BrJP. 2024, v.7:e20240036

EDITORIAL

Transcutaneous electrical nerve stimulation for pain relief: have you kept up with scientific updates?

Estimulação elétrica nervosa transcutânea para alívio da dor: você acompanhou as atualizações científicas?

https://doi.org/10.5935/2595-0118.20240036-en

Transcutaneous electrical nerve stimulation (TENS) is a non-pharmacological intervention characterized by the application of low--frequency electrical current to the skin to promote analgesia[1]. This modality of electrical stimulation can reduce pain intensity, both at rest and during movement, reducing both primary and secondary hyperalgesia as well as allodynia. It also reduces inflammation, fatigue and fear of movement, restores central sensitization and increases function and quality of life without reports of major adverse effects. It is then used as an important alternative for pain relief both by different health professionals who care for patients with pain and by the patients themselves, who have access to simpler equipment that can be purchased in pharmacies.

However, despite so many studies on the subject, there is still a lot of doubt about the best "dose" of TENS, which means, in this case, the combination of several components that must be considered in order to prescribe an individualized treatment with TENS, such as frequency (in Hertz; low/high/mixed/alternating), intensity (in mA; sensory or motor level), pulse duration (in μs or ms), time (in minutes), electrode placement (in the dermatome, acupoint, nerve or paravertebral pathway). However, the optimal TENS program for pain control varies according to the individual context. Not all individuals respond to TENS in the same way as there are different factors that influence the optimal effect, such as the choice of parameters, patient expectations, placebo/nocebo approach, and limiting beliefs.

Mechanistically, preclinical and clinical studies have shown that TENS has both peripheral and central (spinal and supraspinatus) action on the nervous system, reducing neural excitability at both levels. In the periphery, TENS activates μ subunits of opioid receptors and α-2 adrenergic receptors, in addition to decreasing the concentration of substance P. In the spinal cord, TENS activates the μ and δ subunits of opioid receptors, GABA-A GABAergic receptors, serotonergic 5-HT2 and 5-HT3, muscarinic M1 and M3 while reducing levels of excitatory neurotransmitters such as substance P, glutamate, and aspartate. In the brain, TENS also activates opioid receptors μ and δ in the rostrovenromedial region of the medulla oblongata, which activates descending pain inhibitory pathways. TENS also plays an important role in the periaqueductal grey matter. Additionally, at central levels, low and high frequencies of TENS selectively activate μ and δ opioid receptors, respectively. If the frequency or intensity is not modified, the tolerance effect (loss of efficacy) may occur[2].

Clinically, TENS can reduce acute postoperative pain at rest and during movement in a variety of conditions such as abdominal, thoracic and orthopedic surgeries. In addition, TENS can also improve functionality after surgery due to decreased pain and decreased medication consumption, reducing the frequency or number of adverse events. The effect can be optimized if the intensity is increased to a high sensory level as tolerated by the patient. There is evidence that TENS also reduces acute pain in procedural situations, ischemia, renal colic, childbirth, fractures, and during transport after trauma.

Recent studies have shown that TENS reduces pain intensity at rest and movement, reduces fatigue, reduces peripheral and central neural sensitization to pain, promotes better analgesia when applied simultaneously to physical exercise interventions, it generates more pronounced clinical results when pain is measured in movement in both nociceptive and nociplastic pain, decreases fear of movement, improving exercise adherence[3,4]. There is evidence to support the use of TENS in populations such as fibromyalgia, pelvic pain, temporomandibular disorder, osteoarthritis), neurological disorders (spinal cord injury, stroke, and postherpetic neuralgia). However, there are still controversies about the use of TENS alone to treat pain such as low back pain, primary dysmenorrhea, complex regional pain syndrome, and headaches[5,6].

