An Evaluation of Transcutaneous Nerve Stimulation for the Relief of Pain in Labour

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Summary
This study conducted at the Birmingham Maternity Hospital in 1986 presents the results of 50 labours, in which Transcutaneous Nerve Stimulation (TNS) was used as the first form of pain relief. The effectiveness of TNS in combination with pethidine or Entonox or both has been recorded. Its ability to reduce backpain at the onset and during labour, along with its effectiveness in reducing the discomfort of membrane sweeps, prostaglandin therapy and internal examinations has been noted.

Two pairs of electrodes were taped on the woman's back at levels T10–L2 and S2–4. These levels correspond to the nerve roots supplying the body of the uterus, cervix and pelvic floor.

A two-channel Spembly Obstetric Unit producing biphasic pulses, which were variable in amplitude and frequency, were used. Forty-nine women out of 50 would like to use TNS again in labour.

Due to the good results obtained, and no known complications, TNS is recommended as an initial form of pain relief to which pethidine or Entonox can be added later in the labour.

Introduction

On reading several papers stating the effectiveness of TNS in labour[1–3] I was encouraged to evaluate its role, referring my results to the Research Committee at the Birmingham Maternity Hospital.

These are the results of 50 deliveries, in which TNS was used, with the agreement and authority of all the consultants.

Equipment

Two Spembly Obstetric Pulsar Units were used.

Amplitude:	0.48 mA into 1 k ohm load
Frequency:	Normal Mode: 15–200 Hz modulated at 2 bursts/sec 180 m sec on 320 m sec off
	Boost (Continuous Mode): 15–200 Hz
Pulse Width:	200 sec fixed
Battery Types:	9 V type PP3, 6F22 or 1604

Electrodes

Standard carbon rubber (re-usable) electrodes were used, electrode gel was a contact medium. Adhesive strapping was used to fix and maintain electrodes over the appropriate nerve roots making it possible for the women to move freely whilst in labour. Care was taken not to cover the electrode/lead junction in case the leads became detached. It is important to re-apply gel every four hours in case of drying out. With use, impedance increases with this type of electrode and they should be replaced at intervals.

Electrode placement

Electrodes were placed parallel with and close to the spine. The top electrodes extending from T10 to L1, and the lower pair between S2 and S4. These levels were chosen because nociceptive impulses from the body of the uterus and cervix are transmitted through T10, T11, T12 and L1 nerve roots. Nociceptive impulses from the perineal structures are transmitted by the pudendal nerve into the spinal cord, via the posterior roots of S2, S3 and S4. Nociceptive impulses from other pelvic structures involved in the pain of parturition, for example pelvic parietal peritoneum and uterine ligaments, are supplied by the lower lumbar and upper sacral nerves. Abdominal electrodes were considered. However, research carried out by Bundsen *et al.* (1981)[1] concluded that although fetal heart irregularities were not reported when abdominal TNS electrodes were used, there was a theoretical possibility that high intensity stimulation with conventional electrodes over the parturient's lower abdomen could, in unfavourable cases, induce irregularities of the fetal heart function (Bundsen, 1982a).

Introduction of TNS

Women attending Parentcraft sessions at the Birmingham Maternity Hospital, all at least 28 weeks pregnant, were invited to a talk and demonstration of TNS which covered:

1 Brief history and development of TNS.
2 A simple explanation of how TNS is thought to influence pain.
3 The positioning and appropriate time of application of electrodes, i.e. the latent or early active phase of labour, also at least 30 minutes before augmentation of labour.
4 Correct use of the TNS unit. Setting an intensity level, varying the frequency and boosting when appropriate.
5 The use of pethidine or Entonox, or both with TNS.

All were encouraged to have the electrodes on their backs for several minutes and to appreciate the various frequency ranges, once the initial intensity level had been set. The reaction of their skins to the stimulation was also noted.

Husbands/partners were encouraged to attend and they were advised not to alter the intensity or frequency channels of the TNS units for their partners when in labour. However, they could press the boost mode button at her request.

Midwives and midwifery students attended the sessions to familiarise themselves with its function, application and to appreciate the sensation of TNS.

Research forms

Two forms were produced. Please refer to Tables 1 and 2.

Table 1. TNS Survey Form

Name ..... Reg No. .....
Address .....
Consultant ..... Date ..... Edd .....

