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Determination of the Effect of the Fowler and Prone Position on Oxygen Saturation in Patients Diagnosed with COVID-19

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ABSTRACT

Objective: This study was conducted to investigate the effect of the Fowler position and prone position on oxygen saturation in patients receiving treatment in clinics with the diagnosis of COVID-19 disease.

Method: A total of 40 patients, admitted to the pandemic ward who met the inclusion criteria, were included in the quasi-experimental type study without any sampling. The patients were first given the Fowler position and then the prone position. There was a time interval of 15 minutes wait between the two positions. For each position, peripheral oxygen saturation, heart rate, respiratory and blood pressure values were obtained at initial position placement, after the 30th minute and every hour for the first four hours.

Results: The mean age of the participants was 57.57±12.64 years. Respiratory distress, cough, fever, weakness, sweating and headache were the main symptoms. A total of 22.5% of them had a diagnosis of hypertension and Diabetes Mellitus. The requirement for the positioning was found to be 95% in the first five days after admittance. After treatment, 85% of them were discharged home. The mean oxygen saturation values of the patients for every hour in the Prone position were 93.15±1.718 ($p=0.035$), 93.60±1.809 ($p=0.019$), 93.93±1.774 ($p=0.006$) and 94.15±1.718 ($p=0.002$), respectively in the first four hours. These findings were statistically significant compared to the Fowler position. Respiratory values in the prone position were 17.30±1.159 ($p=0.005$), 17.20±1.344 ($p=0.010$), 17.20±1.181 ($p=0.005$), and 17.05±1.280 ($p=0.001$), respectively in the first four hours, which were statistically lower than in the Fowler position. There was no significant difference in the mean heart rate and blood pressure in both positions ($p>0.05$).

Conclusion: The prone position was found to have a positive effect on oxygen saturation levels when Fowler and Prone positions were applied in patients receiving treatment with the diagnosis of COVID-19 in hospital wards. Therefore, it is recommended that patients admitted with the diagnosis of COVID-19 be placed in the prone position at regular intervals.
Keywords: COVID-19, Prone position, Fowler position, Oxygen Saturation

1. INTRODUCTION

Coronavirus-2019(COVID-19) disease is a clinical picture caused by SARS-CoV-2 (Acute Respiratory Syndrome Coronavirus-2) (1). COVID-19 affects many systems, but primarily the respiratory system. It often has the symptoms of fever, dry cough, weakness, myalgia and dyspnea. It travels from the upper respiratory tract to the lower respiratory tract. With the increase in the severity of the disease, the symptoms also become more severe, and hypoxia and severe shortness of breath are observed (2-4). While 14% of the admitted patients had a severe case (dyspnea, hypoxemia and presence of more than 50% lung involvement in imaging) and 5% had a critical case (respiratory failure, shock, multiorgan failure) (5,6).

For clinical patients to continue to breathe effectively, ensuring that the oxygen saturation is at 95-100% should be among the first goals of healthcare professionals. Oxygen therapy should be started with a 5 L/ min nasal or standard face mask for the patient and oxygen saturation should be adjusted to >95% (7,8).

With the development of pulmonary inflammation in COVID-19, impaired lung ventilation/perfusion leads to hypoxemia. Oxygen therapy is included in the first step of follow-up and treatment in the clinical setting before intensive care in the hypoxemia picture (9). Along with the COVID-19 treatment protocol, the importance and effectiveness of patient positioning have also been stated in the literature (2,10). Lung circulation and ventilation may be performed more effectively with the patient positioning, which is the independent role of nursing. The purpose of the prone position in patients with respiratory distress is to make breathing more effective and relieve the pulmonary circulation by reducing abdominal pressure (11). The prone position has been used to improve hypoxemia since 1974 (12). By eliminating the compressive weight of the abdominal region with this position, the alveoli in the dorsal region merge with the pulmonary blood flow, relieving lung perfusion (13,14). This position is known to be important for

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more homogeneous ventilation of the lungs and it contributes significantly to the improvement of oxygenation. The prone position increases the functional residual capacity, opens the atelectatic lung areas, leads to an increase in chest wall elastance, corrects the ventilation/perfusion ratio, and ensures the mobility of secretions (1,10,15). This positioning facilitates the redistribution of pulmonary blood flow rather than opening the collapsed alveoli, thereby reducing the formation of shunts. In this way, the pulmonary circulation is relieved (16). Many studies have been conducted related to the prone position, however, there was not enough clinical evidence available in the literature showing the effectiveness of the prone position in the clinical treatment process of patients with COVID-19 (1).

