Effect of Multimodality Chest Physiotherapy Interventions on Prevention of Ventilator Associated Pneumonia among Mechanically Ventilated Patients

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Abstract

Background: *Ventilator-Associated Pneumonia (VAP) refers to nosocomial pneumonia occurring 48 hours or more after initiation of mechanical ventilation (MV). Critically ill patients who is receiving mechanical ventilation may have an increased risk of VAP due to multiple factors as sputum retentions and atelectasis. Thus, different combinations of chest physiotherapy assist in the re-expansion of the atelectatic lung, confer short-term improvement in total lung-thorax compliance and expiratory flow rates, and reduce the incidence of ventilator-associated pneumonia.* ***Objective:*** *To identify the effect of multimodality chest physiotherapy interventions on prevention of ventilator associated pneumonia among mechanically ventilated patients.* ***Settings:*** *The study was carried out at the general ICUs at Damanhur Medical National institute which is classified to general ICU I (15bed) and the General ICU II (13bed).* ***Subjects:*** *A convenient sample of 60 adult mechanically ventilated patients from the starting day of invasive mechanical ventilation were included in the study.* ***Tools:*** *Two tools were used to collect the data of this study.* ***The first tool*** *was outcomes of multimodality chest physiotherapy assessment that was used to assess the effect of multimodality chest physiotherapy interventions. The* ***second tool*** *was VAP bundle observation checklist that was used to assess nurses' compliance with ventilator bundle practices.* ***Results:*** *The findings of the current study revealed that there was a statistically significant difference between the intervention and control groups regarding the occurrence of VAP (P= 0.001). Patients who were subjected to multimodality chest physiotherapy interventions had lower VAP rate.* ***Conclusion:*** *The present study revealed that patients who had a twice-daily multimodality chest physiotherapy interventions in the form of manual hyperinflation, endotracheal suctioning, patient positioning plus chest percussion and mechanical chest vibration device had a better effect on decreasing VAP occurrence as well as enhance patient`s clinical outcome than those who do not had.* ***Recommendations:*** *The nursing staff should use chest vibrating device with other chest physiotherapy techniques to reduce VAP in mechanically ventilated patients.*

Keywords: Multimodality Chest Physiotherapy, Ventilator Associated Pneumonia, Mechanically Ventilated Patients.

Introduction

Ventilator-associated pneumonia (VAP) is defined as pneumonia that occurs within 48 hours after intubation with patients, who did not have pneumonia prior to intubation, and receiving mechanical ventilation during the intubation. It is a complicated condition in terms of diagnosis and treatment, and it is also a priority condition that should be prevented in clinical settings. For this reason, prevention of VAP

in ICUs is considered as an important practice for patient safety and an indication of health care quality (Al-Thaqafy et al., 2014; Osti et al., 2017).

Chest physiotherapy (CPT) is the term for a group of treatments designed to improve respiratory efficiency, promote expansions of lungs, strengthen respiratory muscles, and eliminate secretion from the respiratory system. It reduces airway obstruction and its consequences, such as atelectasis and hyperinflation. Furthermore, chest physiotherapy can decrease the rate of proteolytic tissue damage by removing infected secretions. It includes gravity-assisted drainage, manual lung hyperinflation (bagging), suctioning to clear pulmonary secretions and hyper oxygenation to prevent suction induced hypoxemia, positioning, chest wall percussion and chest wall vibration are commonly used intensive care procedures (Yang et al., 2013).

Regarding conventional chest physiotherapy methods which are used in the ICU, the mechanical chest vibration by using chest vibrating device is a very important method to dislodge the mucus and help it move out of the airways. This process is repeated over different parts of the chest and back to loosen the mucus in different areas of each lung. (Morrison & Innes, 2017).

The mechanical chest vibration also produces a high frequency and small amplitude which is an appropriate alternative method than other traditional methods. 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. These changes in spontaneous drive to breathe may lead to changes in respiratory sensation. It reduces dyspnea stimulated by a combination of hypercapnia and an extrinsic respiratory load or intrinsic load (Meawad et al., 2018).

There is supportive evidence that various combinations of chest physiotherapy assist in the re-expansion of the atelectatic lung, confer short-term improvement in total lung-thorax compliance and expiratory flow rates, and reduce the incidence of ventilator-associated pneumonia (Pattanshetty & Gaude, 2011).

