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Effectiveness of Transcutaneous Electric Nerve Stimulator for Pain Relief in Labour

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Abstract

The effectiveness of transcutaneous electric nerve stimulation (TENS) for pain relief in labour was compared to inhalation analgesia consisting of 50% nitrous oxide and 50% oxygen (ENTONOX). In the first part of the study 101 patients in early labour were allocated to using TENS (Group A) or ENTONOX (Group B) for pain relief. Our results did not show any beneficial effect on pain relief in labour with the use of TENS over ENTONOX; 18.8% of patients in Group A went through labour without any further form of analgesia as opposed to 17.0% in Group B. In the second part of the study 20 nulliparous patients having induced labour were randomly allocated to use TENS (Group C) or ENTONOX (Group D) as the first modality of pain relief. A switchover was made when labour pains were no longer tolerable. The results showed that both TENS and ENTONOX could be used in early labour up to 5–6 cm cervical dilatation till the frequency of contractions was nearly 5 in 10 min or the first 3–4 hr from the time patients first requested pain relief in labour when frequency of contractions was nearly 4 in 10 min. TENS could be used in early labour for patients who wish to be ambulant and is as effective as ENTONOX. Either modality of pain relief was not adequate for pain relief throughout labour.

Key words: transcutanteous electric nerve stimulation, pain relief in labour

Introduction

Relief of pain during labour continues to raise problems. Present methods of analgesia appear to meet the needs of most parturients but are not without contraindications and complications. Epidural anaesthesia gives satisfactory control of pain but is not without complications. Shortage of suitably trained anaesthetic staff make it difficult for some obstetric units to provide satisfactory service. Fear of neonatal depression at birth limits the use of parenteral analgesics to a level less than that which is required for optimal analgesia. Inhalation analgesia may not provide optimal relief. All these modes of analgesia confine patients to bed. Therefore search continues for a method of pain relief that can be self administered, non-invasive, effective, allows ambulation and interferes minimally with chances

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of a safe spontaneous vaginal delivery with minimal deleterious effect on mother and fetus. TENS, which is based on Melzack and Wall's[1] gate control theory of pain has been used in labour for relief of both the intermittent pain in the lower abdomen associated with uterine contractions as well as the continuous low backache which can be difficult to cope with.

We evaluated the effectiveness of TENS for pain relief in labour. In the first part of the study, its effectiveness in the first stage of labour was compared with that of inhalation analgesia consisting of ENTONOX. In the second part of the trial we attempted to assess the point of time in the first stage of labour till when the TENS or ENTONOX will be effective in affording pain relief.

Patient Selection

All patients admitted in the morning to the labour suite of the National University Hospital, Singapore, in early labour or for induction of labour were considered. The study protocol was discussed and patients consenting to use TENS or ENTONOX for pain relief were recruited. All patients who expressed desire for epidural analgesia were excluded. The study was conducted in 2 parts—Part I and Part II. Patients admitted in advanced labour or having previously been given other forms of analgesia were excluded from our study as it was thought that rational discussion of the technique would not be easy with such patients.

Part I

Those patients in early labour were randomly allocated into 2 groups—A and B according to the order of admission, every second patient being in Group B. Group A used TENS and group B used ENTONOX as the first modality of pain relief. Each mode of pain relief was started in early labour. On recruitment to the study, the following data were entered into a computerized coding sheet: age, parity, type of labour, prior experience of pain in labour, preparation about pain during labour and childbirth, experience of labour pain conveyed by friends who had recently delivered and information obtained about pain relief in antenatal classes. The emotional state regarding present pregnancy was assessed by asking whether she was happy or unhappy with the pregnancy and whether it was planned. Preconception of labour pain was assessed on a scale of 0–10 where 0 is painless and 10 is the most intensive pain imaginable. The probability of requesting additional pain relief besides TENS or ENTONOX was also assessed on a scale of 0–10, where 0 being unlikely and 10 being most likely. The endpoint of the study was arrived at when the patient requested different mode of pain relief because TENS or ENTONOX was no longer sufficient for pain relief. The subsequent modalities of analgesia offered were pethidine alone or pethidine combined with TENS or ENTONOX, or epidural anaesthesia. The day after delivery the patient was asked to score the intensity of pain endured in labour, with the use of TENS or ENTONOX on a scale of 0–10. Neonatal birth weight was noted and the outcome assessed by Apgar scores and admission to neonatal intensive care unit.