A		Please ring labour started	Primigravida/Multipara Time
B	i ii iii	Time of arrival Dilation of cervix TNS applied at	Time CMS Time
C	Fill in if used:		
	i	Pethidine	Time CMS
	ii	Entonox	Time CMS
	iii	Epidural	Time CMS
	iv	C/Section	Time CMS
D		Full dilation at	Time
E	i	Position of patient at 2nd stage (please tick)	Sitting ☐ Birth Chair ☐ Kneeling ☐ Supported Squatting ☐ Side lying ☐ Other! ☐
	ii	Position at delivery	
F		Forceps	Yes/No
G		Episiotomy	Yes/No
H		TNS used during suturing	Yes/No
I		Time TNS removed	AM/PM
J		Time of Delivery	AM/PM
K		Type of Delivery	ND/FD/VE/CS
L		Apgar score at 1 minute Apgar score at 5 minutes	....
M		Naloxone administered	Yes/No
N		If TNS removed please tick or note why was it: (a) Not giving sufficient relief? (b) Interfering with fetal heart rate monitoring? (c) Other reasons please state?	
O		Problems experienced with TNS (please tick) (b) Difficulty with use of TNS unit ☐ (c) Other reasons (please state) ☐	(a) Application ☐

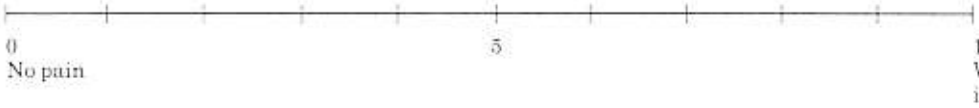
Form 1 — completed by midwives during labour.

Research has shown (Browning, 1983)[2] that women delivering vaginally without any form of pain relief or with pethidine, Entonox or by Caesarean section under general anaesthetic, produce higher levels of beta-lipotrophin, beta-endorphin and gamma-lipotrophin than epidural deliveries. It has been suggested that there may be a link between beta-endorphin levels and neonatal respiratory depression. TNS has also been shown (Salar, 1981)[3] to produce these peptides. Therefore I had to consider whether the combination of such deliveries with TNS could be a

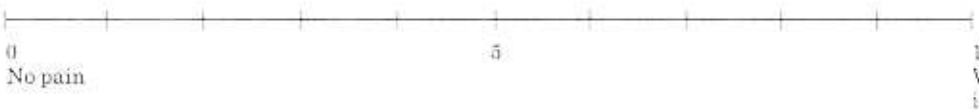
Table 2. TNS Survey: Patient's report Date.....

Name ..... Reg No.....
Address .....
.....
Consultant ..... Date of Delivery.....

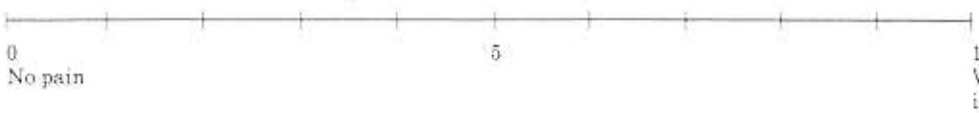
1 Please ring Primigravida/Multipara
2 Did you find out about TNS at Parentcraft sessions? Yes/No
3 If 'no' please state where
4 Did you have backache during the labour? Yes/No
Please mark degree of pain:



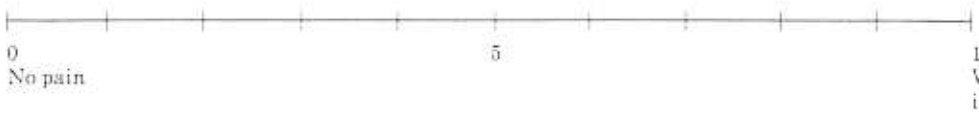
With TNS mark degree of backpain:



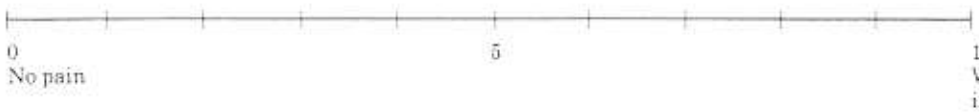
5 Units of Pain Intensity
Without any form of pain relief:



With only TNS



With TNS + pethidine or Entonox or both:



6 Did you use TNS during suturing? Yes/No

factor in producing higher concentration levels of beta-endorphins, thus requiring more frequent administration of Naloxone. This was the reason for noting whether Naloxone was administered at delivery (ref. question m, Form 1, Table 1).

A large percentage of women in labour at the Birmingham Maternity Hospital are internally monitored. It was critical to note if TNS would interfere with the fetal scalp monitor recordings (FSE). If interference was observed the obstetricians were informed. They would evaluate the situation, i.e. if the interference was negligible allowing an adequate fetal recording TNS would be continued. If an unacceptable level of interference was noted, TNS would be discontinued (ref. question N, Form 1, Table 1 was included for this reason).

