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Original Research

The Effect of Prone Position for Increasing OXygen Saturation of COVID-19 Patients

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Abstract

Introduction: Oxygen saturation (SpO2) is an indicator of COVID-19 infection severity. Prone positioning has been widely demonstrated as an effective nursing intervention in improving oxygenation status among COVID-19 patients, characterized by a significant increase in oxygen saturation. This study aimed to explore the effect of prone positioning in increasing oxygenation among COVID-19 patients.

Methods: A pre-experimental design with a one-group pre-posttest design without a control group was employed in this study. The oxygenation was measured before (pretest) and after (posttest) the prone positioning implementation. The study population was all COVID-19 patients in an isolation ward at a general hospital in Bali Province. Thirty participants who met the inclusion criteria were selected using purposive sampling techniques.

Results: Findings revealed that the average percentage of oxygen saturation before and after the prone positioning was 94.90% and 98.40%, respectively. The Wilcoxon Test Analysis showed a p-value of 0.001, indicating the significant effect of the position in improving oxygenation among COVID-19 patients.

Conclusion: These findings suggested nurses' active engagement in delivering adequate information about prone positioning and its influence on oxygenation among COVID-19 patients. COVID-19 patients are also advised to safely perform the position, as it will accelerate their recovery and may contribute to a lower mortality rate due to COVID infection.

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INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic has been reported in many countries worldwide [1]. The SARS-CoV-2 virus is eventually recognized as the cause of the outbreak. These novel viruses primarily attack the respiratory system and trigger several breathing issues [2]. Symptoms that appear among COVID-19 patients would link to the degree of severity [3]. A significant decrease in oxygen saturation (SpO2) marks a moderate to severe degree of infection. Less than 95% oxygen saturation could indicate the presence of breathing or pulmonary ventilation issues. The lower level of SpO2 is associated with a more life-threatening situation that may lead to death. Contrarily, the increase in SpO2 level has been revealed as an indicator of the improved condition of the patients [4].

According to WHO, until February 21st, 2022, COVID-19 infection has been spreading in more than 207 countries, with a total of 423 million cases and 5.8 million fatal deaths worldwide [5]. Around 5.15 million cases with 146,000 deaths also occurred in Indonesia [6]. During those tough times, Bali Province was also considered as a region with a relatively high rate of COVID-19 infection in Indonesia. Bali secured the eighth rank with a total of 147,482 cases of infection and 4,237 deaths [7].

Most people infected by COVID-19 would develop symptoms such as cough, fever, fatigue, body aches, and shortness of breath [8]. People with moderate infection usually experience shortness of breath, increased respiratory rate, and decreased oxygen saturation (SpO2 90-95% in room air). The severe degree of COVID-19 includes all symptoms in the moderate infection and at least one of the following symptoms: respiratory rate >30 times/minutes, severe respiratory distress, or SpO2 <90% in room air [9].

Prone positioning is a nursing intervention applied to conscious non-ventilated COVID-19 patients with Acute Respiratory Distress Syndrome (ARDS) [3]. This position improves oxygenation among COVID-19 patients. Further, its influence in reducing mortality in ARDS patients has been documented elsewhere [10]. The prone positioning would improve pulmonary homogeneity, gas exchange, and breathing mechanisms, allowing a reduction in ventilation intensity and reducing the lung injury risk in ARDS patients [11].

A study by [12] found that prone positioning can increase oxygenation from 94% to 98%. In addition, an increase in PaO2/FIO2 was also documented, from 89 to 165 mmHg. A similar finding was also reported by [13], prone positioning increased the level of SpO2 from 91% to 98%. Additionally, thirteen to fourteen published articles (92%) in a systematic review study by [4] demonstrated the significant influence of prone positioning intervention in conscious non-ventilated COVID-19 patients. Further, they mentioned the strengths of this position: viable, safe, cost-effective, relatively easy, and fewer side effects. Close and continuous monitoring by experienced health workers would help minimize the side effects of the intervention. Unfortunately, the prone positioning was rarely applied to alleviate

breathing issues among COVID-19 patients. The scarcity of scientific evidence of prone positioning among COVID-19 patients may contribute to this situation, as no proper evidence confirmed the effect of the position in improving oxygenation status.

