

Effect of Transcutaneous Electrical Nerve Stimulation on Pulmonary Functions in Patients with Intercostal Drainage Tube

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ABSTRACT

Background: Chest drains or the tube thoracotomy or intercostal drainage tube provides a method of removing the air and fluid from the pleural space. It is a most painful incision inhibiting the coughing, breathing and reduces the pulmonary functions. The application of TENS provides an analgesic effect which reduces the nociceptive pathways and helps in improving the pulmonary functions. Hence the study aims to see the effect of transcutaneous electrical nerve stimulation on pulmonary functions in patients with intercostal drainage tube.

Material and Method: The study design was pre-post experimental study consist of 10 patients with Intercostal Drainage Tube were selected by convenient sampling at Pravara Rural Hospital, Loni. The patients were taken in the age group of 20-40 years according to inclusion criteria and intervention protocol was given for 2 weeks.

Outcome measures: Pulmonary Function Test (FEV1 & FVC).

Results: The mean difference for FEV1 in litre was 0.225, t value 3.406, p value 0.0078 & Pred% was 16, t value 18.674 ,p value<0.0001. The mean difference for FVC in litre was 0.3010, t value 3.4549, p value 0.0062 & Pred% was 16, t value 14.884, p value <0.0001. Both (FEV1 & FVC) have shown significant improvement after the application

of TENS for 2 weeks in patients with Intercostal Drainage Tube.

Conclusion: The study concluded that the application of Transcutaneous Electrical Nerve Stimulation improved the Pulmonary Functions in Patient with Intercostal Drainage Tube.

Keywords: Transcutaneous Electrical Nerve Stimulation, Pulmonary Functions, Intercostal Drainage Tube, Thoracotomy.

INTRODUCTION

The pleural cavity is also known as the pleura space, it is the thin fluid fill space between the two pulmonary pleurae of each lung. A pleura is a serous membrane which folds back onto itself from a two-layered membranous pleural sac. The pleura cavity transmits movements of the ribs muscles to the lungs, particularly during heavy breathing. ^[1] The pleural cavity aids the optimal functioning of the lungs during breathing. This causes the expansion of chest wall that increases the volume of the lungs. ^[2] The pleural cavity consists of pleural fluid. The pleural cavity is 3-5mm in width and consists of 10-20ml of pleural fluid. ^[3]

The intrapleural pressure is the pressure exerting in the pleural cavity and it is the negative pressure in the pleural cavity. The normal intrapleural pressure is -5cm h₂O and during inspiration it increases up to 8cm

h₂O and during expiration it decreases to -4 cm h₂O. Because of negative intrapleural pressure it keeps lung expanded and prevents collapsing tendency of lung produced by elastic recoiling of tissue.

The pleural diseases consist of pleural effusion, hydrothorax, empyema, pneumothorax, pleurisy, hemothorax, hydro pneumothorax, chylothorax, etc. The common symptoms during pleural condition are dyspnea, pleuritic chest pain, cough, fever, and weight loss. The physical examination findings include tachypnea, tachycardia, and fullness of affected chest, reduced chest movements, diminished or absent breath sounds. The medical management includes the treatment of underlying cause with antibiotics and it consists of removal of pleural fluid and it is removed with the help of thoracentesis and intercostal drainage tube insertion. The placement of intercostal drainage tube with underwater seal drainage for pneumothorax is 2nd-3rd intercostal space, and for hydropneumothorax or pleural effusion it is 5th-6th intercostal space. [4]

Chest drains are also referred as under water sealed drainage, thoracic catheter, tube thoracotomy or intercostal drainage tube. Intercostal drainage tube (ICD) provides a method of removing air and fluid substance from the pleural space. Intercostal drainage tube are inserted as an invasive procedure for removal of fluid, air from the pleural space or mediastinum or re-expand the lung and restore negative intrapleural pressure and respiratory function. [5]

Thoracotomy 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 affected side. [6] Thus, the goal of therapist is to develop an analgesic regimen that provides effective pain relief and to allow post thoracotomy patient, the ability to maintain the functional residual capacity by deep breathing and effective clearance of secretion with coughing and early mobilization, which can

lead to recovery and shorter length of hospital stay. [7]

