

Transcranial Direct Current Stimulation Combined with Peripheral Neuromuscular Stimulation Improves Quality of Life, Fatigue, and Pain in a Patient with Rheumatoid Arthritis and Refractory Radicular Pain Related to Spinal Stenosis

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Abstract

Background: Transcranial direct current stimulation (tDCS) has emerged as an adjuvant noninvasive neuromodulation tool to control fatigue and pain. To date, no studies have assessed the safety and efficiency of tDCS in patients with rheumatoid arthritis and with fatigue, poor quality of life, and refractory radicular pain associated with spinal stenosis. **Case Presentation:** An 85-year-old woman patient presented with rheumatoid arthritis in remission, refractory radicular pain-associated spinal stenosis, fatigue, and impaired quality of life. The patient underwent 16 daily sessions of tDCS intervention (2 mA, 20 min, positively and negatively charged electrodes were positioned at C1 and Fp2, respectively), in addition to simultaneous peripheral neuromuscular electrical stimulation (frequency of 100 Hz and amplitude of 500 μ s). After the intervention, neither disease relapse nor clinical intercurrent occurred. Moreover, there was a significant and sustained improvement in her health-related quality of life, with a reduction in the level of pain and chronic fatigue. **Conclusion:** The present case report shows that tDCS is safe and may be an adjuvant tool for the treatment of pain and fatigue in patients with systemic autoimmune disease, as well as for improving quality of life. Further studies are required to corroborate this case report.

Keywords

Neuromodulation, Pain, Radiculopathy, Rheumatoid Arthritis, Treatment

1. Introduction

Rheumatoid arthritis (RA) is a systemic chronic autoimmune disease associated with poor health-related quality of life (HRQoL) characterized mainly by impairment of functionality that leads to chronic fatigue syndrome [1] [2]. In addition, radicular pain has been cited as one of the most common causes of neuropathic pain in the general population and in patients with RA corroborating a significant decline in HRQoL [3] [4].

Notable advances in pharmacological treatment aiming at disease control have allowed most patients to live with RA remission or low disease activity. However, in clinical practice, the management of persistent pain in cases with high refractoriness constitutes a challenge to pain improvement and the consequent HRQoL [2] [3].

In this context, the roles of central sensitization and maladaptive plasticity, which seem to play considerable roles in pain maintenance, have been highlighted [5] [6]. Therefore, strategies are necessary to modulate central processing in cases with high refractoriness to pharmacological treatment.

Transcranial direct current electrical stimulation (tDCS) is a noninvasive neuromodulatory tool that delivers low intensity and utilizes electrical stimulation in the scalp [7] [8] [9]. This electrical stimulation can be delivered transcranially to promote bidirectional, polarity-dependent changes in the brain cortex. Consequently, tDCS induces specific changes in physiological, neurophysiological, and motor activity as a function of targeted brain sites [9] [10] [11] [12].

An emerging strategy is tDCS, which has encouraging results in patients with fibromyalgia, knee osteoarthritis and even surgical procedures, leading to modulation of brain plasticity, resulting in pain analgesic effects and improvement in HRQoL [12] [13] [14] [15].

However, to date, there have been no studies on the potential effects of tDCS associated with neuromuscular stimulation in patients with RA and chronic refractory radicular pain as well as chronic fatigue and quality of life.

2. Case Presentation

An 85-year-old woman presented with chronic symmetrical polyarthritis without an apparent cause, as well as persistently elevated acute-phase reagents, positive rheumatoid factor, and anti-citrullinated cyclic antibodies. The American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) classification criteria for RA [16] was established in 2013. After the introduction of methotrexate 10 mg/week and leflunomide (20 mg/day), the disease entered remission (Disease Activity Score [17], DAS28 < 2.6). In 2015, the patient pre-

sented with generalized fatigue, in addition to progressive neurogenic claudication of the lower limbs, which led to decreased function and quality of life. Magnetic resonance imaging of the lumbosacral spine showed medullary canal stenosis with several lumbar root compressions. Electroneuromyography showed moderate axonal impairment with signs of chronic innervation and no signs of active denervation affecting the L3 to S1 myotomes on the right, and the L4 to S1 myotomes on the left. The patient experienced refractoriness or side effects of various medications, either alone or in combination (gabapentin, carbamazepine, amitriptyline, pregabalin, non-hormonal anti-inflammatory drugs, analgesics, opioids, and intramuscular and intradural glucocorticoids). She underwent motor physical therapy and acupuncture but experienced no significant improvement in her symptoms. The patient refused spinal surgery. In 2019, the patient underwent 16 daily sessions (except on weekends) of tDCS intervention (electric current intensity of 2 mA, density of 0.057 mA/cm², session duration of 20 min). The electrodes were positioned in accordance with the international system. The positively charged electrode was positioned at C1 (contralateral to the dominant limb) and the negatively charged electrode was positioned in the supraorbital region Fp2 (ipsilateral to the dominant limb). Concomitant to tDCS, the patient underwent neuromuscular electrical stimulation for 20 min at an intensity set according to limier sensitivity, a frequency of 100 Hz and an amplitude of 500 µs. The electrodes were positioned on motor points located in the rectus femoris and gastrocnemius muscles. Additionally, the patient performed a specific motor task. Before and after tDCS intervention the patient was submitted to a questionnaire related to quality of life (Short Form questionnaire [18]—SF, values ranging from 0 to 100 for each domain); pain (McGill questionnaire [19] with the following domains: discriminative sensory, affective-motivational, cognitive-evaluative and miscellanea; the total score of all domains ranged from 0.0 to 78.0); physical capacity (Health Assessment Questionnaire [20]—HAQ, values ranging from 0.00 to 3.00); and fatigue (Fatigue Severity Scale [21]—FSS, values ranging from 9 to 63).