The critical care nurse is an integral participant of the multidisciplinary group responsible for the management of patients in the ICU. As a result, it is essential that nurses have vital role in developing best practice to prevent VAP. Therefore, this study will be conducted to assess the effect of multimodality chest physiotherapy interventions on prevention of VAP among mechanically ventilated patents. Improved outcomes will shorten patient's ICU length of stay and hospitalization as well as decreasing hospital costs.

Aims of the Study

This study aims to identify the effect of multimodality chest physiotherapy interventions on prevention of ventilator associated pneumonia among mechanically ventilated patients.

Research Hypotheses

Patients who are subjected to the multimodality chest physiotherapy interventions exhibit lower rate of ventilator associated pneumonia than those who are not subjected

Materials and Method

Materials

Design: A Quasi-experimental research design was used to conduct this study.

Settings: At the general ICUs at Damanhur Medical National institute which is classified to general ICU I (15bed) and the General ICU II (13bed).

Subjects: A convenience sample of 60 adult mechanically ventilated patients from the starting day of invasive mechanical ventilation were included in the study based on the power analysis using Epi-Info program applying the following parameters: population size 90 admitted during 4 months,

expected frequency 50%, acceptable error 5 %, and confidence coefficient 97 %. Patients who met the inclusion criteria were equally and randomly assigned into two groups: intervention group and control group (thirty patients in each).

Exclusion criteria:

- Haemo-dynamic instability
- Patients who are contraindicated to VAP bundle e.g. (spinal cord injury and bleeding risk)
- Patients who are contraindicated to chest physiotherapy e.g. (chest trauma, spinal cord injury, untreated pneumothorax, uncontrolled hypertension, pulmonary embolism, and empyema).

Tools: Two tools were used to collect data of the study:

Tool I: Outcomes of Multimodality Chest Physiotherapy Assessment: This tool was developed by the researcher after reviewing related literature (Nafae, El-Shahat, Shehata et al., 2018; Renu, Pattanshetty & Gaude, 2011). This tool was used to assess the effect of multimodality chest physiotherapy interventions. It consists of three parts.:

Part I: Patients' sociodemographic and clinical data: This part includes demographic data such as age, gender, time and date of admission and clinical data such as admission medical diagnosis, co-morbidities, medical history, vital signs, respiratory assessment, APACHE II score and level of consciousness using FOUR score.

Part II: Multimodality chest physiotherapy care observation checklist: This part was used to assess chest physiotherapy care which includes the following:

- Tracheal suctioning
- Manual hyperinflation
- Positioning
- Postural drainage
- Chest percussion
- Chest vibration

Each item was scored by one if the item done and zero if the item not done.

Part III: Patients' clinical outcome assessment: This part was used to assess presence of Ventilator-Associated Pneumonia and evaluate frequency of recovery which includes the following:

Primary outcomes:

Presence of VAP using Clinical Pulmonary Infection Score (CPIS) including:

- Body temperature
- Chest x-ray of new or worsening infiltrate
- Sputum
- Pao2/FIO2
- Endotracheal tube cultures or minibal culture
- White blood cells count

The scale was adopted from (Zilberberg & Shorr, 2010). Total score of CPIS range from 0 to 12, where as the score of CPIS from 0 to 5 means absent of VAP and the score of CPIS from 6 to 12 means occurrence of VAP

Secondary outcomes:

- Duration of intubation (MV) in days
- Length of stay in the ICU in days
- Oxygenation status parameters:
  - Arterial blood gases
  - Peripheral oxygen saturation (Spo2)
- **Ventilator parameters:**
  - MV data changes (mode of MV)
- **Mortality rate**

Tool II: "Ventilator Associated Pneumonia bundle observation checklist: This tool was adopted from Resar, Pronovost, Haraden et al., 2005 based on the guidelines of The Institute for Healthcare Improvement (IHI). This tool was used to assess the compliance with ventilator bundle practices. It includes the following components:

- Elevating the head of the bed between 30 and 45 degrees
- Providing a daily sedation vacation or holding a sedative
- Providing stress ulcer prophylaxis

- Providing deep vein thrombosis prophylaxis
- Performing a daily oral care with chlorhexidine with 0.12%
- Monitoring of tracheal cuff inflation

Each bundle item was scored by one if the item done and zero if the item not done.

