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Research Article

Effect of Transcutaneous Electrical Nerve Stimulation (TENS) on Labor Pain and the Duration of First Stage of Labor

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ABSTRACT

Purpose: Labor pain is caused by contraction of the uterine muscles and the pressure of the baby's presenting part on the cervix. The effective management of labor pain plays a decisive role in the labor outcome indicating the need for a non-pharmacological therapy to manage labor pain.

Methods: A randomized controlled trial was conducted on 300 pregnant women at low antenatal risk who anticipated full term vaginal delivery in a tertiary care hospital in Urban South India. During the active phase of first stage of labor, the women in the experimental group received TENs which was increased in intensity with the increase in pain and the women in the control group received TENS at baseline intensity. Both groups of women received the routine obstetric care. The primary outcome measure was intensity of labor pain assessed using the Visual Analog Scale at 3 cm-4 cm of cervical dilatation and at full cervical dilatation. An independent sample t-test compared the mean VAS scores and labor duration between groups. A Chi-square test was used to compare categorical variables between the groups.

Results: The experimental group (n=150) had statistically significantly lower mean VAS scores at full cervical dilatation than the control group (n=150) ($p<0.001$) and a statistically significant shorter duration of the active labor phase than the control group ($p<0.001$).

Conclusion: The results of this study indicate that TENS can be used as a non-pharmacological therapy to reduce pain perception and to shorten the active phase of first stage of labor.

Keywords: Transcutaneous electrical nerve stimulation; Labor pain; Non pharmacological management of labor pain

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INTRODUCTION

Labor pain is caused by many factors which include isometric contraction of the uterine muscle, the baby's head causing pressure on the cervix, bladder, and bowels, and the dilatation and effacement of the cervix and the vagina. There are broadly two classifications of labor pain, visceral pain that occurs during the early first stage and the second stage of labor, and somatic pain that occurs during the transition from first to second stage and during second stage of labor. During the first stage of labor i.e., the dilatation phase, pain is located in the region of the uterus, the ovaries, fallopian tubes and the ligaments. This is caused due to the dilatation of the cervix and the lower uterine segment, the pressure and stretching of the pelvic structures like the bladder, urethra, and the rectum, along with pressure on the lumbosacral plexus, traction and pressure on the parietal peritoneum and the structures like the ovaries, the fallopian tubes and the adjacent ligaments, and the reflex skeletal muscle spasms. During the transitional stage from first to second stage of labor, pain is caused by the stretching, distension, ischemia and injury of the pelvic floor, cervix, vagina, and the perineum [1].

The different non-pharmacological methods of pain relief in labor include psychosocial support by helping the parturient to feel in control of herself and to feel accepted whatever her reactions and behavior may be, psycho-prophylaxis by using patterned breathing techniques and relaxation methods, hypnosis which provides comfort, relaxation and pain relief during labor by decreasing stress and fear during parturition, biofeedback that trains the parturient to recognize body signals like muscular tension and increased heart rate and to make changes in the body like relaxing the muscles, competitive sensory stimulation in the form of aromatherapy, music therapy, breathing control, focusing and virtual reality, massage to the abdomen, back and perineum, acupuncture which is believed to help by encouraging the body to produce endorphins which are natural pain-relieving hormones, hydrotherapy with warm water in the birthing tub which helps with relaxation and trigger the release of endorphins and improved blood flow to the uterine muscles, movement and positioning which helps women cope with the labor pain and the upright positions use gravity to bring the baby down and also the frequent positional change moves the bones of the pelvis helping the baby find the best fit, Transcutaneous Electrical Nerve Stimulation (TENS) which inhibits the production of catechol-amines, intradermal sterile water blocks for back pain into the rhombus of michaelis region which provides an analgesic effect for up to 120 mins, etc. [2-11]. The use of systemic medications like opioids, sedatives and amnestic drugs have limited analgesic effect and poor patient satisfaction as the high doses of opioids result in unwanted side effects in the parturient like nausea and vomiting, sedation, respiratory depression, disorientation and lower Apgar Scores in the newborn [12]. The application of local anesthetics and analgesics to the epidural or subarachnoid space through spinal (intrathecal) injection, epidural catheter placement or a combination of spinal and epidural provides excellent pain relief throughout the course of labor but maybe accompanied by potential complications like accidental Dural puncture causing postdural puncture headache, postpartum low back pain, nerve injury, infection, maternal fever, hematoma, hypotension, nausea, urinary retention, etc. Transcutaneous electrical nerve stimulation is a form of electrical stimulation that provides pain relief by the excitation of the sensory nerves that lead to stimulation of the pain gate mechanism and prevention of psycho-emotional perception of pain and the release of endorphins [13-15].

The aim of this double-blinded, randomized, placebo-controlled trial was to investigate the effect of application of TENS during the active phase of the first stage of labor.

METHODOLOGY

This study was a double-blinded randomized controlled trial conducted at the Department of Obstetrics and Gynecology, St John's Medical College & Hospital, Bangalore, India. The study was approved by the Institutional Ethical Committee of the Institution and the procedure of the study along with the randomization was explained to the participants. The informed consent of the participants was duly collected before the commencement of the intervention/placebo.

