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Original Article

Effect of Prone Position on Physiological Indices of Critically ill Patients with Pneumonia

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ABSTRACT

Background: One strategy for treating individuals with acute respiratory inflammation (pneumonia) is the prone posture. Prone positioning is a specific treatment that can be used widely in critical care units as a saving therapy. **Aim:** to evaluate the effect of prone position on the physiological indices of critically ill patients with pneumonia. **Setting:** The study was conducted at the intensive care unit of a general hospital affiliated with the Giza governorate. **Subjects:** A purposive sample of 60 adult patients was selected to achieve the aim of the present study. **Design:** A quasi-experimental research design was utilized to perform the current study. **Tools:** Two tools were utilized to collect data pertinent to this study (1) the Patient's demographic and medical data tool & (2) the Patient's physiological indices assessment tool. **The results** show that the vital signs and ABG parameters before and after the prone position intervention differed in a highly statistically significant way. Additionally, the ABG parameters and the prone position intervention have a very statistically significant favorable association. **Conclusion:** In terms of Pao2, Hco3, PH, and Ca +, the current investigation demonstrated a statistically significant positive connection between ABG parameters and prone posture intervention. Therefore, individuals with respiratory conditions like pneumonia may benefit from a prone position in terms of their physiological indices. **Recommendations:** To generalize the findings, it is advised to replicate the study with a large number of pneumonia patients, and use the prone position when managing patients with pneumonia.

Keywords: Critically ill Patient, Prone Position, Physiological Indices, Pneumonia.

Introduction

Pneumonia is an inflammatory infiltrate of alveolar air the space triggered by bacterial infection of the lungs, or less commonly by viral or fungal infection. It remains the most common infective reason for admission to intensive care as well as being the most common secondary t in the intensive care unit infection acquired whils (ICU). It presents a significant global burden of and -disease and is especially prevalent in low income countries. The major categories of -middle pneumoniathe Intensive Care clinician encounters acquired-atoracquired, ventil-are community non-ventilator-acquiredand pneumonia in , immune-compromised patients ***(Storms, etal.2017).***

In 1974, the prone position was initially suggested theoretically (more advantageous dispersion of mechanical ventilation). In 1976, the first clinical report on five ARDS patients showed a significant improvement in oxygenation following pronation. There has recently been further evidence that this is a successful method of enhancing oxygenation, one of the physiological processes that improve respiratory function. ***(Chun, etal.2020).***

Continuous monitoring of patient parameters in the critical care unit, including blood pressure, heart rate and rhythm, respiration rate, blood oxygen saturation, and many more, is known as physiological indices, and it has become a routine practice in critical care. Thus, shifting from a supine to a prone posture is a new method for enhancing gas exchange in patients suffering from acute respiratory distress syndrome and pneumonia. Due mostly to improved overall ventilation/perfusion matching, arterial blood gases typically show a noticeable improvement after moving to a prone posture. The primary justifications for using the prone position in ARDS patients are improved oxygenation and decreased mortality. ***(Yang, etal.2020).***

Boosting airway patency, facilitating relaxation and energy conservation, boosting fluid intake, preserving nutrition, and educating patients are all part of the nursing management of pneumonia. To reduce infections linked to healthcare, the nurse must follow infection control protocols and maintain proper medical asepsis. To avoid pneumonia in critically sick patients, nurses perform a variety of dynamic tasks, including manager, educator, coordinator, care provider, and assessor. and how the patient should be placed in a prone position. ***(Song, etal.2019)***.

Significance of the study:

The most frequent cause of death for critically ill patients admitted to intensive care units with a confirmed severe infection with pneumonia is pneumonia, which also causes acute respiratory distress-like syndrome. Pneumonia is the most frequently identified and ongoing primary cause of death among critically sick patients. ***(Fernando, et al.2022) & (Zaragoza, et al.2023),*** Due to the increasing disease density, these patients had increased mortality, admission to the intensive care unit (ICU), and longer hospital stays. In the United States, pneumonia is the leading cause of infectious disease-related deaths and the sixth leading cause of death overall. The intensive care unit (ICU) is where the pneumonia sufferer receives treatment. ***(Larcher, etal.2020***). One well-known ventilatory support strategy for raising oxygenation levels is prone positioning. The prone posture is utilized in the current study to help patients with pneumonia enhance their oxygenation and fight hypoxemia.