Form 2— This was completed by myself and physiotherapy colleagues as soon after delivery as humanly possible! (within 24 hours of delivery). A simple pain scale was used.

Results

Group 1 — (Figs 1 and 2)
All were normal deliveries, TNS being the only form of pain relief used.

Six out of the 50 women had a normal delivery using only TNS. Two were primigravidae, four were multiparous. The average length of labour was $6\frac{1}{2}$ hours. Four complained of back pain during labour and all found TNS very beneficial in reducing the pain. Two found it was completely relieved. Figure 1 shows the level of pain experienced by 29 women who suffered from back pain at the onset or during labour. The first scale records the pain without any form of pain relief, and the second scale records the pain level once TNS was applied.

Although all four multiparae felt that their contractions were stronger during this labour TNS was extremely helpful in reducing pain intensity levels, particularly when boosted. Several found boosting very helpful when being internally examined. One forgot to boost on several occasions during a contraction

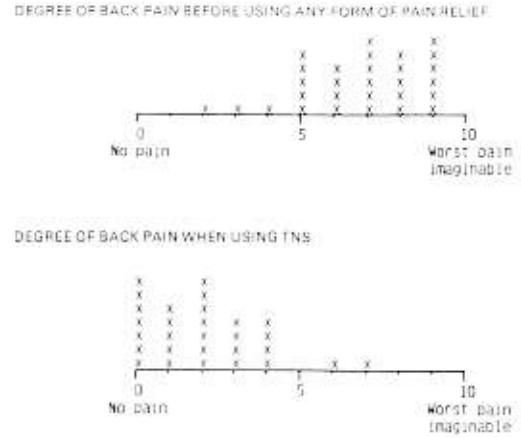


Fig. 1

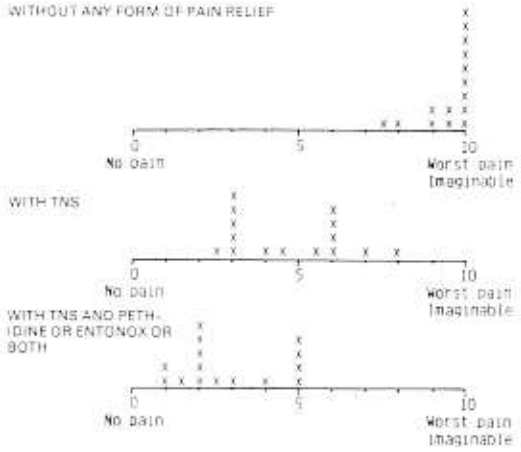


Fig. 3

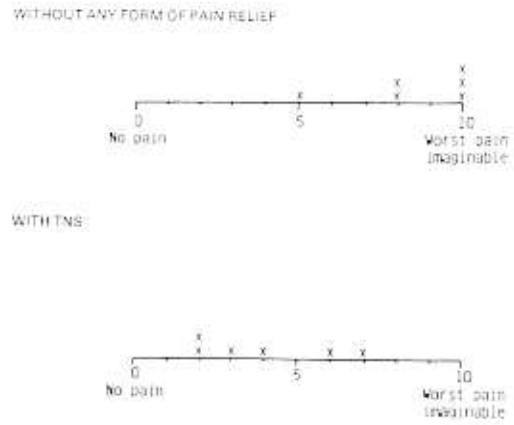


Fig. 2

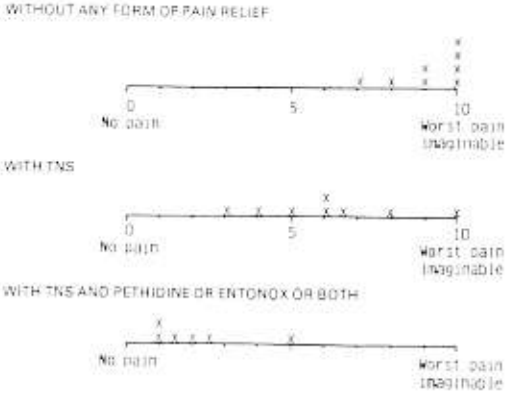


Fig. 4

and noted the difference in relief she obtained. Figure 2 shows the level of pain experienced by the women during labour, before and after the TNS was applied.

All were cephalic occipito-anterior presentations and all would use TNS again in labour. Two out of six used TNS during suturing, but did not feel it was of any significant value. Nine and 9 were the Apgar scores recorded at 1 minute and 5 minutes respectively at delivery for five of the babies. The sixth recorded an Apgar score of 9 and 10. Therefore, Naloxone was not administered.

