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THE ROLE OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION IN THE TREATMENT OF POSTOPERATIVE PAIN AFTER ABDOMINAL SURGERY

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Summary

Postoperative pain is a common consequence of surgery and, if inadequately managed, can impair recovery, increase opioid use, contribute to the development of chronic pain, and create a significant economic burden. Modern analgesic strategies rely on the multimodal approach, which includes the use of both pharmacological and non-pharmacological treatments. Recent guidelines strongly encourage the search and use of effective non-pharmacological methods to reduce opioid use. Transcutaneous electrical nerve stimulation (TENS) is a non-invasive safe method widely used to treat different types of pain. It has been found to reduce pain and analgesic consumption in the postoperative period. Additional benefits include improved patient comfort, satisfaction, and engagement in recovery. Although TENS is commonly implemented in orthopedic postoperative care, its application for abdominal surgery is limited and poorly standardized. This review will examine the effectiveness of TENS for postoperative pain after abdominal surgery and aims to summarize the most efficient parameters.

Introduction

Postoperative pain is defined as acute pain that follows a surgical procedure. It includes different types of pain, such as nociceptive from surgical injury, visceral pain from organ handling, and referred pain (18). Postoperative pain remains one of the most common and consequential problems in surgical care. Roughly more than half of patients report moderate-to-severe postoperative pain in the early postoperative period or after discharge (1,2,4). Poorly managed postoperative pain is associated with impaired recovery, reduced mobility, increased risk of thromboembolic complications, delayed wound healing, prolonged use of opioids and an increased likelihood of developing chronic pain (1,3,4,5). Furthermore, these complications reach beyond individual patients. Nationally, postoperative pain creates a big economic burden, due to prolonged hospitalization, increased anaesthetic or interventional resource needs and individual productivity losses because of chronic pain (1,6,7). Current postoperative analgesia relies on multimodal approaches that combine pharmacological and non-pharmacological techniques to reach successful early rehabilitation. These approaches aim to lower pain scores and reduce side effects from continued pain treatments, distinctly opioids. Standard pharmacological methods include acetaminophen, NSAIDs, local anesthetic infiltration, regional blocks, neuraxial analgesia when appropriate and opioids. Newest discussions also add that analgesia chosen for postoperative pain should be surgical procedure specific. Although opioids remain central for managing moderate-to-severe postoperative pain, their use is associated with adverse effects such as sedation, respiratory depression, ileus, nausea, and the risk of postoperative opioid misuse. Guidelines therefore greatly encourage strategies that reduce opioid exposure without compromising analgesic effectiveness. Despite all this, many patients continue to require relatively high opioid doses postoperatively, reflecting a persistent need for additional non-pharmacological modalities (4,5,12). Given the high prevalence of postoperative abdominal pain, the limitations of current analgesic strategies and the growing interest in non-pharmacological adjuncts, there is need for analysis of the available evidence regarding TENS for postoperative abdominal surgery pain.

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Aim

To evaluate the effectiveness of TENS for postoperative pain after abdominal surgery and to identify which TENS parameters, such as frequency, pulse width, intensity, electrode placement, and timing, are associated with the greatest analgesic benefit.

Research material and methods

For this article a literature review has been done. Sources have been searched for in Pubmed, using keywords and their combinations in english: TENS, postoperative pain, abdominal surgery, acute pain. Found publications were analysed in the english language. Reference lists of relevant systemic reviews were looked through and additional studies found and analysed individually. Analysed publications included relevant to the topic and aims individual research studies, meta-analyses, systemic reviews and narrative reviews.

Results

Basis of TENS. Transcutaneous electrical nerve stimulation (TENS) is a non-invasive physical intervention that applies controlled electrical stimulation through electrodes placed on skin to modulate pain. Proposed mechanisms include the gate-control theory, which states that the mechanical activation of touch-related nerves, such as the large-diameter Aβ afferent fibers, can inhibit transmission from pain nerves, such as the small diameter nociceptive fibers. Pain transmission is interrupted at the spinal dorsal horn, which in turn reduces perceived pain. For the biological basis TENS also acts on neurotransmitters by activating the endogenous opioid system. High frequency TENS activates δ-opioid receptors, while low frequency activates μ-opioid receptors. There is also evidence to suggest that TENS increases GABA concentration. Activating opioid receptors reduces glutamate and substance P release, in turn reducing excitability and decreasing central sensitization (8,9,17). TENS has demonstrated analgesic benefits in a variety of acute and chronic pain conditions and has been used extensively in orthopedic, musculoskeletal postoperative contexts, where multiple studies report reductions in pain scores and postoperative opioid consumption (8,13,14). Evidence for TENS in abdominal procedures, however, remains comparatively limited, heterogenous and lacks standardized methodology as such requiring deeper analysis (8,9,11,16,17).