Subjects and Methods

Aim of the study:

This study aims to evaluate the effect of prone position on the physiological indices of critically ill patients with pneumonia.

Objectives of the study:

1- Evaluate the effect of prone position on the vital signs of critically ill patients with pneumonia.
2- Evaluate the effect of prone position on the arterial blood gases parameters of critically ill patients with pneumonia.
3- Evaluate the effect of prone position on oxygenation parameters of critically ill patients with pneumonia.

Research hypothesis:

H1: Critically Ill Patients with pneumonia who exposed to a prone position will have improved physiological indices than before.

Operational Definition:

Physiological indices**:** includes ABG parameters (oxygen saturation, Pao_2 and $Paco_2$), respiratory rate (RR); number of breaths per minute, and heart rate. Physiological indices assessed by tool 2

Design:

A quasi-experimental pre-post-test research design was implemented to meet the study's aim. This design used for the comparison between pre and post prone position intervention among patients with pneumonia.

Setting:

The study was carried out at five isolated governmental hospital for COVID-19

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This study was conducted at the intensive care unit at a General hospital affiliated to Giza governorate. This unit is a well-equipped unit with needed life support equipment and monitoring devices. It contains 14 beds receiving critically ill patients with different medical and surgical conditions.

Subjects:

A purposive sample of 60 adult patients was recruited to participate in the study. Based on power analysis using PASS program version 20, level of significance=0.05 and power=90%. With the following inclusion criteria:

- Diagnosed with pneumonia.
- Age ≥ 18 years
- Patients can tolerate prone position for at least one hour.

Exclusion criteria: patients who were unwilling to participate in the study and patients who were contraindicated to put on the prone position by physician order.

Tools of Data collection:

Two tools were utilized to collect data pertinent to this study. The researchers developed these tools after extensive review of related literature and web sites.

Tool 1: Patient's demographic and medical data tool: It includes; age, gender, level of education, comorbidity, medications as anticoagulants and BMI categories which are defined by The World Health Organization (WHO) as follows:

Classification	BMI Range (kg/m²)
Underweight	< 18.5
Normal weight	18.5–24.9
Overweight	25.0–29.9
Obesity Class I	30.0–34.9
Obesity Class II	35.0–39.9

Adopted from World Health Organization. (2023). *Body mass index (BMI)*. Available at: https://www.who.int

Tool 2: Patient's physiological indices assessment tool: it involves vital signs, presence of chest secretions, arterial blood gases results, and devices used for oxygen therapy and ventilator parameters for patients connected with mechanical ventilator.

Validity and Reliability

A panel of five critical care nursing experts reviewed the tools to assess their relevance, clarity, comprehensiveness, and applicability. Based on their feedback, minor revisions were made, leading to the final versions. The tools were then evaluated for face and content validity to ensure that the items accurately measured their intended objectives. Reliability was assessed using the internal consistency method. For Tool II, which was developed by the researchers, the Cronbach's alpha reliability coefficient was found to be 0.829.

Pilot study

Prior to starting the main study, a pilot study was carried out on 10% of the participants (six patients) diagnosed with pneumonia. The purpose of the pilot study was to assess the clarity and feasibility of the tools used. The patients involved in the pilot study were not included in the final sample.

Legal and Ethical Considerations

The study was formally approved by the Research Ethics Committee of the Faculty of Nursing at Helwan University on 10/12/2023. Participation was entirely voluntary, and patients had the right to withdraw at any time without providing a reason. Informed consent was obtained from all participants before their involvement in the study. To ensure confidentiality and anonymity, all data were assigned codes, and patients were assured that their information would not be used in any future research without their explicit consent.

Procedures of data collection:

The study was conducted in two phases, preparation and implementation phases.

