

Effect of Chest Physical Therapy Modalities on Oxygen Saturation and Partial Pressure of Arterial Oxygen in Mechanically Ventilated Patients

Maged A. Meawad¹, Akram Abd El Aziz¹, Hany E. Obaya¹, Sabah A. Mohamed², and Khaled Mohamed Mounir³

Departments of ¹Physical Therapy for Cardiovascular/Respiratory Disorder & Geriatrics and ²Chest Medicine, Cairo University, Department of ³Physical Therapy for Cardiopulmonary & Geriatrics Disorders, Egyptian Chinese University, Egypt

Correspondence: Maged A. Meawad, **E-mail:** magedptdr@gmail.com, **Mobile:** 00201007977226

ABSTRACT

Background: Chest physical therapy plays an important role in increasing Pao₂ and SaO₂ among ICU patients which is considered as a good indicator for the general improvement of the patient besides decreasing ICU staying and costs.

Purpose: To figure out the effect of chest physical therapy on oxygen saturation and partial pressure of arterial oxygen.

Patients and Method: Thirty patients post MV, their age ranged from 50 to 60 years old were recruited in this study. The patients were selected from ICUs of Kasr al Ainy hospital, Faculty of Medicine, Cairo University. The patients received chest physiotherapy (percussion, vibration, manual hyperinflation), positioning and upper and lower limbs exercises.

Results: Increase in Pao₂ and SaO₂ in addition to decreased incidence of chest infection and decreased ICU stay.

Conclusion: The results of this study support the importance of chest physiotherapy on increasing SaO₂ and Pao₂, decrease ICU duration and decrease health care costs.

Keywords: chest physiotherapy, partial pressure of arterial oxygen (Pao₂), oxygen saturation (SaO₂) and 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⁾.

MV is always a lifesaving intervention, but carries many potential complications including pneumothorax, lung injury, alveolar damage, and ventilator-associated pneumonia ⁽²⁾.

Chest physiotherapy is one such common preventive strategy where chest physiotherapists routinely treat most of the ICU patients with various chest physiotherapy techniques such as Manual hyperinflation, suctioning, patient positioning, chest vibrations, chest percussions, various coughing techniques in combination or individually to prevent pulmonary complications in the ICUs ⁽³⁾.

Chest physiotherapy procedure help to reinflate the collapsed lobe of a lung, Positioning combined with chest percussion, as well as lung hyperinflation plus suction, are the best ways to quickly solve lung lobe atelectasis ⁽⁴⁾.

Percussion and vibration and shaking methods are based on the assumption that applying an external force to the chest wall to loosen the mucus facilitates airway mobilization and clearance, it involves rhythmical beating with properly shaped hands on the chest wall over specific regions of the lungs and removing the mucus ⁽⁵⁾.

Chest wall percussion and vibration were used by up to 80% of physiotherapists, often in combination with manual hyperinflation. This technique involves the production of large and small oscillatory movements performed during expiration that aim to increase expiratory flow and subsequent pulmonary secretion clearance ⁽⁶⁾.

Mobilization refers to physical activity sufficient to elicit acute physiological effects that improve ventilation, central and peripheral perfusion, circulation, muscle metabolism and alertness and countermeasures for venous stasis and deep vein thrombosis ⁽⁷⁾.

Positioning can be used to increase gravitational stress and associated fluid shifts, through head tilt and other positions that approximate the upright position, That increases lung volumes and gas exchange, stimulates autonomic activity, and can reduce cardiac stress from compression ⁽⁸⁾.

Passive movement has been shown to enhance ventilation in neurological patients in high-dependency units ⁽⁹⁾.

Is one of a number of techniques which provides a greater than baseline tidal volume to the lungs. It is frequently used by physiotherapists in the treatment of intubated mechanically ventilated patients with the aim of increasing alveolar oxygenation, recruiting atelectasis or mobilizing pulmonary secretions ⁽⁶⁾.

Aim of the study: was to evaluate the efficacy of chest physical therapy modalities on SaO₂ and Pao₂.

PATIENT AND METHODS

Randomized study and thirty patients recently mechanically ventilated, randomly selected, their age ranged from 50 to 60 years old were recruited in this study. The patients were selected from ICU Kasr al Ainy hospital, Faculty of Medicine, Cairo University, during the period between June 2016 and April 2017. The patients received chest physiotherapy (percussion, vibration, suctioning, manual hyperinflation), positioning and upper and lower limbs exercise.

Ethical statement: The patients or their relatives were approached to ask if they would be willing to engage in the research. **The study was approved by the Ethics Board of Cairo University.**

Approval statement: The participants signed on a consent form.

Inclusion criteria: All patients from the first day of being mechanically ventilated between the age of 50 to 60 years old

Exclusion criteria: All patients had the following criteria were excluded: Patients younger than 50 and older than 60 years, on NIMV, Acute pulmonary edema, untreated pneumothorax and open heart surgeries, admission with tracheostomy

Methods:

Monitoring: ECG and Heart rate. Oxygen saturation: by pulse oximetry. Respiratory rate.

Laboratory investigation: ABG: for measurement of PaO₂.

Procedures: The procedure was done during the first 3 days of patient admission in ICU. Each patient was given 2 sessions every day. Each session lasted for 30 minutes.