By evaluating the effectiveness of position practice, which is the independent role of nursing, this study is thought to make contributions to the quality of nursing care (12). The study was planned to determine the effect of the Fowler and prone position on oxygen saturation values in patients diagnosed with COVID-19.

The hypothesis of the study: There is a difference between the peripheral oxygen saturation values of the patients who were given the Fowler and Prone positions.

2. METHODS

2.1. Ethic Aspects

Ethics Committee approval of Bahçeşehir University (Decision date and number:14.01.2021-KAEK 2021/1), institutional permission and informed consent of patients were obtained to conduct the study which has been carried out in accordance with the 1964 Helsinki Declaration and its later amendments.

2.2. Design and Setting of the Study

The study was carried out using a quasi-experimental model in the pandemic ward of a public hospital.

2.3. Population and Sample of the Study

The population of the study consisted of patients admitted to the pandemic ward between 14.01.2021 and 30.03.2021. The sample group consisted of individuals who were admitted to the ward within the specified period, who met the inclusion criteria and who agreed to participate in the study. The effect size standardized by Cohen was used due to the unavailability of any study that could be used as a reference in the study. Therefore, the minimum number of samples was determined as 34 by taking the effect size of the study as, the alpha value of 0.05 and the theoretical power of 0.80. Given that there may be losses during the study, it was started with a number of participants (n=40) more than the required (17,18).

2.4. Inclusion and Exclusion Criteria for the Study

From the individuals who were admitted to the pandemic ward and were between the age of 18-79 (young, middle age and early-old age group) with an oxygen saturation level below 95%;

- Those without a history of malnutrition, Parkinson's, dementia, or stroke,
- Those with ground-glass opacity in their lungs and positive PCR test result,
- Those who were literate and could be communicated and were willing to participate were included.
  - Excluded individuals during the study:
- Patients who passed away,
- Patients who needed intubation and transferred to the intensive care unit,
- Patients who could not do the positioning during the study were excluded.
- Pregnant individuals were not included in the study.

This study has been prepared per the TREND guidelines (19).

2.5. Data Collection Tools and Data Collection

The data collection and demographic characteristics forms, prepared by the researchers after the literature review, were used for the data collection (20). Before the data collection process, institutional permission, and ethics committee approval were obtained. The effectiveness of the Fowler and prone positions which were given to the individuals, who were included in the study according to the study criteria were compared. The positioning was started after providing the necessary training to the individuals and obtaining their consent. In the Fowler position, individuals were positioned sitting in the bed. In the prone position, the individuals were positioned lying on their face down. A total of eight-hour positioning, first four-hour Fowler position and then four-hour prone position, was applied during the day (24 hours) determined by using the literature information and vital signs (oxygen saturation, respiratory rate, blood pressure and heart rate) were measured and recorded in this period. Oxygen saturation and heart rate measurements were performed peripherally. Blood pressure was measured with a manual sphygmomanometer. The respiratory rate was counted from the movement of the thoracic cage after the position was given. Participants rested for 15 minutes between two positions. It is stated in the literature that the prone position can be applied to a patient for a maximum of 12 hours with 4-hour rotations (3,7, 15,21). Participants were informed about the benefit of using this positioning during the COVID-19 treatment and they were asked to continue the practice in this process. Data collection was performed on the first day that the positioning was given by the researchers. The process was not repeated until the patients left the clinic. The oxygen saturation values were measured with a pulse oximeter brand device during the positioning period. It was a brand-new device and calibrated by the hospital biomedical unit. Parameters were recorded in the data form. Measurements were planned as such: initial measurement when the positioning was performed, measurement after 30 minutes, measurement after one hour and every one hour for the next three hours (21).

2.6. Data Analysis

SPSS (Statistical Package for Social Sciences) for Windows 25.0 (Z125-5543-05) was used for the analysis of the data in this study. Descriptive statistical methods (number, percentage, mean, standard deviation) were used in the evaluation of the data. In addition to normality tests, distribution measures such as histogram, Q-Q plot and box-plot graphics, Skewness and Kurtosis and coefficient of variation may be used to evaluate whether the data is normally distributed or not (22). In order to ensure normality, the values of the data should be observed close to 45 degrees in the scattering diagram and positioned by centring the median line of the box on the box line chart (23). The normal distribution was checked by conformity normality tests and Skewness and Kurtosis values. In the analysis of the data, the dependent sample t – test was used for comparison of quantitative data when the assumption of the normal distribution is ensured, and Wilcoxon signed-rank test was used in cases where normal distribution was not achieved.

