

Research Article

BENEFICIAL EFFECTS OF AWAKE PRONE POSITIONING IN COVID-19 PATIENTS WITH MODERATE TO SEVERE HYPOXEMIC RESPIRATORY FAILURE

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Abstract: *Introduction:* Coronavirus disease (COVID-19) is a leading cause of acute hypoxemic respiratory failure which can progress to acute respiratory distress syndrome (ARDS). Prone positioning has been known to help in ARDS cases, but they are ventilated, deeply sedated and paralyzed. The aim of the current study was to assess the safety and potential benefits of awake prone positioning in COVID-19 patients with moderate to severe hypoxemic respiratory failure. *Methods:* This is a retrospective cohort study, performed at Bahria International Hospital Lahore. Record of confirmed COVID-19 patients with hypoxic respiratory failure was reviewed thoroughly to collect data. The duration, timing, frequency, tolerability, beneficial effects, and adverse events during prone positioning were recorded from the medical records before and after self-prone positioning. *Results:* The current analysis showed that prone positioning is supportive to maintain good saturation (92%) as compared to keeping patients in spine position (82%). *Conclusion:* It can be concluded from the current study that prone position is helpful to maintain normal oxygen saturation even on low oxygen supply, helping in quick recovery and preventing oxygen induced damage to the lungs.

Introduction

The spread of SARS-CoV-2 began in December 2019, and it has exerted significant stress and pressure on the health care system worldwide because of its potential to develop acute hypoxemic respiratory failure or acute respiratory distress syndrome (ARDS) (Elharrar *et al.*, 2020). Clinicians and researchers have been trying different therapeutic modalities focusing on the treatment of respiratory deficiency and ARDS. One of these is to place patients with ARDS in prone position along with respiratory support through mechanical ventilation (Scholten *et al.*, 2017). It was proposed that this may also be beneficial for patients with hypoxemic respiratory failure associated with SARS-CoV-2 (coronavirus or COVID-19). Understanding heart and lungs physiology is crucial to understand the beneficial effects of prone positioning. When lying down, the fluid accumulates in dependent lung regions that are further augmented by the contents of

the heart and abdomen. As a result, overweight patients have to suffer more when they develop ARDS. This leads to a disparity in perfusion and ventilation (V/Q mismatch), leading to a higher inhaled volume going to the anterior and apical lung units. As these areas have a comparatively less blood circulation, this causes difference between ventilation and perfusion (V/Q mismatch) and increases hypoxemia. When such patients are made to lie prone a more homogeneous distribution of ventilation happens, because the weight of the abdominal cavity and the mediastinum eliminated from the spine areas. This may reopen those closed alveoli, recruit more alveoli and improve gas exchange by decreasing the shunt fraction and improving ventilation and perfusion (Bamford *et al.*, 2020; Slessarev *et al.*, 2020; Teliya *et al.*, 2020). This physiological change may potentially prevent intubation and which can lead to better outcomes. It is a new strategy and demonstrates its feasibility and emerging benefits (Bamford *et al.*, 2020; Elharrar *et al.*, 2020; Sarma

and Calfee, 2020; Slessarev *et al.*, 2020; Telias *et al.*, 2020). In the present study, we investigated the use of prone positioning in a cohort of non-intubated COVID-19 patients with moderate to severe hypoxemia and evaluated its safety, patients' tolerance of position, including duration and frequency, its effects on oxygenation and improvement of respiratory failure in terms of SpO₂/FiO₂ ratio. We also examined the reasons for cessation, possible adverse reactions, and their clinical outcomes as the available data had some queries about their tolerance (Ali *et al.*, 2020; Elharrar *et al.*, 2020; Saddique *et al.*, 2020; Sartini *et al.*, 2020).

Materials and Methods

This study was conducted at the HDU and ICU of Bahira Town International Hospital from 15 May 2020 to 31st of January 2021. The study was approved by the Institutional Review Board and Ethics Committee (IRBEC) of hospital and waived the need for consent. Data were collected retrospectively from medical records.

The data of one hundred and seventy non-intubated patients (n=170) was analyzed who had COVID-19 associated respiratory failure and were admitted to the intensive care unit (ICU) or high dependency unit (HDU) and had moderate to severe hypoxemia, which was defined as the requirement of more than 6 L/min of Oxygen to maintain peripheral Oxygen saturation (SpO₂) greater than 90%. The applied protocol for prone positioning and duration was a standard one that encouraged prone positioning for 8 to 10 hours per day. However, patients were generally encouraged to remain in the prone position

for as long as they tolerated. In case of severe hypoxemia, a high flow nasal cannula (HFNC) was used. Oxygen parameters were monitored with oxygen saturation probes and noninvasive pressure cuffs at the standard intervals. Also, SpO₂/FiO₂ ratios were calculated before and after the prone positioning and their p-value was calculated. All variables were recorded in both supine and prone positions. Causes of aborting the procedure and adverse events, if any, such as intravenous catheter dislodgement, vomiting, pain, pressure ulcers or hemodynamic instability were also reviewed. Statistical analysis was done by using SPSS version 20 Nominal data was presented in the form of percentage and frequencies and continuous variables were compared by using paired T- test. Single tailed P value less than 0.05 were considered statistically significant. The primary goal of the study was to assess the improvement of saturation and decrease in Oxygen demand and secondary outcome was the tolerability of the procedure and the duration of hospital stay.

