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Effect of Prone Positioning and Alternate Nostril Breathing Technique on Oxygen Saturation and Psychological Status in Patients with COVID-19

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ABSTRACT

Prone positioning has certain benefits in improving respiratory parameters. **Objectives:** To study the effects of prone lying position and alternate nostril breathing in patients diagnosed with COVID-19. **Methods:** This quasi-experimental study was conducted at District Headquarters Hospital Faisalabad, Pakistan. After ethical approval, patients between the ages of 40-80 were recruited with a diagnosis of COVID-19 and received supplemental oxygen. Thirty patients with COVID-19 were divided into two groups, group A opted prone lying alone and group B performed prone lying with alternate nostril breathing. Study outcomes were fractional oxygen concentration in inspired air (FiO2), partial pressure of oxygen (PaO2), and general psychological status recorded at baseline and after one hour of re-supination. A paired sample t-test and ANOVA were applied to find between-group and within-group differences ($p \leq 0.05$). **Results:** Out of 30 patients, 16 (53.3) were male and 14 (46.7%) were female. The mean age ± standard deviation of the participants in group A was 57.58±10.4 and in group B was 59.21±9.589. There was a significant inter-group difference in mean scores for General Anxiety Disorder-7, 9.290±2.355 before and 4.677±2.224 after the treatment. The pretreatment mean value of FiO2 was 1.68±0.475; after treatment, the value was 3.45±2.119. A p-value≤0.05 was found statistically significant for all outcome variables improving respiratory parameters and reducing anxiety. **Conclusions:** It was concluded that prone positioning with alternate nostril breathing effectively improves (PaO2), (FiO2) and general psychological state in COVID-19 patients.

INTRODUCTION

COVID-19 has emerged as a disastrous threat to the respiratory system leading to a massive number of patients with respiratory failure and an increased number of hospital admissions. Since the outbreak of this disease, many studies have been published to explore various aspects of this acute respiratory condition [1]. World Health Organization has declared this condition as an ongoing pandemic because different variants are being reported in various parts of the world [2]. Clinically the presentation of Coronavirus varies as mild, moderate, and severe symptoms leading to hospitalization. In most severe cases noninvasive and invasive ventilation becomes unavoidable [3]. The common clinical symptoms of this disease are fever, cough, dyspnea, and chest congestion. Depending on the severity of symptoms some patients may progress to acute respiratory distress syndrome within a week or so [4]. The most disabling condition among hospitalized individuals is reduced oxygen saturation in the blood (<93%) or some may present as stable ones without prominent distress with oxygen saturation between 50-60% [5]. Patients are often treated with medication, steroids, supplemental oxygen, and high flow continuous

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positive airway pressure and prone positioning [6]. In the supine lying position the weight of the viscera and diaphragm's shape hinder breathing and it becomes worse in chest infection. By changing the position to prone lying the ventilation capacity, efficiency of respiration, and gaseous exchange increase [7]. A Study was conducted on the non-intubated subjects with Coronavirus-19 (COVID-19) who were admitted. This study showed that prone positioning is highly beneficial for patients suffering from COVID-19 and it reduces their chances of intubation [8]. In alternate nostril breathing (ANB) technique, breathing is carried out with one nostril at a time and closing the other nostril manually. Plenty of evidence advocates the significant effects of ANB on the autonomic and cardiorespiratory system [9]. According to a review by Vitacca et al., nasal breathing improved ventilator efficiency and lowered the physiological economy for a given work. Respiratory rehabilitation played a great role in the management of COVID-19 patients from favourable breathing to providing strengthening and training to the muscles of respiration [10]. According to a systematic review, respiratory rehabilitation is one of the most important aspects of the COVID-19 treatment regimens [10]. A randomized controlled trial concluded that breathing practices have a positive impact on mental health in hospitalized patients of COVID-19. The improvement of these respiratory parameters calls for more clinical trials to better understand the phenomenon. There have been several studies conducted to investigate the effects of prone position on PaO2, respiratory rate, and other physiological parameters. The addition of alternate nostril breathing with a prone position and assessment of anxiety score along with respiratory parameters is a novel approach in this population.

This study aims to find the effects of prone positioning and alternate nostril breathing in non-intubated patients suffering from COVID-19. The combined approach of COVID-19 patient positioning and ANB helps in improving ventilation and oxygen saturation in the blood.