Method

- Approval from the ethical committee, Faculty of Nursing Alexandria University was obtained.
- An official letter was obtained from the Faculty of Nursing and will be sent to hospital administrative authorities to conduct the study after explanation of the aim of the study.
- An official approval to carry out the study was obtained from the hospital administrative authorities to collect the necessary data from the selected settings.
- The study tool I was developed by the researcher after reviewing the relevant literature.
- The study tool was submitted to a jury of 5 experts in the field of critical to assess content validity. The necessary modifications were done accordingly.
- Reliability of the study tool I was measured using Cronbach Alpha reliability.
- A pilot study was carried out to assess feasibility of the study and applicability of the tools. It was performed on 6 patients, and these patients were not included in the study. The necessary modifications were done accordingly.
- The data collection started at the beginning of October till the end of February 2021.
- All newly mechanically ventilated patients were assessed by the researcher for meeting the inclusion and exclusion criteria upon admission.
- Patients who were met the inclusion criteria were assigned randomly into two equal groups, intervention group and control group.
- The socio demographic data of both groups was obtained and recorded using tool **I** Part **I**.
- Severity of illness was assessed on admission using acute physiological and chronic health evaluation (APACHE II) scoring system using tool **I** part **I**.
- Level of consciousness was assessed using four score using tool **I** part **I**.
- Patients were observed for receiving ventilator care bundle using tool **II**.
- **The control group** was subjected to conventional chest physiotherapy. Routine hospital care was observed and recorded using tool **I** part **II**
- **The intervention group** was subjected to conventional chest physiotherapy in addition to chest percussion and mechanical chest vibration by chest vibrating device.
- **Chest percussion** manually was provided by the researcher by cupped hands together to provide more force for the chest anterior, laterally and posterior to the back for a period of 3-5 minutes.
- **The chest vibration** nursing intervention was applied by chest vibrating device which includes placing a mechanical chest wall vibration pad on the patient's back and chest.
- **The postural drainage positions** during percussion and mechanical vibration were provided according to the affected area to promote drainage of the lung segment.
- **Manual hyperinflation (MH)** technique also was provided by the researcher of which achieved by slowly compressed with both hands. The manual hyperinflation procedure was carried out at rate of 8 to 13 breaths/min for a period of 5 minutes.

- **Tracheal suctioning** was done after percussion and mechanical vibration according to patient assessment including auscultation of chest and visual inspection of ventilator graphics, mechanical hyper oxygenation by 100% and duration was limited to 15 second.
- **For both groups**, patients were assessed for primary and secondary outcomes. Primary outcome is VAP occurrence was assessed and recorded using tool **I** part **III** of the study tools. Secondary outcomes are length of stay in ICU, duration on mechanical ventilation, MV data changes, peripheral oxygen saturation (Spo_2), arterial blood gases and mortality rate was recorded using tool **I** part **III**. Comparison between two groups regarding the outcomes after completion of the study was done using suitable statistical analysis
- The collected data was analyzed by using appropriate statistical test to determine whether the occurrence of ventilator associated pneumonia will be reduced in mechanically ventilated patients by using multimodality chest physiotherapy interventions.

Ethical considerations:

- Informed written consent was obtained from head nurses for observation.
- Written informed consent was obtained from patients' family for their participation.
- Patients' privacy was maintained.
- Data confidentiality was assured during implementation of the study.

Statistical Analysis

The collected data were organized, tabulated and statically analyzed using the statistical package for social studies (SPSS) Version 25.0.Qualitative data were described using number and percent. Quantitative data were described mean ± standard deviation. Finally analysis and interpretation of data were conducted. P-values of 0.05 or less were considered statistically significant

Results

Table (1) illustrates the characteristics of **Table (1)** illustrates the distribution of the studied groups according to their demographic data. Regarding gender, this table shows that more than half of the intervention group were male patients 63.3% as compared to 40% of the control group. Regarding age, it can be noted that the mean age of the intervention group was 45.37 ± 9.07 years as compared to 42.47 ± 8.92 years of the control group. There was no statistically significant difference between the two groups regarding gender and age (p=0.79 and 0.17 respectively).