Treatment procedures:

The program was designed as follows, [1]. Percussion: Was done for 5 minutes performed manually (using cupped hands) by clapping the chest wall over of the lung [2]. Chest vibrations: Was done for 5 minutes all over the lung from distal to proximal and from lateral to medial direction. [3]. Manual hyperinflation: The waveform consisted of an inspiration of three seconds, sustained inspiration for 2 seconds, and a fast release of the valve to ensure a short expiration, during which bag was held compressed. Expiration was passive and unobstructed to facilitate expiratory flow [4]. Limb exercises: In the form of passive or active assisted movement for the 4 limbs (2 sets for each limb and each set 10 repetitions) for 15 minutes.

Limb exercises (passive, active assisted or active) were performed according to patient's status. [5]. Suctioning: Duration of endotracheal suctioning was limited to 15sec [6]. Positioning: At the end of the treatment session and after suctioning, the head end was arranged to be positioned at an angle of elevation in the range of 30-45.

Statistical analysis:

Student t-test conducted for comparison between pre and post treatment mean values of PaO₂ and Sao₂. The level of significance for all statistical tests was set at p < 0.05. All statistical measures were performed through the statistical package for social studies (SPSS) version 19 for windows.

RESULTS

There were an increase in PaO₂ and SaO₂.

Table (1): Comparison between pre-treatment and post-treatment mean value of the variables.

Partial pressure (mmHg)	Pre	Post	MD	% of change	F- value	p-value	Sig
	$\bar{X} \pm SD$	$\bar{X} \pm SD$					
PaO ₂	76.33 ± 11.83	82.13 ± 9.74	-5.8	7.59	5.85	0.02	S
SaO ₂ (%)	89.63 ± 3.36	96.96 ± 3.4	-7.33	8.17	192.8	0.0001	S

\bar{X} : Mean MD : Mean difference p value : Probability value
SD : Standard deviation S : Significant

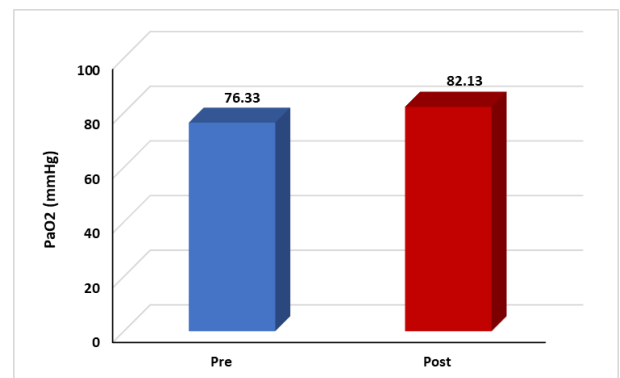


Figure (1): Pre and post treatment mean values of PaO₂

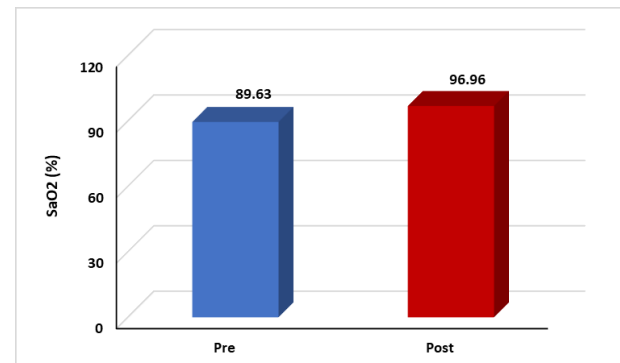


Figure (2): Pre and post treatment mean values of SaO₂

DISCUSSION

This study was conducted to evaluate the effect of chest physiotherapy on pao₂ and saO₂. There were an increase in PaO₂ and SaO₂.

Zeyu *et al.*⁽¹⁰⁾ investigated the clinical effect of the chest physiotherapy for the postoperative sputum excretion. After chest physiotherapy, the increase of PaO₂ was significant higher than before after three days. **Farahat *et al.***, investigated the response of mechanically ventilated to chest physical therapy, there was significant increase in PaO₂ after chest physical therapy (positioning, percussion, vibration and suction.) in the study group⁽¹¹⁾. **Zeng *et al.***⁽¹²⁾ concluded that chest physical therapy decrease the incidence of VAP and increase in PaO₂ in his study group who received comprehensive chest physical therapy.

Chen *et al.*⁽¹³⁾ found that SaO₂ was significantly increased after chest physical ventilated to chest physical therapy, there was significant increase in SaO₂ after chest physical therapy (positioning, percussion, vibration and suction.) in the study group. **Zeyu *et al.***⁽¹⁰⁾ concluded that SaO₂ was significant higher than before after chest physical therapy in the study group.

Paratz *et al.*⁽¹⁴⁾ demonstrated that there was a decrease in Pao₂ after manual hyperinflation in patient with acute intrapulmonary lung injuries. This may be as a result of the candidates were having acute intrapulmonary lung injuries who were excluded from this study, besides applying manual hyperinflation only. **Berny *et al.***⁽¹⁵⁾ demonstrated that a slight decrease in partial pressure of arterial oxygen was observed in his study group following mobilization in ICU, this result may differs from this current study used a comprehensive chest physical therapy program was added including percussion, vibration, manual hyperinflation and positioning besides, limb exercises.

Monica *et al.*⁽¹⁶⁾ demonstrated no increase in SaO₂ in a prospective, interventional study A respiratory physiotherapy was initiated, twice a day, to a randomized group of mechanical ventilated patients This disagreement resulted from smaller sample size than used in this current study.

CONCLUSION

The results support the importance of adding chest physiotherapy program to early MV patients as it increases PAO₂, SAO₂, decreases

complications in patients undergoing MV, decrease ICU duration, ICU related psychological disorders and decrease healthcare costs.

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