Transcutaneous Electrical Nerve Stimulation (TENS) in Patients with Pregnancy-Induced Low Back Pain and/or Pelvic Girdle Pain

Transkutane elektrische Nervenstimulation (TENS) bei Kreuzschmerz und/oder Beckengürtelschmerzen in der Schwangerschaft

Abstract

Purpose: Low back and/or pelvic girdle pain is common during pregnancy and may persist after delivery. Therapeutic methods to alleviate pain, with no side effects for mother and child, are of high clinical importance. The consensus statement expresses the position of the Working Group on Evidence-Based Medicine in Physical and Rehabilitation Medicine, the Austrian Society of Physical Medicine and Rehabilitation and the Austrian Pain Society, for the treatment of low back and/or pelvic girdle pain by transcutaneous electrical nerve stimulation (TENS) during pregnancy.

Materials and Methods: The literature was reviewed followed by a subsequent interdisciplinary discussion.

Results: Diagnostic investigations, therapeutic options, mode of application as well as efficacy and side effects of the method are presented.

Conclusion: TENS is a safe therapy for low back and/or pelvic girdle pain in the last trimester of pregnancy with no side effects, low costs and the possibility of home application.

Introduction

Many women develop low back pain and/or pelvic girdle pain during pregnancy. The pain usually occurs in the second or third trimester of pregnancy and may persist for some time after delivery. Lumbar lordosis is suspected to cause painful dysfunction of the trunk muscles and lumbar spine muscles [1,2]. Drug treatment, therapeutic exercise, and other physical therapy options are usually limited due to pregnancy. Therefore, such pain may markedly impair the women’s sleep, quality of life, and working capacity. Additional therapeutic procedures to alleviate pain, with no side effects for the mother or the child, are therefore of high clinical importance.

Aims and contents of the Consensus Statement

This consensus statement expresses the position of the Working Group on Evidence-Based Medicine in Physical and Rehabilitation Medicine, the Austrian Society of Physical Medicine and Rehabilitation, and the Austrian Pain Society, for the treatment of pregnancy-induced low back pain...
and/or pelvic girdle pain by means of transcutaneous electrical nerve stimulation (TENS). It is intended to serve as a medical basis for decision-making in regard of additional therapy options for the treatment of such pain. Concerning the diagnostic investigation of pregnancy-induced low back pain and/or pelvic girdle pain in pregnancy, this consensus statement is based on the European guidelines of Vleeming et al. [3] and the Austrian guidelines for the management of acute and chronic low back pain [4,5]. Furthermore, the recent recommendations of the Cochrane Collaboration for the treatment of pregnancy-induced pelvic girdle pain were taken into account [6]. However, the last update of the Cochrane Collaboration, which takes all studies until July 2012 into account, does not provide any recommendation about TENS treatment because no clinical trials on the subject were available at this point in time. In the meantime, a randomized controlled study in pregnant women has been published in addition to the existing animal experiments. As TENS is a very economical and effective form of pain therapy, the panel of experts believes that it should not be withheld from pregnant women as a method of adjuvant pain treatment. The aim of the consensus statement is to reflect recent scientific conclusions and the clinical experience of the panel of experts. The current level of published literature and the rationale for TENS therapy will be explained. On this basis, the patient can be offered the most beneficial and individualized treatment for her condition.

Target population
The Consensus Statement addresses all doctors who treat patients with pregnancy-induced low back pain or pelvic girdle pain.

Methods
After the existing literature had been reviewed carefully by members of the Working Group on Evidence-Based Medicine in Physical and Rehabilitation Medicine and subsequent interdisciplinary discussion, the written correspondence between the members resulted in a consensus which is the subject of this statement. All members confirmed that there were no financial conflicts of interest with regard to the statement.

