



# EFFECT OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) ALONG WITH CONVENTIONAL PHYSIOTHERAPY ON POST INTERCOSTAL CHEST DRAINAGE (ICD) IN PNEUMOTHORAX PATIENT: A CASE STUDY

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## **Abstract**

**Introduction:** Pneumothorax is the most common respiratory condition seen. It can occur in conjunction with other diseases or can be traumatic. Intercostal drainage is the standard form of treatment for pneumothorax that basically removes the excess air filled in the pleural space. This ICD causes a decrease in mobility of the chest wall and chest expansion, dyspnea, and Pain. Physiotherapy added with early mobilization and when started initially in the post-ICD period is helpful to get better outcomes and decrease hospital stay length. For this, Chest physiotherapy plays a main role in enhancing lung expansion and regaining the chest wall and lung mobility after a thoracic surgical procedure. TENS is a readily used modality in post-surgical pain complaints.

**Aim:** The aim of this study was to find the additional Effects of TENS along with conventional physiotherapy on dyspnea and chest mobility in post-intercostal chest drainage (ICD) patient at the end of 10 days.

**Design:** Single subject case study.

**Method and procedure:** Single subject with complaint of pain, dyspnea, and reduced chest expansion post-ICD tube removal was selected for the study. A formal informed consent was taken from the patient and all the outcome measures were noted on day 1. Conventional TENS was applied around the site of the incision and conventional physiotherapy such as ACBT, pursed lip breathing (PLB), diaphragmatic breathing, and segmental breathing were also given. After 10 days of protocol, post-readings were noted. Then pre- and post-outcome results were compared to evaluate the significance of the study.

**Result:** After the intervention, there was a significant improvement in chest expansion and there was a substantial decrease in NPRS and mMRC dyspnea scale scoring.

**Conclusion:** Based on the results, it can be concluded that conventional TENS can be used in conjunction with chest physiotherapy for post-ICD removal subjects as it significantly improves chest expansion and decreases pain and dyspnea scores.

**Keywords:** TENS, Pneumothorax, Intercostal Drainage, Physiotherapy

## I. INTRODUCTION:

The term "pneumothorax" refers to the presence of air in pleural space. The empty space between the two pleurae (Visceral and Parietal) of the lungs is known as the pleural cavity or pleural space<sup>[1]</sup>. The pleural cavity aids in the optimal operation of the lungs during breathing. In particular, during periods of deep breathing, it transmits motions of the chest wall to the lungs which helps in expansion. The visceral pleural surface, which is supported by the chest wall, transmits negative pressures to the lung<sup>[2]</sup>.

If the air is found in the pleural space, one of three things must have happened: either connectivity between the pleura and alveolar spaces, direct or indirect communication with the atmosphere, or the existence of organisms that produce gas in the pleural cavity<sup>[3]</sup>. Pneumothorax can be categorized as primary, secondary, iatrogenic, or traumatic according to etiology. The majority of Spontaneous Pneumothorax cases are secondary, which occurs in the existence of underlying lung disease, mainly chronic obstructive pulmonary disease.

Pneumothoraxes can be categorized as open, closed, or tension pneumothoraxes based on their physiological characteristics. Chest discomfort, which accounts for 90% of pneumothorax complaints, is followed by dyspnea (86%), cough (82%), and dizziness (86%). The right lung side is more commonly affected than the left. According to research by *Boghant AB and Patel RB* et al, bilateral pneumothorax was extremely uncommon (2.5%), and the right side was slightly more frequently affected (52.5%) than the left side (45%)<sup>[4]</sup>. Emergency intervention is required if the patient's symptoms or a physical examination reveals an air leak, including significant chest pain, the detection of lung collapse on a chest radiograph, and high intrathoracic pressure<sup>[5]</sup>.

Placing a thoracostomy tube comes after needle decompression or in pneumothoraxes as a treatment. This is often positioned anterior to the mid axillary line in the fifth intercostal gap above the rib. The thoracostomy tube size often varies based on the patient's height, weight, and the presence or absence of a hemothorax<sup>[6]</sup>. Chest tube, chest drain, and tube thoracostomy are all used interchangeably. "Safe triangle" is where chest drains are most easily placed using the Seldinger procedure (tube over the wire)<sup>[7]</sup>.