Effectiveness. Pain intensity after surgery with TENS versus with other methods or placebo was the most researched outcome. Most often studies used VAS to identify pain intensity, making analyzing results easier and more reliable. In turn, this outcome can now reliably be used to determine the general effectiveness of TENS for abdominal surgery. Two studies looked into TENS for open abdominal surgery and found pain scores to be reduced by around 1 on VAS (21, 24). One of them noted shorter admission time and time till first defecation (21). The most studied surgery type is abdominal laparoscopic cholecystectomy. Research here found that pain scores were reduced by 1 on VAS (15,22, 23). One study here did not measure pain scores directly but instead compared a patient group receiving TENS directly against a patient group receiving only opioids for pain control and noted an equal reduction for both methods, as such concluding TENS to reduce opioid consumption, specifically oxycodone (19). One study additionally noted that TENS reduces the use of diclofenac (23). Another group of surgeries are abdominal wall surgeries, with only one study on open hernia Lichtenstein repair that showed pain reduction by 40%. This study also noted reduced ketorolac use (11). The last surgery type is laparoscopic gynecological surgeries, where only one study reported scores to be lowered by 1 on VAS. This study also noted the reduced use of emetics and rescue sufentanil(20). It is important to note that in two studies it can be seen, that pain is greatly reduced after TENS, but tends to increase with time, until a repeat of the therapy reduces it again. A rebound effect can be seen as this event reoccurs for the whole length of treatment, however in general pain is unlikely to return and reach similar high scores as in groups with no TENS intervention (11, 15). This suggests that TENS is more of a short-term relief for pain, which is concise with other more general research (26). Overviewing all studies we can continue to conclude that TENS is effective in reducing post operative pain after abdominal surgeries, just as it is known to be effective in reducing pain in other types of surgeries as well (11,15,19-24, 26).

Patient attitudes to TENS. Another important finding is the correlation between TENS and patient satisfaction, mood and proactiveness. In one study, patients receiving active TENS described greater confidence levels, increased autonomy leading to increased mobilization and a higher willingness to proactively continue therapy (10).

Adverse effects. TENS produces minor and very rare adverse effects, such as skin irritation and TENS discomfort (25, 26). TENS is also noted to need intact postoperative sensibility to produce effects and avoid likely skin irritation (19). For clear contraindications, TENS should not be used with a pacemaker, pregnancy, epilepsy and should be avoided with known allergies to adhesives, extensive surgical complications and preexisting neuronal damage at electrode placement site (11,16,19, 21, 24).

Parameters. TENS parameters used across all studies for abdominal surgeries vary greatly and are hard to summarize for a universal number, due to all studies including very