Group 2 — (Fig. 3)
This shows pain intensity levels before any form of pain relief was used. Then when TNS was used initially and finally when TNS was combined with pethidine or Entonox or both.

All were normal deliveries, the women used TNS initially then combined it with pethidine or Entonox or both.

There were 15 women in this group, including a twin delivery (both twins were cephalic occipito-anterior presentations). Two used TNS initially, then combined it with pethidine, seven used TNS first then combined it with Entonox and six used TNS initially, then combined it with both pethidine and Entonox.

Eleven were primigravidae and four multiparous. The average length of labour was 9 hours. Three of the 15 labours were induced. Ten complained of back pain (Fig. 1). All 15 women found TNS very helpful in the early active phase of labour. As they progressed all found combining it with pethidine or Entonox or both very successful. All would use TNS again.

During one labour, the leads became detached and the woman appreciated the difference in pain relief.

Interference with FSE monitoring was noted in two labours. However, only one TNS unit was removed. The obstetrician concluded in one case that the interference was negligible and that an adequate fetal heart recording was being obtained; TNS was therefore continued. In the second case the level of interference was unacceptable in the presence of several low base line recordings; TNS was discontinued. One particular woman had been very impressed with TNS throughout the night prior to her induction. Following a membrane sweep she was unable to sleep due to discomfort. She was given a TNS unit and was able to sleep, relaxed and pain free.

Fourteen of the babies delivered had Apgar scores of 9 + 10 at 1 and 5 minutes respectively. An Apgar of 4 at 1 minute and 9 at 5 minutes was recorded where a baby had the cord tightly wound around the neck.

No Naloxone was therefore administered.

Group 3 — (Fig. 4)
All were forceps deliveries. Women used TNS initially, then combined it with pethidine or Entonox, or both. There were eight women in this group. Seven were primigravidae and one a multipara. One used TNS alone until her baby was delivered by Simpson's forceps with

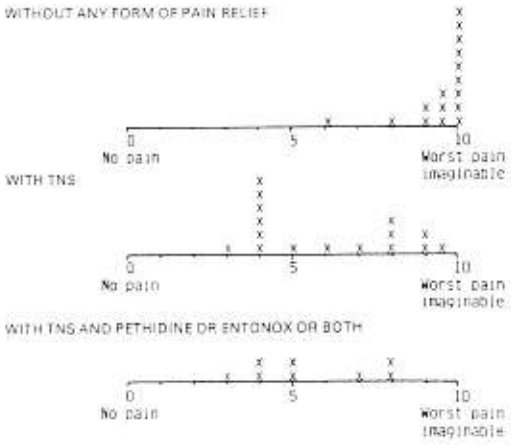


Fig. 5

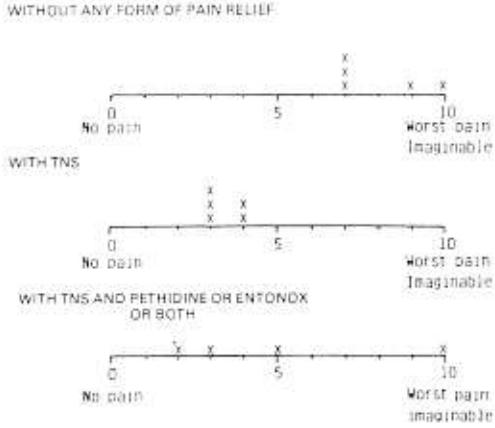


Fig. 6

a pudendal block. One with pre-eclampsia used TNS for one hour following induction, but did not find it helpful. She discontinued using it. The remaining six women found it very helpful initially. One went on to combine it with pethidine and five found the combination of TNS, pethidine and Entonox more suitable. Five of these women had the TNS removed when pudendal blocks were administered. The sixth woman in this group had the TNS unit removed because of unacceptable interference with the FSE recording in the presence of low baseline recordings. Naloxone was administered to this woman's baby. She had received 100 mg of pethidine three hours before delivery. TNS had been removed two hours before delivery.

The average duration of the labour was 13 hours. One out of the three women who complained of back pain obtained complete relief (Fig. 1). Two found it helped considerably. The leads became detached in one case, and this woman noticed the difference in relief. Six were cephalic occipito-anterior presentations and two were occipito-posterior.

Apgar scores were 9+9, 9+9, 9+9, 7+10, 6+10, 5+9, 9+10 and 8+10 respectively. All would use TNS again.

Group 4 — (Fig. 5)
All were epidural deliveries, TNS being used initially.

