Effect of Trans-Cutaneous Electrical Nerve Stimulation (TENS) on Pain Intensity among multipara women during the First Stage of Labor

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Abstract

Background: A none-randomized (single blind) - placebo controlled clinical trial research aimed to determine the Effect of Trans-Cutaneous Electrical Nerve Stimulation (TENS) on Pain Intensity among multipara women undergoing First Stage of Labor. The study was conducted at labor and delivery unit of El Shatby Maternity University Hospital in Alexandria. .A convenience sample of 40 laboring woman, in their active phase of the first stage of labor (cervical dilatation 4-7 cm) & who were available at the time of data collection were recruited from the above mentioned setting. Two tools were used for data collection: Socio-demographic & clinical characteristics structured interview schedule and the Visual Analogue Scale (VAS).

Methods: for the Experimental group: TENS unit was placed near the woman. The two pairs of skin electrodes were placed on both sides of the vertebral column between contractions. The upper pair of electrodes was taped Para vertebra by 5 cm at the level of 10^{th} thoracic to 1^{st} lumbar root. The lower pair of electrodes was tapped Para vertebra by 5 cm at the level of the 2^{nd} to 4^{th} sacral nerves. Frequency of electrical pulse was started at 100-150 HZ. Electrical current was gradually increased till a pleasant tingling sensation was felt by the woman. The duration of TENS application was 30 minutes. Control group, TENS placebo group, TENS unit electrodes were applied as previously mentioned while the TENS unite was off. I.e. without any current production. Using tool II pain intensity was assessed three times, once before TENS placebo application and twice after application by 60 & 90 minutes. Using tool II (VAS) the intensity of labor pains was measured for both groups, three times, once before and twice after TENS application by 60 & 90 minutes. Each parturient was asked to put a mark on the line indicating their perceived intensity of labor pain.

Results: A highly statistically significant difference was noticed between the experimental and the control groups after 60 & 90 minutes of intervention regarding the severity of labor pains. In conclusion TENS machine as non-pharmacological methods of pain relief was effective and safe in the experimental group, they also very highly significantly of TENS action than the control group within 60 and 90 minute.

Keywords: Trans-cutaneous Electrical Nerve Stimulation (TENS), multipara, non-pharmacological, active phase, parturient.

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1. Introduction

Management of labor pain is one of the main goals of maternity care. There are two models of care, namely, the medical model and the midwifery model. Each model uses fundamentally different means to achieve its end. [1, 2]

Non-pharmacologic measures are often simple and safe, have few major adverse reactions, they are relatively inexpensive, and can be used throughout labor. In addition, they provide the parturient with a sense of control over her childbirth experience as she makes choices about the measures that are best for her. Examples of these measures are; therapeutic touch; walking; application of heat and cold compresses; aromatherapy and Trans-cutaneous Electrical Nerve Stimulation (TENS). [3, 4]

TENS is the use of electric current produced by a device to stimulate the nerves for therapeutic purposes. TENS was introduced into maternity care in Scandinavia in the 1970s. Now, it is widely used and highly rated by users in the UK, Scandinavia, parts of Canada, and in many other countries around the globe.[5]

TENS is presumed to block pain signals travelling to spinal cord, by virtue of mild electrical impulses delivered to nerve fibers via electrode pads attached to the skin. In this process nerve impulses to the brain are believed to be blocked. It also helps stimulate production of pain – killing endorphins, which are endogenous opioid compounds. They resemble opiates in producing analgesia &a sense of wellbeing, since they attach to the same neuronal receptors as morphine & heroin, & interfere with the transmission of pain impulses to the brain. [6, 7]

TENS involves the placing of two pairs of flat electrodes on either sides of the woman's thoracic and sacral spine. These electrodes provide continuous low-intensity electrical impulses or stimuli from a battery-operated device. During a contraction, the laboring woman or professional attendant increases the stimulation from low to high intensity by turning the control knobs on the device. [8]