Preparation phase:

This phase started with reviewing the literature to develop the study tools and obtaining ethical approval from the ethical committee and approval from hospital administrators to conduct the study. This phase ended by conducting the pilot study.

Implementation phase:

Data collection took place from January 2024 to July 2024. The researchers first contacted the head nurse of the intensive care unit to identify patients diagnosed with pneumonia. Then, the researchers explained the study’s purpose and details to the physicians and nurses to gain their cooperation. Following this, the researchers assessed patients who met the inclusion criteria and were willing to participate in the study. Informed consent was obtained from these patients. Next, Tool I was completed for those who agreed to participate, followed by the completion of Tool II before applying for the prone position. The prone positioning was then implemented in the presence of the assigned nurse and physician.

Protocol of applying the prone position:

Pulmonary secretions were carefully aspirated while patients were in the supine position, and again after they were repositioned to the prone position. Initially, patients were turned to a lateral position before being fully turned prone, ensuring their entire body remained in contact with the bed. Throughout the first hour in the prone position, patients were closely monitored, with the ICU team prepared to return them to the supine position if any significant cardiac or respiratory issues arose. During the repositioning, special attention was given to relieving pressure on the neck and face. Protective pillows were placed at the shoulders, iliac crests, and knees, while the shoulders and elbows were aligned properly, and the arms rested along the body. Tool II was completed once more under stable conditions after the patient had been in the prone position for at least 20 minutes. The patient stayed in the prone position as long as they were able to tolerate it.

Statistical analysis

Gathered data were organized, tabulated, and analyzed using the Statistical Package for Social Sciences (SPSS) version 21 (SPSS Inc, Chicago, USA). For qualitative data, frequency and percentage distributions were computed. For quantitative data, the mean and standard deviation were determined. To compare pre and post-prone positions, t-tests and chi-square tests were applied. A p-value of less than 0.05 was considered statistically significant for all tests.

Results

Table (1) Shows that 68 % of studied patients' age ≥ 48 with Mean ± SD 50.34 ± 10.54, 75% of them worked and 40 % were illiterate and university level of education respectively. Also, this table shows that 70 % from patients under study were smokers.

Table (2) illustrates that, about half of the studied patients 45 % had comorbid respiratory diseases. Also, this table shows above half 55% taken anticoagulant drugs, and about half of the patient under study 48% obese class I with Mean ± SD 29.13±5.47.

Table (3) Indicates that there were highly statistically significant differences between pre and post-prone position intervention regarding pulse, systolic B.P and temperature with P value= (0.000, 0.009, and 0.000) respectively and statistically significant differences regarding diastolic B.P with P value = 0.013. Also, this table appears no statistically significant differences between pre and post-prone position intervention regarding respiration.

Table (4) Shows that highly statistically significant differences between pre and post - prone position intervention regarding ABG parameter Po_2, Pco_2 and Hco_3 with P. value = 0.004, 0.000, and 0.000 respectively. Also there are statistically significant differences between pre- and post- prone position intervention regarding Ca + with p. value = 0.038, while this table appears no statistically significant differences between Ph, Na, K, Mg in pre prone and post prone position intervention p. value= >0.05.

Table (5) Shows that statistically significant differences between pre and post -prone position intervention regarding oxygen saturation and secretion with P. value = 0.001, 0.019 respectively.

Table (7) Illustrates that there were highly statistically significant positive correlation between ABG parameter and prone position intervention regarding PH, Pao_2 & Hco_3 and also appear statistically significant positive correlation as regard Ca, and this table also shows no statistically significant correlation between prone position intervention and $Paco_2$,Na,K, and Mg with p-value< 0.05.