The physiotherapy management for this condition includes the pain management with TENS, inspiratory exercises, expiratory exercises, segmental breathing exercises, and thoracic expansion exercises. [8]

Pain is a common symptom felt during postoperative period at the incision site, which might interfere with pulmonary functions and healing. Respiratory complications are the most common complications that may occur in postoperative period which typically develops during the first 48 hours after the surgery. [9] Anesthesia and tissue dissection during insertion of intercostal drainage tube contributes to changes in lung volume and gas exchange. Because of anesthesia the motility of cilia reduces and causes retaining secretions, thereby causing atelectasis. Reduction in functional capacity has implication for postoperative complications and the course of recovery. Therefore an early pain reduction helps to keep the patient relieved from the adverse effect of analgesia, cough, and thereby helps to speed up recovery. [10]

Transcutaneous electrical nerve stimulation (TENS) is popularized name for electrical stimulation produced by a portable stimulator used to treat pain and also to see the effect of pulmonary function of the patient. 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 and the pulse duration is normally 50-200µs. [11]

Johnson et al. reported that the efficacy of transcutaneous electrical nerve stimulation in producing analgesia in cold-induced pain was assessed using a range of 5 stimulating frequencies (10Hz, 20Hz, 40Hz, 80Hz, and 160Hz) in 83 normal healthy subjects. TENS significantly elevated ice pain threshold when compared with sham and control groups. TENS frequencies between 20 and 80Hz produced greatest analgesia, while frequencies below

and above this level (10 and 160Hz) although significantly elevating ice pain threshold, produced effects of lesser magnitude. [12]

Cheung D & C et al. reported that high TENS has been used to control postoperative pain after thoracotomy and improve the pulmonary functions. [13]

MATERIAL AND METHODS

The present study was approved by Institutional Ethical Committee Reference no: IEC/2019:459 by Dr. A P J Abdul Kalam College of Physiotherapy. The study design was Pre-Post Experimental study with convenient sampling and the study was conducted at Pravara Rural Hospital, Ioni, Maharashtra. The source of data was collected from In Patients Surgery and Medicine wards referred to Cardiorespiratory Physiotherapy Department. Among all the participants referred to cardiorespiratory physiotherapy, the written consent was taken and 10 patients with age group of 20-40 years who had underwent insertion of intercostal drainage tube were conveniently selected on the basis of Selection criteria. For the study Transcutaneous electrical nerve stimulation was given for 2 weeks & Pulmonary Function test was perform before and after 2 weeks of intervention with TENS.

INTERVENTION PROTOCOL:

TENS:

Type: Conventional Type.

Frequency: 100-150 Hz

Duration of treatment: 10-15 min.

Intensity: as per patients' tolerance.

Electrode placement: At the site of insertion of intercostal drainage tube.

STATISTICAL METHOD

Data analysis was done using INSTAT statistical software and Pre-Post intervention value were compared with paired t test and it was statistically significant.

RESULT

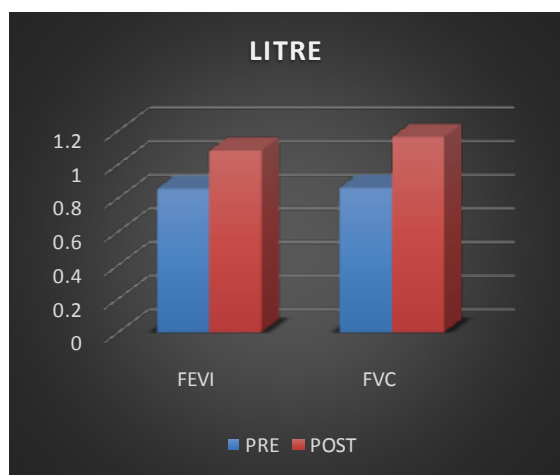
The present study included total 10 participants among which 6 were males and 4 were females.

The pre-intervention Mean \pm SD for FEV1 was 0.858 \pm 0.2133 in litre & 39.1 \pm 7.505 in Pred%. The post interventional Mean \pm SD of FEV1 was 1.083 \pm 0.3690 in litre & 55.2 \pm 7.786 in pred%. The pre and post value of FEV1 was compared and the mean difference was 0.225, t value was 3.406 and P value was 0.0078 in litre & the mean difference in Pred% was 16, t value was 18.674 and P value was <0.0001.