TENS has been advocated as an effective & non-invasive adjuvant means of providing pain relief during the early first stage of labor. It enables the woman to be in control of her pain. Furthermore, it has been also reported to reduce the duration of the first stage of labor. In a relevant study it was observed that TENS provided pain relief in 87% of the participants, while 20% reported excellent pain relief. However, the effectiveness of TENS application remains controversial since there are no known side effects on the mother or the fetus to date. [9, 10]

The aim of this study is to
Determine Effect of Trans-Cutaneous Electrical Nerve Stimulation (TENS) on Pain Intensity among multipara women undergoing First Stage of Labor

Operational definition

-TENS placebo intervention in this study refers to placement of the TENS unit electrodes on both sides of the vertebral column between contractions while it will be off.

-The First Stage of Labor: refer to active phase of the first stage of labour.

Research Hypothesis

Multipara women who receive Trans-Cutaneous Electrical nerve Stimulation (TENS) during the active phase of the first stage of labor exhibit less labor pain intensity than those who receive TENS placebo intervention.

2. Material and methods

Material

Design:

This is a none-randomized (single blind) - placebo controlled clinical trial research.

Setting: The study was conducted at labor and delivery unit of El Shatby Maternity University Hospital in Alexandria.

Subjects: A convenient sample size of 40 laboring woman, estimated using Epi info program, in their active phase of the first stage of labor (cervical dilatation 4-7 cm) & who were available at the time of data collection were recruited from the above mentioned setting. Subjects were selected by using the non-probability sampling technique. They were then randomly assigned into two equal groups of 20; experimental (group 1) and control (group 2).

Tools: Two tools were used for data collection:

Tool I:

Socio-demographic & clinical characteristics structured interview schedule: this tool was developed and used by the researcher to collect the basic data. It included two main parts:

Part I:

Socio-demographic characteristics: such as age, level of education, occupation and current residence.

Part II:

1- Clinical characteristics & obstetric history including: gravidity, parity, No of abortions, No of living children, weeks of gestation.

2- Pain profile (labor pain): site and intensity.

3- Local obstetric examination (p.v).

4- Site of pain relief

Tool II:

Visual Analogue Scale (VAS): It is a subjective self-reported device used to measure the intensity of labor pain. VAS has been used in different nursing studies as an evaluation tool to assess labor pain experienced by parturients in the 1st stage of labor. It is a 10 point numerical scale consisting of 10 cm horizontal straight line ranging from 0-10 cm with words ''no pain'' on the left which denotes the least pain and ''unbearable'' on the right which denotes the worst pain. Pain intensity is evaluated by asking the women to point on the line a mark & then it is measured in cm from the "no pain" end to obtain the woman's score. This number represents the intensity of their pain. Descriptive terms are used as follows: No pain (0), Mild pain (1 – 3cm), Moderate pain (4 – 6cm), Severe pain (7 –9cm), and finally (10cm) Unbearable pain. This tool was originally developed by Melzack and Katz (1994). [11]

Methods

1. The researcher earned an official certificate (knowledge and practice) from The Open Academy of Complementary Medicine After training for 50 hours.
2. Application of TENS was done by the researcher between contractions. Parturients of both groups were helped to assume comfortable position either left lateral or sitting position.
3. Experimental group. TENS unit was placed near the woman. The two pairs of skin electrodes were placed on both sides of the vertebral column between contractions. The upper pair of electrodes was taped Para vertebra by 5 cm at the level of 10^{th} thoracic to 1^{st} lumbar root. The lower pair of electrodes was tapped Para vertebra by 5 cm at the level of the 2^{nd} to 4^{th} sacral nerves. Frequency of electrical pulse was started at 100-150 HZ. Electrical current was gradually increased till a pleasant tingling sensation was felt by the woman. The duration of TENS application was 30 minutes.
4. Control group, TENS placebo group, TENS unit electrodes were applied as previously mentioned while the TENS unite was off. I.e. without any current production.
5. Using tool II pain intensity was assessed three times, once before TENS placebo application and twice after application by 60 & 90 minutes. Using tool II (VAS) the intensity of labor pains was measured for both groups, three times, once before and twice after TENS application by 60 & 90 minutes. Each parturient was asked to put a mark on the line indicating their perceived intensity of labor pain

