ORIGINAL ARTICLE

Transcutaneous electrical nerve stimulation as an adjunct to non-steroidal anti-inflammatory medications for pain management during pleurodesis

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ABSTRACT

Aim: To evaluate the effectiveness of transcutaneous electrical nerve stimulation (TENS) as an adjunctive to non-steroidal anti-inflammatory drugs (NSAID) for the post-procedural pain in patients who underwent pleurodesis for pneumothorax.

Methodology: Sixty patients in the age group of 20-60 years, planned for pleurodesis in the operating rooms of our hospital, were divided into two groups of 30 each. Patients were alternatively assigned to one of the two groups. In Group I diclofenac sodium 75 mg in 100 ml of normal saline was started IV after the procedure, while TENS was applied for 45 minutes during this period. In Group II (control group) diclofenac sodium was started after the procedure, and an apparatus identical to TENS, but which did not deliver any electric current was applied as placebo. The blood pressure and pulse rate were noted at predefined intervals i.e. immediately after the procedure and then at 2, 4, 6 and 8 hrs after the procedure. A 0-10 visual analogue scale (VAS) was used to assess pain at regular intervals. When the VAS score was ≥3, inj. diclofenac sodium 50 mg was repeated intramuscularly.

Results: The systolic blood pressure was comparable in both groups immediately and 2 h after the procedure but it was significantly less in Group I at 4, 6 and 8 hrs respectively ($P<0.05$). The pulse rate was comparable in both groups immediately after, but decreased significantly in Group I at 2 hrs ($P<0.05$), 4 hrs ($P<0.02$), 6 hrs ($P<0.02$) and 8 hrs ($P<0.02$) after the procedure. The VAS score was comparable immediately and at 2 h in both groups (P=NS), but was significantly less in Group I at 4, 6 and 8 hrs after the procedure ($P<0.001$). The dose of diclofenac sodium used in Group I was significantly less than in the Group II ($P<0.02$).

Conclusion: TENS is useful as an adjunctive to NSAIDs for pain relief in pleurodesis and it lead to reduction in subsequent requirement of NSAIDs. TENS is a valuable strategy to alleviate pain of pleurodesis with no adverse effects and with a good hemodynamic stability.

Key words: Pleurodesis; Sclerosing agents; Transcutaneous electrical nerve stimulation; TENS; Non-steroidal anti-inflammatory drugs; NSAIDs

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INTRODUCTION

Pleurodesis aims to achieve a symphysis between the parietal and visceral pleural surfaces by instillation of chemicals or other agents in order to prevent accumulation of fluid or air in the pleural space. Its major indications are pneumothorax and malignant effusions.[1] Pain is the most common complication associated with doxycycline pleruodesis. In a study by Heffner it was stated that narcotic analgesic and or conscious sedation must be used to reduce pain or the solution may be mixed with 10 ml of

1.5% lignoacaine.[2] However, to avoid the adverse effects of opioids and to limit the dose of local anesthetics, we decided to add transcutaneous nerve stimulation (TENS) for intensifying the pain relief. The various studies do mention that pleurodesis is a painful procedure but there is not much focus on analgesia and various treatment modalities tried in the medical literature.

This study was designed to evaluate the role of non-pharmacological adjuvant like TENS with non-steroidal anti-inflammatory drugs (NSAIDs) for pain relief of pleurodesis. The objectives of this study were to compare the degree of pain relief, hemodynamic changes and the requirement of additional analgesics by adding TENS. We hypothesized that a non-pharmacological intervention like TENS would intensify the acute pain relief and would reduce the dosage of NSAIDs and the use of narcotics after the procedure.

