RESPIRATORY PARAMETERS OF COVID-19 PATIENTS AFTER THE PRONE POSITION

V.E. Salvera Arnoldy[1], Julianus Yudhistira Tan[1], H. Haris Pastiyanto[1]
[1] Nurse in Siloam Sriwijaya Hospitals, Palembang
Email: salvera.arnoldy@siloamhospitals.com

ABSTRACT

Hypoxemia is a condition when there is a lack of oxygen levels in the blood, especially from the arteries. In the early stages of COVID-19, several mechanisms such as intrapulmonary shunting, loss of pulmonary perfusion regulation, intravascular micro thrombus, and impaired diffusion capacity can contribute to the development of arterial hypoxemia, although there is no increase in respiratory work. The prone position is one of the most widely used therapies for patients with hypoxemia because the dorsal area has a large number of alveolar units that are notcompressed by the weight of the abdominal cavity and mediastinum, thus creating a more efficient area for gas exchange. This study aimed to determine the effect of the prone position on changes in respiratory parameters of COVID-19 patients. This study used the descriptive correlation methodon 27 respondents with purposive sampling. Each respondent was given a prone position for three hours and being observed before, during the three-hour, and after one hour of the prone position administration". The results of the descriptive analysis of this study showed that the majority of respondents were middle adulthood (63%) with 70% of the respondents being male, 59% having a history of hypertension, and 85% experiencing coagulation disorders. The change in the mean respiratory rate during one hour of supination after three hours of prone position in males was greater than that in females although the mean decrease in oxygen saturation was the same. This shows that the prone position for three hours accompanied by oxygen therapy made an improvement in respiratory status in COVID-19 patients, although it needs further investigation with more respondents and different research methods.

Keyword: Prone position; respiratory parameters; COVID-19

Introduction

COVID-19 is a disease caused by severe acute respiratory syndrome coronavirus 2, which was first identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, China (Centers for Disease Control and Prevention, 2020). The large number of patients globally, coronavirus disease 2019 (COVID-19) became a pandemic, overloading intensive care units (ICUs) as it requires respiratory supports. There is no clear data on the incidence and prevalence of hypoxemia in COVID-19 patients. Therefore, only estimates of hypoxemia-related deaths exist as research on COVID-19 is still ongoing and evolving; and deaths from COVID-19 infection are complex and multifactorial.

Hypoxemia is a condition when there is a lack of oxygen levels in the blood, especially from the arteries (Sarkar et al., 2017). This condition can be caused by inadequate amount of oxygen in the air, respiratory system disease, nervous system dysfunction, or circulatory dysfunction. Generally, hypoxemia occurs due to more than one mechanism in people with respiratory or cardiac disease (Porth, 2011).

Guan et al. (2020) reported that dyspnea occurred in 18.7% of 1099 COVID-19 patients who had a low PaO2/FiO2 ratio, abnormal pulmonary CT scan (86%), and supplemental oxygen requirements (41%). Generally, the adequacy of gas exchange is determined by the balance between pulmonary ventilation and capillary blood flow or known better as ventilation/perfusion matching (V/Q). In the early stages of COVID-19, several mechanisms such as intrapulmonary shunting, loss of pulmonary perfusion regulation, intravascular micro thrombus, and impaired diffusion capacity can contribute to the development of arterial hypoxemia, although there is no increase in respiratory work (Dhont et al., 2020).

In the hospitalized stage of COVID-19 patients with hypoxemia, viral replication is well underway. Besides providing antiviral drugs, optimization of V/Q mismatch and emerging cytokine storms are the main therapeutic goal. Burhan et al. (2020) stated that there are three important steps in preventing the worsening of COVID-19: using a high-flow nasal cannula or non-invasive mechanical ventilation, maintaining fluid resuscitation, and the prone position in conscious patients. The prone position has two advantages: increasing oxygenation through decreased V/Q mismatch and potentially lowering the risk of lunginjury. That can occur because dorsal zones are not compressed by the weight of the abdominal cavity and the mediastinum, allowing more alveoli to participate in gas exchange (Albert & Hubmayr, 2000; Scholten et al., 2017).

Sartini et al. studied 15 COVID-19 patients who received NIV therapy and the prone position for 60 minutes. The results showed a decrease in respiratory rate and a significant increase in oxygen saturation one hour after the therapy was given ($p<.001$). Although the study is not representative of all patients with COVID-19, these results suggest a significant benefit of the prone position.