3. RESULTS

Personal information of the patients (n=40) included in the study and admitted to the pandemic ward is given in Table 1. According to the results, 60% of the participants were male patients. While 50% (n=20) of them were in the 45-64 (middle age) age range, 47.5% (n=19) had a bodyweight between 70-84 kg. Looking at the symptoms, 60% (n=26) of them were observed to have respiratory distress, cough, fever, weakness, sweating and headache. There was no chronic disease in 37.5% (n=15) of the patients. While steroid was used in the treatment of 67.5% (n=27) of them, 95% (n=38) of them needed positioning in the first five days after admittance. A total of 85% (n=34) of them were discharged home.

In all of the hourly as well as the initial and 30th-minute measurements for the oxygen saturation values of the patients given Fowler and Prone positions, no statistical significance was found according to the descriptive characteristics of the patients such as whether the patients had a chronic disease, weight or age (p>0.05).

There was no statistically significant difference between the initial and 30th-minute oxygen saturation measurements of the patients given Fowler and Prone positions (p>0.05). The first – hour mean oxygen saturation value of the patients was 92.33±2.043 in the Fowler position and 93.15±1.718 in the prone position and a statistically significant difference was found between the positions (p=0,035). The second-hour mean oxygen saturation value of the patients was 92.58±2.024 in the Fowler position and 93.60±1.809 in the prone position and a statistically significant difference was found between the positions (p=0.019). The third-hour mean oxygen saturation value of the patients was 92.70±1.937 in the Fowler position and 93,93±1,774 in the prone position and a statistically significant difference was found between the positions(p=0.006). The fourth-hour mean oxygen saturation value of the patients was 92.78±1.968 in the Fowler position and 94.15±1.718 in the prone position and a statistically significant difference was found between the positions (p=0.002). It was statistically significant that the oxygen saturation values of the patients in the prone position were higher than the oxygen saturation values in the Fowler position in all of the hourly measurements. It was concluded that the longer the prone position was applied, the more effective it was (Table 2).

Table 1. *Descriptive characteristics and health information of patients*

Descriptive characteristics and health information		n	%
Gender	Female	16	40
	Male	24	60
Age (years)	<= 44	6	15
	45-64	20	50
	>= 65	14	35
Weight	55 – 69 kg	8	20
	70-84 kg	19	47.5
	>=85 kg	13	32.5
Presence of symptoms	Respiratory distress, cough, fever, weakness, sweating, headache	26	65
	Cough, weakness, back pain, nausea, vomiting	9	22.5
	Respiratory distress, cough, fever, weakness, sweating, headache, cough, fatigue, back pain, nausea, vomiting, fainting, loss of appetite, loss of smell and taste	4	10
	No symptoms	1	2.5
	Chest pain and headache	1	2.5
Chronic diseases	No	15	37.5
	Hypertension	5	12.5
	Hypertension and diabetes	9	22.5
	Hypertension, diabetes, heart diseases	2	5
	Cancer and infections	2	5
	Diabetes mellitus	3	7.5
	DM and chronic heart failure	1	2.5
	Hypertension and hypothyroidism	1	2.5
	Chronic renal failure	1	2.5
	Hypertension and asthma	1	2.5
Use of Steroids	Yes	27	67.5
	No	13	32.5
The need for positioning	The need for positioning in the first five days of admittance	38	95
	The need for positioning five days after the admittance	2	5
Discharge outcome	Discharged to home	34	85
	Transferred to intensive care	6	15

Table 2. Oxygen saturation measurement values in Fowler and prone positions

	Mean	SD	Test value	p-value
Fowler position initial SPO2	91.33	1.992	-0.919 ^{t}	0.364
Prone position initial SPO2	91.63	1.807		
Fowler position 30th minute SPO2	92.05	2.075	-1.308 ^{t}	0.199
Prone position 30th minute SPO2	92.55	1.724		
Fowler position 1st hour SPO2	92.33	2.043	-2.718 ^{t}	**0.035***
Prone position 1st hour SPO2	93.15	1.718		
Fowler position 2nd hour SPO2	92.58	2.024	-2.441 ^{t}	**0.019***
Prone position 2nd hour SPO2	93.60	1.809		
Fowler position 3rd hour SPO2	92.70	1.937	-2.939 ^{t}	**0.006***
Prone position 3rd hour SPO2	93.93	1.774		
Fowler position 4th hour SPO2	92.78	1.968	-3.049 ^{z}	**0.002***
Prone position 4th hour SPO2	94.15	1.718		

t: Dependent sample t-test; z: Wilcoxon signed-rank test, SD: Standard Deviation, SPO2: Oxygen saturation

There was no statistically significant difference in the heart rates at all measurement times of the patients between the positions (p>0.05).