METHODOLOGY

After obtaining institutional ethical committee approval, 60 patients in the age group 20-60yrs, of either sex undergoing pleurodesis in the operating room complex of Rajan Babu Institute of Pulmonary Medicine & Tuberculosis between June 2011 to December 2011 were included in this study. An informed written consent was taken from the patients after explaining the purpose of the study. The patients were randomly divided into two groups of 30 each. The random number system of odd or even numbers for patient selection was used to randomize patients into either group. One group received intravenous infusion of 75 mg of diclofenac sodium (Dynapar™, Troikaa) in 100 ml of normal saline. Infusion set was started immediately after the procedure and was completed in 15-20 min along with transcutaneous electrical nerve stimulation (TENS) by two self-adhesive electrodes placed on either side of the chest tube ensuring that they were within the same dermatome in the post-procedural period. The other group received only diclofenac sodium after the procedure. The choice of electrode position may often be dictated by an effective result i.e. relief of pain. Patients with neurological diseases, diabetes mellitus, cardiac disease and a pacemaker implantation were excluded from the study. All the patients of primary/secondary and recurrent pneumothoraces booked for pleurodesis were included in the study during the period of 6 months. Tetracycline derivative doxycyline 10 mg/kg crushed to powder plus lignocaine 3 mg/kg, diluted to 50 ml in saline was injected in the intrapleural space through the chest tubes. The hemodynamic parameters, i.e. blood pressure, pulse rate and oxygen saturation, were monitored throughout the procedure. Intravenous infusion of injection diclofenac sodium was started after the procedure in all the patients of both the groups. In the post-procedural period TENS was started immediately in Group I patients by a portable stimulator (Model No. MES 124, Meditech Electronics®). The electric current was delivered by two self-adhesive surface electrodes, placed on either side of the chest tube. During the 45min. treatment period the frequency was kept constant at 80Hz. An identical apparatus which did not deliver an electric current was applied to the control group (Group I). The blood pressure, pulse and VAS scores were noted at predefined intervals i.e immediately after the procedure with the infusion of NSAIDs running in both the groups and then at 2, 4, 6, 8 hrs after the procedure . The patients were shown the visual analog scale in the wards before the procedure and were asked to quantify their pain using a 10 cm scale. The patients who had a VAS score ≥3 were supplemented with inj. diclofenac sodium (Voveran™, Novartis®) 50 mg deep intramuscularly. The systolic blood pressure and pulse rate were recorded regularly as planned and plotted against time. Side effects like fever, dysponea due to chemical pleurodesis were also observed and noted.

Statistical analysis: The mean and standard deviation was calculated. The data were analyzed using chi-square test, finding the degree of freedom and than probablilty table was used to find the P values. $P<0.05$ was considered significant.

RESULTS

Sixty patients were studied as two groups of 30 each. Group I patients were given NSAIDs and TENS and in Group II only NSAIDs were given. Analysis and comparison are discussed subsequently. The age of patients in Group I (41.76 ± 11.24) was comparable with that in Group II (40.93 ± 11.56, P=NS). The gender distribution in the two groups was also comparable. Time intervals are as follows: A= Immediate after the procedure; B= 2 h after procedure; C= 4 h after procedure; D= 6h after the procedure, and E= 8 h after the procedure.

Mean basal values of systolic blood pressure in both groups were comparable in the immediate post-procedural period and 2 h after the procedure (Table 1). In Group I the systolic blood pressure decreased significantly at 4 h ($P<0.05$), 6 h ($P<0.05$) and 8 h ($P<0.05$) after the procedure compared to the Group II where TENS was not applied (Figure 1). As shown in the Table 2 the pulse rate was also comparable immediately after the procedure but it decreased significantly in Group I at 2 h ($P<0.05$), at 4 h ($P<0.02$), at 6 h ($P<0.02$) and at 8 h ($P<0.0.02$) after the procedure (Figure 2). The values of VAS scores were comparable immediately and 2 h after the procedure (Table 3). However, in Group I the score reduced significantly at 4 h ($P<0.001$), 6 h ($P<0.001$) and 8 h ($P<0.001$) after the procedure, where TENS was applied. The