Preliminary study data at Siloam Sriwijaya Hospital in January 2021 showed that COVID-19 cases from May to December 2020 were quite high, although they fluctuated every month, with the highest number of cases being 66 in June 2020. Based on interviews with nurses about hypoxemia management, it is known that supplemental oxygen and the prone position are integrative management of hypoxemia which are rarely given due to unknown exact benefits and unavailable standard procedure. This description shows that the case of COVID-19 was quite high in the hospital and can result in worsening conditions and an increase in the number of ICU patients. The prone position can be an option for non-pharmacological hypoxemia management.

METHOD

This research was conducted using the descriptive approach at Siloam Sriwijaya Hospital in February 2021. Twenty-seven respondents were taken by purposive sampling. They were selected based on several criteria: the patient is fully conscious, tested positive of SARS Cov-2 through a swab test, having pneumonia through radiological impression or Ground Glass Opacity (GGO), willing to participate in the study, not experiencing verbal and visual impairment, not intubated or impending intubation, and following the treatment time until finish. Research data was obtained by interviews and observation sheets containing the identity of respondents, patient-owned comorbidities, respiratory rate, and oxygen saturation using calibrated oximetry. Each respondent was given standard oxygen therapy according to the indication and the prone position for three hours, with measurement time before the prone position, during the three hours of the prone position, and one hour after the prone position.

RESULTS AND DISCUSSSIONS

Respondent Characteristics

The results of the respondent characteristics analysis showed that the majority of respondents were in the age range of 40-64 years old (63%) with a mean of 62 years old who happened to be male (70%) having a history of hypertension (59%) and having blood coagulation disorders (85%). A literature review study of Salunkhe et al. (2020) from 14 studies about COVID-19 mortality rate stratified by comorbidities or by age groups shows that the age range was 40-64 years old, 64% male, 41% had hypertension, 21% had Diabetes Mellitus and the highest mortality were >60 years (82%). According to Liu et al. (2020), the clinical features and prognosis of COVID-19 patients varied due to different ages. Patients aged ≥60 years showed heavier clinical manifestations, greater severity, and longer disease courses compared with those aged <60 years.

Table 1. Respondent's characteristics

Variable	f	%
Age		
Middle adulthood (40-64 years old)	17	63
Elderly (65-70 years old)	3	11
Aged (≥71 years old)	7	26
Gender		
Male	19	70
Female	8	30
Comorbid		
Hypertension	16	59
Diabetes Mellitus	7	26
CVD	1	.03
Blood Coagulation Disorders		
Yes	23	85
No	4	15

Barek et al. (2020) reported that COVID-19 patients aged ≥50 years had 3.36 times more risk of severity in comparison with those aged below 50 years (p=.0002), whereas patients aged ≥65 years showed 0.79 times risk compared to severe patients aged below 65 years (p=.110). It was thought that elderly or older people are more susceptible to severity due to weak immunity and other organ dysfunction. Older age can lead to defects in T-cell and B-cell function, causing an excess inflammatory response contributing to worse outcomes. Generally, lymphocytes are elevated in response to viral infections, but according to several study, lymphocytes abnormally decreased in COVID-19 and older patients. Although the underlying mechanism is still unclear, low lymphocyte levels could be a key indicator of disease severity in COVID-19 (Wang et al., 2020; Zhang et al., 2020). Thus, elderly and a higher frequency of comorbid patients are more susceptible to SARS-CoV-2. A study by Moraga et al. (2020) revealed that the severity and case fatality rate are higher in males and aged people (>60 years old). According to Bwire (2020), there are several factors which make males more vulnerable to COVID-19 than females, i.e., high expression of ACE2 receptor to which coronavirus binds easily, gender behavior such as smoking, compliance undertaking preventive measures, and hormones. Lieberman et al. (2020) said that ACE2 expression, decreased B-cell and NK cell-specific transcripts, male hormones, and increased NF-κB inhibitor are responsible for the higher viral load in men.

Besides age, several studies have shown a variety of underlying medical conditions related to the severity and mortality of COVID-19 (Centers for Disease Control and Prevention, 2021). Cardiovascular disease, diabetes, and chronic pulmonary disease are comorbid and play a fairly high role in the development of COVID-19 infection (World Health Organization, 2020) because it is closely related to the ACE-2 receptor.

Although the underlying mechanisms of COVID-19 are still elusive, the ACE-2 receptor on the host cell that is used by the virus to enter has been believed as one of the media (Guo et al., 2020). Hypertension, which is a global cause of death with a range of 10.4 million per year (Global Burden of Disease Risk Factor Collaborators, 2018) and affecting 1.39 billion people in 2010 (Mills et al., 2016), can make patients with COVID-19 experience severity and mortality nearly 2.5 times higher than other comorbidities (Lippi et al., 2020). However, Shibata et al. (2020) showed that there are no reports that reliably state hypertension will increase the risk of being infected with the SARS-Cov-2 virus.

