



Effect of Prone Positioning on Oxygen Saturation in COVID-19 Patients in Sri Aurobindo Hospital, Indore

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i50B33435

Editor(s):

- (1) Mohamed Fawzy Ramadan Hassanien, Zagazig University, Egypt.
- (2) Syed A. A. Rizvi, Nova Southeastern University, USA.
- (3) Sung-Kun Kim, Northeastern State University, USA.

Reviewers:

- (1) Khadija Ayed, Tunisia.
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- (3) Sushil Kumar Sah, Wuhan University, Nepal.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/77333>

Original Research Article

Received 10 October 2021
Accepted 17 November 2021
Published 18 November 2021

ABSTRACT

Background: Physiotherapeutic intervention body positioning have been observed to increase oxygen saturation. In COVID-19 patients, we intended to investigate how the prone position worked in conjunction with conventional respiratory physiotherapy. The objective was to determine the effect of prone position along with conventional respiratory physiotherapy on SpO₂ of COVID-19 patients in Aurobindo hospital, Indore district.

Methods: The Ministry of Health, Government of India, authorized the rules for collecting data from infected patients. In this study, 400 patients between the ages of 20 and 80 years old were recruited from Sri Aurobindo Hospital in the Indore district, all of them had a confirmed diagnosis of COVID-19 and required oxygen treatment. SpO₂ data was collected as a baseline. Patients were helped into the prone position after baseline data collection and conventional respiratory physiotherapy. Clinical data was obtained again after using the prone posture in conjunction with conventional respiratory physiotherapy. To demonstrate the various prone variations, a patient information sheet was supplied. At 0 and 60 minutes after the exercise, oxygen saturation was measured.

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Results: Between April 2020 to June 2020, we assessed SpO₂ of 400 Patients pre and post prone position along with conventional respiratory physiotherapy. Prone positioning was feasible. Oxygenation was significantly improved from supine to prone position. The data were processed for mean and standard deviation. It was analyzed that there was difference in pre to post value of mean, from 95.685 to 98.123 with standard deviation from 1.645 to 1.445. The result shows significant improvement in SpO₂ after applying prone positioning in patients infected with COVID-19. The findings suggest that prone positioning is both possible and beneficial in increasing blood oxygenation in awake COVID-19 patients. Further study is needed to find the technique's potential value in terms of enhancing overall respiratory and global outcomes.

Conclusion: The difference between the saturation of the two position was significant.

Keywords: SpO₂; saturation of oxygen; non-intubated patients; COVID-19.

1. INTRODUCTION

The virus that results in COVID-19, Severe Acute Respiratory Syndrome Coronavirus 2 was discovered in a patient in Wuhan, China [1]. It has lately expanded globally with various effects on different persons. This implies that symptoms differ from one individual to another. The majority of infected persons will experience mild to moderate symptoms, while a minority will experience no symptoms at all. After being infected with SARS-CoV-2, children in particular experience minimal or no symptoms [2]. The severity of the illness is determined by a person's level of immunity before to infection. As a result, older individuals, particularly men, and those with other health problems that impair their immune system are at a higher risk of getting acute respiratory distress syndrome (ARDS) and death [3]. Within one week after the beginning of the disease, this subset of patients may develop dyspnea and hypoxemia owing to pneumonia, which can swiftly proceed to ARDS or end-organ failure [4]. However, medicines do not kill the pathogenic organisms in cases of viral pneumonia, therefore dealing with the symptoms aims to minimize the patient's exposure to the condition [5]. In general, COVID-19 patients have a weakened respiratory system. Pyrexia, nonproductive cough, dyspnea, fatigue, radiographic indications of pneumonia, anxiety, and depression are common clinical symptoms in individuals [6]. Other complaints include nasal congestion, runny nose, sore throat, sneezing, myalgia, and gastrointestinal issues including diarrhea and vomiting. There is indeed a decrease in lung compliance, increased effort of breathing, as well as a change in blood oxygenation (hypoxemia) in the context of acute respiratory failure under serious situations, resulting in a fast and shallow respiratory pattern (hyperventilation). According to Thomas et al., physiotherapy may be effective in the respiratory

treatment and rehabilitation programs of COVID-19 patients. Because chest physiotherapy increases ventilation and reduces respiratory problems in patients with respiratory disorders, it is widely used [7]. It is highly recommended in the management of COVID-19 patients to relieve symptoms, prevent the progression of symptom severity, and lower the illness's mortality rate.