Definition of pregnancy-induced low back pain and pelvic girdle pain
In the published literature, a distinction is made between pregnancy-induced low back pain and pelvic girdle pain [7]. Low back pain is defined as pain in the spine, between the costal arch and the lower gluteal folds, with or without pain spreading to the legs [4,5]. Pelvic girdle pain is defined as pain between the posterior iliac crest and the gluteal fold, especially in the region of the sacroiliac joint, with or without radiating pain into the dorsal portion of the thigh. Additional or even isolated pain in the symphysis is also regarded as pelvic girdle pain [3]. Quite often it occurs after a prolonged period of standing or sitting. Evidently, the locations mentioned in these 2 definitions may overlap. Clinically as well, the transitions are fluid and the 2 forms may occur simultaneously. Therefore this Consensus Statement may be regarded as a guideline for the treatment of both types of pain.

Prevalence
Due to the overlapping definitions of low back pain and pelvic girdle pain, the prevalence of these conditions in the published literature is highly variable. Depending on the population [8–10], the location of pain [3,7], and the diagnostic tests used, the prevalence ranges between 4 and 85% [1,11,12].

Etiology
The causes of pregnancy-induced low back and pelvic girdle pain have not been conclusively established yet but several factors are believed to be involved. On the one hand the hormone relaxin seems to play a role in the condition. Relaxin is produced by the uterus and is capable of altering the laxity of ligaments [3,13]. On the other hand, the increasing mass of the growing infant displaces the body's center of gravity and therefore intensifies lumbar lordosis. This, in turn, may lead to a dysfunction of lumbar spine muscles and cause greater strain on the ligaments [2]. Gutke et al. [1] report reduced strength in the hip extensors and reduced endurance of spinal extensor and flexor muscles in pregnant women with low back pain and/or pelvic girdle pain. Vermani et al. [12] list a number of risk factors, but emphasize nonspecific low back pain before pregnancy, heavy physical work, and early traumatic injury to the pelvis as strong predictors.

Diagnostic investigation
Medical history
Detailed recording of the patient's medical history is mandatory at the start of the diagnostic procedure in order to rule out a potential specific cause of pain. In accordance with the guidelines for chronic nonspecific low back pain, the foremost aspect to be looked for is the presence of red flags. Red flags indicate an inflammatory, infectious, traumatic, neoplastic, degenerative or metabolic cause, and must be subjected to further diagnostic investigation as well as therapy [4,5,14]. Thus, the aim of medical history-taking is to rule out red flags on the one hand, and determine the exact history of pain on the other. This includes the duration of pain, its intensity, location, any radiating pain, the potential cause of pain, and its dependence on physical exercise. Besides, it is important to note whether similar pain episodes occurred before pregnancy.

A further aspect in pregnant women is that low back pain may mask other pregnancy-related diseases in the mother or the child. Therefore, a gynecological expertise must be obtained before the initiation of any pain therapy.

Clinical investigation
The aim of the clinical investigation, in combination with the patient's medical history, is to rule out specific causes of low back pain and delineate the area of pain as accurately as possible. Therefore, the minimal version of the clinical investigation must include the inspection of body posture and gait, palpation, a movement test, and a neurological examination. During the inspection of posture the clinician should look for the presence of pain-relieving posture, intensified lumbar lordosis, deformities, or injuries. While the patient walks the clinician should especially look for limping mechanisms and their causes. Palpation should include the entire paravertebral and gluteal muscles as well as the ligaments of the spine and the pelvis. In addition, the sacroiliac joint, the facet joints, and the symphysis should be checked for tenderness. The mobility of the lumbar spine should be inspected in all major planes, and the clinician should look for pain, limitations, or muscular insufficiency. Additionally, provocation tests for the sacroiliac joint, the symphysis, and the sacroiliac ligaments are recommended in accordance with the European guidelines for pelvic girdle pain [3].

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Imaging investigations
When the patient has no signs of red flags, further diagnostic imaging is not necessary.

Follow-up
Regular controls should be performed during the entire period of treatment in order to evaluate the success of therapy and/or rule out new red flags. A postpartal follow-up investigation should also be performed for the purpose of drafting an optimal therapy program in case of persistent symptoms.

