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The analgesic efficacy of APS is equal to TENS. Pilot study of patients with chronic pain in the musculoskeletal disorders

Abstract

Background. Pain accompanying the musculoskeletal disorders appears to be one of the most frequent medical problem. It concerns both office workers who sit for long hours in one position and people who do hard physical labor. The pain is usually difficult to treat. Change of the life style, pharmacotherapy and different techniques of physical therapy are all important. APS-therapy and TENS are the physical methods based on therapeutic use of the electrical current. They both can be very useful in many pain-related disorders, providing fast relief of symptoms. The aim of this pilot clinical study was to compare the analgesic efficacy of APS-therapy and TENS in chronic pain due to musculoskeletal disorders.

Material and methods. The study involved 25 patients with musculoskeletal disorders who suffered from chronic pain. Thirteen of them were treated by the use of TENS and 12 — by APS. In the TENS group each patient received treatment for 2 weeks and in the APS — for 3 weeks. TENS was administered for a period of 60 minutes while APS for 16 minutes, both 5 times a week. The treatment was given by portable units, that generated an APS waveform and TENS current. NRS evaluation was performed for 3 days of pre-treatment period, before each treatment, which reflected the pain situation of the previous 24 hours, and once daily for 2 weeks after the treatment.

Results. The study showed that both methods have almost equal analgesic efficacy. Comparing with the initial period, NRS significantly decreased during the treatment and observation. The difference between the mean values of NRS score in TENS and APS was not of the statistical significance.

Conclusion. Both TENS and APS-therapy may be the effective methods of nonpharmacological treatment of chronic pain in the musculoskeletal disorders.

Key words: APS-therapy, TENS, musculoskeletal disorder, chronic pain

Introduction

Chronic pain in the musculoskeletal disorders is quite common and causes a lot of suffering and disability. Analgesia achieved by pharmacotherapy is frequently unsatisfactory, and the presence of adverse reactions, particularly after non-steroidal anti-inflammatory drugs, is well known. Therefore many patients need physical methods such as TENS (Transcutaneous Electrical Nerve Stimulation) or APS--therapy (Action Potential Simulation). Indeed, electrotherapy may be the main or a complementary

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Advances in Palliative Medicine 2007, 6, 59–62

method for treating many pain related disorders, providing fast relief of symptoms.

Conventional TENS was originally developed as a way of controlling pain according to "the gate theory", in which selective stimulation of certain nerve fibres should block, or "close the gate" on signals carrying pain impulses to the brain [1]. TENS has been reported to be highly effective in the management of a wide variety of acute and chronic syndromes [2–5].

APS-therapy falls under the broad definition of MET (Microcurrent Electrical Stimulation). This type of electrical modality uses an electrical current of less than 1 mA, which is measured in the microamperage range. The APS-therapy produces a current that is claimed to stimulate an action potential in the neuron. According to the Arndt-Schultz Law, weak stimuli increase physiological activity [6]. Investigation into the physiological mechanisms has shown that these sub-threshold currents cause the following effects: changes in the cell wall permeability, increase of the intracellular concentrations of Ca^{2+} and adenosine triphosphate (ATP) production, stimulation of protein synthesis and increase of fibroblast activity [7]. The APS device was invented and designed by Lubbe in 1991 in South Africa, and marketed in 1994 even without published studies in peer-reviewed journals [7]. Publications on APS-therapy are still very rare and there is a great need of formal control studies.

A controlled trial using APS-therapy and TENS to treat the pain of osteoarthritis of the knee was reported by Berger [8]. In this study both methods of electrotherapy proved to be equally beneficial in the relief of stiffness and pain, especially occurring at night [8]. Other authors who studied the usage of APS-therapy in chronic and acute post-traumatic pain conditions (low back pain, tennis elbow, sports injuries, shoulder pain, arthritis) indicate that APS-therapy produces 40–80% pain relief after 5–15 treatment sessions [9–13]. Our previous study showed that APS-therapy significantly decreased pain due to different musculoskeletal disorders [14]. In this study we compare analgesic efficacy of APS and TENS.

Material and methods

The study protocol was accepted by the Ethics Committee of the Nicolaus Copernicus University, Collegium Medicum in Bydgoszcz in Poland. Before the trial each patient was examined by the physician and signed an informed consent. The study included patients with chronic pain due to musculoskeletal disorders with average pain intensity not less than 3 measured in NRS (Numerical Rating Scale; values from 0 to 10; 0 means "no pain", 10 — "overwhelming pain"). Patients had to be over 18 and able to estimate pain intensity.

Table 1. Patients characteristics

Total number of patients	25
Gender	
Female	17
Male	8
Clinical diagnosis	
Degenerative joint disease	11
Painful Shoulder Syndrome	10
Rheumatoid arthritis	2
Knee joint injury	2
Medication	
NSAIDs	2
Opioids	2
No medications	21

NSAIDs — Non-steroidal anti-flammatory drugs

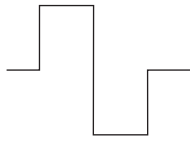
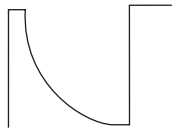
The study involved 25 patients (TENS group, n = 13; APS group, n = 12) with musculoskeletal disorders, who suffered from chronic pain. The demographic and clinical data of the investigated subjects are presented in the Table 1. Each patient received 2 weeks time treatment in TENS group and 3 weeks in APS group. The current was administered for a period of 60 minutes in TENS group and 16 minutes in APS group, both 5 times a week. The treatment was given by portable units. Technical specifications of the TENS and APS-therapy device, information about stimulation parameters and electrodes placements are presented in the Table 2. Numerical Rating Scale evaluation was performed for 3 days of pre-treatment period, before each treatment, which reflected the pain situation of the previous 24 hours, and once daily for 2 weeks after treatment.