The pre-interventional Mean \pm SD of FVC was 0.864 \pm 0.2156 in litre & 31 \pm 4.397 in Pred%. The post interventional Mean \pm SD of FVC was 1.165 \pm 0.3996 in litre & 47 \pm 5.735 in Pred%. The pre and post value of FVC was compared and the mean difference was 0.3010, t value was 3.4549 and P value was 0.0062 in litre & the mean difference in Pred% was 16, t value was 14.884 and P value was <0.0001. Paired t-test was used to compare the pre and post interventional value and it showed statistically significant difference after 2 weeks of intervention with TENS.

Table no.1: Pre and Post comparison of FEV1 & FVC in litre and pred%.

		PRE MEAN \pm SD	POST MEAN \pm SD	MEAN DIFFERENCE	t VALUE	P VALUE
FEV1	litre	0.858 \pm 0.2133	1.083 \pm 0.3690	0.225	3.406	0.0078 Significant
	Pred%	39.1 \pm 7.505	55.2 \pm 7.786	16	18.674	<0.0001 significant
FVC	litre	0.864 \pm 0.2156	1.165 \pm 0.3996	0.3010	3.549	0.0062 significant
	Pred%	31 \pm 4.397	47 \pm 5.735	16	14.884	<0.0001 significant



Graph no.1: Graphical Representation of Pre and Post comparison of FEV1& FVC in litre .

DISCUSSION

The present study was conducted to find out the Effect of Transcutaneous Electrical Nerve Stimulation on Pulmonary Functions in Patient with Intercostal Drainage Tube. Result of the present study showed that TENS was effective in improvement of pulmonary functions after 2 weeks of application of TENS in patients with intercostal drainage tube.

A similar research supporting the present study was conducted by Mukerrem Erdogan, Bdulah Erdogan on postthoracotomy pain and pulmonary functions, It included 60 patients in first group with TENS and 56 patients in other group without TENS. They observed the pain with Visual analog scale and also observed the pulmonary functions of the patients and thus concluded that TENS is beneficial for pain relief and no side effects and also improves the pulmonary function of the patients after thoracic surgery [14] Another similar study was conducted by Steven A Stratton on effect of transcutaneous electrical nerve stimulation on force vital capacity. Twenty-one patients were randomly selected to an experimental group (n=11) or a control group (n=10). Each group performed three trials of forced vital capacity testing over 20-minutes period. The experimental group was given 10 minutes of transcutaneous electrical nerve stimulation at the sites of greatest pain. The study concluded that there is a

significant increase in force vital capacity during the stimulation and suggested that application of TENS improves the chest expansion and mobility in patients who had thoracotomies. [15]

Thoracotomy or insertion of intercostal drainage tube is one of the most painful incisions the patient can experience. Pain inhibits the effectiveness of coughing, affects the deep breathing, and restricts the upper limb mobility of affected side, this results into reduction of lung volume and lung capacities and also result in reduction of pulmonary functions and causes the restrictive ventilatory defect. The application of TENS helps in pain reduction and indirectly improves the lung volume and capacities this helps the patient to breathe effectively and indirectly improves the pulmonary functions.

O Solank , A Turna also conducted a similar type of study to determine the effect of transcutaneous electrical nerve stimulation on pain intensity and pulmonary functions in patients undergoing coronary artery bypass surgery .They were divided into two groups one intervention group(n=50),patients received routine care along with the (TENS) and other the placebo group(n=50) received only routine care .The pain intensity was measured using a visual analog scale every 6 hours for 72 hours after surgery at rest and coughing. Pulmonary functions was assessed through Forced expiratory volume in one second (Fev₁) and forced vital capacity (FVC) at 24,48,72 hours after surgery. The study concluded that TENS may reduce postoperative pain in resting and coughing conditions, improve the pulmonary function in patients undergoing coronary artery bypass surgery. [16]

The present study concluded that there is improvement in pulmonary functions after the application of TENS and the mechanism behind this is the application of TENS provides an analgesic effect which reduces the activation of nociceptive pathway and provides pain relief which indirectly improves the depth of breathing

and improves the lung volume and lung capacities and also improves the pulmonary functions in patients with intercostal drainage tube.