Statistical analysis: was done by the researcher after collection of data by using Statistical Package for Social Sciences (SPSS version 22) program. A descriptive & analytical statistics were utilized. The collected data was categorized, coded, computerized, tabulated and analyzed using frequency distribution tables, percentage, means and standard deviations. The difference sample test, independent t-test, fissure exact test and chi-square test at ≤ 0.05 level of significance were used to find out the statistical significant difference of the results.

Ethical consideration:
Written informed consent will be obtained after explanation of the study purpose. Each of those who agree to participate in the study will be assured about their confidentiality, privacy and right to withdraw from the study at any time.

3. Results

Table (I) demonstrates the number and percent distribution of the study sample according to their socio-demographic characteristics. It can be observed that **no *statistically significant difference*** was found among the two groups in relation to their socio-demographic characteristics.
Table (II) shows the number and percent distribution of the study sample according to their clinical characteristics, it was noticed that ***No significant difference*** was observed among the two groups concerning all of their clinical characteristics.
Table (III) reveals the number and percent distribution of the study sample according to their labor pain profile before intervention. It was observed that the ***sites of pain*** more than half (55.0 %) of the experimental and three fifth (60%) of the control groups had labor pain manifested in the lower back radiated to the genitalia. On the other hand, it was noticed that ***Intensity of labor pain*** (65.0% &**70.0**%) of the experimental and the control groups

respectively had strong intensity. ***No statistically significant difference*** was detected among the experimental and control groups in relation to intensity of uterine contractions.
Table (IV) demonstrates the number and percent distribution of the study sample according to the findings of their local examination (p.v). It was found that ***the mean cervical dilatation*** was 4.66 ± 1.76 cm & 5.70 ± 1.33 cm among the experimental & the control groups respectively. Also ***no statistical significant difference*** was found between the two groups in relation to cervical dilatation.
Table (V): reveals the number and percent distribution of the study sample according to intensity of labor pain as measured by Visual Analogue Scale (VAS) before and after TENS and TENS placebo application**.** The table clearly reveals that all women of the experimental and the control groups ***experienced labor pains of different intensity*** before TENS & TENS placebo application. ***A highly significant difference*** was detected among women of the experimental and the control groups before & after 60 & 90 min of intervention in relation to their intensity of labor pain as measured by VAS, where (P =0.000).

4. Discussion

The results of the current study showed that the experimental and the control groups were matching in almost all socio-demographic and clinical characteristics as well as history of current labor (Tables I- II). The results of the current study revealed that labor pains were manifested mainly in the lower back and genitalia as reported by nearly one-half of both groups (Table III). This was explained by Tournaire & Theau-Yonneau (2007) as during dilatation of the first stage of labor, visceral pain predominates due to mechanical distention of the cervix and of the lower part of the uterus. These stimuli are transmitted to the spinal cord at the level of the 10th thoracic to the 1st lumbar root. Therefore, uterine contractions may be felt as back pain because the nerves that supply the uterus also supply the skin on the lower back or lumbosacral area. [(12)]

The findings of the present study also corresponds with the study of Tzneg & Su (2008); They noticed that as many as 75.3% of the participants suffered from episodes of low back pain during labor and this pain intensified as labor progressed. [(13)] In addition, it is conforms to the Cochrane Database systematic review of Derry et al (2012). They concluded that all participants reported only low back pain in labor. [(14)]

In addition, the findings of the current study is consistent with the study of Mohamed (2014). She found that lower back pain radiating to the lower abdomen was reported by a sizable proportion (70% & 77.5%) of the experimental and the control groups respectively. [(15)] However, assessment of intensity of labor pain explicates that (65 % & 70%) of the experimental and the control groups reported strong intensity and 35% & 30% of both groups reported moderate intensity. No statistically significant difference was observed among the experimental and control groups in relation to intensity of uterine contractions.

