Intrapartum Transcutaneous Electrical Nerve Stimulation for Pain Relief and Outcome of Labour

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Objective:
Transcutaneous electrical nerve stimulation (TENS) has been introduced as an option for the relief of labour pain in our hospital, but its efficacy and impact on labour outcome remains uncertain. A non-blinded study was therefore performed to address these issues.

Methods:
This study was conducted over a 5-month period by purposive sampling of all the women who had requested TENS for pain relief during the early phase of labour and in the absence of significant complications or contraindications. Maternal demographics, pain scores as assessed by a validated pain assessment form, and labour outcomes were analysed according to the types of pain relief method used in the form of: TENS with or without entonox (TENS group); TENS and pethidine injection (pethidine group); and TENS with epidural analgesia (epidural group).

Results:
In the final study, 265 women (18% of labouring women within the study period) completed the assessment forms. TENS alone was sufficient for pain relief in 38% of these women, and 87% achieved spontaneous delivery compared with the other groups altogether (p = 0.004; adjusted odds ratio = 3.21; 95% confidence interval, 1.44-7.15). The duration of first stage (p = 0.046) and second stage (p < 0.001) were the shortest in the TENS group.

Conclusion:
The result of this survey showed that TENS alone with or without the addition of entonox was sufficient for pain relief in 38% of the women. Furthermore, the use of TENS was associated with the shortest first and second stages of labour, and highest rate of spontaneous delivery. The role and merits of TENS for pain relief in uncomplicated labour should be explored further.
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Introduction

Pain relief during labour is an important concern in midwifery. Nowadays, natural birth and use of non-pharmacological pain relief methods are being advocated for women in labour. A number of non-pharmacological pain relief modalities are now available, including the birth ball, transcutaneous electrical nerve stimulation (TENS), aromatherapy, hypnosis, water bath, and cold and hot compresses. Among these, TENS is used not only for women in labour, but also for a wide variety of patients with chronic pain. It is presumed to block pain signals travelling to the spinal cord, by virtue of mild electrical impulses delivered to nerve fibres via electrode pads attached to the skin, and in the process the nerve impulses to the brain are believed to be blocked[1]. It also helps stimulate the production of pain-killing endorphins[2], which are endogenous opioid compounds.

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They resemble the opiates in producing analgesia and a sense of wellbeing, since they attach to the same neuronal receptors as morphine and heroin, and interfere with the transmission of pain impulses to the brain.

TENS has been advocated as an effective and non-invasive means of pain relief during the early first stage of labour. It enables the women to be in control of their pain, yet there are no known side-effects on the mother or baby. However, the effectiveness of the TENS remains controversial. A systematic review of randomised controlled trials of TENS for analgesia during labour indicated that evidence for reduced pain using TENS in labour was weak[3]. There was no difference between TENS and placebo in terms of the extent of pain relief[4], and it was reported to be ineffective as a routine method of pain relief in labour[5]. On the other hand, it has also been reported to be an effective, non-invasive adjuvant means of providing pain relief during labour and delivery; it was also reported to reduce the duration of the first stage of labour[6]. In another study, TENS provided pain relief in 87% of the participants, while 20% reported excellent pain relief[7].

In Hong Kong, there was no previous experience in the use of TENS in public hospital obstetric units, where the impact of this method remained largely unknown. As the current trend towards natural birth and non-pharmacological pain relief methods has led to the introduction of TENS as one of the options for analgesia in the first stage of labour, we performed a non-blinded study to generate local data on the efficacy of TENS for women in labour.

Methods

In April 2007, non-pharmacological methods in pain relief, including the use of TENS, were introduced in the obstetric unit of our hospital. During the antenatal talks, explanations on different pain relief options, such as the use of TENS, birth ball, pethidine injection, and epidural analgesia were given; and the women had to choose among these for their labour. A pain relief assessment form was designed for collecting suitable data (maternal demographics, gestational age, maternal problems and complications during pregnancy). The assessment form was sent to experts including department operation managers, ward managers, nurse specialists of the obstetric units, for comments and validation. A pilot study was also performed to test their content, after which some amendments were made based on their feedback.

The previously established practice for pain relief was to offer pethidine injections to women admitted with signs and symptoms of labour, when they requested pain relief upon admission. If the women requested epidural analgesia, the on-call obstetric anaesthetist would be consulted. Finally, if there was no contraindication, women could choose their preferred pain relief method. This study was conducted after the formal introduction of TENS as an option of pain relief, and was designed for purposive sampling of all the women who requested using TENS. Following their requests, they were invited to participate in this study. The purpose and objectives of this study were explained and verbal consent was obtained. The assessment form was used to record pain scores before, during and after use of TENS, as well as the characteristic of the pain (frequency, strength, and intensity). The progress of labour as assessed by vaginal assessment of cervical dilatation was all recorded in the data sheet. The women could discontinue the use of the TENS and choose another pain relief method at any time.

