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Research Article

Impact of Chest Physical Therapy Modalities on Total Leucocyte Count and Body Temperature in Mechanically Ventilated Patients

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Abstract

Background: Chest physical therapy have an important role in the reduction of infection rate and getting rid of secretions which in turn lowers TLC and body temperature in patients on MV in ICU which is a good indicator for improvement of patients and decreasing ICU staying, morbidity, mortality and expenses.

Purpose: To determine the impact of chest physical therapy on TLC and body temperature.

Patients and Method: Eighty seven patients on MV, from 55 to 70 years old. From ICUs of Cairo University hospitals. The intervention include percussion, manual hyperinflation, vibration, positioning and range of motion exercises for both upper and lower extremities.

Results: lowered TLC and body temperature.

Conclusion: The results of this study support the impact of chest physical therapy on TLC and body temperature.

Keywords: *Chest Physical Therapy; Total Leucocyte Count (TLC); Body Temperature; Mechanical Ventilation (MV)*

Introduction

Intensive Care Units (ICUs) are special units used to provide care for critically ill patients. ICU is expensive to operate; consuming 15 - 40% of total hospital costs [1].

Mechanical ventilation (MV) assist or replace normal respiratory process. The breathing may be assisted by a respiratory therapist, physician or other medical team members compressing a bag or set of bellows. The mechanical ventilation is either invasive or non-invasive ventilation [2].

Tracheal intubation indeed seriously impairs cough reflex and mucociliary escalator function leading to sequestration and impaction of secretions in the lower airways. This exposes MV patients to severe lung complications [i.e. ventilator associated tracheobronchitis, VAP and lung atelectasis], prolongs the weaning process and may increase mortality [3].

Pneumonia defined as the presence of lung infiltrate of an infectious origin, fever, purulent sputum, increased TLC and decreased oxygen saturation [4].

Ventilator-associated pneumonia refers to the development of parenchymal lung infection after a patient has undergone intubation and received mechanical ventilation for more than 48 hours that leads to reduce the normal clearance of air way secretions [5].

VAP is a known cause of longer ICU stay and increased healthcare cost. The duration of intubation directly affects the likelihood of VAP, which is more evident in patients with ICU exceeding 5 days, the incidence of VAP increases by 1% per day of MV [6].

Physical therapy assessment of critically ill patients is less driven by medical diagnosis, instead focusing on deficiencies at a physiological and functional level [7].

Physical therapy in ICU focusing on early mobilization and chest physical therapy of patients on ventilator. Early intervention leads to better quality of care [26].

Chest physical therapy assist in the reexpansion of atelectatic lung, promote air way clearance, improve total lung and thorax compliance and expiratory flow rates [25].

Chest physical therapy(Positioning, percussion, manual hyperinflation and suction) helps in the reinflation the collapsed lobe of a lung [9].

Percussion and vibration and shaking maneuvers producing mechanical force to the chest wall to loosen the mucus facilitates airway mobilization and clearance, it is a rhythmical beatings with properly shaped hands on the chest wall over specific regions of the lungs and moving out the mucus [10].

Chest wall percussion, vibration and manual hyperinflation are the most common used techniques among chest physical therapists These techniques involves the production of oscillations during expiration that aim to increase expiratory flow and pulmonary secretions [11].

Manual chest percussion technique uses a cupped-hand position to gives vibration on the chest wall into the peripheral airway. Manual chest percussion does not need extreme forces to be effective, can be done with a single or both hands, it frequency is 3:7 beats per second or 180:420 beats per minute and should be continuous for two and half mins for each lung segment [27].

Mobilization is a physical activity that improves ventilation, central and peripheral perfusion, circulation, muscle metabolism and consciousness and protect from venous stasis and its complications like deep vein thrombosis and thromboembolism [12].

Mobilizing patients in ICU has some risks such as Catheters and supportive equipment attached to patients can become dislodged and cause injury. Insertion and reinsertion of catheters can increase infection risk and cause stress and pain for patients.Some patients with physiological derangements can have adverse hemodynamic responses to activity. Patients with limited aerobic capacity may respond to mobilization with tachycardia and increased blood pressure [28].