Table 1: Percentage distribution of studied patients with pneumonia according to their characteristics (n=60)

Variable	Categories	No.	%
Age	18 < 28	2	3.0
	28 < 38	4	6.0
	38 < 48	14	23.0
	≥ 48	41	68.0
Mean ± SD	50.34 ± 10.54		
Work	Work	45	75.0
	Not-work	15	25.0
Education	Illiterate	24	40.0
	Secondary	12	20.0
	University	24	40.0
Smoking	Yes	42	70.0
	No	18	30

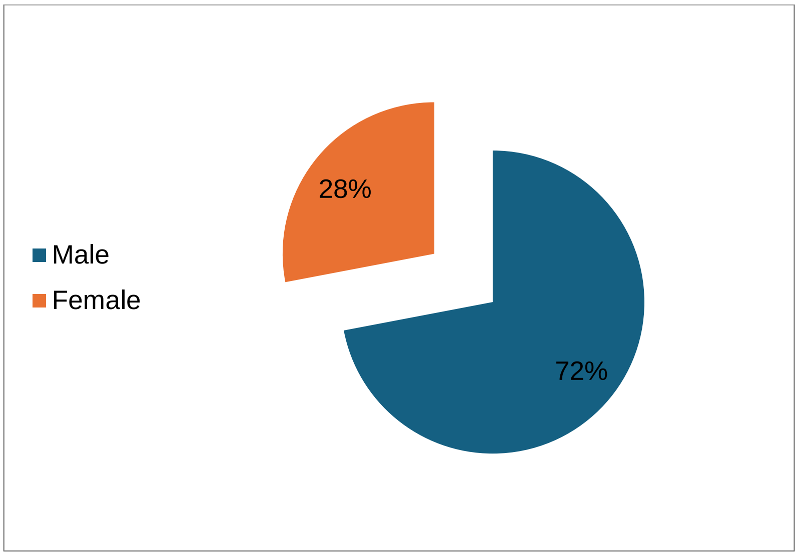

Figure (1): Gender distribution of the studied patients with pneumonia

This figure reveals that the highest percentage 72% of patients were male.

Table 2: Percentage distribution of studied patients with pneumonia according to their health-related characteristics (n=60)

Variable	Categories	No.	%
Comorbidities	Septicemia	3	5.0
	Cancer	3	5.0
	Anemia	2	3.0
	Cerebrovascular Stroke	2	3.0
	Comorbid Respiratory Diseases	27	45.0
	Ischemic Heart Diseases	6	10.0
	Exploration	4	7.0
	Road Traffic Accidents	2	3.0
	Hypertension	11	19.0
Anticoagulation medications	Yes	33	55.0
	No	27	45.0
BMI	Normal	19	32.0
	Overweight	11	18.0
	Obesity class I	29	48.0
	Obesity class II	1	2,0
	Mean+ SD	29.13+5.47	
Data are expressed as numbers, percentages, Mean, and SD: Standard Deviation			

Table 3: Mean and standard deviation of patients' vital signs pre and post-prone position intervention (n=60)

Vital signs	Pre-prone	Post-prone	t	P-value
	Mean ± SD	Mean ± SD		
Pulse	107.13 ± 16.596	99.93 ± 12.010	2.722	0.000**
Systolic. B.P	127.67 ± 22.502	121.67 ± 11.523	1.838	0.009**
Diastolic. B.P	72.50 ± 11.879	72.00 ± 9.169	0.258	0.013*
Respiration	26.00 ± 5.421	24.78 ± 4.755	1.307	0.670
Temperature	36.305 ± 3.5645	37.140 ± 0.1475	1.813	0.000**

Data are expressed as mean and, SD: Standard Deviation, t=independent sample t-test, (*) statistically significant at p-value> 0.05, (**) statistically significant at p-value> 0.01

Table 4: Mean and standard deviation of patients' ABG parameters pre and post-prone position intervention (n=60)

ABG parameter	Pre-prone	Post-prone	t	P-value
	Mean ± SD	Mean ± SD		
Ph	7.34 ± 0.055	7.37 ± 0.04	-3.360	0.088
Po_2	82.22 ± 9.68	87.85 ± 6.63	-3.720	0.004**
Pco_2	54.17 ± 12.93	49.48 ±7.89	2.395	0.000**
Hco_3	23.77 ± 3.11	24.05 ± 2.27	-0.570	0.000**
Na	140.30± 4.26	139.68 ± 3.81	0.836	0.648
Ca	5.48 ± 2.11	6.26 ± 2.46	-1.867	0.038*
K	3.76 ± 0.42	3.78 ± 0.41	-0.156	0.327
Mg	2.60 ± 0.31	2.64 ± 0.29	-0.662	0.592