Furthermore, this findings is in harmony with studies of Padma et al (2000) "who found that, in early first stage of labor back was predominant, while abdominal pain became apparent in the late first stage. According to Padma et al (2000) the pain in the first stage of labor, may be due predominantly to cervical dilatation with contractions of the uterus contributing significantly as labor progresses. Repeated stimulation reduces the high threshold of receptors, while contractions may cause cellular breakdown releasing "Pain producing substances". These Pain impulses are transmitted via the A-delta and C-afferent fibers reaching segments T11 and T12 the increasing intensity gives rise to pain in segments

corresponding to dermatome distribution T10 and Ll. The full dilation2, extension and stretching of the birth canal activates the pudendal nerves and roots S2-4. [16]

This finding is similar to the finding of a study done by Gaballa et all (2008) she stated that 30% of the experimental group had moderate contractions while 70% had sever contractions. This literature indicates that uterine contractions of labor are mild at first and then become increasingly more intense as labor progress. [17] On the other hand, the findings of the current study is not congruent with the study of Gohar et al (2012) who found that intensity of uterine contractions before the implementation of the study interventions more than three fifths (62.5% & 70%) of the experimental and control groups had moderate, while (30% & 37.5 of both groups had strong uterine contractions with no statistically significant difference between them. [18]

It is interesting to notice that the application of TENS in the present study had lowered pain intensity after 60 min and continue to 90 min, in spite of the fact that labor pain intensity increases with the progress of the first stage of labor. Vickers and Zollman (1999) had commented on this phenomenon by claiming that labor pain relief build up as treatment progresses, even if pain intensity progresses. [19] According to literature, the use of TENS in obstetrics by applying TENS to areas of the spinal cord that correspond to the input of nociceptive afferents (T10-L1) in first stages of labor. [16]
The results of the present study demonstrated that, A highly statistical significant difference was found between both groups regarding sites of pain relief, where P = 0.001

The results of the current study is partial similar to findings reported by Bundsen (1982) prospective randomized study of pain relief in labor, the effect of TENS performed over both the low-back and suprapubic region was evaluated and compared with a control group not receiving TENS. Assessment of low-back and suprapubic pain was performed by the parturient each hour during the first stage. In the TENS group most of the parturients reported minimal or moderate low-back pain throughout labor, while parturients in the control group reported an increased intensity of low-back pain as labor progressed. The effect of suprapubic pain was insignificant in both groups. [20]

In addition, the findings of the current study is also partially in accordance with the results of a study conducted by Padma (2000) and reported, TENS seems an effective, simple to administer method of pain relief with no side effects on the mother or the child. It is effective in relieving the low back pain in 50%, but has no effect on the lower abdominal pain with the present stimulation technique. [16]

Moreover, the finding of the current study is in harmony with the study of Jones (1980) which reported that the majority of parturients (82%) had substantial relief of back labor pain and a sizeable proportion of them (71%) had significant relief of abdominal pain during the first stage of labor. [21, 22]

The result of present study is also harmony with finding by Erkola et al 1985 used TENS for pain management during the first stage of labor, in this study they described that, experimental group 31% of the patients reported good pain relief, 55% reported moderate pain relief within one hour of initiating treatment, in comparison of control group (placebo) who didn't use TENS requested pain medication during labor. [23]

The findings of the present study illustrated that, intensity of labor pain as measured by VAS) before and after TENS and TENS placebo application**.** All of women of the experimental group experienced pain before TENS application compared to half 50.0% of them had no

pain after TENS application with 60 & 90 minutes. While in the control group ***experienced labor pains of different intensity*** before TENS & TENS placebo application