There was no statistically significant difference between the initial and 30th-minute respiratory rates of the patients given Fowler and Prone positions (p>0.05). The first-hour mean respiratory rates of the patients were 17.93±1.328 per minute in the Fowler position and 17.30±1.159 in the prone position and a statistically significant difference was found between the positions (p=0,005). The second-hour mean respiratory measurement value of the patients was 17.75±1.214 in the Fowler position and 17.20±1.344 in the prone position and a statistically significant difference was found between the positions (p=0,010). The third-hour mean respiratory measurement value of the patients was 19.25±9.604 in the Fowler position and 17.20±1.181 in the prone position and a statistically significant difference was found between the positions (p=0,005). The fourth-hour mean respiratory measurement value of the patients was 19.25±9.604 in the Fowler position and 17.05±1.280 in the prone position and a statistically significant difference was found between the positions (p=0,001). According to the findings, the respiratory values of the patients in the prone position were found to be lower (Table 3). The respiratory rate of the patients given Fowler and Prone position was found to be statistically significantly lower (p=0.001). The mean respiratory rate of 25% of the patients in the prone position was 20 (per minute) while it was 18 in 50% of the patients and 16 in 25% of them. The respiratory rate is lower in the prone position. As the time of the prone position increases, the respiratory rates of the patients get lower.

There was no statistically significant difference in the systolic blood pressure values at all measurement times of the patients between the positions (p>0.05).

There was no statistically significant difference in the diastolic blood pressure values at all measurement times of the patients between the positions (p>0.05).

Table 3. Respiratory rates in Fowler and prone positions

	Mean	SD	Test value	p-value
Fowler position initial RR	18.05	0.959	-0.577 ^{z}	0.564
Prone position initial RR	17.95	1.154		
Fowler position 30th minute RR	17.85	1.231	0.572 t	0.570
Prone position 30th minute RR	17.45	1.197		
Fowler position 1st hour RR	17.93	1.328	2.964 ^{t}	**0.005***
Prone position 1st hour RR	17.30	1.159		
Fowler position 2nd hour RR	17.75	1.214	2.718 ^{t}	**0.010***
Prone position 2nd hour RR	17.20	1.344		
Fowler position 3rd hour RR	19.25	9.604	-2.837 ^{z}	**0.005***
Prone position 3rd hour RR	17.20	1.181		
Fowler position 4th hour RR	19.25	9.604	-3.257 ^{z}	**0.001***
Prone position 4th hour RR	17.05	1.280		

RR: Respiratory rate, t: Dependent sample t-test; z: Wilcoxon signed-rank test

When oxygen saturation measurements were compared during the Fowler and prone positioning of the individuals with COVID 19, we see that oxygen saturation levels were higher in the prone position (Fig. 1).

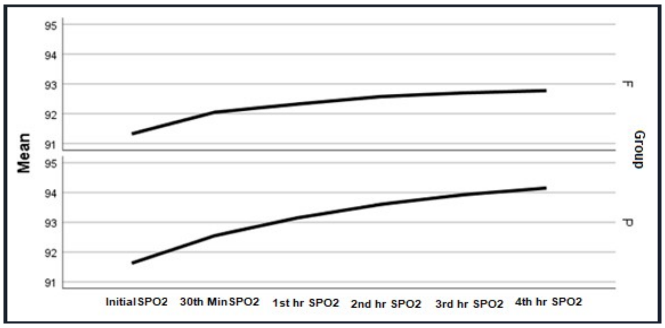

Figure 1. *Oxygen saturation levels of the individuals with COVID 19 during the positioning (Initial, 1st, 2nd, 3rd, 4th hour).*

4. DISCUSSION

In the literature review, the prone position was seen to be mostly given to intubated patients and those diagnosed with Acute Respiratory Distress Syndrome (ARDS) in the intensive care settings. There have been few studies in which positioning was used for awake patients with COVID-19 in the clinical setting outside the intensive care unit (15,20,24,25,26).

In our experimental study, ward patients with a diagnosis of COVID-19 were able to perform prone positioning continuously for four hours. No major complications were observed to develop during the positioning. It was concluded that the prone position was more effective on oxygen saturation levels. In the study of Elharrar et al (26), 63% of hypoxemic patients with a diagnosis of COVID-19 who received treatment outside the intensive care unit were able to tolerate the prone position for more than three hours. However, they reported that oxygen saturation levels increased by 25% during the prone position.