different abdominal surgeries. If trying to note the most often used parameters, we can find that high frequency and high intensity are the most used. Most popular frequency range concluded to be from 80Hz to 150Hz (11,15,19,20,22-24). Pulse width varied quite equally, if set to wide, one study chose around 200qs (11), with one going further and using 500qs (21). Other studies found success with a shorter width of 75qs (15,22). Intensity was the most varied setting, since even if a baseline amplitude was set and recorded it then was individually adjusted for each patient to the strongest possible sensation that did not cause pain or discomfort. (15,19,20,22,24). The gap most studies have not filled was to summarize the individual amplitude settings of each patient. However, such a gap doesn't necessarily need to be filled since amplitude was in some studies continuously corrected to fight accommodation (11,22,15). The current settings were not usually noted, but some studies chose biphasic and sometimes combined it with an alternating mode (11,15,22,24). When discussing the duration and initiation of treatment, most studies initiate TENS shortly after surgery (11,15,19,21-24). The whole duration of treatment varies in studies, with some doing only 1 time application (22,23), and others choosing to use TENS for the whole hospital stay (19). However, to make a suggestion on duration of treatment it is relevant to remember two studies showing the rebound of TENS pain relief (11,15), thus suggesting the use of TENS for longer periods to be more effective, than a one-time application. However, when talking about TENS parameters for abdominal surgery, it is also important to analyze and include some big, recent reviews that have been done for a more general application of TENS (25,26). Both reviews highlight that parameter variability by pathology is not as important as it would seem. The main goal for effective treatment is to simply produce a strong but comfortable TENS sensation at the site of pain, while adjusting the amplitude to maintain intensity if sensation fades due to accommodation. There is also evidence to suggest that no significant difference in outcomes of TENS is seen when comparing high and low frequencies. TENS can be seen to be effective for both acute and chronic pain (25,26). For pain types, one of the reviews suggested that nociceptive pain is more receptive to TENS than neuropathic, but this suggestion is influenced by having more research done on pain of nociceptive origin (26). Lastly for electrode placement, the suggested location is simply where pain is the most bothersome (25,26). For incisional pain one study noted 2-3 inches away from the cut to be optimal (23). There is also need to keep electrodes away from active, treatable tumor sites or drug delivery sites (16). To add more, some studies successfully included dermatome based placements (11,19,24), or acupuncture point based (20,21). These raise the need to further explore dermatome and acupuncture based locations and clearly focus on their isolated effectiveness in reducing postoperative pain. To summarize, usually a wide, high frequency current is used, with electrode placement on the main site of pain, with the most important parameter becoming intensity, which should be individualized for each patient to produce the strongest felt sensation without causing pain and should be continuously changed to fight accommodation.

Conclusions

1. TENS is an effective non-invasive method for pain reduction after abdominal surgery, reducing pain by at least 1 point on VAS scale.

2. TENS decreases analgesic and opioid consumption and increases patient satisfaction, mood and proactiveness in recovery.

3. TENS has minor and rare complications, such as skin irritation or procedure discomfort.

4. TENS is contraindicated to use for patients with pacemakers or with diagnosis of pregnancy or epilepsy and should be avoided with known adhesive allergies, preexisting neuronal damage at electrode sites or extensive surgical complications.

5. Suggested TENS parameters for postoperative pain after abdominal surgery are high frequency (80-150Hz), wide (200qs) currents, with intensity individually matched to each patient to produce the strongest possible sensation, without causing additional pain or discomfort.

6. TENS should be initiated shortly after surgery and should be used at least for a few days and if possible, kept for the whole hospital stay.

7. TENS electrodes should be placed on the main site of pain, keeping a few centimeters away from incision sites. Dermatome and acupuncture site placements could be considered, however isolated results are too sparse to fully recommend.

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TRANSKUTANINĖS ELEKTRINĖS NERVŲ STIMULIACIJOS VAIDMUO GYDANT POOPERACINĮ SKAUSMĄ PO ABDOMINALINĖS CHIRURGIJOS

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Raktažodžiai: transkutaninė elektrinė nervų stimuliacija, TENS, pooperacinis skausmas, pooperacinė analgezija, pooperacinė priežiūra.

Santrauka

Pooperacinis skausmas yra dažna operacijos pasekmė. Tinkamai negydomas, jis gali sutrikdyti gijimą, didinti opioidų vartojimą, prisidėti prie lėtinio skausmo atsiradimo ir sukelti reikšmingą ekonominę naštą. Šiuolaikiniai analgezijos metodai remiasi multimodalinėmis strategijomis, kurios apima tiek farmakologinį, tiek nefarmakologinį gydymą. Naujausiose gairėse tvirtai rekomenduojama ieškoti ir naudoti veiksmingus nefarmakologinius metodus, siekiant sumažinti opioidų vartojimą. Transkutaninė elektrinė nervų stimuliacija (TENS) yra neinvazinis, saugus metodas, plačiai naudojamas įvairių tipų skausmui gydyti. Nustatyta, kad jis mažina skausmą ir analgetikų vartojimą pooperaciniu laikotarpiu. Papildomi privalumai apima pacientų komforto, pasitenkinimo ir įsitraukimo į reabilitaciją pagerėjimą. Nors TENS dažniausiai taikomas ortopedinėje pooperacinėje priežiūroje, jo taikymas pilvo chirurgijoje yra ribotas ir menkai standartizuotas. Šiame straipsnyje nagrinėjamas TENS veiksmingumas malšinant pooperacinį skausmą po abdominalinės chirurgijos ir siekiama apibendrinti veiksmingiausius jo taikymo parametrus.

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