Table 1: Systolic blood pressure at predefined intervals

Time interval	Group I	Group II	X^2 value	P value
A	128.46±8.07	128.23±8.90	1.48	P=NS
B	128.33±7.26	128.66±8.77	4.92	P=NS
C	128.13±6.77	132.03±8.66	5.92	P<0.05
D	127.30±7.44	132.20±8.40	5.20	P<0.05
E	127.46±7.57	132.33±7.40	5.32	P<0.05

P<0.05 is considered significant, NS : Not significant. BP in mm of Hg

Table 2: Pulse rate at predefined intervals

Time interval	Group I	Group II	X^2 value	P value
A	85.06±9.17	86.13±8.46	1	P=NS
B	85.13±8.73	88.53±7.86	5.94	P<0.05
C	85.46±8.17	89.50±8.32	8.26	P<0.02
D	86.13±9.59	90.96±8.17	7.30	P<0.02
E	87.23±9.14	91.50±8.18	7.28	P<0.02

Table 3: VAS score at predefined intervals

Time interval	Group I	Group II	X^2 value	P value
A	0.26±0.44	0.50±0.57	0.66	P=NS
B	0.56±0.50	0.60±0.67	3.60	P=NS
C	0.63±0.66	1.43±0.62	21.7	P<0.001
D	0.83±0.69	1.56±0.62	15.4	P<0.001
E	0.96±0.85	1.86±0.62	19.14	P<0.001

Table 4: Total dose of NSAID used in both groups

Group	Dose in mg	X^2 value	P value
Group I	80.0±15.25	5.30	P<0.02
Group II	93.33±24.50		

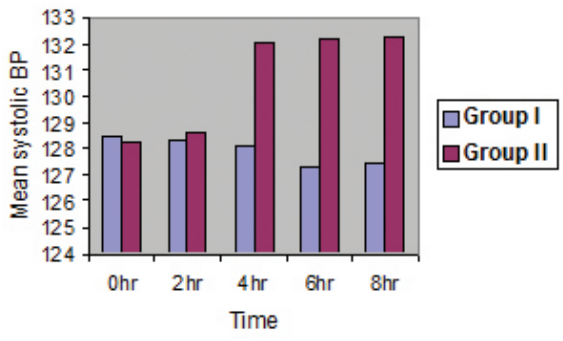

Figure 1: Mean systolic BP plotted against time

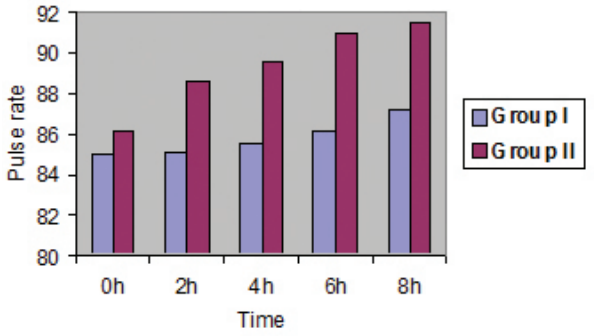

Figure 2: Pulse rate plotted against time

total dose of diclofenac sodium used in Group II was significantly higher than that used in Group I (93.33± 24.50 vs. 80± 15.25 mg respectively) (P<0.02) (Table 4).

DISCUSSION

Chemcial pleurodesis causes severe pain, requiring the procedure to be carried out under general or neurolept analgesia. In a study by Lee P et al[3] 250mg lignocaine sprayed via catheter was found to be effective for pain control before pleurodesis. Narcotic analgesics and / or sedation are often recommended because of the pain associated with many sclerosing agents.[4]