Part II

Twenty nulliparous patients who were to have surgical induction were randomly allocated by use of sealed envelopes, into 2 groups, C or D. Patients in group C used TENS as the first modality of pain relief and those in Group D used ENTONOX. Details of patient characteristics and labour were entered into a computerized coding sheet. Data obtained included cervical dilatation, frequency of contractions per 10 min and description of pain at the time when patient first requested pain relief. The pain was described as mild, moderate or severe. When labour pain was no longer tolerable with the use of the chosen modality, the duration of use, cervical dilatation and number of contractions per 10 min were noted and the patient was requested to score the pain relief experienced as nil, partial or complete. A switch over of the modes of pain relief was made; patient using TENS was commenced on ENTONOX and vice versa. When the patient found labour pains no longer

tolerable even with the next modality, data on duration of use of second modality, cervical dilatation and frequency of contractions were collected as mentioned previously. Further analgesia was given in the form of combined TENS and ENTONOX, or intramuscular Pethidine 75 mg along with the first modality of pain relief. The endpoint of the study was reached when patient requested for further analgesia after the second modality did not offer relief or when second stage of labour was reached.

Method

TENS

Transcutaneous nerve stimulation was achieved by using the "obstetric pulsar", a specially designed twin-channel nerve stimulator (Spembly Medical, Hampshire, England). In this equipment the pulse duration is fixed at 200 microseconds, but the amplitude and frequency can be altered by the patient to produce the required sensation. The amplitude ranged from 0–48 mA (into 1 k ohm load). In the continuous mode, the frequency ranged from 15–200 Hz. In the burst mode the frequency ranged from 15–200 Hz modulated at 2 bursts/sec; on for 180 milliseconds and off for 320 milliseconds. The electrodes are firmly fixed to the skin with adhesive tape. The electrode is placed on either side of the midline approximately 5 cm apart with 1 pair in the region of the 10th and 11th thoracic vertebrae and the second pair in the region of the upper sacral vertebrae. A control box which had controls to adjust the flow of current to thoracic (Channel 1) and sacral (Channel 2) electrodes was given to the patient after explaining and demonstrating the equipment prior to the onset of painful contractions. An additional demand switch to control the burst modes which increased the frequency of the electric pulse during a uterine contraction was also available.

ENTONOX

The ENTONOX used in this study was a mixture of 50% nitrous oxide and 50% oxygen. The patient using ENTONOX was instructed by the midwife on the breathing technique on admission to the labour ward.

Results

Part I

Group A consisted of 48 patients, with equal numbers of nulliparae and multiparae. Group B consisted of 53 patients, with 27 nullipara and 26 multipara. In group A, 25 had spontaneous labour while 23 were either augmented or induced. In group B, the corresponding numbers were 37 and 16, respectively (Table 1). There was no significant difference between groups A and B in terms of parity, type of labour, observed length of first stage of labour, numbers who had planned pregnancy, feelings of having a baby, experience of pain in previous labour or labour pain as related by friends and probability of requesting further pain relief (Table 2). There was no difference in outcome of the neonates in both groups.

In group A, 18.8% (9/48) did not request further pain relief as compared to a similar number (17%) in group B (Table 3). In group A 58.3% (28/48) needed Pethidine compared with 71.7% (38/53) in group B. These results

Table 1. Obstetric characteristics according to mode of pain relief

Mode of pain relief	Group A TENS $n=48$ (100%)	Group B ENTONOX $n=53$ (100%)	Significance
Mean age (yrs)±SD	28.4±4.2	28.3±4.3	N.S.
Number of nulliparae	26 (54.2%)	33 (62.3%)	N.S.
Augmented or induced labour	23 (47.9%)	16 (30.2%)	N.S.
Observed 1st stage of labour			
≤8 hr	35 (72.9%)	30 (56.6%)	N.S.
>8 hr	13 (27.1%)	23 (43.4%)	N.S.