Data are expressed as mean and, SD: Standard Deviation, t=independent sample t-test, (*) statistically significant at p-value> 0.05, (**) statistically significant at p-value> 0.01

Table 5: Studied patients' oxygenation parameters pre and post-prone position intervention (n=60)

Oxygenation		Pre-prone		Post-prone		X^2	p-value
		No.	%	No.	%		
Oxygen Saturation	≥95	0	0.0	11	18.3	12.11	0.001*
	<95	60	100.0	49	81.7		
Chest Secretions.	Yes	47	78.3	35	58.3	5.55	0.019*
	No	13	21.7	25	41.7		

Data are expressed as numbers (No), percentage (%), X^2: Pearson Chi-square, (*) statistically significant at p-value> 0.05, (**) statistically significant at p-value> 0.01

Table 7: Correlations between prone position and patients' ABG parameters

ABG parameters		Pre-prone		Post-prone		X^2	P-value
		No	%	No	%		
Ph	**Normal**	27	45.0	39	65.0	4.85	0.028*
	Abnormal	33	55.0	21	35.0		
Pao_2	**Normal**	36	60.0	54	90.0	14.4	0.000**
	Abnormal	24	40.0	6	10.0		
$Paco_2$	**Normal**	12	20.0	13	21.7	0.05	0.82
	Abnormal	48	80.0	47	78.3		
Hco_3	**Normal**	36	60.0	52	86.7	10.91	0.001**
	Abnormal	24	40.0	8	13.3		
Na	**Normal**	46	76.7	50	83.3	0.83	0.36
	Abnormal	14	23.3	10	16.7		
Ca	**Normal**	8	13.3	17	28.3	4.09	0.043*
	Abnormal	52	86.7	43	71.7		
K	**Normal**	52	86.7	48	80.0	0.96	0.33
	Abnormal	8	13.3	12	20.0		
Mg	**Normal**	14	23.3	9	15.0	1.35	0.25
	Abnormal	46	76.7	51	85.0		

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Discussion

For patients with severe or moderate-to-severe acute respiratory distress syndrome (ARDS) undergoing invasive mechanical ventilation with sedation and paralysis, the prone position has been the standard for many years. When a patient's oxygen levels are too low because of a serious respiratory condition, medical professionals can raise them by putting them in a prone position. *(**Guérin et al 2020)***.

Pron position is used by healthcare professionals to aid patients with severe respiratory disorders who aren't getting enough oxygen. Fluid builds up in the lungs' tiny air sacs called alveoli as a result of ARDS. Breathing becomes difficult as a result. A major side effect of several respiratory diseases, such as pneumonia and COVID-19, is acute respiratory distress syndrome (ARDS). (***Cleveland clinic, 2024).***

Regarding patient demographics, the current study's results showed that, with a mean ±SD of 50.34± 10.54, over two-thirds of the patients were ≥48 years old. This result ran counter to WHO (2024), which said that persons over 65 and those with underlying medical conditions are among those at risk for pneumonia.

This conclusion is in conflict with research on pneumonia published by the Mayo Clinic in

2024, which found that the disease is most dangerous for young children and newborns, those over 65, and those with compromised immune systems or other health issues. The population's median age was 65 (56; 72) years, its median BMI was 28 (28; 32), and it was reported that 71% of the population was male.

According to the researcher, those findings could be caused by the current study sample size not being representative of all pneumonia patients as well as the surrounding environment. Approximately three-quarters of study participants had smoke, and about half of them have comorbid respiratory conditions. The remaining subjects have other comorbid conditions like cancer and ischemic heart diseases.

