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Effect of transcutaneous electrical nerve stimulation on pain in patients with intercostal drainage tube: A pilot study

Dr. Hina S Dangar[1], Dr. Jayesh Parmar[2]

[1] FYMPT Student, Department of Physiotherapy, Government Physiotherapy College, Jamnagar, Gujarat, India
[2] Senior Lecturer, Department of Physiotherapy, Government Physiotherapy College, Jamnagar, Gujarat, India

Abstract
Background: Transcutaneous electrical nerve stimulation (TENS) has been used extensively to control pain mainly in post-operative thoracotomy patient, but it effects are controversial. We aimed to assess the efficacy of high TENS on ICDT pain by using NPRS.
Method: A pilot study was done at TB hospital Jamnagar. Total ten patient were selected on the basis of inclusion & exclusion criteria. The effectiveness of TENS was assessed by numerical pain rating scale (NPRS).Each patient receive high TENS (frequency: 80-120 Hz, pulse duration: 50μs) treatment time is 20 min/day for 7 days.
Result: All patient with ICDT Pain at rest and at activity (coughing, movement of upper limb) were assessed on NPRS after the treatment session. There is significant difference between pre & post NPRS score in all patients.
Conclusion: A high TENS is effective to reducing ICDT site pain in patient with ICDT.

Keywords: high transcutaneous electrical nerve stimulation, intercostal drainage tube, numeric pain rating scale, pain

Introduction

Chest drains are also referred as under water sealed drainage, thoracic catheter**,** tube thoracostomy or intercostals drainage tube [1]. ICD tube provides a method of removing air and fluid substance from the pleural space [2].

ICDT are inserted as in invasive procedure to remove fluid, air from pleural space or mediastinum or re-expand the lung & restore negative intrapleural pressure and respiratory function [1]. Conditions like pleural effusion, pneumothorax, hemothorax chylothorax, empyema, post cardiac or thoracic surgery require chest drainage tube [2].

Thoracostomy can be one of the most painful types of incision that patient can experience. Pain may inhibit effective coughing, deep breathing, restrict upper limb mobilization of the affected side [3]. As a result of improper lung ventilation and inadequate acute post ICDT pain management contributes to the development of a chronic post thoracotomy pain syndrome [4].

Thus the goal of the therapist is to develop an analgesic regimen that provides effective pain relief & to allow post thoracostomy patient, the ability to maintain their functional residual capacity by deep breathing and effective clearance of secretion with cough and early mobilization, which can lead to quicker recovery and shorter length of hospital stay [3].

TENS is popularized name for electrical stimulation produced by a portable stimulator used to treat pain. Pain control TENS unit typically produce a continuous train of pulsed current at frequencies ranging from 1-120 Hz. The pulses are normally rectangular in shape, biphasic & the pulse duration is normally 50-200μs [5].

The aim is to selectively excite Aβ (sensory) nerve fibers & produce an analgesic effect to reduce pain conveyed by Aδ & C fibers [5]. TENS has been shown to have a positive effect in pain relief following a variety of operative procedures including hip surgery, obstetric & gynecological surgery & abdominal surgery [6].

Johnson *et al*. reported that the use of high frequency stimulation produce greater analgesic effects [7]. Cheung D & C *et al*. reported that high TENS has been used to control postoperative pain after thoracotomy [8]. Many authors do not agree on the effectiveness of TENS for acute postoperative pain. Forster EL *et al*. study show that TENS may not be a major benefit when compared to regular opiate analgesics after cardiac operation [9]. Liu Y-C *et al*. reported TENS is not beneficial for post thoracotomy pain [10].

No consensus has been reported for the relief of pain at ICDT site by TENS, so we conducted this pilot study to find out whether TENS is helpful in relieving the pain or not.

Null Hypothesis: High TENS is not useful in pain relief in patient with ICDT. Alternative Hypothesis: High TENS is useful in pain relief in patient with ICDT.