A pilot study was conducted in a general Hospital in Bali. This hospital has been implementing the prone positioning exercise program in several COVID-19 isolation wards. However, it merely organized through the dissemination of educational videos and posters. Further, no evaluation was directed to track its effectiveness in improving oxygenation status. Hence, we were intrigued to explore the effect of the prone positioning by a study entitled "The Effect of Prone Positioning in Improving Oxygenation Status among COVID-19 Patients". This study aimed to investigate the effect of prone positioning in improving oxygenation status among COVID-19 patients treated in the isolation ward.

METHODS

This research was a quantitative study with a pre-experimental one-group pretest-posttest design without a control group. COVID-19 patients in an Isolation Ward at a general hospital in Bali were considered as the study population. Thirty participants who met the inclusion criteria were selected using a purposive sampling technique. Patients aged between 18 to 50 years with moderate and severe symptoms of COVID-19 were included as eligible participants. However, those with mechanical ventilator assistance, loss of consciousness, and pregnancy were subsequently excluded from the study. The data collection was conducted from April to September 2022. We used a calibrated oximeter tool to measure the oxygen saturation level. An observational sheet applied to track the oxygenation status. The study initially began with the selection of eligible participants and the informed-consent procedure. After gaining consent, the prone positioning was performed by the nurses for 120 minutes in the morning. The oxygen saturation level was measured before (pretest) and after (posttest) the prone positioning implementation. A Wilcoxon Statistical Analysis Test with a 95% confidence level was enrolled due to the abnormally-data distribution. The ethical clearance of the study has been granted by the Research Ethics Commission (KEP) of the Faculty of Medicine with the number 877/UN14.2.2.VII.14/LT/2022.

RESULTS

Characteristics of Participants

Findings reported that the majority of participants were female (19;63.3%), graduated from senior high school (15; 50.0%), working in private-based sectors (15; 50.0), demonstrating moderate symptoms of COVID-19 (17; 56.7%), using nasal cannula as respiratory assist device (17;56.7%), had no comorbidities (20; 66.7%), had been receiving the first dose of COVID-19 vaccine (14; 46.7%), not COVID-19 survivors (25; 83.3%), aged between 21 to 48 years with an average of 36.83 years, and had an initial saturation level of 80-96% with an average of

91.03%. These characteristics are specifically presented in Table 1.

Oxygen Saturation Level Before and After Prone Positioning

The lowest, highest, and level of oxygen saturation before the prone positioning implementation was 88%, 98%, and 94.90%, respectively. Subsequently, after the prone positioning, the lowest level of oxygenation increased to 92%. Further, the highest level of oxygenation reached 100% with an average of 98.40%. Wilcoxon test analysis revealed a p-value of 0.001 ($p<\alpha$; $\alpha=0.05$), implying a significant effect of prone positioning in improving oxygen saturation among COVID-19 patients. Table 2 shows the oxygen saturation level before and after prone positioning.

Table 1

Participant's Characteristics (n=30)

Characteristic	Frequency (f)	Percentage (%)
Gender		
Male	11	36.7
Female	19	63.3
Educational Background		
Junior High School	6	20.0
Senior High School	15	50.0
College/University	9	30.0
Occupation		
Private-based sector	15	50.0
Self-employed	10	33.3
Civil servants/police	2	6.7
Housewife	3	10.0
Degree of Symptoms		
Moderate	17	56.7
Severe	13	43.3
Respiratory Assist Device Use		
Nasal cannula	17	56.7
Simple mask	9	30.0
Non-rebreathing mask	4	13.3
Comorbidities		
Yes	10	33.3
No	20	66.7
COVID-19 Vaccination History		
Had not been vaccinated	4	13.3
Only the first dose	14	46.7
Only until the second dose	10	33.3
Have obtained the third dose	2	6.7
COVID-19 Survivor		
Yes	5	16.7
Not	25	83.3
	Min-Max	**Mean**
Age	21-48	36.83
Initial SpO_2 Level	80-96	91.03

Table 2

Oxygen Saturation Level Before and After Prone Positioning Implementation (n=30)

Oxygen Saturation Level (SpO_2)	Min (%)	Max (%)	Mean (%)	p-value
Pre-test	88	98	94.90	0.001
Post-test	92	100	98.40	

DISCUSSION

Oxygen Saturation Level among the COVID-19 Patients Before and After Prone Positioning

Findings indicated an increase in the oxygen saturation level mean, from 94.90% to 98.40% after the prone positioning. This finding was in line with a study [13] that revealed an increase in peripheral oxygen saturation from an average of 91% to 98% after prone positioning. Another study by [14] discovered an increase in oxygen saturation (SpO2) from an average of 96% to 97.5% in the first two hours after the prone positioning implementation. In addition, a study by [15] also showed that prone positioning increased oxygenation with the mean of oxygen saturation level from 94% to 98%.

