the intensity of the nociceptive-stimulus pain has been linked to the activation of widespread central sensitization and psychological factors such as somatization, depression, helplessness, anxiety and catastrophizing [2,3]. The central sensitization has been described as combining an impaired descending inhibitory mechanism and altered pain facilitatory pathways, whereas catastrophizing is understood as a maintenance phenomenon of the worst possible result of a situation, and the relationship between the conditions equally worsens the results in future situations [7]. Catastrophizing has been associated with impaired neural pathways related to affective regulation and positively linked to measures of physical disability in pain experiences [8]. In this context, DLPFC is an important brain region for emotional processing and is linked with downregulation of negative affective conditions [5].

Our patient showed a considerable decrease in ruminative catastrophism and in pain after stimulation of the DLPFC (Fig. 1),

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Table 1
Scores for pain, disease, sleep and psychological scales before and after each transcranial direct current stimulation (tDCS) protocol.

Scales	tDCS over M1		Sham tDCS		tDCS over DLPFC	
	Before	After	Before	After	Before	After
Pain, visual analogue scale (0–10)	7.5	4 (−46.7%)	8	7.5 (−6.3%)	7	3.5 (−50%)
Fibromyalgia impact questionnaire (0–80)	69	65 (−5.8%)	68	67 (−1.5%)	66	61 (−7.6%)
Brazilian state-trait anxiety inventory (0–100)						
State-anxiety (0–52)	30	20 (−33.3%)	25	24 (−4%)	21	22 (4.8%)
Trait-anxiety (0–48)	31	32 (3.2%)	30	30 (0%)	30	24 (−20%)
Beck depression inventory (0–63)	17	15 (−11.8%)	19	19 (0%)	11	11 (0%)
Pain catastrophizing scale for the Brazilian population (0–52)						
Rumination (0–16)	14	15 (7.4%)	15	16 (6.7%)	14	10 (−28.6%)
Magnification (0–12)	9	9 (0%)	11	11 (0%)	10	9 (0%)
Helplessness (0–24)	18	19 (5.6%)	19	19 (0%)	17	17 (0%)

The values in parentheses express the percentage improvement compared with pre-intervention. MI: motor cortex; DLPFC: dorsolateral prefrontal cortex.

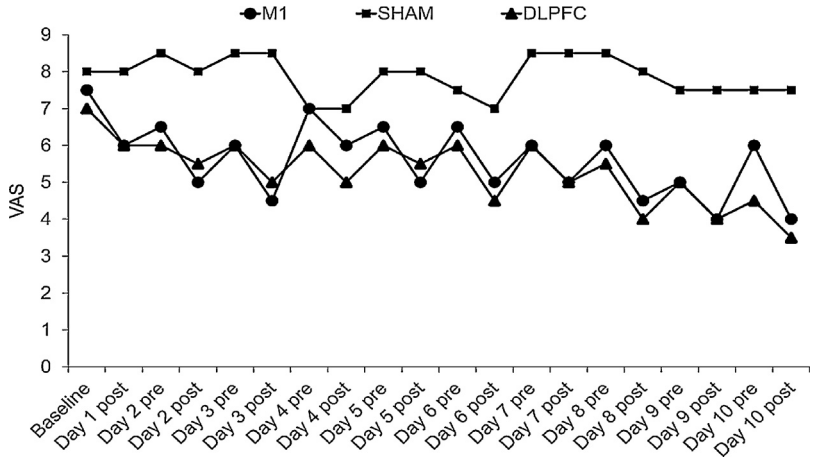

Fig. 1. Pain scores on a visual analogue scale (VAS; 0–10) at baseline (day 1) and on days 2 to 10 before (pre) and after (post) each 10-session treatment.

which suggests that the stimulation of the DLPFC could affect the networks involved in the emotional processing of pain perception. These findings agree with studies of patients with chronic neuropathic pain [8], which suggests that catastrophizing is positively related to affective aspects of pain perception.

In the same context, anxiety is known to involve both physiological and psychological aspects that affect sensorial interpretation and associated with altered brain excitability [9]. We found considerably decreased state-anxiety (i.e., with references to an acute situation that changes over time) and trait-anxiety (i.e., with references to personality pattern) after M1 and DLPFC stimulation, respectively, in our patient. After stimulation, the patient reported decreased pain perception, which agreed with previous reports suggesting that anxiety levels are directly proportional to a predisposition to the development of musculoskeletal pain [9]. Although the underlying mechanism between pain and anxiety is not clear, our findings suggest that the dysfunctional cortical processing in our patient could be modulated at least in part after M1 and DLPFC stimulation, thereby contributing to decreased anxiety.

Our patient showed considerably decreased pain levels after M1 and DLPFC stimulation (Fig. 1). Nevertheless, we found few antidepressant effects with tDCS with both stimulation types. This finding disagrees with previous results, showing tDCS to the DLPFC associated with ameliorated depressive symptoms in patients with major depression [5]. However, our findings agree with those of Fregni et al. [10], who showed lack of antidepressant effects associated with tDCS as compared with sham stimulation in patients with fibromyalgia. In this context, the pathophysiologic mechanisms of depression in fibromyalgia differ from those of major depression [2,5,10]. Furthermore, we observed the effects of tDCS in only one patient presenting mildly severe depressive symptoms, which might explain the results.

In our patient, sham tDCS stimulation had little effect on most of the variables studied and increased the helplessness catastrophism. The lack of significant reduction in anxiety level after sham stimulation may indicate that the sham intervention did not affect the psychological aspects involving the therapeutic effects.

Our results suggest that active stimulation of the M1 and the DLPFC might decrease pain perception and anxiety levels. Besides affecting pain level, the DLPFC stimulation seemed to have effects on ruminative catastrophism.

One limitation to our study was that although we applied a regimen of 10 daily tDCS sessions for each protocol, we did not investigate the long-lasting effects of the therapy. However, this is the first assessment of the relationship between catastrophism and fibromyalgia. Future research investigating cortical excitability, catastrophism and fibromyalgia might provide more explanations for our findings. Finally, this study was a case study that involved only one patient, and studies with larger sample sizes might better explore the present study results.

Disclosure of interest

The authors declare that they have no competing interest.

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