In terms of gender, the current study's findings showed that almost three quarter of the patients were men who were employed and smokers, while just over two fifth of them were illiterate and had a university degree. From the perspective of the researchers, most of Egyptians who smoke cigarettes are men who are employed because they are productive, with a mean ±SD of 50.34± 10.54 for those aged ≥48. Additionally, according to the researchers, around three-quarters of the study participants who had pneumonia were smoke, which may be because smoking weakens the body's defenses against the bacteria and viruses that cause the illness.

In a study titled "Epidemiology, clinical and biological characteristics, and prognosis of critically ill COVID 19 patients: a single-center experience through 4 successive waves," Tchakerian et al. (2024) supported this finding by reporting that 71% of the population was male.

Furthermore, according to this study's findings, which the WHO supports (2024), Nearly forty Percent of Egyptian men smoke, whereas less than 2% of women report smoking.

According to the current study's findings, over half of the participants take anticoagulant drugs, and over two-fifths of them had concomitant respiratory conditions. Additionally, this study revealed that approximately half of the patients were obese. According to the researchers, these changes in lung mechanics—such as decreased lung volumes, decreased compliance, abnormal ventilation and perfusion relationship and gas exchange, and inefficient respiratory muscles—can increase the risk and severity of respiratory infections.

The results of this study were in line with those of Fernandez and Manuel's (2017) investigation into obesity, respiratory conditions, and pulmonary infections, which found that adult obesity is known to raise the risk of heart failure, coronary artery disease, diabetes mellitus, hypertension, dyslipidemia, respiratory conditions, and several types of cancer. Additionally, the same study discovered that obesity is the primary factor determining the risk of respiratory infections. Community-acquired pneumonia (CAP) and flu pneumonitis are the primary areas of evidence on the risk of lung infections in obese personnel, with equipoise regarding the extent of elevated risk in both illnesses.

The results of a study by Lai et al. (2022) titled "Effects of oral anticoagulant therapy in patients with pulmonary diseases" contradict this finding claimed that patients with pulmonary hypertension (PH), pulmonary embolism (PE), or COPD were benefit from oral anticoagulant therapy, but patients with idiopathic pulmonary fibrosis (IPF) or sclerosis-associated pulmonary arterial hypertension (SSc-PAH) need to give careful thought to their anticoagulation regimen.

About the vital signs of the patient before and after the prone position intervention. The results of the current investigation showed statistically significant differences in diastolic blood pressure and highly statistically significant differences in pulse, systolic blood pressure, and temperature before and after the prone posture intervention. According to the researcher, this could be because the prone position reduced pulse rate, dropped systolic and diastolic blood pressure, and slightly raised temperature compared to the pre-prone position intervention, but it was still within normal limits.

According to a study by Dharmavaram et al. (2024) titled "Effect of prone positioning systems on hemodynamic and cardiac function during lumbar spine surgery: an echocardiographic study," prone positioning lowers blood pressure and improves cardiac function. These study results are in line with their findings. Numerous investigations have assessed alterations in cardiac function following prone positioning and connected them to decreased ventricular compliance and venous return.

Additionally, this study explained that there were no statistically significant variations in breathing between the pre and post prone posture intervention. According to the researchers, this might be because the majority of patients were on mechanical ventilators, hence there was no change in the respiration mean ± SD. In a study titled "Determination of the Effects of Prone Position on Oxygenation in Patients with Acute Respiratory Failure Under Mechanical Ventilation in ICU" in Iran, Jahani et al. (2018) found that the average respiratory rate in the prone position was 0.35 higher than the supine position, which was not significant according to the paired t-test (p-value>0.05). These study results are in line with their findings. Additionally, this research demonstrated that the prone position enhances PaO2 and Spo2 without negatively affecting physiological indicators.

Regarding ABG measures, the results of this investigation demonstrated significant variations between Ca and changing position, as well as highly statistically significant differences between pre and post prone position intervention regarding Pao2, Paco2, and Hco3. Since the lung was thought to be a fixed anatomical entity situated in the dorsal region of the thoracic cage, the researcher speculated that an improved gravity-dependent perfusion of the patient's lung in a prone posture could be the cause of the oxygenation improvement.