In our study, while 60% of the patients were male, the mean age was 57.57±12.64 (min: 27 max: 78). Hypertension and

Diabetes were the most common chronic diseases with 22.5%. In a similar study by Coppo et al (27), the mean age was 57.4 years and 78% of the patients were male. The same study reported that most of the patients had hypertension and diabetes. Our study supports the literature in this aspect. In our study, 95% of the patients admitted to the clinic were started early positioning (in the first five days), and each patient was given positioning for a total of eight hours. In all the hourly measurements, the oxygen saturation values of the patients in the prone position were found to be higher than the values in the Fowler position. Golestani-Eraghi et al (28) evaluated the effectiveness of the positions on oxygen saturation levels by giving supine and prone positions to 10 awake patients in the intensive care unit. The patients were monitored in the prone position for an average of nine hours. Based on the results of their study, the oxygen saturation efficiency of the prone position in the first hour was found to be 60%, and the oxygenation efficiency has been moderate in the measurements of the next hourly oxygen saturation. In the cohort study of Solverson et al (29), positioning was applied to 17 awake patients (12 intensive care, 5 clinical patients). Prone and supine positions were applied for 75 minutes every day for a week. While the mean oxygen saturation measurement in the supine position was 91% (84 – 95), it was 98% (92-100) in the prone position. Our study supports the studies that show that prone positioning is more effective in patients with COVID-19 with hypoxemic, non – intubated high-risk and with a critical illness (22,24,25,30). The respiratory rate of the patients given Fowler and Prone position was found to be statistically significantly lower (p=0.001). The mean respiratory rate of 25% of the patients in the prone position was 20 (per minute) while it was 18 in 50% of the patients and 16 in 25% of them. The respiratory rate is lower in the prone position. As the time of the prone position increases, the respiratory rates of the patients get lower. In the cohort study of Solverson et al (29), positioning was applied to 17 awake patients. Prone and supine positions were applied for 75 minutes every day for a week. The respiratory rate measured during the positioning was 28 minutes in the supine position and 22 minutes in the prone position. In this respect, our results are consistent with the literature. In the study of Golestani-Eraghi et al (28), the rate of patients who could tolerate the prone position and who were discharged was reported as 80%, while the rate of patients given this position and discharged was 85% in our study. Studies have shown that prone positioning can be used in COVID-19 patients, especially in awake clinical patients who are not intubated (20,31,32), and that the use of prone positioning improves oxygenation and lung capacity at high tolerance (20,31,32). The use of the prone position in non – intubated patients is increasing. The prone positioning has been stated to be beneficial in preventing and delaying the need for intubation by improving oxygenation in awake and spontaneously breathing patients (15,26,33).

In our study, the prone position was found to be more effective on oxygen saturation in non – intubated COVID-19 patients. However, further studies investigating the effect of prone position on delaying and preventing the intubation, need for intensive care unit, length of hospital stay and respiration are needed to support our study. Furthermore, the effectiveness of the prone positioning in non-intubated COVID-19 patients has not yet been determined due to the lack of adequate studies (26,27,34) and there is a need for further studies on this subject.

During the positioning, there were difficulties with the patient follow-up due to isolation conditions. There were patients who experienced low back pain. To solve this, the pelvis area was supported with a pillow. There were difficulties in communication and nutritional needs in the prone position. Measurements were performed over a four-hour period and the patient's needs were checked in between the measurements. The positioning time of the patients who had difficulties with the positioning was rescheduled and their measurements were taken from the beginning. This led to an extended time of stay for the researchers inside the isolated rooms which may possibly have increased the transmission risk to the researchers. The study was carried out in a public hospital in one of the cities therefore the results cannot be generalized to all the COVID-19 patients.

5. CONCLUSION

When Fowler and prone positions were given to the clinical patients with COVID-19, the prone position was observed to have a positive effect on oxygen saturation. Considering the results of this study, giving prone position at certain intervals until discharge to the admitted patients with COVID-19 is recommended.

Since the beginning of the pandemic, prone positioning has become important as a supportive treatment method that can reduce the burden on the health sector both by improving short – term outcomes and also by reducing or delaying the need for intubation. There are studies on prone positioning in intensive care patients with COVID-19. However, there is a need for studies that will reveal more clinical evidence with a larger number of patients in order to apply prone positioning routinely to clinical patients outside the intensive care unit.

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Research idea: YİI, FEA, GP

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Acquisition of data for the study: YİI, GP

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