If the women requested the termination of TENS, the reasons for the request to switch to another pain relief methods were also recorded. Nevertheless, the assessment continued till delivery. The satisfaction level with the pain relief method used was also documented. The study was conducted from December 2007 to April 2008. After delivery, the assessment forms were collected, and obstetric outcomes such as onset of labour, duration of the first and second stages of labour, mode of delivery, birthweight and the position of the baby at delivery were retrieved from the computer for analysis. The study objectives were to determine the frequency of TENS as the primary method of pain relief among women who had started off with TENS, and the impact of TENS on the outcome of labour.

Data Analysis

Among the 1500 women in labour during the study period, 267 (17.8%) of them requested to have TENS for pain relief. In the final analysis, only two women were excluded because the assessment forms were not completed. A total of 265 women who completed the assessment form were included in the analysis. For the

purpose of comparison, the women were divided into three groups according to whether they used: TENS with or without entonox (TENS group); TENS and pethidine injection (pethidine group); TENS with or without pethidine injection and epidural analgesia (epidural group). Statistical calculations were performed using a commercially available statistical package (Statistical Package for the Social Sciences, Windows version 10.0; SPSS Inc, Chicago [IL], US). Continuous variables were expressed as means ± standard deviation and tested by the one-way analysis of variance, with a post-hoc analysis by the Duncan's multiple range test set at a 5% level for normally distributed data, and the Kendell's W test for non-normally distributed data. Categorical variables were analysed by the Chi-square test and Spearman's correlation coefficient (*rho*). Multiple logistic regression analysis was used to determine the independent associations between the use of the TENS machine with the likelihood of normal spontaneous delivery. This was after adjustment for non–occiput anterior (non-OA) position, use of oxytocin for induction or augmentation of labour, and nulliparity.

Results

Of the 265 women in the analysis, 102 (38%) used TENS alone with or without additional entonox (TENS group) which was considered sufficient for pain relief; 107 (40%) received additional pethidine (pethidine group); 56 (21%) received additional epidural analgesia (epidural group). The demographic profile of the three groups is illustrated in Table 1. Mean maternal age in the TENS, pethidine and epidural groups were 31.0 ± 4.6, 29.6 ± 5.1, and 31.5 ± 5.0 years, respectively (one-way ANOVA, p = 0.02). Post-hoc analysis with Duncan's test indicated that the mean age in the pethidine group was significantly lower than the other two groups. More multiparous women chose TENS for pain relief, while more nulliparous ones requested additional pethidine or epidural analgesia. Nevertheless, there were no differences in the mean pain scores, frequency of uterine contractions per 10 minutes, or cervical dilatation, among the three groups at the time TENS was applied or when the women complained of greatest pain. Although there was no significant difference in the pain scores before the application of TENS in the three groups, the satisfaction level was highest in the epidural group.

Regarding the outcome of labour (Table 2), there were significant differences between the three groups. Thus, spontaneous labour occurred more frequently in the TENS than epidural group ($p < 0.001$). Similarly, the mode of delivery was significantly different between the three groups; the highest rate of spontaneous delivery was in the TENS group and was lowest in the epidural group; while the figures for instrumental and Caesarean delivery showed an opposite trend ($p < 0.001$). There were also significant differences in the duration of the first and second stages of labour in the three groups. The

Table 1. Maternal and infant characteristic when using different modes of analgesia*

	TENS (n = 102)	Pethidine (n = 107)	Epidural (n = 56)	p Value
Maternal age (years)	31.0 ± 4.6	29.6 ± 5.1‡	31.5 ± 5.0	0.02
Parity†				
Primigravida (%)	62.4	83.2	87.5	<0.001
Multiparous (%)	37.6	16.8	12.5	
Gestational age (weeks)	39.0 ± 1.4§	39.5 ± 1.0	39.5 ± 1.3	0.024
No. of contractions/10 mins				
At application of TENS	2.77 ± 0.86	2.70 ± 1.03	2.40 ± 0.88	0.09
At highest pain score	2.81 ± 0.78	2.97 ± 1.06	2.78 ± 0.93	0.43
Cervical dilatation (cm)				
At application of TENS	1.76 ± 0.61	1.71 ± 0.64	1.48 ± 0.51	0.16
At highest pain score	1.72 ± 0.27	2.33 ± 0.33	1.67 ± 0.48	0.09
Birthweight (g)	3152 ± 426§	3209 ± 365	3287 ± 440	0.17

* TENS denotes transcutaneous electrical nerve stimulation; data are shown as mean ± standard deviation, or as otherwise stated