Table (2) shows distribution of the studied groups as regards clinical characteristics. In relation to medications, it can be noted that the majority of both studied groups received bronchodilators 83.3% of the intervention group 93.3% of the control group. It can be noted that more than one third of both studied groups received prophylactic antibiotics 40% of the intervention group 43.3% of the control group. There was no statistically significant difference between the two groups regarding medication (p= 1.000)

Regarding, the mean score FOUR score level of consciousness in the intervention group was 9.20 ± 1.19 as compared to 7.93 ± 1.46 of the control group was. The mean of APACHE-II score in the intervention group was 17.60 ± 3.27. While, in the control group was 12.83 ± 4.14. There was no statistically significant difference between the two groups regarding level of consciousness and APACHE-II score (p= 0.779, 0.073 respectively).

Table (3): shows distribution of the studied groups as regard assessment of VAP through comparison of CPIS parameters at the seventh day through six items including (body temperature, chest x-ray, Sputum, oxygenations Pao2/FIO2, tracheal culture,

and WBC). Regarding body temperature in the intervention group 93.3% were between (≥ 36.5- ≤ 38.4) and 6.7 % were between (≥ 38.5- ≤ 38.9). While body temperature in control group 60 % were between (≥ 36.5- ≤ 38.4) and 40 % were between (≥ 38.5- ≤ 38.9). The difference was statistically significant (p= 0.002).

Concerning, chest x- ray in the intervention group 76.7 % had no infiltrate and 23.3% with localized infiltration. While, in the control group 16.7 % had no infiltrate and 83.3% with localized infiltration. The difference was statistically significant (p= <0.001). In relation to sputum, this table shows that more than half of the intervention group had no/mild growth 83.3 % and 16.7% had moderate/florid growth and pathogen consistent with gram stain as compared to 30 % had no/mild growth and 36.7 % were moderate/florid growth and pathogen consistent with gram stain in the control group. The difference was statistically significant (p= <0.001).

As regard oxygenations, 93.3% in the intervention group were free of ARDS and 6.7 % were presence of ARDS. While oxygenations in the control group 76.6% of the sample were free of ARDS and 23.3% were presence of ARDS. Relating to tracheal secretions, most of the intervention group 83.3% had non secretions, 16.7% mild/no purulent as compared to 20% had no secretions and 66.7% mild/non purulent in the control group. The difference was statistically significant (p= <0.001).

Regarding WBC, 90% in the intervention group were between (4.000-11.000) which is the normal range, 10% were between (< 4.000- ≥ 11.000). In the control group 36.7% were between (4.000-11.000) and 63.3% were between (< 4.000- ≥ 11.000). The difference was statistically significant (p= <0.001). Patients' evaluation towards VAP revealed that 80% of intervention group didn't have VAP and 20% had VAP. While 30% of control group didn't have VAP and 70 % had VAP which means that there was a positive association between using different modalities of CPT and prevention of VAP. Concerning CPIS score, it can be noted that the mean CPIS score of the intervention group was 3.00 ± 2.08 as compared to 6.23 ± 2.97 of the control group and there was statistically significant difference between the two groups regarding the CPIS score (P= <0.001).

Table (4): shows comparison between the intervention and control groups as regards oxygenation status parameters. It can be observed from this table that oxygenation status parameters including arterial blood gases as PH, Pao2, Paco2 and Sao2 as well as oxygen saturation (Spo2). In relation to Pao2, the mean Pao2 in the intervention group was 93.65 ± 5.59 as compared to 85.62 ± 18.47 of the control group. Regarding Sao2, the mean Sao2 in the intervention group was 96.44 ± 2.31 as compared to 92.81 ± 2.87 of the control group.

Concerning Spo2, the mean Spo2 in the intervention group was 96.82 ± 2.07 as compared to 93.08 ± 2.87 of the control group. There was a statistically significant difference between the two groups regarding Pao2, Sao2 and Spo2 (p= 0.026, <0.001 and <0.001 respectively) and there was no statistically significant difference between the two groups as regards pH and Paco2 (p=0.168 and 0.319 respectively).

Discussion

Ventilator Associated Pneumonia (VAP) increases risk of mortality, days spent on mechanical ventilator, length of time spent at hospital and cost of care in critically ill patients (Karagözoğlu et al., 2018).

The studied samples were homogenous and there was no statistically significant difference between the two groups. Regarding VAP occurrence through CIPS after CPT care, the current study result revealed that the mean score of CIPS in the intervention group less than the control group and there was statistically significant difference between the two groups. This can be attributed to the fact that the application of different methods of chest physiotherapy

have played their respective significant roles to assist in the re-expansion of the lung and mechanical chest vibrating device was used to remove of pulmonary secretion through external forces application on chest and had an excellent impact on reduces the incidence of VAP occurrence in the intervention group as compared to the control group.