CONCLUSION

The study concluded that the application of Transcutaneous Nerve Stimulation improved the Pulmonary Functions in patients with Intercostal Drainage Tube. Hence TENS should be applied in regular practice of physiotherapy in pain management in patients with Intercostal drainage tube.

REFERENCES

1. Wang NS. Anatomy and physiology of the pleural space. Clinics in chest medicine. 1985 Mar;6(1):3-16.
2. Charalampidis C, Youroukou A, Lazaridis G, Baka S, Mpoukovinas I, Karavasilis V, Kioumis I, Pitsiou G, Papaiwannou A, Karavergou A, Tsakiridis K, Katsikogiannis N, Sarika E, Kapanidis Sakkas L, Korantzis I, Lampaki S, Zarogoulidis K, Zarogoulidis P. Pleura space Anatomy. J Thorac Dis 2015; 7(S1):S27-S32.
3. Williams PL, Warwick R, Dyson M, Bannister LH. Gray's anatomy. Edinburgh: Churchill livingstone; 1989.
4. Kacmarek RM, Stoller JK, Heuer A. Egan's Fundamentals of Respiratory Care-E-Book. Elsevier Health Sciences; 2016 Feb 5.
5. <http://www.physio-pedia.com/chestdrain>.
6. Fiorelli A, Morgillo F, Milione R, Pace MC, Passavanti MB, Laperuta P, Aurilio C, Santini M. Control of post-thoracotomy pain by transcutaneous electrical nerve stimulation: effect on serum cytokine levels, visual analogue scale, pulmonary function and medication. European Journal of Cardio-Thoracic Surgery. 2012 Apr 1;41(4):861-8.
7. Richardson J, Sabanathan S, Shah R. Post-thoracotomy spirometric lung function: the effect of analgesia: a review. Journal of Cardiovascular Surgery. 1999 Jun 1;40(3): 445.
8. Dr.Hina S Danger, Dr.Jayesh Parmar effect of transcutaneous electrical nerve stimulation on pain in patients with

- intercostal drainage tube: a pilot study 3(2), march 2018.
9. Karcz M, Papadacos PJ. Respiratory complications in the postanesthesia care unit: a review of pathophysiological mechanisms. Canadian journal of respiratory therapy: CJRT= Revue canadienne de la therapie respiratoire: RCTR. 2013;49(4):21.
 10. Monisha R. Amutha k, Krishnakumar A. Efficacy of TENS and Respiratory Physiotherapy to Improve Functional Capacity in Post CABG Patients. J Physiother Res. 2017;1(2):8.
 11. Val Robertson, Alex ward, John low and Ann Reed, 4th edition, 2006, 110(11) :170-86.
 12. Johnson MI, Ashton CH, Bousfield DR, Thompson JW. Analgesic effects of different frequencies of transcutaneous electrical nerve stimulation on cold-induced pain in normal subjects. Pain. 1989 Nov 1;39(2):231-6.
 13. Ho A, Hui PW, Cheung J, Cheung C. Effectiveness of transcutaneous electrical nerve stimulation in relieving pain following thoracotomy. Physiotherapy. 1987;73(1):33-5.
 14. Erdogan M, Erdogan A, Erbil N, Karakaya HK, Demircan A. Prospective, randomized, placebo-controlled study of the effect of TENS on postthoracotomy pain and pulmonary function. World journal of surgery. 2005 Dec 1;29(12):1563-70.
 15. Stratton SA, Smith MM. Postoperative thoracotomy: effect of transcutaneous electrical nerve stimulation on forced vital capacity. Physical therapy. 1980 Jan 1; 60(1):45-7.
 16. Solak O, Turna A, Pekcolaklar A, Metin M, Sayar A, Gürses A. Transcutaneous electric nerve stimulation for the treatment of postthoracotomy pain: a randomized prospective study. The Thoracic and cardiovascular surgeon. 2007 Apr; 55(03):182-5.

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