Aim of the study is to make an effective protocol for relief of pain in patient with post ICDT site pain using TENS.

Materials and Methods

Study Design

It is a pilot study including patient who have undergone a standard insertion of intercostal drainage tube to drain fluid or air from pleural cavity. Patient were selected on the basis of inclusion & exclusion criteria and who are willing to participate in study.

Inclusion Criteria

1. Patient with ICDT

2. Minimum NPRS is 3 at activity
3. Co-operative
4. Age > 40 yrs

Exclusion Criteria
1. Presence of pacemaker
2. Neurological disease/ Cerebral confuse
3. Patient of Sensory deficit
4. Previous history of chronic pain

Patient Population
Between December 2017 to February 2018 total ten patients were taken from T.B. hospital Jamnagar on the basis of inclusion-exclusion criteria. A subjective numerical pain rating scale was taken before and after every treatment session for values at rest and during activity (coughing & UL movement) for 7 days. In which 0 means no pain 5 means moderate pain 10 means unbearable pain.

Apparatus and TENS treatment
TENS mechine was used with four rubber electrode from two channels. For the contact medium, ultrasonic gel was used. After taking pre NPRS two electrodes from 1st chennel were placed on lateral side of the ICDT another two electrodes from 2nd chennel were placed on medial side of ICDT. Patient's positon is supine lying.A high TENS was applied at frequency of 120 Hz, pulse duration is 75µs and intensity was set on the basis of patient's tolerance for 20 minutes per day for seven days. After each treatment session post NPRS at rest and at activity was taken for seven days.
Numeric pain rating scale (NPRS) is measure of pain intensity in adults. The NPRS is a segmented numeric version of the visual analog scale (VAS) in which a respondent select a whole number (0-10 integers) that best reflects the intensity of his/her pain. The 11 point numeric scale in which, 0 means no pain, 5 means moderate pain and 10 means worst pain has been shown to have high test-retest reliability and validity in both literate and illiterate patients [11].

Statistical Analysis
The differences between pre and post treatment in pain scale (NPRS) were measured by one tailed paired t-test. Data are presented as the mead ± standard deviation. Differences were considered to be significant as a p value is less than 0.05.

Results
All the patients who selected on the basis of inclusion exclusion criteria were completed the study. Out of ten 7 patients having ICDT at 4th intercostal space and 3 patients having at 5th intercostal space.
In result pre NPRS score are at rest mean 3.4 ± 1.26 SD, At activity mean 6.8 ± 1.31 SD. After the treatment of high TENS the post NPRS score are At rest mean 0.6 ± 0.69 SD, At activity mean 2.5 ± 0.8 SD.
Figure1 suggestive of comparison between pre and post NPRS score At rest after seven days. And figure 2 suggestive of comparison between pre and post NPRS score At activity after seven days.

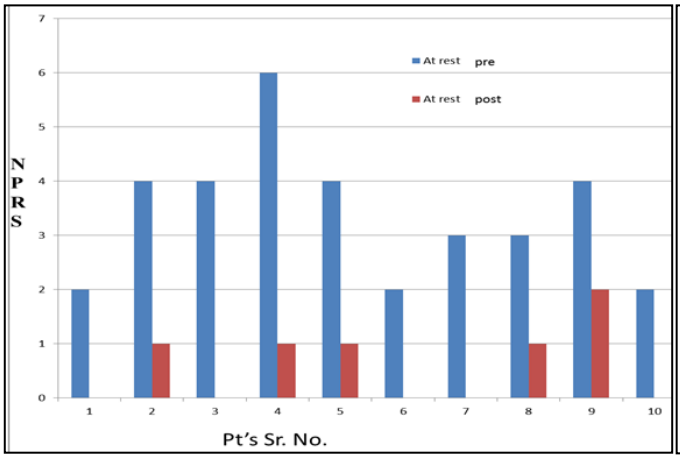

Fig 1: pre & post NPRS at rest)