† Analysis by one-way analysis of variance and Chi-square as indicated

‡ $p < 0.05$ of pethidine group

§ $p < 0.05$ comparing TENS group with pethidine group

Table 2. Relationship between mode of analgesia and obstetric outcomes*

	TENS (n = 102)	Pethidine (n = 107)	Epidural (n = 56)	p Value
Onset of labour (%)				
Spontaneous	89.1	75.7	44.6	<0.001
Induced	10.9	24.3	55.4	
Mode of delivery (%)†				
NSD	87.3	69.2	48.2	<0.001
Instrumental	8.8	19.6	19.6	
Emergency Caesarean	3.9	11.2	32.1	
First stage of labour (hours)	3.6 ± 3.1	4.8 ± 4.0	4.7 ± 4.3	0.046
Second stage of labour (hours)	0.37 ± 0.4	0.57 ± 0.5	1.26 ± 1.4	<0.001
Baby's position at delivery (%)†				
OA	80.4	72.0	67.9	0.77
OP	6.9	11.2	10.7	
OT	12.7	16.8	21.4	
Pain score				
Before using TENS	7.14 ± 1.75	7.23 ± 1.86	6.56 ± 2.08	0.11
At highest pain score	7.75 ± 1.79	7.91 ± 1.75	7.66 ± 1.62	0.68
Satisfactory level	5.82 ± 2.79	5.47 ± 2.54	6.17 ± 3.78	<0.05

* TENS denotes transcutaneous electrical nerve stimulation, NSD normal spontaenous delivery, OA occiput anterior, OP occiput posterior, and OT occiput transverse; data are shown as mean ± standard deviation, or as otherwise stated

† Analysis by one-way analysis of variance and Chi-square as indicated

duration of first stage in the TENS group was shorter than in the other two groups (p = 0.046). The duration of the second stage was also shortest in the TENS group and greatest in the epidural group (p < 0.001).

Regarding outcomes in the babies, there were no significant differences in the baby's position between the groups at delivery (Table 2). In the TENS group, the gestational age at delivery (39.0 ± 1.4 weeks) was slightly shorter than the respective durations in the pethidine and epidural groups (39.5 ± 1.0 weeks, 39.5 ± 1.3 weeks; p = 0.024). There was no difference between the groups with respect to the mean birthweights (Table 1).

In order to determine if there was any independent association between TENS use and spontaneous delivery, multiple logistic regression analysis was performed. The confounding factors that were taken into account included: the use of TENS, non-OA position, use of syntocinon, and nulliparity. The results showed that TENS was significantly associated with spontaneous delivery (p = 0.004; adjusted odds ratio = 3.21; 95% confidence interval, 1.44-7.15), while non-OA position (p < 0.001; 0.13; 0.06-0.26) and use of syntocinon (p = 0.024; 0.45; 0.22-0.91) were associated with a significantly reduced likelihood of spontaneous delivery.

Discussion

This study used a purposive sampling, and all the women who requested use of the TENS machine were invited to participate in this study. The higher frequency of multiparity and spontaneous labour in the TENS group suggested that this group probably had a more efficient / less complicated labour, which was also consistent with the higher frequency of spontaneous delivery. Yet there was no difference in the pain score, birthweight, or the stage of labour at the time TENS was started. Since pain is largely a subjective parameter and was similar among the three groups, in this study the relationship between the mode of analgesia and the outcome of labour was dictated more by natural events and the women's own choices than selection bias on the part of the medical and midwifery staff, even though the study was neither randomised nor blinded.

The use of TENS was shown to be an independent factor for spontaneous delivery, increasing the likelihood by 3.2-fold on multiple logistic regression analysis; while use of syntocinon and non-OA position were associated with a decreased likelihood of spontaneous

delivery. Our results therefore suggest a beneficial effect of TENS on the outcome of labour.

Arguably, a non-randomised and unblinded study could exhibit a degree of bias both in the selection of patients and the subsequent additional means of analgesia. However, since all the women in this study had been briefed antenatally before starting TENS and other modes of analgesia (on their own requests), in these women any bias would have been largely self-generated. Furthermore, the management of labour and delivery was uniform (according to set protocols), so that any demonstrated relationship between the use of TENS and the outcome of labour were likely to reflect the effect of TENS rather than the effect of medical intention.

The reasons for the increased rates of spontaneous delivery in women who had used TENS alone are not clear. However, pethidine can cause sedation and epidural analgesia can paralyse the pelvic floor and lower limb muscles, while women receiving TENS can still remain mobile during the first stage of labour. Thus TENS could shorten the first and second stages of labour, and enhance spontaneous delivery by circumventing such adverse effects. TENS use can largely replace pethidine (a possible cause of neonatal respiratory suppression). In a previous pilot study, we showed that the use of pethidine injections had dropped off significantly from 11.5% (October 2006 to March 2007) to 7.8% (April to September 2007) [$p < 0.001$] after the introduction of TENS[8], and resulted in a reduction in the rate of side-effects attributed to pethidine[9]. A reduction in the number of neonates being admitted to the special care baby unit for close observation also enhances the maternal and infant bonding and enhances the rate of successful breastfeeding.

Not surprisingly, epidural analgesia was chosen as the most effective pain relief method with higher levels of satisfaction ($p < 0.05$) compared to having TENS alone or with pethidine. However, on account of the higher risk of emergency Caesarean section (32%) and instrumental delivery (20%) in the epidural group, the merits of such analgesia for women in labour remain questionable.

In conclusion, this survey suggested that TENS alone with or without the addition of entonox was sufficient for pain relief in one-third (38%) of the women during the first stage of labour. Furthermore, it was associated with shorter first and second stages of labour, and higher rates of spontaneous delivery. The role and merits of TENS for uncomplicated labour should be explored further.

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