Therapeutic options
Pregnant women constitute a special patient population in terms of potential therapeutic approaches. The use of painkillers is markedly limited with regard to the choice of approved drugs as well as the duration of drug treatment during pregnancy. As the pain described here may persist for several weeks or even months the European Guidelines for Pelvic Girdle Pain recommend multimodal therapy. Obviously, it is important to inform the patients about the cause of pain and instruct them to continue their activities of daily living. Further therapeutic measures could include the following:
- Exercises to improve the control of muscles of the lumbar spine
- Exercises to strengthen the muscles of the lumbar spine
- Manual therapy
- Gentle massage in sitting position
- Heat treatment
- Pelvic belt

No statement could be made in the European guideline about the use of physical pain therapy with TENS because no studies addressing the efficacy of this method in pregnant women were available at the time of its publication. However, a blinded randomized controlled study on the application of this method in pregnant women has been published in the meantime. Therefore TENS therapy could be an effective additional method to reduce pain during pregnancy. In the following section the method of TENS application, its effects, side – effects and its applicability will be evaluated.

Physical Pain Therapy with TENS

Theoretical principles
Electric currents to combat pain have been used in physical pain therapy for several decades. It usually involves the application of surface electrodes on the skin and thus including the human body in the electric circuit. The term TENS is used in English to designate the application of electric current through the skin. However, in the published literature this term is used for specific types of electricity and specific indications. The term TENS therapy, as used in the published literature, refers to specific currents with narrow rectangular single pulses of 0.1–0.2 milliseconds’ duration, which can be emitted in 2 typical frequency ranges. Frequencies of about 100Hz are referred to as high-frequency TENS, whereas frequencies between 2 and 10Hz are referred to as low-frequency TENS.

TENS has been successfully used for several decades to alleviate acute and chronic pain, especially in the back. The exact mechanism of action is not fully clarified yet. One proposed mechanism is the gate control theory [15] while another is the excessive release of endorphins. It is widely accepted that pulse frequencies of about 100Hz probably act through the modified gate control theory. The release of endorphins is attributed to pulse frequencies of 2–10Hz.

The efficacy of TENS in pain therapy
The meta-analyses published so far do not express a clear conclusion about the efficacy of TENS in low back pain [16–18]. One reason could be the fact that, in the reviewed studies, TENS was used at different intensities. However, this is a decisive aspect of the success of the treatment [19]. A further reason is that many publications do not fulfil the high quality standards needed for inclusion in a meta-analysis or a systematic review. In addition as the use of TENS in these review articles is limited to the diagnosis of low back pain alone, the statistical power of the meta-analyses is markedly reduced and in fact, it is doubtful whether a potential therapeutic effect can be identified at all. Johnson and Martinson have addressed this problem. Their meta-analysis includes all studies investigating the effect of electric stimulation in chronic musculoskeletal pain. The primary target parameter selected for this report was pain at rest. Reviewing 38 studies with a total of 1 227 patients, the authors came to the unequivocal conclusion that electric stimulation, compared to placebo, exerts a significantly better effect in terms of pain reduction. On average, the reduction of pain after electric nerve stimulation was nearly 3-fold higher than the pain relief achieved by the placebo treatment [20].

The use of TENS as adjuvant pain therapy during delivery has been investigated in a number of published studies. A Cochrane review comprising 13 studies showed that there was very little evidence of pain relief by TENS during delivery, but all of the treated women wished to receive TENS at their next delivery. Therefore, the authors suggest that women should be given the option of receiving TENS if they believe it would be helpful during delivery [21].

Finally, the use of TENS for the treatment of pain during pregnancy was investigated in a prospective randomized controlled blinded study. 79 women in the ≥32nd week of gestation, with pregnancy-associated low back pain and a visual analogue scale (VAS) score ≥5, were included in the study. The women were randomized to one of 4 groups. Exercise therapy, analgesic treatment with acetaminophen, or TENS were given to one treatment group each and one group served as control. Electric stimulation was administered through four electrodes of 5cm2 on the specified lumbar pain region with continuous stimulation, at a frequency of 120Hz and a pulse duration of 0.1 ms. The intensity of the current was 2- to 4-fold higher than the sensitivity threshold. TENS therapy was given twice a week for 3 weeks. The subsequent evaluation of VAS and the Roland-Morris disability questionnaire showed that the use of TENS had no side effects and led to a significantly greater reduction of pain compared to the group receiving exercise therapy or the group receiving acetaminophen. The mean reduction on the VAS score in the TENS group was 4 ± 1 points while the score on the Roland Morris disability questionnaire was reduced by 8.5 ± 5 points [22].