METHODS

In this quasi-experimental study, patients diagnosed with COVID-19, receiving supplemental oxygen at District Headquarters Hospital, Faisalabad, Pakistan were recruited. The study was conducted from November 2020 to March 2021 after ethical approval from Sialkot College of Physical Therapy (IRB-SCPT-DPT-138-2020). A sample of 30 patients was estimated using the EPI tool, with a 95% confidence interval and a 5% margin of error. Patients of either gender, diagnosed with COVID-19, between age 40-80, oxygen saturation not less than 70, and with a Glasgow Coma Scale (GCS) score of 15 were included. In contrast, patients with a history of acute respiratory distress syndrome (ARDS) chronic smokers, chronic obstructive pulmonary disease (COPD), intubated patients, and patients with neurological disorders were excluded from the study. Written informed consent was obtained from the patients. After initial screening for the inclusion criteria, thirty patients were divided into two groups A and B. The data were collected at baseline, and patients were instructed to lie in the prone position, for three hours for group A. In group B, the patients maintained a prone lying position for three hours and after returning to the supine position, performed supervised alternate nostril breathing. In this method patient was instructed to close one nostril with the help of the index finger inhale deeply from the other nostril for three seconds and exhale through the mouth. After that perform the same maneuver with other nostrils and continue doing so for 10 minutes with a rest of 30 seconds after every three minutes. Generalized anxiety was apparent in most of the patients suffering from COVID, so this subjective measure was included along with the facilities available at the COVID ward, the outcome measures were the General psychological state measured through GAD-7 [11], the partial pressure of oxygen (PaO2) measured through a pulse oximeter [12], and the inspired air oxygen fractional concentration (FiO2) measured through a FiO2 monitoring device [13]. The outcome measures were assessed before prone positioning and returning to the supine position after an hour in both groups. Data were analyzed using SPSS version 23.0. The data were found normally distributed (Shapiro Wilk's test) so parametric tests were used. The paired sample t-test was applied to find the within-group difference before and after the intervention and one-way ANOVA was applied to find the difference between the groups. p-value<0.05 was considered statistically significant with a 95% confidence interval.

RESULTS

After screening 30 patients participated in the study. Out of 30 patients, 17 (54.8%) were men and 14 (45.2%) were women. The mean age of the participants in Group A was 57.58 ± 10.41 and in Group B was 59.21 ± 9.58. The mean value of the pulse was 89.03 ± 12.85 (beats/minute) and the mean temperature was 98.45 ± 0.925 Fahrenheit (Table 1).

Table 1: Demographic and Baseline Characteristics of the study participants

Variables	Group-A n=14	Group-B n=16	Total n=30
	Mean ± SD		
Age (Years)	59.21 ± 9.58	57.58 ± 10.40	58.39 ± 9.99
Height (cm)	164.21 ± 7.42	163.16 ± 5.62	163.43 ± 6.52
Weight (kg)	67.79 ± 9.25	63.92 ± 7.60	65.855 ± 8.42
BMI (kg/m^2)	25.1 ± 0.852	23.8 ± 0.937	24.7 ± 9.58
Pulse (Beats/minute) 77-134	89.86±14.673	87.50 ± 11.165	88.60 ± 12.848
Temp (F) 98-102	98.57 ± 0.852	98.38 ± 1.025	98.47 ± 0.937
GAD Score 0-16	10.00 ± 2.353	8.63 ± 2.306	9.27 ± 2.392

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Gender			
Male	7	9	16 (53.3%)
Female	7	7	14 (46.7%)

A paired sample t-test was applied to find the difference before and after the intervention within the groups. In Group A, the mean of the GAD-7 score was 10.00 ± 2.35 before treatment and after the treatment, its value was 5.50 ± 2.029. Whereas the pretreatment means value O2 saturation and FiO2 were 85.43 ± 5.36 and 0.36 ± 2.470 respectively whereas after-treatment values were 87.71.57 ± 7.89 and 0.28 ± 1.18 respectively. For Group B the mean of the GAD-7 score was 8.63 ±2.30 before treatment and after the treatment, its value was 4.25 ± 1.770 reflecting a reduced generalized anxiety in both the groups. Whereas the pretreatment means value O2 saturation and FiO2 were 89.88 ± 3.13 and 0.36 ± 2.470 respectively whereas after-treatment values were 94.94 ± 2.99 and 0.20 ± 1.14 respectively. The Independent t-test was applied to find the difference between the groups. p-value≤0.05 was considered statistically significant. The Fractional Concentration of Oxygen in inspired air and Partial Pressure of Oxygen improved in both groups. (Table 2).