As per the previous studies, Ineffective coughing, reduced lung volume, postoperative pulmonary complications (PPCs), which can be infectious (e.g., pneumonia) or non-infectious (e.g., atelectasis), impaired airway clearance, restricted movement at the incision site, postural abnormalities, and persistent chest wall tightness along with pain are the main problems that patients present with after ICD removal<sup>[8]</sup>. Changes in lung volume and gas exchange are a result of anesthesia and tissue dissection during the placement of the intercostal drainage tube. The anesthetic causes the cilia's motility to decrease and their ability to retain secretions<sup>[9]</sup>.

Deep breathing exercises, relaxation techniques, incentive spirometry, thoracic mobility exercises, modified postural drainage, and ROM exercises for the upper and lower limbs are among the most often used therapy by Physiotherapists<sup>[9]</sup>. Various studies coins that TENS works to reduce pain primarily through two mechanisms of action: the modification of nociceptive input signals in the dorsal horn of the spinal cord through peripheral stimulation of large, myelinated nerve fibers and type A fibers, and the release of endogenous opioids, which have analgesic effects. When TENS is applied, these two mechanisms are at work, and the results last even after the application is finished<sup>[10]</sup>.

The European Society of Thoracic Surgeons, the European Respiratory Society, and the American College of Chest Physicians have recommended physiotherapy, and it is now viewed as a crucial component of enhanced recovery protocols (ERPs)<sup>[8]</sup>.

## II. PURPOSE OF THE STUDY:

This study aimed to determine the Effect of transcutaneous electrical nerve stimulation (TENS) along with conventional physiotherapy on Chest Mobility and dyspnea grading in post-intercostal chest drainage (ICD) patient at the end of 10 days.

### III. MATERIALS AND METHOD:

#### 3.1 Participant:

A single subject was taken into the study from College of Physiotherapy, Jaipur National University after ethical clearance and a formal informed consent were taken from the patient.

A post-ICD pneumothorax patient aged 57 years was invited for the study without having uncontrolled hypertension, O<sub>2</sub> support, and comprehensibility in English or Hindi. The subject was excluded if he was unable to participate in the measuring session and unable to follow the commands.

#### 3.2 Experimental case study:

A single subject was selected. A comprehensive assessment was taken of the subject, before starting the intervention.

#### 3.3 Exercise and training interventions:

TENS was applied along with conventional physiotherapy post-ICD. Conventional TENS was applied for the duration of 10-15 mins with a frequency of 100-150 Hz and intensity as per patient's tolerance. 4 electrodes were placed around the incision in a crossed pattern. it was applied once a day. Conventional therapy included ACBT, pursed lip breathing, diaphragmatic breathing, and segmental breathing. These exercises were performed in 3 sets of 10 repetitions, 60 seconds of an interval between sets, and 3 minutes rest between each exercise, once a day for 10 days. The outcome measures such as Chest expansion, NPRS, and mMRC readings were noted pre and post-intervention. The data were analyzed using MS Excel.