Positioning is use of the gravitational forces to increases lung volumes, gas exchange, stimulates autonomic nervous system and reduces cardiac stress [13].

Passive movement improve ventilation in neurological patients with a decreased conscious leve in neuro intensive care units [14].

Manual hyperinflation one of the most popular maneuver in ICU gives a greater than baseline tidal volume. Aiming at increasing alveolar oxygenation, recruiting atelectasis, decrease air way resistance and mobilizing secretions [11].

Manual hyperinflation (MH) technique targeting the prevention of pulmonary collapse (or re-expanding collapsed alveoli), improving oxygenation and lung compliance and facilitating the movement of secretions toward the central airways [15].

Mechanical vibration of the chest-wall has been shown to modify respiratory sensation. The prevailing hypothesis is that vibration stimulates afferent activity from the chest-wall muscles (i.e., muscle spindles and/or Golgi tendon organs). These changes in spontaneous drive to breathe may lead to the changes in respiratory sensation. Chest-wall vibration reduces dyspnea stimulated by a combination of hypercapnia and an extrinsic respiratory load or intrinsic load, If vibration over the chest-wall reaches the airways, it is possible that the effects upon sensation are mediated by pulmonary receptors. The effects of pulmonary receptor afferents upon the control of breathing are well documented,. It is possible that rapid oscillations of the lung parenchyma and airways result from vibration of the chest-wall surface. Chest-wall vibration has been used in physical therapy to increase mucus clearance from the lungs, suggesting that vibration reach the airways [16].

Suctioning is one such therapy indicated to remove respiratory secretion from patient's airways, however, it is uncomfortable and associated with complications, such as pain, uncontrollable coughing, infection, atelectasis, hypoxemia, haemoptysis and airway injuries, but reassurance, sedation and preoxygenation of the patient may minimize these effects [14].

Aim of the Study

Aim of the study was to figure out the impact of chest physical therapy on TLC and body temperature.

Patients and Methods

Randomized study and eighty seven patients recently mechanically ventilated, randomly selected, their age ranged from 55 to 70 years old were recruited in this study. The patients were selected from different ICUs of Cairo University Hospitals, during the period between June 2018 and May 2019. The interventions included were percussion, manual hyperinflation, positioning, vibration and upper and lower limbs exercises (passive, active assisted or active).

Ethical statement

The patients or their next of keen were asked if they would like to participate in the research.

Approval statement

The participants or their next of keen signed on a consent form.

Inclusion criteria

All patients from the first day of being mechanically ventilated between the age of 55 to 70 years old.

Exclusion criteria

All patients had the following criteria were excluded: Patients younger than 55 and older than 70 years, on NIMV, Acute pulmonary edema, untreated pneumothorax and open heart surgeries, admission with tracheostomy.

Methods

Monitoring

- ECG and Heart rate.
- Blood oxygen saturation: In a non invasive method by the use of pulse oximeter.
- Respiratory rate.

Laboratory investigation

Total leukocyte count (TLC) test: to asses infection and inflammation.

Procedures

- These procedures toke place in the first 96 hours of patient admission in ICU.
- The interventions were twice daily.
- The interventions duration was 30 minutes.

Treatment procedures

The interventions were, [1]. Chest wall percussion for 5 minutes, manually with cupped hands [2]. Chest wall vibration: for 5 minutes from distal to proximal and from lateral to medial [3]. Manual hyperinflation: Focusing on short expirations by the fast release of the valve of the resuscitator bag, passive and unobstructed to facilitate expiration flow rate [4]. Limb exercises: Passive, active assisted or active range of movement depending on patients conditions, for the upper and lower limbs, 20 repetitions for each limb in all planes eg (flexion, extension, abduction, adduction and rotation)and lasted for 15 minutes [5]. Suctioning: open circuit, suctioning lasted up to 15seconds and it stopped if the patients was severely distressed [6]. Positioning: after suctioning, the patient positioned in a half supine position at an angle (30 - 45).