In addition, there are similar finding by Kubista (1985) in German. The result revealed that Methods of electric stimulation have been tested for their effect on labour pain during delivery. Beside the central (cerebral) electric stimulation electro-acupuncture and transcutaneous electric stimulation have been used. Because of the only moderate results and the difficulties in clinical handling electro-acupuncture is not very useful for pain reduction during child birth. Central stimulation and transcutaneous stimulation brought relief of pain in about 60% of the 209 patients treated with these methods in addition to a significant reduction of the labour period. No side effects on mother or child were observed. [24]

This finding is also in congruence with Chaillet et al (2014) in Canada, who analyzed Nonpharmacologic approaches, based on Gate Control such as water immersion and Diffuse Noxious Inhibitory Control such as electrical stimulation are associated with a reduction in pain and a higher maternal satisfaction with childbirth? Also concluded that nonpharmacologic approaches to relieve pain during labor, when used as a part of hospital pain relief strategies, provide significant benefits to women and their infants without causing additional harm. [25]

Table (I): Number and percent distribution of the study sample according to their socio - demographic characteristics

Socio-demographic characteristics	Experimental group		Control group		F / χ^2(P)
	No (20)	%	No (20)	%	
Age in years:					0.523
25-< 30	8	40.0	10	50.0	0.505
30 - <35	8	40.0	6	30.0	
35 -≤ 40	4	20.0	4	20.0	
Mean ± SD	33.33±11.55		33.33±15.28		
CI 95.0%	4.65; 62.02		-4.61; 71.28		
Level of education:					
- Illiterate/read and write	5	25.0	6	30.0	0.723
- Basic	8	40.0	6	30.0	0.505
- Secondary	5	25.0	3	15.00	0.426
- University or above	2	10.0	5	25.0	0.091
Mean ± SD	25.00±12.25		25.00±7.07		P= (0.013)
CI 95.0%	5.51; 44.49		13.75; 36.25		
Occupation:					
- Housewife(not work)	10	50.00	7	35.00	
- Working	10	50.00	13	65.00	
Mean ± SD	50.0000±0.0000		50.0±21.2		P= (0.03)
CI 95.0%	50.0000; 50.0000		-140.6; 240.6		

χ^2 (P): Chi-Square Test &P for χ^2 Test
F (P): Fisher Exact test &P for F Test
*: Significant at P ≤0.05

Table (II): Number and percent distribution of the study sample according to their clinical characteristics

Clinical characteristics	Experimental group		Control group		F / χ^2(P)
	No (20)	%	No (20)	%	
Gravidity: <3 3+	 9 11	 45.0 55.0	 10 10	 50.0 50.0	
Mean ± SD	50.00±7.07		50.0000±0.0000		
CI 95.0%	-13.53; 113.53		50.0000; 50.0000		
Parity: Nullipara <3 3 +	 2 10 8	 10 50 40	 3 11 6	 15.0 55.0 30.0	
Mean ± SD	33.3±20.8		33.3±20.2		
CI 95.0%	-18.4; 85.0		-16.9; 83.5		
Number of abortions: No <3 3+	 15 3 2	 75.0 15.0 10	 14 3 3	 70.0 15.0 15.0	P= (0.556)
Mean ± SD	33.3±36.2		33.3±31.8		
CI 95.0%	-56.5; 123.2		-45.5; 112.2		
Number of living children: No <3 3+	 3 12 5	 15.0 60.0 25.0	 4 11 5	 20.0 55.0 25.0	P= (0.628)
Mean ± SD	33.3±23.6		33.3±18.9		
CI 95.0%	-25.4; 92.0		-13.7; 80.4		
Weeks of gestation: 37-39 40-41	 15 5	 75.0 25.0	 17 3	 85.0 15.0	P= (0.07)
Mean ± SD	50.0±35.4		50.0±49.5		
CI 95.0%	-267.7; 367.7		-394.7; 494.7		