The participants included for the study

Parturient at term (37 weeks-42 weeks of gestational age), primigravida and multigravida parturient with no known medical complications in the antenatal period, parturient identified by the treating obstetrician in the active phase of first stage of labor, parturient with single live fetus in the cephalic presentation, and parturient who were not taking any other forms of labor analgesia. The parturient in both the groups received all other routine obstetric care. The parturient were advised to choose the most comfortable position and the participants in both the groups were permitted change of position as deemed most comfortable. The most common comfortable positions adopted by the parturient in both the groups were either standing, or lateral decubitus.

Randomization and blinding

The parturient were randomized by block randomization method with sealed envelope. The nurse checking on the visual analogue scale was blinded to the group that the parturient belonged to. The statistician who analyzed the results was blinded to the group that the parturient belonged to.

Statistical analysis

We used SPSS 21.0 software for the statistical analyses. The two sample t-test with equal variances was used to identify the difference in the VAS score between the interventional and control groups. The two sample t-test with equal variances was used to identify the difference in the length of the first stage between the interventional and the control group. The p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 300 patients were assigned into the experimental (n=150) and the control (n=150) group. Table 1 represents the baseline characteristics of the participants in each group. There was no statistically significant difference between the groups in

terms of maternal age, and cervical dilatation. There was no statistically significant difference between the groups in the mean VAS scores before the commencement of the intervention. But the experimental group had a statistically significantly lower mean VAS score ($p<0.001$) than the control group at the end of the first stage. Also, the experimental group demonstrated a statistically significant shorter duration of the active phase of first stage of labor ($p<0.001$).

Table 1: Baseline participant characteristics and obstetric outcome.

Characteristic	Interventional Group	Control Group
Age of parturient (in years)	25.4 ± 3.3*	24.4 ± 2.7*
VAS at baseline	7.5 ± 0.48*	7.4 ± 0.33*
Duration (in mins) of TENS application	112.9 ± 12.2*	156.4 ± 9.9*
VAS at the end of first stage of labor	4.9 ± 0.43*	9.5 ± 0.23*
Total duration (in mins) of first stage of labor	159.1 ± 12.1*	223.3 ± 13.5*

*Mean ± SD

DISCUSSION

The main purpose of this study was to evaluate the effect of TENS on pain relief during the first stage of labor and the duration of first stage of labor [16]. The comparison of the VAS scores at the end of the study indicated a clinically significant decrease in the pain perception in the participants in the interventional group as compared to the control group. Reports from previous studies have suggested that there are different opioid peptides that are released into the central nervous system by TENS application. Endogenous opioid peptides like encephalins and β- endorphins with a powerful analgesic effect are activated under the effect of TENS, which explains the clinically significant decrease in pain in the interventional group of participants [17]. The high intensity titrated at the peak of the painful contractions blocks the afferent fibres, thus preventing the pain from traveling to the spinal cord synapses from the uterus. The increased stress levels and hypoglycaemia being mediated by the labor pain brings about changes in the sympathetic nervous system which in turn increases the release of catecholamines like epinephrine and norepinephrine. These catecholamines cause increased heart rate and blood pressure, vasoconstriction, and other autonomic responses. These changes result in lower uterine blood flow which causes a decrease in the uterine tone and foetal bradycardia or acidosis. This inhibits contraction of the uterus and delay progress of labor. TENS will supress the release of catecholamines [18]. By improving the coping mechanism of the parturient and thereby enhance the progress of labor. The advantages of using TENS are that it is non-invasive, easy to apply, does not interfere with maternal consciousness or mobility, is safe and is free from any significant side effects. The increased physiological arousal during labor due to the anxiety about the birth experience has been associated with reducing contractions and increasing the duration of labor along with foetal distress [19]. When the parturient is educated about the probable effects of TENS on labor, this physiological arousal is under control. The limitation of the current study is that we have not compared the effect of TENS with any other non-pharmacological modality for pain relief in labor.

CONCLUSION

With the results obtained from the above study we can conclude that TENS is a non-pharmacological, cost effective and relatively safe modality for relief of pain during labor. The comparative pain relief during labor achieved through the use of interventional TENS increased the satisfaction levels about the childbirth experience among the parturient in the interventional group which in turn would be beneficial for better parenting experiences.

LIMITATIONS AND FUTURE DIRECTIONS

The sample size has to be increased and future research has to be conducted. This study involves in-vitro cell culture which may not replicate the complex in-vivo conditions.

For future directions, a large cohort should be done with a more diverse patient population to increase generalizability and to explore potential therapeutic strategies targeting EMT, mitochondrial function, or hypoxia-related pathways in endometriosis.

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COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design.

ETHICS APPROVAL

This study was initiated after approval from the Institutional Ethical Review Board at St Johns Medical College, Bangalore, India.

CONSENT TO PARTICIPATE

Informed consent was obtained from all individual participants included in the study.

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