In our institute where the study was conducted, the majority of the patients for pleurodesis have tuberculosis, are malnourished and have compromised lung and liver function tests. Hence the use of sedatives, narcotics and high dose of lignocaine becomes a limitation. The lack of intensive care unit to tackle the side effects of narcotics is another limitation. The use of anti-inflammatory medication should be avoided in patients with talc-induced pleurodesis and appropriate clinical studies with silver nitrate need to be conducted in patients chronically treated with anti-inflammatory agents.[5] However in a study by Lia OH[6] on rabbits they showed that the short-term systemic administration of NSAID does not affect the efficacy of pleurodesis induced by talc or doxycyline. The intrapleural injection of tetracycline derivatives is an intensely painful experience for many patients. In a study over 50% of the patients reported severe pain at the time of tetracycline injection and 70% of the individuals stated that the pain was greater at the time of tetracycline injection than at either the onset of the pneumothorax or at the time the chest tube was placed. The intrapleural administration of 100mg of Lidocaine was not effective in ameliorating the intense chest pain.[7] Sherman et al[8] tried to find the most promising approach to control pleuritic pain of pleurodesis by using a subjective and objective assessment of pain by measuring serum concentration of Lidocaine and by observing patients for possible toxic effects of drug and concluded that to achieve optimum anesthesia during chemical pleurodesis it is necessary to use doses of intrapleural lidocaine larger than previously reported until the feasibility of

a further escalation is demonstrated, 250 mg should be considered the standard dose.

However we decided to add transcutaneous electrical nerve stimulation for pain relief to avoid the use of narcotics, frequent use of NSAIDs and high dose of lignocaine during pleurodesis. Lignocaine toxicity is directly correlated with its concentration in the blood. The risk of more serious side effects increases when blood concentrations exceed 5 mg/L with seizure and hallucinations occurring at concentrations of 8-12mg/L and cardiorespiratory arrest at 20-25 mg/L.[9] The mechanism of action of TENS is still not completely understood. Analgesia may be produced by the modulation of nociceptive input in the dorsal horn of the spinal cord by peripheral electrical stimulation of large sensory afferent nerves, the so-called gate control theory of pain.[10] Alternatively electrical stimulation of certain receptor sites in the dorsal horn of the spinal cord may release endorphins, in turn producing analgesia that can be reversed by naloxone.[11] TENS has been shown to produce antinociceptive effects similar to those of acupuncture with slow onset and gradual offset that persists after the stimulation stops.[12] Benedetti et al[13] emphasized in their study that the absence of complications and side effects of TENS compared with conventional opioid and non-opioid analgesics makes electrical stimulation a safe and reliable therapeutic procedure. TENS is not of major benefit compared with the usual opioid and non-opioid analgesics when pain intensity is high, but it can be used as an adjunct to other medications when pain is moderate and can be the only pain therapy when the pain is mild. The search for improved and cost effective means for pain relief has led to evaluation of effectiveness of non-pharmacological interventions like TNES for acute pain relief. TENS has been shown to be more effective than NSAIDs or placebo in patients with uncomplicated minor rib fractures and its use was recommended because of its prominent and admirable efficacy in reduction of pain.[14] Thus solution to pain relief is not developing a single technique or a drug to relieve it but to implement simple protocols that suit in different settings with strategies to exploit the available expertise.

In our study a tetracycline derivative, doxycycline, 10 mg/kg along with lignocaine 3 mg/kg was injected intrapleurally through the chest tubes. Intravenous infusion of injection diclofenac sodium 75 mg was started after the procedure in both the groups. TENS was started immediately in Group II patients by a portable stimulator. While an identical apparatus which did not deliver an electric current was applied to the control group (Group I). The hemodynamics i.e. blood pressure and pulse rate were recorded at 2-hourly interval when the pain was assessed using visual analogue scale. The systolic blood pressure was comparable in both the groups immediately after the procedure and 2 hrs after the surgery but the pressure reduced significantly in Group I subsequently. The pulse rate was also significantly less in Group I at subsequent intervals. The patients having VAS score of > 3 were supplemented with an intramuscular dose of diclofenac sodium. The VAS score was similar in both the groups immediately after the procedure and 2 h after the procedure(P=NS). At 4, 6, and 8 h, the score was significantly lower in the Group I ($P < 0.001$). The incidence of side effects was negligible in both the groups. The satisfaction level of the patients who received TENS was also more compared to those who did not receive it.

CONCLUSION

TENS can be effectively and safely used as an adjunctive to NSAID's for pain relief in pleurodesis.

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