A literature review by Sanyaolu et al. (2020) says that hypertension and diabetes mellitus tend to make COVID-19 developed to be more severe.In line with the results of the study that showed hypertension was the highest comorbidity among respondents and with the majority having coagulation disorders, pre-existing ACE-2 deficiency coupled with binding by the SARS-Cov-2 virus will increase the development of endothelial or pulmonary inflammatory processes and thrombotic microvascular processes (Verdecchia et al., 2020). In addition, older patients, especially those aged ≥65 years, who have comorbidities and are infected by the SARS-Cov-2 virus, have an increased rate of admission to the intensive care unit (ICU) and death from COVID-19. Therefore, patients with comorbidities should take all necessary precautions to avoid becoming infected with SARS CoV-2, as they usually have the worst prognosis.

Table 2. Respiratory Status

Variable	N	Mean ± SD	SE
Pre-RR	27	24.3 ± 2.05	.39
Pre-SpO2	27	96.3 ± .79	.15
3H-RR	27	21.8 ± 1.31	.25
3H-SpO2	27	98.1 ± .87	.16
Post-RR	27	21 ± 1.38	.26
Post-SpO2	27	98.7 ± .99	.19

The results of the univariate analysis of this study also showed that there was a change in the mean respiratory rate and SpO2 of COVID-19 patients both when the prone position was administered for three hours and one hour after the prone position was finished in the supine position. However, the change in value from when the three hours of prone was given (RR= 21.8 ± 1.31; SpO2= 98.1 ± .87) to one hour after the prone was finished in the supine position (RR= 21 ± 1.38; SpO2= 98.7 ± .99) was not remarkable. This shows that the effect of improving respiratory status is still felt by the patient even though the proneposition has been completed, but the significance of this value remains unknown by the researcher.

A study by Darmala et al. (2020) showed that there was a significant change in oxygen saturation with a median of 94% to 98% (p=.004) and in respiratory rate (p=.002) with a median of 31 to 22 breaths/min one hour after the prone position. This significant change occurred because patients in the study were treated with the prone position every night while sleeping and supine-prone positions back and forth every two hours during the day. The increased lung function occurred because the prone position reduced pulmonary compression and redistributed more blood and airflow.