Side effects of the method
Especially when dealing with pregnant women, it is important to know whether a specific therapy procedure is expected to have side effects. Therefore, the hitherto published studies in animals and humans will be explained here briefly.

3 animal experiments in which the application of low-frequency electric pulses was investigated in pregnant rats have been pub-
lished so far. As 2 of these studies were focused on the prolongation of delivery and the treatment of bladder voiding disorders, the electric pulses were not administered through the skin. Instead, the electrodes were directly implanted in the uterus or at the nerve root of S1 [23, 24]. Moreover, in a recent 3-arm placebo-controlled study, TENS was applied using frequencies of 100 Hz or 150 Hz, a pulse duration of 200 μs, and a current of 2–6 mA for the entire duration of pregnancy [25]. No complication or pathological change was observed in any maternal animal or fetus.

The use of TENS for the treatment of pain during delivery has also been investigated in several human studies. In a Cochrane review it was found that TENS appears to have no impact on the duration of labor or the wellbeing of mothers or infants during labor, and therefore it was stated that TENS had no side effects [21]. All further studies were performed in pregnant women in the last trimester of pregnancy. As early as in 1979 and 1980, Kubista et al. [26] investigated the effects of low-frequency electrical pulses on placental circulation in pregnant women. In the first study, 12 patients in the 28th–35th week of gestation were placed electrodes in the regions from T10 to L1 and S2 to S4 on both sides; high-frequency TENS with bipolar rectangular pulses and a pulse duration of 0.25 ms was used. Stimulation was administered once for 60 min. TENS was found to significantly enhance uterine blood flow. In another article, long-term application of the method was investigated in 25 patients in the 28th–35th week of gestation. The same application was used for 2 h daily over a period of 2–3 weeks. Again, uterine blood flow was found to be increased [27]. No side effects were registered after single use or after application over a period of 2–3 weeks. A Cochrane review mentions 2 further studies which reported no side effects [28].

In summary, no side effects have been observed in mothers or infants after the use of TENS. It should be noted, however, that all human studies performed thus far were conducted in the last trimester of pregnancy; investigations in the first or second trimester have not been published so far.

**Recommendations for Use**

Given the body of data on the safety and efficacy of TENS in pregnant women, the absence of side effects, low costs, and the possibility of using the method at home, the expert panel believes that TENS may be used as a safe therapeutic measure for pregnancy-induced low back pain and/or pelvic girdle pain. Based on current data, the use of TENS in pregnant women is recommended exclusively in the last trimester. It is especially important to rule out other causes of pain by performing a preliminary investigation and regular follow-ups. Contraindications include implanted defibrillators and skin lesions in the region of electrode placement. Cardiac pacemakers are no contraindication, but do call for a thorough and careful medical investigation before the start of therapy [29].

The following mode of application is recommended

4 electrodes measuring 5 × 5–9 cm should be used. All potentially painful structures can be treated by symmetrical placement of 2 electrodes in paravertebral location at the level of L3 and 2 electrodes in the distal and lateral aspect of the sacroiliac joint. The position of the distal electrode pair should be oriented to the area of radiating pain, but the lateral limit of the posterior axillary line should not be crossed even when the patient experiences pain up to the symphysis. “Constant current” devices are used for stimulation. Based on the existing studies, high-frequency TENS of 80–120 Hz and a pulse duration of 0.1–0.2 ms is recommended. The intensity of the current should be 2–3-fold higher than the sensitivity threshold. The sensitivity threshold, by experience, is about 5–8 mA. TENS should be applied daily for at least 30 min. As the treatment will probably be continued for several weeks, it is advisable to administer the therapy at home. In order to learn how to handle the device and test the efficacy of pain therapy, the treatment should be administered several times under the supervision of a doctor before prescribing a home device. Regular follow-ups to re-evaluate pain and the efficacy of therapy are also recommended.

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**Conflict of Interest**

The authors declare no conflicts of interest.

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