These findings supported by a study done by Pattanshetty and Gaude (2010) who conduct a study on the effect of multimodality chest physiotherapy in prevention of ventilator-associated pneumonia. They concluded that twice-daily multimodality chest physiotherapy was associated with a significant decrease in the CPIS scores in the intervention group as compared to the control group.

In addition, the current study findings were in agreement with the results of Renu (2011) who conducted a study on effect of multimodality chest physiotherapy on the rate of recovery, prevention of ventilator associated pneumonia and reported that the CPIS score at the end of intubation/discharge from ICU was higher in the control group who received only manual hyperinflation (MH) and suctioning as compared to the study group who received positioning and chest wall vibrations in addition to MH plus suctioning suggesting a decrease in the occurrence of VAP with twice-daily multimodality CPT.

As regard to oxygenation status parameters, the results of the current study reveal that there was a significant improvement in the mean of PaO2, SaO2 and SPO2 in the intervention group more than the control group. This may be because due to that decreasing resistance and obstruction caused by secretions and bulges that increases airway pressure & decrease compliance.

These results were supported by a study done by Zhong et al., (2016) who conducted a study to identify the effect of early chest physiotherapy (positioning, percussion, vibration, and suction) on blood gas and circulatory function in 15 elderly, ventilated patients after thoracotomy and found that PaO2, SaO2 were significantly increased and PaCO2 were decreased at 30 minutes after treatment.

Moreover, these results were congruent with the study conducted by Kriemler et al. (2016) findings who found that there were no changes in PaCO2 and PaO2 in patients with cystic fibrosis on mechanical ventilator after chest physical therapy and suggested that their results could be due to the relatively high baseline oxygen-saturation values of the patients in their study.

Conclusion

Based upon the findings of the current study, it could be concluded that twice-daily multimodality chest physiotherapy interventions in the form of MH, endotracheal suctioning, patient positioning plus chest percussion and mechanical chest vibration device had a better effect on decreasing VAP occurrence as well as enhance patient`s clinical outcome. and there was a statistically significant relationship exists between application of different methods of chest physiotherapy care plus mechanical chest vibration device and VAP occurrence between two groups.

Recommendations

In line with the findings of the study, the following recommendations are made:

The nursing staff must understand importance of using mechanical chest vibrating device and application of different methods of chest physiotherapy regarding patient`s condition.

Provide training program to upgrade nurses` knowledge and practices regarding benefits, limitations, and guidelines of using mechanical chest vibrating device.

Adequate number of mechanical chest vibrating devices should be available in critical care settings

Table I: Distribution of the studied groups according to demographic data

Patients' sex& age	Intervention group (n=30)		Control group (n=30)		Test of Sig.	p
	No.	%	No.	%		
Gender						
Male	19	63.3	12	40	χ^2= 0.071	0.79
Female	11	36.7	18	60		
Age (years)						
18-30	2	6.7	3	10		
31 – 40	5	16.7	12	40	χ^2=	^{MC}p=
41 – 50	11	36.7	9	30	5.247	0.166
51-60	12	40.0	6	20		
Mean ± SD.	45.37 ± 9.07		42.47 ± 8.92		t= 1.249	0.217

Table 2: **Distribution of the studied groups as regard clinical characteristics**

Clinical characteristics	Intervention group (n=30)		Control group (n=30)		Test of Sig.	p
	No.	%	No.	%		
Medication*						
Bronchodilators	25	83.3	28	93.3	0.107	MCp= 1.000
Prophylactic antibiotics	12	40	13	43.3		
ACEI	4	13.3	5	16.7		
Level of consciousness						
Mean ± SD.	8.70 ± 1.34		8.60 ± 1.40		t= 0.282	0.78
APACHE II Score						
Mean ± SD.	17.60 ± 3.27		15.73 ± 4.53		t= 1.832	0.07

χ2: **Chi square test** MC: **Monte Carlo** **t: Student t-test** SD: **Standard deviation** p: p value for comparing between the studied groups *: Statistically significant at $p \leq 0.05$ *: More than one answer

Table (3): Distribution of the studied groups as regard VAP occurrence through CIPS after CPT care.