Statistical analysis was made using licensed version of STATISTICA 5.0 PL software for Windows. The data were presented as the mean ± standard deviation of NRS values, calculated separately for the every study phases: initial observation, treatment phase and observation period after therapy (Fig. 1). The comparisons of the respective values were made by ANOVA method with three repetitions and Schefe post hoc test.

Results

The comparison of mean NRS values for: initial and therapy phases as well as observation period after TENS and APS treatment were presented in Figure 1. The comparison of mean summary NRS

Table 2. Transcutaneous Electrical Nerve Stimulation and Action Potential Simulation parameters

Stimulation parameters	Electrodes placements	Wave form
TENS		
Frequency = 80–100 Hz Pulse width = 100–200 μs Intensity — up to evoke the painless paresthesia Treatment duration = 60 min	One channel, electrodes were placed to surround the target area	
APS		
Frequency = 150 Hz Pulse width = 800 ms Intensity = 0.5–1.5 mA Treatment duration = 16 min	Two channels, electrodes were placed to surround the target area	

TENS — Transcutaneous Electrical Nerve Stimulation; APS — Action Potential Simulation

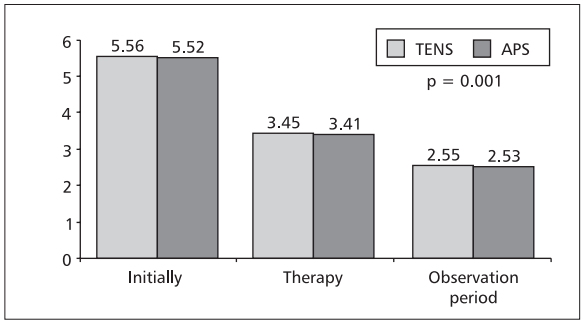


Figure 1. The comparison of mean NRS (Numerical Rating Scale) values for: initial and therapy phases as well as observation period after Transcutaneous Electrical Nerve Stimulation and Action Potential Simulation treatment; ANOVA F (2.46) = 0.01; p = 0.98; TENS — Transcutaneous Electrical Nerve Stimulation; APS — Action Potential Simulation

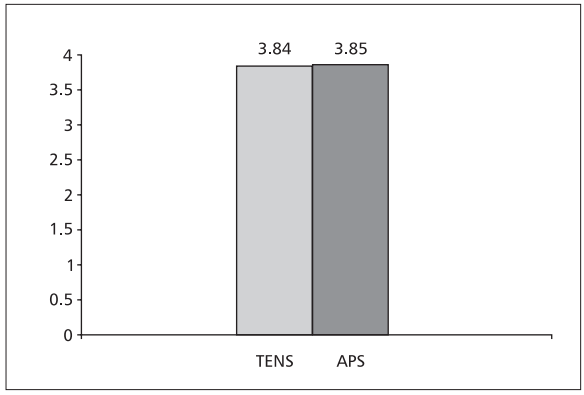


Figure 2. The comparison of mean summary NRS (Numerical Rating Scale) values for the whole period of the study; ANOVA F (1.23) = 0; p = 0.99; TENS — Transcutaneous Electrical Nerve Stimulation; APS — Action Potential Simulation

values for the whole period of the study were presented in Figure 2.

The study showed that both methods have almost identical analgesic efficacy. Comparing with the initial period NRS significantly decreased during the treatment and observation. The difference between the mean values of NRS score in TENS and APS was not of statistical significance. During the treatment no side effects were observed.

Discussion

The pilot study showed similar analgesic efficacy of two physical methods: TENS and APS. Considering the fact that after 14 days of TENS treatment and 21 days of APS the effects were identical, TENS seems to be more clinically useful. However, the duration of each session (TENS — 60 min and APS — 16 min) and physiological mechanisms causing analgesic effect should be taken into consideration. The mechanisms are connected with the time of maintaining decreased NRS scores. TENS is the method which "cure" pain only symptomatically while APS is a causal treatment of pain. Increase of ATP generation after microcurrent stimulation in rat skin models was reported by Cheng [15]. ATP plays an essential role in the inter-body communication (generation of nerve impulses for communication and control purposes), muscle contraction (e.g. during walking, breathing etc.), nerve conduction, transport, growth etc. That is the reason that APS-therapy can be used in pain relief, breakdown of inflammation and wound healing. To establish which post stimulation analgesic effect lasts longer the observation period should be prolonged.

The study suggests that both physical methods can be used as an alternative to drugs or complementary methods for chronic pain management. We showed that they significantly decrease pain due to different musculoskeletal disorders. Furthermore, these kinds of treatment are cheap and cause no side effects. Another advantage of these methods is the fact that the treatment session takes a short

time (approximately 16 minutes once a day for 3 weeks in APS, 60 minutes once a day for 2 weeks in TENS) and in many cases can be applied by the patient himself at home.

The results of this pilot study indicate that it ought to be continued in a bigger group of patients.

Conclusion

APS-therapy and TENS are useful non-pharmacological therapeutic modalities of comparable efficacies for the treatment of chronic pain in musculoskeletal disorders.

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