In response to the coronavirus infection of the airways and lungs, the body's defence mechanism fights back by deploying inflammatory cells, chemicals and fluid in the blood through the vascular circulation to the lungs [8]. Human coronavirus pathophysiology is unknown, however in Middle East respiratory syndrome (MERS), the degree of lung injury is associated with significant pulmonary infiltration of neutrophils and macrophages, as well as increased number of such cells in the peripheral circulation [9,10]. Neutrophils are the primary source of chemokines and cytokines, and when a cytokine storm occurs, it can result in ARDS, which is a significant cause of mortality in individuals mostly with SARS and MERS [11]. Wu et al. found that individuals with COVID-19 pneumonia who became afflicted with ARDS had substantially raised neutrophil counts than others who did not develop ARDS [12]. Consolidation occurs when the alveoli sacs in the lungs, which are typically filled with air, become inflamed and packed with inflammatory cells and fluid during this process [5].

The mechanical and physiological exchange of gases are altered in the prone posture, resulting in continuously enhanced oxygenation. Prone posture increases ventilation by alleviating the ventral-dorsal transpulmonary pressure differential, lowering compression of dorsal lung, and increasing perfusion of lung, as seen in the diagram below. Increase in functional residual capacity (FRC) has been claimed, although in

most prone ventilation investigations, increases in FRC have not been a major result [13,14].

Prone posture decreases the difference in both the dorsal and ventral PTP, resulting in more uniform ventilation [15], resulting in less overinflation of ventral alveolar and dorsal alveolar collapse [16]. This may result in the risk of ventilator-associated lung damage from overdistention also cyclic atelectasis is decreased. Ventilation in Prone also promotes (or opens) alveoli which had collapsed after ventilation in supine, a process that can last for a long period if the patient is in prone lying position and getting adequate positive end expiratory pressure (PEEP). Increase in ventilation and oxygenation are the outcome, which several patients maintain also after returning to the supine position. It reduces lung compression and help to reduce compression over lung caused by the heart and also the diaphragm. During prone breathing, the heart becomes reliant on the sternum, effectively reducing medial posterior lung compression. Furthermore, the diaphragm is shifted caudally (particularly in obese people and when the abdomen remains unsupported), allowing the posterior-caudal lung parenchyma to breathe more easily [17,18].

The increased oxygenation seen with prone ventilation is considered to be largely due to better perfusion of the dependent lung regions. When the patient is placed into prone position, the formerly dependent lung gets filled with the majority of the flow of blood (independent of the gravitational gradient) as alveoli expand, while the newly dependent lung gets the minority of the flow of blood as alveoli begin to collapse [19]. Improvement in cardiac output have also been noted, which are thought to be the result of increased lung recruitment and decreased hypoxic pulmonary vasoconstriction, which results in increased right ventricular preload and decreased afterload in right ventricular, as well as a decrease in pulmonary vascular resistance [20].

The prone posture also aids in patient recovery by influencing recruitment in the dorsal lung areas, increasing end-expiratory lung capacity and improving chest wall elastane. Increase tidal volume and decrease alveolar shunt. Patients who remain in the prone posture for an extended period of time have a lower death rate. However, it's only successful if the right patients are chosen and the right treatment regimen for prone positioning is followed. Munshiet. al. reported in a

meta-analysis that using the prone position to patients with severe ARDS for at least 12 hours a day can reduce the incidence of death [21]. Prone position (laying face down) is indicated in moderate to severe COVID-19 patients. Prone position over long durations might raise oxygen saturation levels. This is due to the fact that it helps match air to blood supply in the lungs while also opening up regions of lung tissue to allow for greater gas exchange [22].