Table 2: Intergroup and Intragroup Comparison of PaO2, FiO2 and GAD-7 Scores

Variables	Group-A n=14	Group-B n=16	Mean Difference	p-value
P_aO_2 Saturation				
Pre Values	85.43 ± 5.360	89.88 ± 3.138	4.43	0.009
Post Values	87.71 ± 7.898	94.94 ± 2.999	7.23	0.002
Mean Difference	2.28	5.06	-	-
p-value	0.000*	0.000*	-	-
FiO_2				
Pre Values	0.36 ± 2.470	0.34 ± 2.119	0.02	0.008
Post Values	0.28 ± 1.18	0.20 ± 1.14	0.08	0.003
Mean Difference	0.08	0.14	-	-
p-value	0.000*	0.000*	-	-
GAD-7 Scores				
Pre Values	10.00 ± 2.353	8.63 ± 2.306	1.37	0.118
Post Values	5.50 ± 2.029	4.25 ± 1.770	1.25	0.082
Mean Difference	4.50	3.38	-	-
p-value	0.000*	0.000*	-	-

GAD-7: Generalized Anxiety Disorder Questionnaire. FiO2: Fractional Concentration of Oxygen in Inspired Air. PaO2: Partial Pressure of Oxygen.

DISCUSSION

This quasi-experimental study assessed the effects of prone positioning with alternate nostril breathing in patients with COVID-19. The results revealed that patients with prone positioning and alternate nostril breathing showed significant improvement in PaO2, FiO2, and GAD-7 scores. There was a significant between-group difference in mean scores for the GAD-7 score of 9.290 ± 2.355 before treatment and 4.677 ± 2.224 after the treatment. The effects of prone positioning in patients with COVID-19 have been reported numerous times. A study by Nay et.al 2023 to see the impact of prone positioning versus usual care in intensive care units in COVID-19 awake patients concluded that there was a significant improvement in the prone positioning group and the likelihood of these patients for the intubation was less [14]. The findings of the current study where within-group comparison revealed that prone position significantly improved PaO2, FIO2, and GAD-7 in hospitalized patients, are supported by literature as well. Shelhamer et al., conducted a study to observe the effects of prone positioning in COVID-19 patients with moderate to severe ARDS and concluded that prone position is beneficial in improving physiological parameters and decreasing the mortality rate [15]. In the current study parameters like oxygen saturation were significantly improved in the prone positioning group with pursed lip breathing. In a randomized clinical trial to see the effects of diaphragmatic breathing and pursed lip breathing exercises (PLB), it was concluded that the rate of perceived exertion was significantly reduced [16]. It was an instruction-based program and the way patients performed it was not recorded. Contrary to this intervention, we improvised a supervised clinical intervention and it was observed that physiological parameters and overall psychological state were improved. In most of the studies, the pulmonary parameters of COVID-affected patients have been observed whereas in the current study, the psychological impact caused by both physiological and psychological factors has been addressed by using GAD-7. In a study by G Schifino et al., it was found that a prone lying position in awake non-intubated patients of COVID-19 had a strong association with improved oxygenation. The increased V/Q ratio to the dependent areas of the lungs was evident in all patients. These findings provide a unique rationale in contrast to our study where an increase in PaO2 was observed in the group that remained in the prone position for the specified time [17]. In another review to analyse the outcomes associated with awake prone positioning, it was concluded that it reduced the need for intubation in patients with acute respiratory failure associated with COVID-19. The results of this study provide a strong basis to incorporate this intervention in the treatment of non-intubated patients with COVID-19 [18]. In a randomized clinical trial by Siregar et al., to see the effects of orthopneic positioning and PLB in patients of COPD the respiratory frequency and oxygen saturation were significantly improved in the treatment group [19]. These results advocate for the findings of our study where prone positioning followed by pursed lip

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breathing exercises improved oxygen saturation and the fraction of inspired oxygen. In another study by Kader et al., 2022, it was concluded that even a short span of respiratory exercises improves specific respiratory parameters [20]. Prone position and pursed limb breathing is a simple non-invasive and economical technique and may be used to improve respiratory parameters and decrease the anxiety of COVID-19 patients [21]. The current study showed that the prone positioning with alternate nostril breathing is effective in COVID-19 patients in improving ventilation, increasing their partial pressure of oxygen, and reducing their chances of ventilator dependence. Incorporation of this simple yet effective regime can contribute to reducing their hospital stay and improving their anxiety status. A small sample was a major limitation and some other outcomes could add strength to the study. More studies with randomization and sufficient follow-up are suggested to further validate the findings of current studies.

CONCLUSIONS

It was concluded that in inspired air oxygen fractional concentration (FiO2) was increased and anxiety disorder was decreased in both groups. However, the partial pressure of oxygen was improved in group B only.

Authors Contribution

Conceptualization: SA, WP, MC
Methodology: SA, MC, SKR
Formal analysis: AH, SKR
Writing review and editing: WP

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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