Clinical Pulmonary Infection Score (CPIS)	Intervention group (n = 30)		Control group (n = 30)		Test of sig.	P
	No.	%	No.	%		
Body temperature (°C)						
≥36.5and ≤ 38.4	28	93.3	18	60	χ^2 9.317*	0.002*
≥ 38.5and ≤ 38.9	2	6.7	12	40		
≥39 and ≤ 36	0	0.0	0	0.0		
Mean ±SD.	0.07 ± 0.25		0.40 ± 0.50		t=3.265*	0.002*
Chest radiograph infiltrate						
No filtration	23	76.7	5	16.7	χ^2 21.696*	<0.001*
Diffuse/patchy infiltrates	0	0.0	0	0.0		
Localized infiltration	7	23.3	25	83.3		
Mean ±SD.	0.47 ± 0.86		1.67 ± 0.76		t=5.732*	<0.001*
Sputum						
No/mild growth	25	83.3	9	30.0	χ^2 19.779*	<0.001*
Moderate/florid growth	0	0.0	10	33.3		
Moderate/florid growth and pathogen consistent with Gram stain	5	16.7	11	36.7		
Mean ±SD.	0.33 ± 0.76		1.07 ± 0.83		t=3.579*	0.001*
Pao_2/FIo_2						
240 or ARDS	2	6.7	7	23.3	χ^2 3.268	^{FE}p= 0.145
240 and absence of ARDS	28	93.3	23	76.7		
Mean ±SD.	1.87 ± 0.51		1.53 ± 0.86		t=1.828	0.074
Endotracheal tube cultures or minibal culture					χ^2 24.996*	^{MC}p <0.001*
None	25	83.3	6	20		
Mild/nonpurulent	5	16.7	20	66.7		
Purulent	0	0.0	4	13.3		
Mean ±SD.	0.17 ± 0.38		0.93 ± 0.58		t=6.037*	<0.001*
White blood cells count						
4,000-11 000	27	90	11	36.7	χ^2 18.373*	<0.001*
< 4,000 or ≥11,000	3	10	19	63.3		
500 band cells	0	0.0	0	0.0		
Mean ±SD.	0.10 ± 0.31		0.63 ± 0.49		t=5.060*	<0.001*
VAP occurrence						
Absent (0 to 5)	24	80.0	9	30.0	χ^2 15.152*	<0.001*
Present (6 to 12)	6	20.0	21	70.0		
Total score						
Min. – Max.	2.0 – 9.0		0.0 – 10.0		t=4.884*	<0.001*
Mean ± SD.	3.00 ± 2.08		6.23 ± 2.97			

χ^2: **Chi square test** FE**: Fisher Exact** **t: Student t-test** SD: **Standard deviation**
p: p value for comparing between the studied groups
*: Statistically significant at p ≤ 0.05 **VAP:** Ventilator-Associated Pneumonia

Table (4): Comparison between the intervention and control groups as regards oxygenation status parameters

Oxygenation status parameters	Intervention group (n = 30)	Control group (n = 30)	Test of sig.	p
Oxygenation status parameters:				
Arterial blood gases				
PH				
Min. – Max.	6.98 – 7.45	7.24 – 7.48	t	0.168
Mean ± SD.	7.39 ± 0.09	7.41 ± 0.05	1.396	
$PaCo_2$				
Min. – Max.	22.71 – 48.0	30.14 – 46.43	t	0.319
Mean ± SD.	38.02 ± 5.92	39.37 ± 4.33	1.006	
PaO_2				
Min. – Max.	83.71 – 106.3	74.0 – 188.9	t=	0.026*
Mean ± SD.	93.65 ± 5.59	85.62 ± 18.47	2.279*	
SaO_2				
Min. – Max.	90.86 – 99.43	88.71 – 98.43	t	<.0.001*
Mean ± SD.	96.44 ± 2.31	92.81 ± 2.87	5.399*	
Peripheral oxygen saturation (Spo_2)				
Min. – Max.	90.86 – 99.43	88.86 – 98.43	t	<.0.001*
Mean ± SD.	96.82 ± 2.07	93.08 ± 2.87	5.804*	

χ^2: **Chi square test** FE**: Fisher Exact** **t: Student t-test** SD: **Standard deviation**
p: p value for comparing between the studied groups *: Statistically significant at $p \leq 0.05$

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