χ^2 (P): Chi-Square Test &P for χ^2 Test
F (P): Fisher Exact test &P for F Test
*: Significant at P ≤0.05

Table (III): Number and percent distribution of the study sample according to their labor pain profile before intervention

Labor pain profile before intervention	Experimental group		Control group		F/χ^2(P)
	No (20)	%	No (20)	%	
Site of labor pain: - Lower back and radiating to genitalia - Lower back - Lower abdomen	 11 6 3	 55.0 30.0 15.0	 12 5 3	 60.0 25.0 15.0	P=(0.715)
Mean ± SD	33.3±20.2		33.3±23.6		
CI 95.0%	-16.9; 83.5		-25.4; 92.0		
Intensity of labor pain: - Moderate - Strong	 7 13	 35.0 65.0	 6 14	 30.0 **70.0**	P=(0.450)
Mean ± SD	25.0±20.0		25.00±13.54		
CI 95.0%	-6.8; 56.8		3.45; 46.55		

χ^2 (P): Chi-Square Test &P for χ^2 Test
F (P): Fisher Exact test &P for F Test
*: Significant at P ≤0.05

Table (IV): Number and percent distribution of the study sample according to their local examination (PV)

Local examination (PV)	Experimental group		Control group		χ^2 (P)
	No (20)	%	No (20)	%	
Cervical dilatation: - 4 cm - 5 cm - 6 cm - 7 cm	 3 3 3 11	 15.0 15.0 15.0 55.0	 4 3 4 9	 20.0 15.0 20.0 45.0	2.429 P=(0.488)
MEAN ± SD	4.66 ± 1.76		5.70 ± 1.33		

χ^2 (P): Chi-Square Test &P forχ^2Test *: Significant at P ≤0.05

Table (V): Number and percent distribution of the study sample according to sites of pain relief

Pain relief	Experimental group		Control group		χ^2(P)
	No (20)	%	No (20)	%	
Site of pain relief #					
- Back	17	85.0	4	20.0	χ^2**=36.6** **P = 0.001***
-	25.0±20.0		25.00±13.54		
- Abdomen	12	60.0	1	5.0	χ^2 **= 37.1** **P = 0.001***

#More than one answer

χ^2: Chi Square Test, * P < 0.05 (significant)

Table (VI): Number and percent distribution of the study sample according to their intensity of labor pain as measured by VAS.

Intensity of labor pain using VAS	Before TENS application				After TENS application (60 min)				After TENS application (90 min)			
	Experimental group (G1)		Control group (G2)		Experimental group (G1)		Control group (G2)		Experimental group (G1)		Control group (G2)	
	No (n=20)	%	No (n=20)	%	No (n=20)	%	No (n=20)	%	No (n=20)	%	No (n=20)	%
- No pain (zero)	0	0.00	0	0.00	10	50.0	0	0.00	10	50.0	0	0.00
- Mild pain (1 – 3 cm)	0	0.00	0	0.00	5	25.0	1	5.0	5	25.0	1	5.0
- Moderate pain (4 – 6 cm)	4	20.0	3	15.0	3	15.0	4	20.0	3	15.0	4	20.0
- Severe pain (7 – 9 cm)	7	35.0	8	40.0	2	10.0	6	30.0	2	10.0	6	30.0
- Unbearable pain (10cm)	9	45.0	9	45.0	0	00.0	9	45.0	0	00.0	9	45.0
Mean ± SD	20.00±20.31		20.00±21.51		20.00±19.04		20.00±18.37		20.00±19.04		20.00±18.37	
F/χ^2(P)	(P) 0-592 / χ^2= 1.048				P= 0.000 χ^2– 119) **				P = 0.000		χ^2 = 119 -04 **	

χ^2 (P): Chi-Square Test &P forχ^2Test
FET (P): Fisher Exact Test & P for FET-Test
*: Significant at P ≤0.05

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