There were 16 women in this group. Fourteen were primigravidae and two were multiparous. Eight used TNS for 75% of the duration of their labours and then requested an epidural. Six used TNS initially, then combined it with Entonox before requesting an epidural, and two used TNS initially then combined it with pethidine and Entonox before once again requesting an epidural. The average duration of the labour was 16 hours. The epidural was on average requested after 75% duration of the labour. Twelve complained of back pain (Fig. 1). Three found it gave them complete relief, 15 out of the 16 would use TNS again. One woman did have very slight skin soreness under the electrodes. She had been using the TNS for 12 hours. Apgar scores were 9+9 for 15 babies, Apgar scores of 5 at 1 minute and 8 at 5 minutes were recorded for the final baby. No Naloxone was administered.

Group 5 — (Fig. 6)
There were five women in this group, four were primigravidae and one multiparous. All were delivered by Caesarean section. Initially, they all used TNS. One woman required a Caesarean section because of fetal distress. The remaining four then used Entonox with TNS. One in this group after 13 hours of labouring and coping well with her contractions was given a general anaesthetic because of fetal distress. The remaining three requested epidurals. All three were sectioned because of failure to progress. Only one woman in this group complained of back pain before using TNS. All of them would use TNS again.

All Apgar scores recorded were 9 or above at 1 minute and 5 minutes respectively. Therefore, Naloxone was not administered.

Discussion

Although TNS can be applied at any stage in labour, it is most helpful in the *latent* and *early active* phases of most labours. Those who have short duration labours and are coping well with breathing techniques and positions of ease may find it is all they need. It can be very easily combined with pethidine, and/or Entonox later in labour, to reduce the pain intensity of contractions. In prolonged labours, some women using TNS can be mobile for 75% of the time and then progress to an epidural without being left with any unwanted side-effects. Occasionally, interference was noted on the FSE monitor recordings. However, this was not a major problem. It mainly occurred when the boost mode was used. In these infrequently occurring situations, the obstetricians would decide whether the degree of interference was acceptable or not especially if any Type I or II dips were being recorded. They took the decision to remove a TNS unit. TNS is of value in relieving discomfort following membrane sweeps, prostaglandin therapy, backache prior to and during labour, and internal examinations. Only one baby required the administration of Naloxone, 100 mg of pethidine had been administered to the woman three hours before the delivery. All the women commented on the distraction element of the stimulation and the importance of varying it during labour. One even used the boost mode whilst a drip was being inserted into her arm!

Nowadays women are questioning the effects of various forms of pain relief on themselves and their babies. The non-invasive nature of TNS is certainly an important factor to them.

The ability to be in control of one's own pain relief is often of major consideration when using TNS. Partners have occasionally assisted by boosting the stimulation at the command of the woman. All husbands/partners were told not to alter the intensity or frequency controls. TNS does not restrict the mobility of the woman and again this is an important factor.

The fact that 49 of the 50 women would use TNS again speaks for itself. Perhaps Community Midwives should in future apply TNS to women at home thus reducing the few extra hours spent on the admission wards or delivery suites. It is very important that any midwife using TNS should have had instruction on the correct positioning of electrodes over the nerve roots, the appropriate time of application and the method of use of TNS from an obstetric physiotherapist.

The only side-effect noted was skin irritation, recorded on one woman. She had been using the unit for 12 hours.

During the demonstration sessions only one woman showed slight irritation and reddening of the skin after only five minutes of stimulation. This woman was advised not to use TNS. The problem of skin irritation may be due to the contact medium producing an allergic reaction. No other side-effect or complications were noted.

On evaluation of this report, the Clinicians Committee agreed to purchase a further five TNS units, so that the Birmingham Maternity Hospital now has seven units available for use on the delivery suite or wards. TNS has been included on the list of pain relief available at this hospital.

Note

One woman on the trial who was placed in a lithotomy position for a forceps delivery, because of poor maternal effort, prolonged second stage and a history of heart murmurs, complained post delivery of severe coccygeal pain. Following a complete back assessment by an obstetric physiotherapist, it was decided to use TNS, positioning a pair of electrodes over S2–4 nerve roots. She obtained valuable relief of symptoms and on discharge took the unit home for one week. She was delighted with the relief obtained whilst the bruising resolved.

Acknowledgements

I would like to express my thanks to all colleagues in the Physiotherapy Department and Midwifery staff on the Delivery Suite, without whose help this study would not have been conducted.

Addendum

Please note that on reading Browning *et al.*[2] I need not have considered the administration of Naloxone. They concluded that there was no relationship between cord levels of any of the three peptides and the type of analgesia used or mode of delivery.

Editorial note

Where women show an allergic reaction to the transmission gel, during labour, Karaya gum pads can safely be substituted.

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