Table 2. Factors that may influence the perception of pain according to mode of pain relie

	Group A TENS $n=48$	Group B ENTONOX $n=53$	Significa
1) Intensity of pain in previous labour:			
1-5 on a scale of 10	4/22 (18.2%)	3/20 (15.0%)	N.S.
6-10 on a scale of 10	18/22 (81.8%)	17/20 (85.0%)	N.S.
2) Experience of pain in labour related by friend:			
No account	2 (4.2%)	3 (5.7%)	N.S.
1-5 on a scale of 10	7 (14.6%)	4 (7.5%)	N.S.
6-10 on a scale of 10	39 (81.3%)	46 (86.8%)	N.S.
3) Planned pregnancy	30 (62.5%)	30 (56.6%)	N.S.
4) Feelings about having a baby:			
A) Happy	47 (97.9%)	49 (92.5%)	N.S.
B) Unsure or unhappy	1 (2.1%)	4 (7.5%)	N.S.
5) Description of pain anticipated:			
1-5 on a scale of 10	11 (22.9%)	16 (30.2%)	N.S.
6-10 on a scale of 10	37 (77.1%)	37 (69.8%)	N.S.
6) Probability of requesting pain relief:			
1-5 on a scale of 10	33 (68.8%)	33 (62.3%)	N.S.
6-10 on a scale of 10	15 (31.2%)	20 (37.7%)	N.S.

Table 3. Subjective and objective measure of pain according to mode of pain relief

	Group A TENS $n=48$	Group B ENTONOX $n=53$	Significance
1) Additional pain relief needed:			
None	9 (18.8%)	9 (17.0%)	N.S.
Pethidine	28 (58.3%)	38 (71.7%)	N.S.
Other modalities	11 (22.9%)	6 (11.3%)	N.S.
2) Intensity of pain experienced in labour described by patient:			
1-5 on a scale of 10	4 (8.3%)	2 (3.2%)	N.S.
6-10 on a scale of 10	44 (91.7%)	51 (96.2%)	N.S.

were not statistically significant.

The intensity of labour pain as described by the patients was categorised into 2 groups, 0–5 and 6–10, according to the scale provided (0–10). In group A 77.1% and in group B 69.8% described the anticipated labour pain to be between 6–10 (Table 2). But 91.7% in group A and 96.2% in group B described the experienced labour pain to be 6–10. The difference in the results were not statistically significant (Table 3).

The 20 patients in the second part of the study requested analgesia in the early active phase of labour. At the time of request, mean frequency of contractions was 3.7 per 10 min in group C (TENS) compared to 4.5 per 10 min in group D (ENTONOX) which was statistically significant ($p<0.05$) (Table 4). There was a tendency for TENS to give better pain relief as 89% in group C found partial relief as compared to 50% in group D although the difference was not statistically significant. In group C, 11% of the patients found no relief compared to 50% in group D. But these results have to be interpreted with caution as the frequency of contractions in group D was statistically more than that in group C. Mean duration of use of either modality was similar, and was about 1 hr 20 min.

One patient in group D delivered without

Table 4. Characteristics in nulliparous patients undergoing induction of labour according to the first selected modality of pain relief

	Group C TENS $n=10$	Group D ENTONOX $n=10$	Significance
Mean cervical dilatation at time of requesting pain relief (cm)	3.3± 1.6	3.1± 0.7	N.S.
Description of pain at time of request			
Mild	7	3	N.S.
Moderate	0	4	N.S.
Severe	2	3	N.S.
Mean frequency of contractions/10 min at time of request	3.7± 1.1	4.5± 0.8	$p<0.05$
Mean duration of use of 1st selected modality (min)	81.8±31.4	82.6±53.9	N.S.
Type of relief			
Nil	1 (11%)	5 (50%)	N.S.
Partial	0 (89%)	5 (50%)	N.S.
Complete	0	0	N.S.

Table 5. Labour characteristics after switch over from 1 modality to another

	Group C $n=10$	Group D $n=9$	Significance
Mean dilatation of cervix at time of change to 2nd modality (cm)	5.1± 2.5	4.2± 1.25	N.S.
Description of pain at time of request			
Mild	0	0	N.S.
Moderate	4	5	N.S.
Severe	5	4	N.S.
Mean frequency of contractions/10 min at time of request	4.9± 1.1	4.9± 1.2	N.S.
Mean duration of use of 2nd modality (min)	32.7±21.0	31.8±24.2	N.S.
Type of relief			
Nil (same as before)	1	4	N.S.
(worse than before)	2	6	N.S.
Parital	6	4	N.S.
Complete	0	0	N.S.

requesting further analgesia and was excluded from the subsequent analysis. When further analgesia was requested after patients found the first modality of analgesia inadequate, the patients in group C, who were using TENS were switched over to ENTONOX and vice versa.