As a result, the aim of this study is to assess the capacity of the prone positioning to enhance oxygenation in COVID-19 patients as a lung recruitment measure. Surviving an infectious disease is simply the first step; the infectious disease itself can cause long-term impairments, activity limitations, and participation restrictions. Given this expanding body of data, we advocate for more completely integrating multidisciplinary rehabilitation teams, including physiotherapy, across the illness trajectory, from acute and inpatient treatment through ambulatory settings and out into the population.

2. METHODOLOGY

The purpose of the study was to determine the effect of prone position along with conventional respiratory physiotherapy on SpO₂ of COVID-19 patients in Aurobindo hospital, Indore district. The study aimed to improve saturation of oxygen (SpO₂) and to detect the outcome of prone position on SpO₂ in COVID-19 patients in Sri Aurobindo hospital, Indore district. The hypothesized that prone positioning would result in a considerable increase in oxygen saturation in patients infected with COVID-19.

The experimental study was conducted at Sri Aurobindo hospital, Indore district, Madhya Pradesh, India for three months. 400 COVID-19 patients were allotted using non-random convenient sampling in this single-center, prospective feasibility study. The inclusion criteria were both the genders with age group 20-80 years, patients with oxygen therapy, hospitalized in a COVID-19 ward or ICU, actively breathing, COVID-19 positive in RT-PCR or ICMR guideline. The exclusions were critically ill COVID-19 patients with ventilator or BiPAP support, intubated patients, uncooperative patients, alteration of consciousness, active or recent hemoptysis (within the last one month), recent thrombo-embolic venous disease (within the last one month), pericardial effusion, pleural effusion of high abundance, clinical or

scannographic, history of spinal surgery/ bone metastases, wounds, facial trauma, tracheal, sternal or facial surgery < 15 days, recent abdominal surgery (within the last one month), intracranial hypertension > 30mmhg, pregnant or lactating woman.

The dependent variable was Oxygen saturation however the independent variables were prone position and Conventional Respiratory Physiotherapy. Oxygen saturation using Pulse oximeter was used as an outcome measure.

2.1 Procedure

Total 400 COVID-19 patients were taken from the Sri Aurobindo hospital which is the largest teaching hospital of central India. As large number of patients were brought to the hospital, individuals who were eligible for participation and had a proven diagnosis of COVID-19 were asked for verbal informed permission for participating as subjects. The total duration of the convention was 60 minutes. The patient lied down in prone position with the abdomen in contact with the bed, hands and elbow were flexed by the side of head, and head was towards either right or left side. After taking proper hygienic precautions and wearing PPE kit assessment of oxygen saturation by pulse oximeter was done in COVID-19 patients. Than specific body position that was prone position is selected and explained and duration of time spent in position was noted. All individuals were shifted to the prone position for a minimum period of 45-60 minutes. During the process, position tolerance, oxygen saturation, heart rate, and breathing were all examined. If extreme prone position was not assumed than three quarter turn prone with hip and chest supported position may produce Favorable results. Progression and modification of duration was response dependent rather than time dependent.

2.2 Conventional Respiratory Physiotherapy

Along with prone position a set of 5-10 repetition and two times a day of following exercises were given by physiotherapist including diaphragmatic

breathing, thoracic expansion exercises, active ROM of upper and lower limb, active cycle of breathing exercises, glossopharyngeal breathing, and forced expiratory technique.

After a duration of half an hour again oxygen saturation is measured by pulse oxymeter oxygen saturation (SpO2) tested as outcome measure for analysis. Under medical and paramedical supervision, the manoeuvre and clinical monitoring of the patient's compliance to the prone position were performed, including observation of saturation after and during therapy. Obtained data were used for Statistical analysis.