In the recent study, 120-minute-prone positioning was conducted to improve oxygenation, accompanied by continuous observation on the oxygen saturation level. According to [16], prone positioning was advised with a maximum of six-hour duration. Contrarily, [17] mentioned that prone positioning could be performed at least for three hours, while [13] found that patients were able to tolerate prone positioning for 75 minutes. Eventually, [18] stated that the duration of prone positioning was varied, depending on the patient's capability to endure the positions.

Prone positioning is an effective technique employed to increase oxygenation in the lungs, improving pulmonary ventilation through increased pulmonary perfusion and the final volume mechanism of pulmonary expiration. It would provide a fair distribution of tidal volume in all parts of the lung [19]. The prone positioning is performed by asking the patients to lie in a prone or face-down position. It intends to increase ventilation and oxygen perfusion, maximizing the chest wall movement and restoring the collapsed alveoli [4]. Lung takes more oxygen from the dorsal region in prone positioning, slowly alleviating the shortness of breath and improving the oxygen saturation level [20].

Researchers argued that the increase in oxygen saturation in COVID-19 patients after the prone positioning was a clear sign of an increase in pulmonary ventilation. Prone positioning helps the lung to redistribute the oxygen evenly due to more unoccupied and less suppressed areas in the lung, producing higher oxygenation status. The oxygenation improvement is subsequently confirmed by an increase in oxygen saturation level. This finding supported the need to incorporate prone positioning in the nursing care plan for

COVID-19 patients. However, it required to be adequately and safely performed to accelerate the patient's recovery.

Effect of Prone Positioning in Improving Oxygen Saturation among COVID-19 Patients

Findings demonstrated a significant effect of prone positioning in increasing oxygen saturation levels among COVID-19 patients with a p-value of <0.001. This finding was parallel with a study [20] that revealed the significant effect of the dominant prone position in improving oxygenation among COVID-19 patients. Additionally, a study from [19] stated that the prone positioning produced an increase in oxygenation status, lowering the severity of the disease and the need for intubation by 65.5%.

According to [15] prone positioning in COVID-19 patients with moderate to severe respiratory symptoms was considered "a safe enough" intervention. Further [19] stated that the prone positioning could help alleviate the breathing difficulties among pneumonia patients before the occurrence of ARDS or more critical situations. These shreds of evidence summed the effect of prone positioning in improving oxygenation and reducing mortality in COVID-19 patients with severe acute respiratory distress [21].

According to [18], prone positioning was a maneuver that increases oxygenation status in a safe way. Prone positioning improved pulmonary homogeneity, gas exchange, and breathing mechanisms, allowing a decline in ventilation intensity and lowering the risk of lung injury among ARDS patients with invasive mechanical ventilation therapies [11]. An increased oxygenation level due to the prone positioning is the outcome of better ventilation-perfusion process conformity. The dorsal part of the lungs (which anatomically has a greater number of alveolar units) would reopen due to the less pressure provided by the mediastinum or abdominal cavity. Thus, the lung would take more oxygen and enhance the gas exchange process in the alveolar pulmonary capillaries [22]. The prone positioning also raises the aeration of the poorly ventilated alveolar part. This position shifts the part of the lung that used to be rich in gravity-dependent blood flow to a non-dependent place, allowing more sufficient breathing that could be demonstrated by increased oxygen saturation level [23].

Researchers discussed the prone positioning effect in improving the oxygen saturation level among COVID-19 patients. Findings have confirmed its beneficial and effective outcomes in relieving shortness of breath, proposing their role as an additional nursing intervention in the COVID-19 patients' care. However, this intervention required to be performed after a thorough assessment of the patient's condition. Patients' tolerance to the procedure needs to be assured to achieve optimal outcomes and minimize the risk of injuries.

LIMITATION

Several hindrances were encountered during the study. However, it has been resolved adequately through relevant discussion and assistance.

CONFLICT OF INTEREST

Authors declared no conflict of interest to disclose.

CONCLUSION

Prone positioning was effective in increasing oxygenation among COVID-19 patients. These findings implied nurses' active engagement in delivering adequate information about prone positioning and its influence on oxygenation among COVID-19 patients. COVID-19 patients are also advised to safely perform the position, as it will accelerate their recovery and may contribute to a lower mortality rate due to COVID infection.

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