At the time of the change, the cervical dilatation was 5.1 cm in group C and 4.2 cm in group D. The description of pain was similar and the mean frequencies of contractions were not different (Table 5). The mean duration of use of second modality was short and not significantly different between the groups. Group C who used ENTONOX as a second modality found partial relief in 66.6% of patients compared with 44.4% in group D who used TENS as the second modality. The difference was not statistically significant.

When the second modality of analgesia could no longer relief the labour pains, the endpoint of the study was reached. The mean cervical dilatation, mean frequency of contractions and severity of labour pain was similar in each group at this point. The length of labour in group C was 4 hr 48 min compared

with 6 hr 16 min in group D. This was not statistically significant.

Discussion

There is no objective method of measuring pain. The intensity of pain and the effect of analgesia provided by any method can only be judged from the patient's statements. The intensity of pain depends upon several factors, one of these being the emotional stability of the patient. According to Bonica[2] prenatal education diminishes or completely eliminates factors that facilitate the pain process and under some circumstances, initiate psychodynamic mechanisms that actually diminish transmission of nociceptive impulses. Our study design took these into consideration and hence the detailed questionnaire about pain anticipated based on patients' knowledge and emotional state.

Results of studies by different groups on the effect of TENS on labour pain have been variable. Controlled trials using TENS/TENS placebo by Nesheim,[3] Harrison[4] and Thomas *et al.*[5] found no difference in pain relief. In Harrison's study,[4] 12% of nulliparae and 49% of para 2 underwent labour using TENS without additional forms of analgesia, compared with 12% of nulliparae and 39% of para 2 women in the TENS/placebo group. These objective findings may be because the whole length of labour was considered. Highly significant differences in favourable and unfavourable comments from patients and midwives between TENS and TENS/placebo users in both parity groups suggests that TENS has a part to play in analgesia in labour. Erkkola *et al.*[6] in a randomized controlled study found no difference in the amount of conventional analgesia required by the 2 groups. Significantly more mothers in the TENS groups reported that labour had been moderately or intensely painful compared to the control group up to a cervical dilatation of 7 cm. Beyond 7 cm dilatation, the subjective judgement regarding pain was similar in both groups. Non-controlled studies have, however, been more positive. Robson[7] reported that 34% of TENS users found it useful throughout labour and Steward[8] found 23.5% TENS users had considerable pain relief. Bundsen[9] concluded that those using TENS needed less ENTONOX, and found it to be helpful for pain relief of the back but not suprapubic region.

The aim of the first part of the study was to compare the effectiveness of TENS over ENTONOX which is a standard method used in our labour ward. The results suggested that they did not differ in their effectiveness but the subjective impression by the patients and the attending staff was that TENS was as equally effective as ENTONOX in the early first stage of labour but not for the whole labour. Since pain relief by TENS in a patient who likes to be ambulant may be of some advantage, we proceeded to evaluate its use in a randomized manner with strict inclusion criteria and objective parameters in the second part of the study. Nulliparae were chosen as previous experience of childbirth in multiparae might be a confounding factor in the total experience of pain in this index labour. The study was limited to patients undergoing surgical induction so that labour could be observed from the start and the contraction pain induced by syntocinon and early rupture of membranes would be similar in the groups studied.

This group of patients requested pain relief around 3 cm cervical dilatation. The results showed no difference in duration of pain relief with the first modality, mean cervical dilatation at time of request for another mode of pain relief, pain experienced before switch over of modality and mean frequency of contractions. Both TENS and ENTONOX were fairly effective in early labour up to 5–6 cm cervical dilatation or the first 3–4 hr from the time they first requested pain relief in labour. These observations suggest that TENS could be used in early labour for patients who wish to be ambulant and is as effective as ENTONOX. From the first and second part of the study we could conclude that neither ENTONOX nor TENS were adequate for pain relief throughout labour.

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