3. RESULTS

This statistical analysis of data collected on more than 400 subjects belonging to one single group has been presented in this chapter. The subjects were patients of COVID-19 with confirmed diagnosis from Aurobindo hospital Indore district. Patients were examined for SpO2 pre and post prone position and Conventional Respiratory Physiotherapy.

The data was examined by applying Mean, standard deviation and analysis of covariance within the group. The pre and post analysis of SpO2 values shows a significant difference after applying prone position and Conventional Respiratory physiotherapy.

Table 1 shows statistical comparison of SPO2 values in single Group. The pre-test means is 95.685 and the post-test means is 98.123.

The Table 1 shows significant differences between the pre-test and post-test means of the group in relation to SPO2 and obtained p-value is less than 0.05(p=0.0001).

From the Table 2 Analysis of covariance (ANCOVA) indicate that F value of SPO2 is 903.883 and the corresponding p value on the chart was less than 0.05 (p<0.0001).

Hence there was significant difference between the means of SPO2 values of the group.

Table 1. Descriptive table of single group in relation to SPO2

Group	TestSPO2	N	Mean	SD	Min	Max
Single	Pre	400	95.685	1.645	91	99
Group	Post	400	98.123	1.445	93	100

**level of Significant 0.05*

Table 2. Analysis of covariance of single group in relation to SPO2

Source	DF	Sum of Squares	Mean of Square	F Value	PValue
Single group	1	578.341	578.341	903.883	P<0.0001
Within group	398	254.657	0.640		
Total	399	832.998			