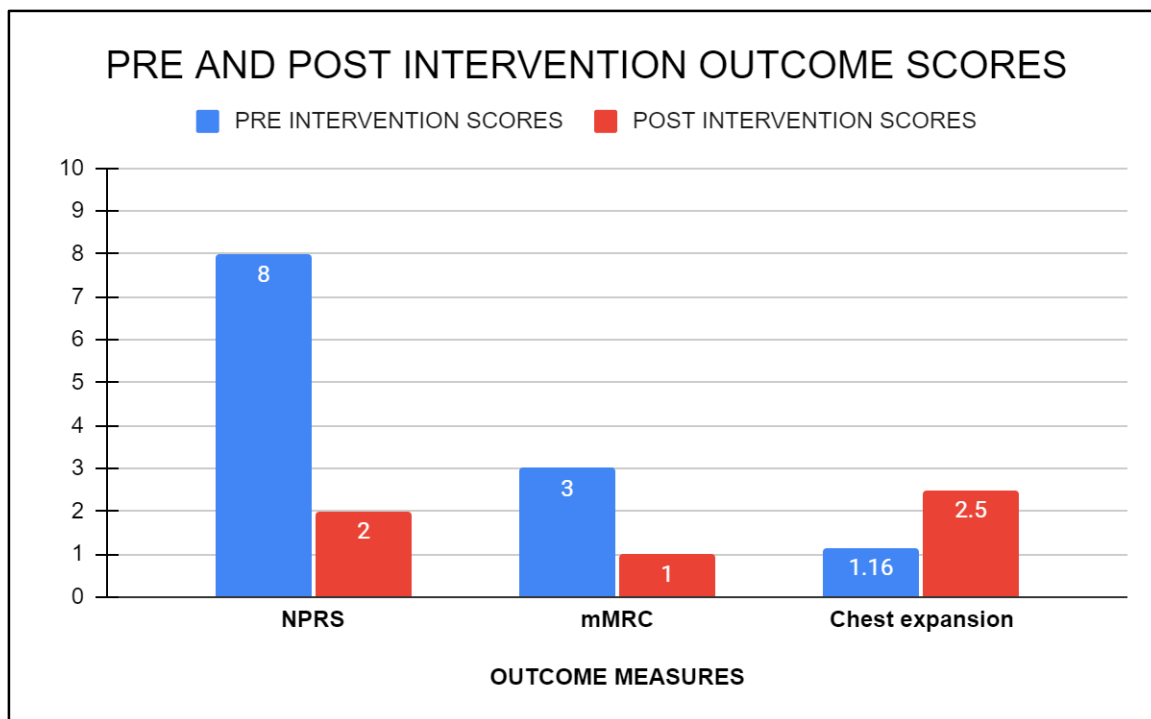
### IV. RESULT:

NPRS, mMRC scale, and the measuring tape was used to measure the pain, dyspnea, and chest expansion respectively, a comparison was made between pre-test values and post-test values of NPRS, mMRC scale for dyspnea, and chest expansion.

The first reading was taken on the initial day i.e., Day 0 and the second reading was taken on the last day i.e., Day 10, Readings of the Day 0 and Day 10 were compared using MS-Excel.

**Table 1: Shows pre- and post-intervention outcome measure values**

OUTCOME MEASURES	PRE-INTERVENTION SCORES	POST-INTERVENTION SCORES
NPRS	8	2
mMRC	3	1
Chest expansion (inches)	1.16	2.5



**Graph 1 Graphical representations of pre and post intervention outcome measures.**

## V. DISCUSSION:

The purpose of the discussion that follows is to clarify the conclusions drawn from this study's findings and observations in the context of the supporting data. The goal of the current study was to evaluate the effects of transcutaneous electrical nerve stimulation (TENS) combined with conventional physiotherapy in a post-intercostal drainage tube (ICD) removal patient having pneumothorax on pain, dyspnea, and chest expansion. The subject in this study was a 57-year-old man who recently had his ICD tube removed. He also had a history of chronic smoking. By executing the interventions over the subject for 10 days in succession, it was possible to establish a significant influence of Transcutaneous Electrical Nerve Stimulation (TENS) combined with conventional physiotherapy on the NPRS scale, mMRC scale, and chest expansion. It was found that transcutaneous electrical nerve stimulation (TENS) has a good impact in addition to conventional physiotherapeutic exercises. The basis for this observation was the patient's outcome measures on Days 0 and 10, as determined by the NPRS scale, mMRC scale, and chest expansion scores. According to the reevaluation of outcome measures on day 10, this intervention caused a significant increase in chest expansion and a striking decrease in scores on the NPRS and mMRC scales. It was discovered that there have been no published studies that discuss how this combined approach affects individuals who have their ICD tube removed after the treatment of pneumothorax.

But the results that follow are in line with research done on patients with pleural effusion with ICD tube administered and other thoracic surgical procedures, which has demonstrated a similar effect with various breathing techniques and TENS.