Before the intervention, the patient presented with disease remission according to the DAS28 scores (<2.6). Her total McGill pain score was 47.0 out of 78.0 (discriminative sensory score of 21.0, affective-motivational of 11.0, cognitive-evaluative of 5.0, and miscellaneous of 10.0). Her FSS score was 56 out of 63, whereas her HAQ score was 1.60 out of 3.00. The SF domain scores were as follows: physical aspect was 10.0, pain was 22.0, vitality was 45.0, emotional aspects were 100.0, mental health was 48.0, and general health was 15.0 (Table 1).

After 16 tDCS sessions associated with peripheral neuromuscular stimulation, neither disease relapse nor clinical intercurrent occurred. The patient's total McGill pain score decreased by 55.3% (from 47.0 to 21.0). In addition, her discriminative sensory, affective-motivational, cognitive-evaluative and miscellaneous domain scores decreased by 23.8%, 100.0%, 60.0% and 70.0%, respectively. Her FSS and HAQ scores decreased by 70% and 25%, respectively. Concerning SF domains, physical aspects, pain and vitality increased by 100.0%, whereas

Table 1. General features of the patient reported in the present study at baseline and after 16 tDCS sessions associated with peripheral neuromuscular stimulation.

	Baseline	After tDCS intervention	Percentage of reduction (%)
Disease status	Remission	Remission	-
SF (0 - 100)			
Physical aspect	10.0	0	100
Pain	22.0	0	100
Vitality	45.0	0	100
Emotional aspects	100	100	0
Mental health	48.0	48.0	0
General health	15.0	10.0	33.3
McGill questionnaire (0 - 78)	47.0	21.0	55.3
Discriminative sensory	21.0	16.0	23.8
Affective-motivational	11.0	0	100
Cognitive-evaluative	5.0	2.0	60.0
Miscellanea	10.0	3.0	70.0
HAQ (0.00 - 300)	1.60	1.20	25.0
FSS (9 - 63)	56.0	16.8	70.0

DAS: Disease Assessment Score; FSS: Fatigue Severity Scale; HAQ: Health Assessment Questionnaire; SF: Short Form Questionnaire.

general health increased by 33.3%. However, no changes were observed in the emotional or mental health domains (**Table 1**).

After the intervention, neither disease relapse nor clinical intercurrent was observed. Moreover, all previous characteristics remained stable for at least one month of follow-up.

3. Discussion

To our knowledge, this is the first study to demonstrate the effectiveness of 16 daily sessions on chronic fatigue and refractory pain related to root pain. In addition, improvements in HRQoL were observed in the patient with RA and radicular refractory pain related to spinal stenosis.

The findings of this study are similar to those reported in the literature for patients with neuropathic pain [12]. However, in the context of systemic autoimmune rheumatic diseases there is a clear gap in studies on the application of tDCS with complementary therapy.

In several systemic autoimmune rheumatic diseases, there is a significant prevalence of fatigue and chronic pain, which have a remarkable impact on HRQoL in these patients [1] [2] [3]. Therefore, studies in patients with fibromyalgia [13]

and knee osteoarthritis [14] [15] show that the application of tDCS can attenuate chronic pain and fatigue, leading to improved HRQoL [12] [15] [22] [23] [24].

In the present case report, refractory pain related to root pain and RA contributed to a significant worsening of pain and chronic fatigue [22] [23] [24]. In this context, the tDCS proved to be effective in the management of these parameters resulting in a significant improvement in HRQoL. In addition, there were no signs of worsening of the clinical manifestations of RA suggesting that tDCS was safe in this patient. Therefore, the proposed study offers a new possibility of treatment in patients with RA and refractory pain associated with lumbar canal stenosis.

However, there is an imminent need for further studies, considering the limitations of this study, which makes any broad application to the population impossible. Furthermore, given the association between neuromuscular stimulation and tDCS, the additive effects of neuromuscular stimulation on tDCS are not well understood. Finally, there is an imminent need for future studies with appropriate designs and a larger number of patients to confirm our findings.

4. Conclusion

In conclusion, this study showed that 16 tDCS sessions associated with neuromuscular stimulation were safe and may be an adjuvant tool for the treatment of pain and fatigue in patients with systemic autoimmune disease, as well as for improving quality of life. Further studies are required to corroborate this case report.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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