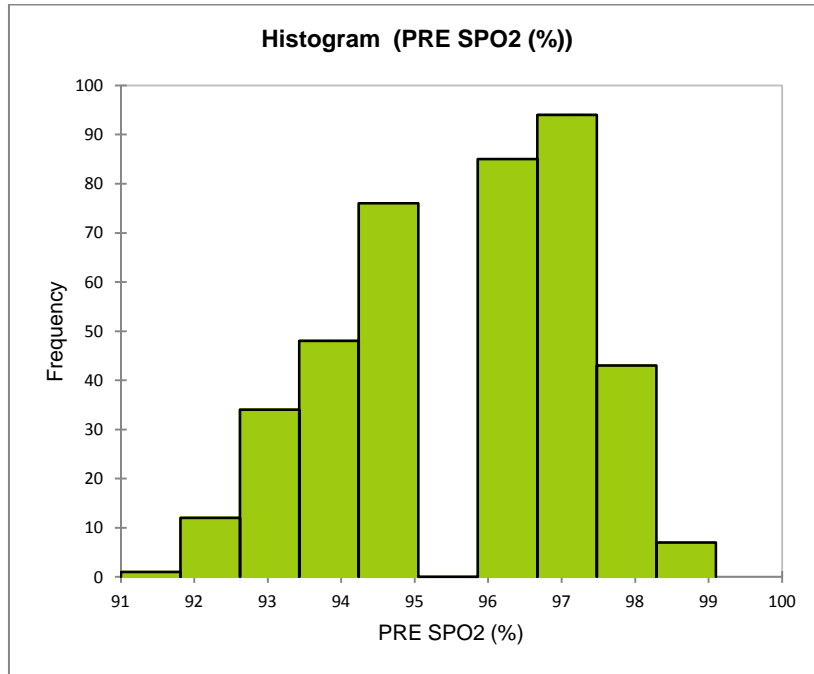


Fig. 1. Graphical Histogram for the Pre SPO2

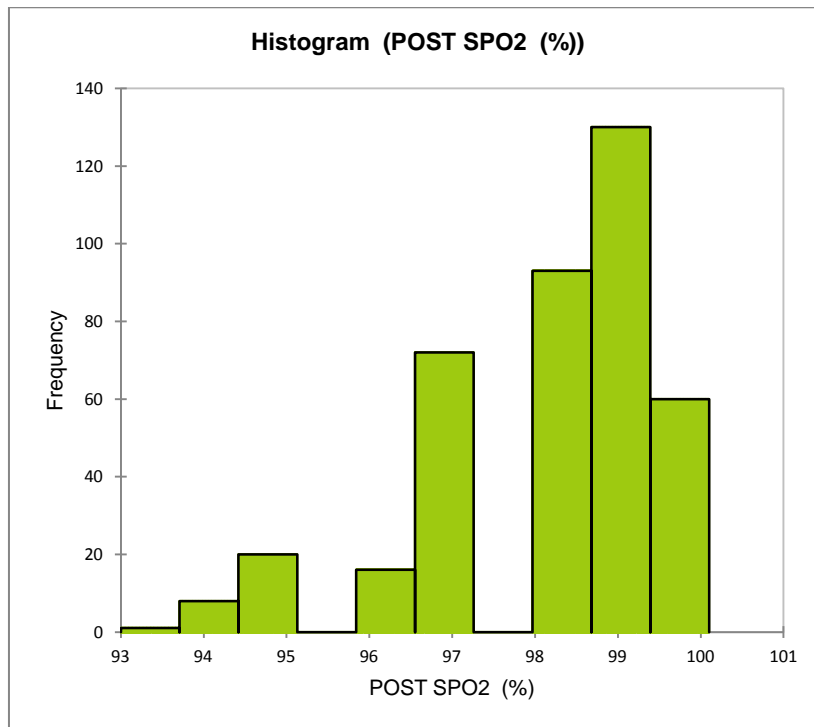


Fig. 2. Graphical histogram for the post SPO2

4. DISCUSSION

The practicality and impact of prone position in voluntarily breathing, COVID-19 patients without intubation were explored in this study. In most patients, prone posture was shown to be safe and practical, and it significantly enhanced physiological oxygenation measurements.

The majority of patients said their symptoms had improved, although some had minor adverse effects such as musculoskeletal discomfort, nausea, or vomiting. Due to the bilateral character of COVID-19 pneumonia, we recommend laying in the left and right decubitus positions for 30 minutes each for patients who cannot tolerate prone positioning. To avoid gastrointestinal adverse effects, the prone positioning was scheduled at least one hour after meal times.

This intervention has a great potential for lowering ICU task strain since it is a low-risk and simple-to-implement therapy in cooperative patients. Furthermore, it is particularly beneficial when -specific COVID-19 therapies are either not available or appears to be ineffective due to the patient's pre-existing illnesses (e.g. liver dysfunction, thrombocytopenia). In our research, there was also no increase in adverse effects. Because the patients were awake and could change their postures for comfort, the danger of problems seen with ARDS ventilation or prolonged spine operations was also reduced.

Physiologically this can be explained with the reason that in supine position the weight of lung causes compression on dorsal region of lung and when the prone position is given to the patients than dorsal region becomes free and expands more freely leading to increase oxygenation. Secondly, when patient takes prone position than the triangular shape of thorax becomes more rectangular leading to more ventilation and oxygenation. With prone position use of mobilization is also causing further opening of inter-costal spaces. All this results in improvement in SpO₂ of COVID-19 patients.

The findings of this study are reinforced by a study trial published in 2020 by Ding et al, in which the researchers evaluated the impact of combining prone position with the use of high-flow nasal cannulae and non-invasive ventilation in patients with moderate-to-severe ARDS [23]. They discovered that adding prone posture to the mix may have helped patients avoid intubation, and that the PaO₂/FiO₂ ratio was considerably

higher in those who avoided intubation. Our findings are also consistent with previous research on COVID-19 patients [24].

In the emergency room, Caputo et al used prone posture on COVID-19 patients and found a substantial improvement in peripheral oxygen saturation. In all of these trials, the percentage of subjects whose oxygenation improved after supine repositioning varied significantly [25]. The findings of our investigation add to the growing body of data that prone position in conscious, voluntarily breathing patients is possible outside of the ICU. Patients are able to respond if they are taken to prone posture immediately after hospitalization and in subjects with high inflammatory markers, according to our findings (e.g., raised lactate dehydrogenase and C-reactive protein concentrations, and decreased platelet counts).