According to previous census, *Parmar R et. al.*, conducted a study to conclude the Effect of Conventional TENS at the ICD Site in Patients with Pleural Effusion on Pain, Dyspnea, and Chest Expansion. The Control group underwent supervised sessions of conventional physical therapy that included active limb mobilization, and positioning to promote fluid drainage with the ICD site down, and segmental and patient education on the ICD site. The experimental group also got conventional TENS for 15 minutes. The study's findings support the use of TENS in conjunction with standard physiotherapy for the treatment of pain, dyspnea, and chest expansion in pleural effusion patients with chest drains<sup>[8]</sup>.

According to a systemic review by *A. Freynet et al*, TENS is better compared to narcotic analgesics for improving post-thoracic surgical outcomes in seven out of the nine studies that were reported. In addition to reduced usage of narcotic analgesics, decreased length of stay in the hospital, increased physical tolerance in the chest, and improved pulmonary function, there was relief from pain. This demonstrates that TENS combined with postoperative medicines is safe and beneficial in reducing post-operative pain and enhancing recovery following thoracic surgery<sup>[11]</sup>.

Thus, as pain is a significant factor in the decreased lung expansion following ICD installation and removal, treating pain would also aid in enhancing the expansion and reducing dyspnea.

The results of this study support the use of TENS as an additional therapy along with conventional physiotherapy to enhance functional outcomes in patients who recently had an ICD tube removed.

## VI. CONCLUSION:

In conclusion, this study demonstrates that the utilization of transcutaneous electrical nerve stimulation (TENS) in conjunction with conventional physiotherapy effectively alleviates chest pain, dyspnea, and improves chest expansion in patients recovering from pneumothorax following ICD tube removal. These findings shed light on the potential benefits of integrating TENS with conventional physiotherapy in the medical and post-surgical treatment of increased chest pain, dyspnea, and decreased chest expansion among post-ICD pneumothorax patients. This novel approach has the potential to enhance the management and recovery outcomes for this specific patient population.

## VII. REFERENCES:

- [1].D'Agostino HP, Edens MA. Physiology, pleural fluid. InStatPearls [Internet] 2021 Sep 1. StatPearls Publishing.
- [2].Charalampidis C, Youroukou A, Lazaridis G, Baka S, Mpoukovinas I, Karavasilis V, Kioumis I, Pitsiou G, Papaiwannou A, Karavergou A, Tsakiridis K. Physiology of the pleural space. *Journal of thoracic disease*. 2015 Feb;7(Suppl 1):S33.
- [3].Noppen M, De Keukeleire T. Pneumothorax. *Respiration*. 2008;76(2):121-7.
- [4].Patil SV, Bhagwat RV, Mohite RV, Barphe SS. Clinical profile and treatment outcome of patients with spontaneous pneumothorax. *International Journal of Research in Medical Sciences*. 2017 Mar;5(3):944.
- [5].Kaneda H, Nakano T, Taniguchi Y, Saito T, Konobu T, Saito Y. Three-step management of pneumothorax: time for a re-think on initial management. *Interactive cardiovascular and thoracic surgery*. 2013 Feb 1;16(2):186-92.
- [6].McKnight CL, Burns B. Pneumothorax.
- [7].Porcel JM. Chest tube drainage of the pleural space: a concise review for pulmonologists. *Tuberculosis and respiratory diseases*. 2018 Apr 1;81(2):106-15.
- [8].Ahmad AM. Essentials of physiotherapy after thoracic surgery: What physiotherapists need to know. A narrative review. *The Korean journal of thoracic and cardiovascular surgery*. 2018 Oct;51(5):293.
- [9].Sultanpuram S, Alaparathi GK, Krishnakumar SK, Ottayil ZC. Physiotherapy practice patterns for management of patients undergoing thoracic surgeries in India: a survey. *Surgery research and practice*. 2016 Jan 1;2016.
- [10].Vance CG, Dailey DL, Rakel BA, Sluka KA. Using TENS for pain control: the state of the evidence. *Pain management*. 2014 May;4(3):197-209.
- [11].Freynet A, Falcoz PE. Is transcutaneous electrical nerve stimulation effective in relieving postoperative pain after thoracotomy? *Interactive cardiovascular and thoracic surgery*. 2010 Feb 1;10(2):283-8