The results of the current study were in line with those of a study called "Effects of the prone position on arterial blood gas analysis and respiratory parameters of acute respiratory distress syndrome patients: An observational retrospective study" by Furkan et al., published in 2023. In addition to showing that PaO2 was significantly higher in the post-prone compared to pre-prone comparison in both groups, prone positioning has been utilized for years to improve oxygenation in ARDS patients. However, the rise in the PaO2/FiO2 ratio was not statistically significant. Only in the non-COVID ARDS group was there a significant difference between the pre-prone and post-prone PaO2/FiO2 ratios.

Additionally, the results of the current study are consistent with those of a study, "Effect of Prone Positioning on Hemodynamic Parameters among Pregnant Women with COVID-19-related Hypoxemia," by Mansour et al. (2022), which found a significant difference between pre and post-test results in favor of post-intervention. However, following prone positioning, the mean scores for the majority of hemodynamic parameters improved, as shown by a significant decrease in the average measurements of heart rate, PaCO2, PaO2/FiO2, and respiratory rate and a significant increase in the average measurements of arterial oxygen saturation, PH, peripheral oxygen saturation, and PaO2.

Part V: Studied Patients' Oxygen Parameters Pre and Post Prone Position Intervention

According to the current investigation, there were statistically significant variations in oxygen saturation and secretions before and after the prone posture intervention. Because the lungs, which physically resemble a cone, fit into their cylinder-like thorax enclosure with less distortion when patients are prone as opposed to supine, the researcher believes that the improvement is the result of a reduction in shunt and ventilation-perfusion heterogeneity.

The results of this study are in line with those of Milroy et al. (2020), who discovered that lying prone can alleviate dyspnea and increase the body's intake of oxygen. Additionally, make coughing more efficient. This facilitates the removal of any chest secretions.

The findings of Adeola et al. (2021), who conducted a study titled "A Quick Review on the Multisystem Effects of Prone Position in Acute Respiratory Distress Syndrome (ARDS) Including COVID-19," contradict this finding. They discovered that patients in the prone position were more likely than supine patients to experience complications such as the need for sedation, increased vasopressors, and device displacement.

Part VI: Correlation between prone position intervention and ABG parameters

This study demonstrated a highly statistically significant positive correlation between prone position intervention and Ca+ and a statistically significant positive correlation between prone position intervention and Po2, Hco3, and PH in relation to the correlation between prone position and ABG parameters. Additionally, from a research perspective, the current study found no statistically significant correlation between Paco2, Na, K, and Mg, and prone position. This finding might be because, in patients with pneumonia, shifting from supine to prone position results in a more uniform distribution of lung stress and strain as well as a more even distribution of gas-tissue ratios along the dependent-nondependent axis. The findings of this study were consistent with those of "Behesht et al. 2021," *who conducted a study "Effect of prone position on respiratory parameters, intubation and death rate in COVID-19 patients: systematic review and meta-analysis"* in Iran, stated that the prone position in COVID-19 patients leads to significant improvement corresponding to Spo_2 (Sao_2), No significant change was observed for PMD of $PaCo_2$ in the before-after design. It should be noted that the prone position leads to improvement of PaO_2 but does not have any effects on the respiratory rate in general, especially in the quasi-experimental design.

Therefore, the current results partially supported the research hypothesis which is critically Ill Patients with pneumonia who receive prone position have improved physiological indices than before.

Conclusion

Based on the results of the current study, it can be said that: There were statistically significant differences between the pre and post prone position intervention in terms of temperature, ABG parameters related to Pao2, Paco2, Hco3, Ca +, oxygen saturation, and chest secretions, as well as pulse, systolic and diastolic blood pressure, with regard to Pao2, Hco3, PH, and Ca +, there is a statistically significant positive association between the ABG parameter and the prone position intervention. Therefore, patients with respiratory conditions like pneumonia may benefit from the prone posture in terms of their physiological indicators.

Recommendation:

In light of the study findings, it is suggested to:

- Use the prone position in the management of patients with pneumonia.
- Replication of the study with many patients with pneumonia to generalize the results.

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