As a result, in patients in which intubation cannot be performed, the prone position might be employed as a supplementary non-invasive technique. This is the biggest prospective trial of prone positioning in awake patients, specifically in patients with COVID-19 pneumonia, that we are aware of. This technique in awake COVID-19 patients has been put forth informally in various clinicians' personal correspondence and on social media. As a result, we feel that a formal assessment of the consequences of prone positioning in this situation is necessary. We gathered high-quality, comprehensive data owing to a clear, straightforward, and well-defined research study. More research on the impact of prone posture on intubation delay and avoidance, ICU admission, duration of weaning from oxygen support, hospitalisation, and respiratory-related fatality is urgently needed. In conclusion, we discovered that in most conscious, voluntarily breathing patients, prone positioning outside of the ICU setting is possible. Prone positioning has been proven to be an effective and patient-friendly strategy for raising blood gas indicators in patients with COVID-19 in the short term. In a meta-analysis, for example, when patients with severe ARDS are placed in the prone position for at least 12 hours a day, Munshi et al. found that the incidence of death decreases [26]. In other words, prone posture can lower death rate only when it is indicated for patients with acute oxygen deficiency in the first hours and for extended periods of time.

Valter et al. observed in 2003 that prone posture improved oxygen levels quickly and allowed

intubation to be avoided [27]. Feltracco et al. documented on five lung transplant recipients who effectively underwent awake prone posture with non-invasive ventilation, with refractory hypoxaemia resolved [28].

In 2015, Scaravilli et al. performed a retrospective analysis on 15 non-intubated patients who had undergone prone positioning operations. Authors discovered that the technique was possible in 95% of all cases and that there was a substantial rise in PaO₂ from before positioning in prone to after repositioning in supine, with PaO₂ reverting to baseline values 6 hours later [29].

In COVID-19 patients, our research confirms the feasibility of prone positioning. Furthermore, prone position is associated with excellent tolerance among cooperative patients, perhaps suggesting the possibility of clinical or subjective benefit. Overall, it appears that research have demonstrated the beneficial effect of the prone positioning in COVID 19 patients explicitly prove that proper selection of patient, timely initiation, and time period of the placement of patient in this position can all influence the success of this therapeutic approach and improve patients' situation, minimize artificial oxygen support, shorten hospitalization, and show some good prognosis.

5. CONCLUSION

Result of study indicates significant improvement in oxygen saturation in COVID-19 patients after giving prone position. So, with the result, it can be concluded that physiotherapy plays an vital role in rehabilitation of patients affected with COVID-19. So, implementation of prone body positioning protocol and Conventional Respiratory Physiotherapy is the need of today to reduce hospital stay. These findings might help in the clinical management of severe COVID-19 patients, especially in situations when limited critical care resources must be used strategically.

The results of this study show a substantial increase in oxygen saturation in COVID-19 patients. We report primary evidence that awake prone position can be a low-risk, low-cost approach that might assist COVID-19 patients delay or avoid the need for ICU. As the number of severe COVID-19 pneumonia patients rises day by day, this will relieve the strain on healthcare resources and personnel. More research is needed to validate our findings and

assess their therapeutic use, including the advantages of prolonging each awake prone positioning period even after one hour if the patient can tolerate it.

6. LIMITATIONS

The lack of a control group. Each patient has a different weight and different immunity resistance. We did not compare prone position with other standard obtained position. Each patients has a different level of chest infection not measure. We did not gather information on lung shape or the effects of prone position on patients. Only oxygen saturation was measured other parameters were not included.

CONSENT

Written informed consent was obtained from all individual participants included in the study.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

ACKNOWLEDGEMENT

We thank the patients who participated and contributed samples to the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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