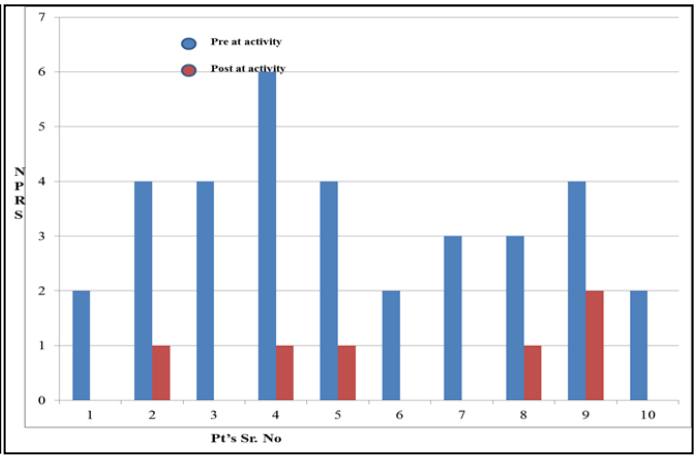

Fig 2: Pre & post NPRS at activity

Discussion
In this study we were interested mainly in the effectiveness of TENS therapy, immediately after insertion of ICDT, to understand if TENS can be a useful tool in the control of acute ICDT pain. The data obtained from the ten patients helped us to formulate some guidelines for the use of TENS in acute post ICDT insertion pain.
Our study result shows that TENS is effective in acute post ICDT insertion pain relief at rest and during movement. The theory behind the effectiveness of TENS is the 'gate control' theory of pain as postulated by Melzack and Wall [17]. The pain was largely transmitted by small unmyelinated C fibers which could be inhibited by the activation of myelinated Aδ & Aβ fibers. By the stimulation of these large diameter Aδ & Aβ fibers it could close the signals from spinal segment by gating mechanism in the substantia gelatinosa and thus can prevent painful peripheral stimuli from gaining access to higher cortical centers. Another mechanism to relieve pain by using TENS is the release of inhibitory neurotransmitters endorphin, dynorphin and enkephaline in substania gelatinosa. It inhibits the C fibers and ultimately pain is reduced by these two mechanisms [5].
One might say that the pain could reduce without use of TENS due to natural healing process of body by time but to find out

this, in the study we took pre and post NPRS of each patient after every session for seven day's, in which we got a 2 point difference in pre and post NPRS reading which shows that pain is reducing very next day. So it is suggest that reducing of pain is due to TENS.

The result from other studies give mixed reviews in support for the efficacy of TENS in patients undergone thoracotomy or TENS having little or no value in patients undergone thoracotomy.

Mohamed A. Hamza *et al*. conducted a study "Effects of different frequency of TENS in postoperative opioid analgesic requirement &recovery profile" in which they took 100 women undergone major gynecological procedure &divided them into four groups. Conclusion of their study is that mixed type of TENS (ν alternating between 2-100Hz/3sec), significantly decreases postoperative pain & analgesic requirements [5].

In a study conducted by Alfonso Fiorelli *et al*. concluded that TENS is a valuable strategy to alleviate post thoracotomy pain with reduction of analgesic consumption & positive effect on pulmonary function [3].

Study limitation

Limitation of our study includes use of only one outcome measure for pain which is subjective. To make it better we could include chest expansion, ROM of trunk and upper extremity as outcome measures.

Future Study Scopes

This was a pilot study so we could go with a larger sample size and control group to generalize the efficacy of use of TENS. Also we can compare the effect of different parameters of TENS like high TENS, low TENS on post ICDT insertion pain.

Conclusion

In the end on the basis of result our study accept the alternative hypothesis. We conclude that the high TENS is significantly reduce the acute post ICDT insertion pain. Furthermore TENS is safe, inexpensive and easy to use.

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