In more recent years, studies have not classified TENS as conventional, burst, brief and intense, and acupuncture. Both low and high frequencies of TENS can be prescribed for any case of pain, whether acute or chronic, contrary to what many clinicians still think. Maintaining a constant frequency throughout the calls can promote a loss of efficacy due to the development of the tolerance mechanism, but the modulation between low and high frequencies (either mixed – low and high frequency cycles during the same call – or alternating – alternating between low and high frequencies in consecutive calls) can delay the development of tolerance to TENS. Higher levels of TENS intens, including at the point of motor contraction, may be more effective in promoting optimal pain relief. Additionally, combining frequency modulation and increasing the intensity of TENS produces greater analgesia. Twenty or thirty minutes may be enough to promote analgesia. Because TENS produces systemic effects due to its role in the central nervous sys-

tem, electrodes can be applied locally or to extrasegmental areas to generate pain relief. In case of not applying the electrodes in painful sites, educational strategies should be offered to patients in order to provide sufficient information about their biological action even outside the primary site of the pain report.

It is important to mention that the professional's approach is essential; positive communication and attitudes increase the analgesic effect promoted by TENS (placebo effect) and negative expectations may impair analgesia due to the potential nocebo effect[7]. In the last 30 years, a better understanding of the mechanisms of action and clinical efficacy of TENS is notorious, with evolutions in the understanding of its peripheral and central actions in the nervous system, in the appropriate choice of stimulation parameters and the time of action. Methodological procedures for conducting and reporting clinical trials and systematic reviews have evolved considerably and it is possible that in the next five to ten years there will be very high quality information and a strong level of evidence regarding the therapeutic effect of TENS in different pain conditions and its impacts on function and quality of life.

Josimari Melo DeSantana[1]
Mariana Arias Avila[2]

1. Federal University of Sergipe, Department of Physiotherapy, Postgraduate Program in Physiological Sciences, Program of Postgraduate Studies in Health Sciences, Aracaju, SE, Brazil
https://orcid.org/0000-0003-1432-0737
E-mail: josimelo@academico.ufs.br

2. Federal University of São Carlos, Department of Physiotherapy, Postgraduate Program in Physiotherapy, São Carlos, SP, Brazil
https://orcid.org/0000-0002-5081-5326
E-mail: m.avila@ufscar.br

REFERENCES

1. Dailey DL, Vance CGT, Rakel BA, Zimmerman MB, Embree J, Merriwether EN, Geasland KM, Chimenti R, Williams JM, Golchha M, Crofford LJ, Sluka KA. Transcutaneous electrical nerve stimulation reduces movement-evoked pain and fatigue: a randomized, controlled trial. Arthritis Rheumatol. 2020;72(5):824-36.
2. Vance CG, Dailey DL, Rakel BA, Sluka KA. Using TENS for pain control: the state of the evidence. Pain Manag. 2014;4(3):197-209.
3. DeJesus BM, Rodrigues IKL, Azevedo-Santos IF, DeSantana JM. Effect of transcutaneous electrical nerve stimulation on pain-related quantitative sensory tests in chronic musculoskeletal pain and acute experimental pain: systematic review and meta-analysis. J Pain. 2023;24(8):1337-82.
4. Tavares Oliveira M, Maciel Santos M, Lucas Mayara da Cruz Reis K, Resende Oliveira L, DeSantana JM. Transcutaneous electric nerve stimulation in animal model studies: from neural mechanisms to biological effects for analgesia. Neuromodulation. 2023;27:S1094-7159(23)00145-9.
5. Bjordal JM, Johnson MI, Ljunggreen AE. Transcutaneous electrical nerve stimulation (TENS) can reduce postoperative analgesic consumption. A meta-analysis with assessment of optimal treatment parameters for postoperative pain. Eur J Pain. 2003;7(2):181-8.
6. Johnson MI, Paley CA, Jones G, Mulvey MR, Wittkopf PG. Efficacy and safety of transcutaneous electrical nerve stimulation (TENS) for acute and chronic pain in adults: a systematic review and meta-analysis of 381 studies (the meta-TENS study). BMJ Open. 2022;12(2):e051073.
7. Agripino ME, Lima LV, Freitas IF, Souto NB, Carvalho TC, DeSantana JM. Influence of therapeutic approach in the TENS-induced hypoalgesia. Clin J Pain. 2016;32(7):594-601.