Change of Respiratory Status Based on Gender

Figure 1. Change of Respiratory Rate Based on Gender

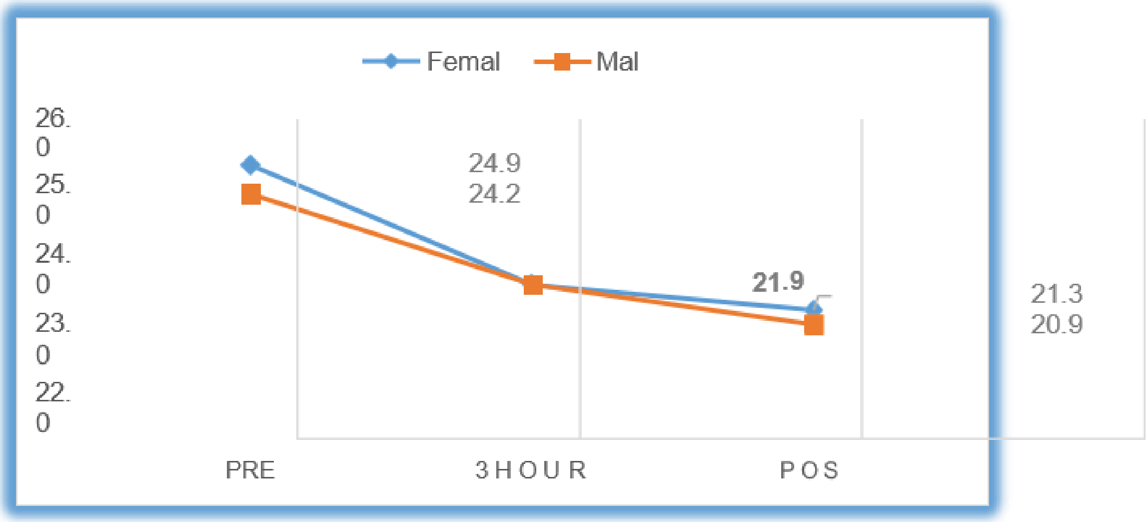
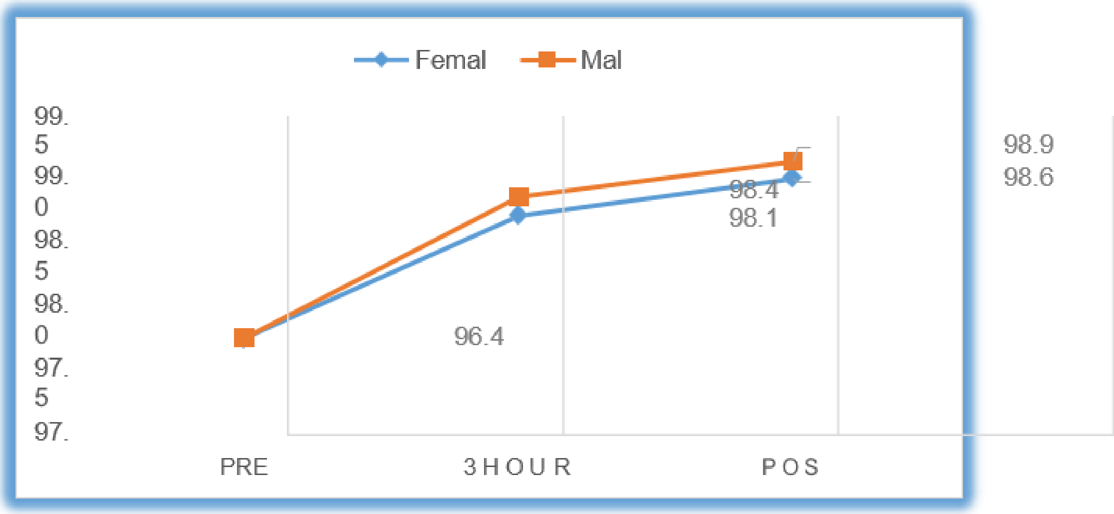


Figure 2. Change of SpO2 Based on Gender



Based on the graphs of the results of the analysis, the data show that there was an improvement in respiratory status in patients who were given the prone position,although the significance value is unknown. In addition, it was also known that there were differences in mean changes in respiratory rate and peripheral oxygen saturation towards improvement between males and females in this study. The difference was quite visible in the mean of the respiratory rate after prone position administration, namely 21.3 breaths/min (female) and 20.9 breaths/min (male); the difference in peripheral oxygen saturation was not quite visible.

One of the causes of the increasing number of COVID-19 ICU patients is due to respiratory failure (Grasselli et al., 2020). ARDS is one of the most common complications of COVID-19, comprising about 41% of patients with severe disease (Wu et al., 2020). The prone position is one of the most recommended non-pharmacological treatments to increase oxygenation of ARDS patients. This measure is intended to overcome the increased atelectasis and decreased pulmonary compliance that can result from ventilation in the supine position (Ashbaugh et al., 1967). In theory, when the expansion of the anterior chest wall is limited, chest wall compliance will be more homogeneous and the gravitational pressure on the lung parenchyma will cause more of the alveoli of the posterior lung to exchange gas. In addition, an even distribution of pressure on the lungs from the diaphragm will also help reduce lung injury, whether by using a ventilator or spontaneous breathing (Telias et al., 2020).

In their literature review, Venus et al. (2020) also said that the prone position can be given to patients on ventilators or patients with respiratory failure who are fully conscious and not intubated. Nevertheless, many RCTs are still needed to find clinical benefits, safety profiles, especially inpatient selection, and accuracy of time to start and stop the intervention because the quality of the evidence-based practice is still low. In addition, the difference in changes in mean respiratory rate and peripheral oxygen saturation after the prone position is seen to be more effective in men because is anatomically larger than in women. A study by LoMauro & Aliverti (2018) demonstrates that women have smaller airway diameter, lung volume, maximum expiratory flow, and diffusion surface than men. Some of these anatomical differences appear to be propaedeutic for pregnancy. Therefore, in the results of this study, it appeared that men felt the effectiveness of the prone position more than women. However, this can be inversely proportional since the controlled variables and respondents were limited.

CONCLUSION

The results of this study indicate that the administration of the prone position for three hours has a positive impact on respiratory rate and peripheral oxygen saturation, especially in male patients. In addition, improvement in respiratory status is stilluseful up to one hour after the prone position, but the significance value is still unknown in this study. Therefore, further research is needed with more respondents, more controlled variables, and more advanced methods to obtain more generalizable results.

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