Statistical analysis

T-test to compare between pre and post treatment mean values of TLC and temperature. P value< 0.05 is considered significant. All statistical measures were performed by the use of statistical package for social studies (SPSS).

Results

TLC and body temperature are decreased at the end of the study.

Variable	Pre	Post	MD	% of change	F-value	p-value	Sig
	C ± SD	C ± SD					
TLC (x10^3/ul)	13.21 ± 3.88	9.82 ± 3.28	3.39	25.66	140.15	0.0001	**S**
Temperature (°C)	38.21 ± 0.81	37.26 ± 0.54	0.95	2.48	39.7	0.0001	**S**

Table 1: *Comparison between pre-treatment and post-treatment mean value of the TLC and Tempreture. X: Mean; MD: Mean difference; p value: Probability value; SD: Standard deviation; S: Significant.*

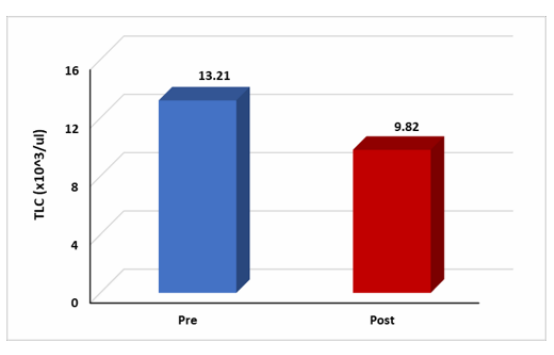

Figure 1: *TLC mean values, pre and post treatment.*

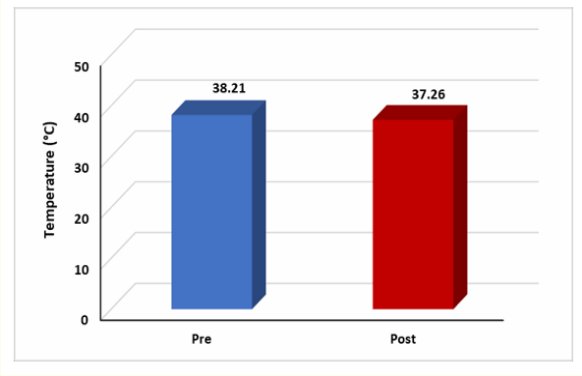

Figure 2: *Temperature mean values, pre and post treatment.*

Discussion

This study was conducted to evaluate the impact of chest physical therapy on TLC and Body Temperature. There is a decrease in TLC and Body Temperature.

With accordance to this results Renu B and Pattanshetty G demonstrated that twice-daily CPT was associated with decrease TLC [8].

Ali., *et al*. stated that chest physical therapy lowers TLC through acting on the prevention of infection or even reduce it [23].

Zeyu., *et al*. concluded that significant decrease in $PaCO_2$ after chest physical therapy in comparing to control group $PaCO_2$ which showed no significant different [18].

Farahat., *et al*. who studied the response of mechanically ventilated patients to chest physical therapy, there was significant decrease in TLC after chest physical therapy in the study group [19].

Antonio., *et al*. (2011) who conducted a study, on One hundred and forty-six patients were enrolled receiving chest physical therapy presented with lower respiratory infections which plays a pivot role in body temperature and fever [24].

In this respect Renu B and Pattanshetty G concluded that critically ill patients who were subjected to intubation and receiving mechanical ventilation demonstrated that twice-daily chest physical therapy was associated with normal temperature [8].

On contrary with the current study, Patman., *et al*. 2008 concluded that: regular chest physical therapy in addition to routine medical/nursing care showed no prevention of VAP or lowering body temperature. This might be explained by evaluating the effect of chest physical therapy after less than 24 hours compared to the current study which was conducted for a long period of time and used multiple modalities of chest physical therapy.

Conclusion

The results support the importance of adding chest physical therapy program to MV patients as it lowers TLC and body temperature, decreases complications in patients on MV, decrease ICU stay, psychological disorders related to ICU and decrease healthcare expenses.

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