Results

In the current study, total of one hundred and seventy patients were recruited and analyzed about their respiratory status in two positions, prone and supine. First in prone positioning and the second was in spine position. All included cases were already diagnosed to have moderate to severe covid-19 infection confirmed on PCR. In this study 51.2% of cases were male and 49.8% were females. Age of the patients were categorized into the subgroups having comparable subjects. Patients having prior respiratory illnesses were excluded from the study. (Table-1)

Table :1 Demographic variables

VARIABLES	CONSTRUCTS	FREQUENCY (%)	TOTAL	P-value*
Gender	Male	87 (51.2%)	170	0.569
	Female	83 (49.8%)		
Age	30 To 39	51 (30%)	170	0.662
	40 To 49	61 (35.89%)		
	50 And above	58 (34.11%)		
Comorbid¹ Conditions	Respiratory Problems	0	170	> 0.05
	Non-Respiratory Diseases (DM, IHD, HTN)	81		
	No co-morbidity	89		
Location	HDU	120	170	>0.05
	ICU	50		

1 DM= Diabetes mellitus, IHD= Ischemic heart disease, HTN= hypertension

*Insignificant p value showed both male and female group were not comparable.

The average duration of prone positioning was 165 (30–300) minutes, and the peripheral oxygen saturation was 87% (80%– 93%) in supine position and 96% (92%–100%) when the patients were in

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prone position. In supine position, patients had saturation of 85% on 60% FiO₂ but after 2 hours of prone positioning it improved to 94% on same FiO₂. (Table-2) Limitations of the prone position were general discomfort, duration, low back pain (5.5%),

and fear of hypoxia (5%). Seven patients (4.1%) needed intubation and two patients (1.2%) died. 84.2% of patients had no limitations and recovered from mild to moderate respiratory distress syndrome associated with the COVID-19 infection.

Table 2: Levels of Different Parameters Before and After Prone Positioning:

Parameters	In Supine Position		In Prone Position		P-VALUE*
	Mean (M)	Standard Deviation (S.D)	Mean (M)	Standard Deviation (S.D)	
O ₂ saturation (SpO ₂ %)	87.17	4.83	96.41	3.96	0.00063
O ₂ demand (litters)	6.00	2.00	3.00	1.00	0.00011
SpO ₂ /FiO ₂ ratio	87.5	3.5	95	4	0.00077

*Paired t-test was used to check the significance of variance.

Discussion

We analyzed oxygen saturation levels of one hundred and seventy non-intubated patients of covid-19 infection. As a whole, in our study significant adverse effects were observed. Fear of desaturation and backpain were the most important factors causing hindrance in prone positioning. Those who tolerated the prone positioning more than ten hours per day showed improvement in their oxygen saturation levels. Similar study has been done on COVID patients (Mady *et al.*, 2020; Pavlov *et al.*, 2020; Tabassum *et al.*, 2020). Their mortality rate was extremely high as compared to our study due to smaller sample size and the patients needed intubation were more than 40% as compared to our study which showed only 4.1% patients that were intubated. The attraction of using awake prone position is to alleviate the need for mechanical ventilation (VIN or invasive ventilation) for patients who are at the greatest risk of needing intubation. Our study revealed that prone positioning of non-intubated hypoxemic patients of COVID-19 is possible. However, a considerable number of patients may not tolerate prolonged periods of lying prone or more than one session in this position while awake. But it was observed that after 2 hours of lying prone Oxygen saturation improved with same fraction of inspired Oxygen (FiO₂), which favors the beneficial effects of this position (Elharrar *et al.*, 2020). Those who could not tolerate prolonged prone positioning showed worse outcome like extended stay in the hospital and greater chances of intubation as compared to those who were able to manage long duration of prone positioning. Given this observation, the clinical benefits of short durations of prone

positioning durations may be limited. This study is also one of the few studies that revealed the adverse effects and complexities of prone positioning. In this cohort, we discovered no iatrogenic withdrawal of lines or tubes associated with the prone positioning. No pressure ulcers, aspiration events, or hemodynamic instabilities were found. Only few studies notified such changes and findings of these match with our results. As a whole, 84.2% of our patients were successfully and safely treated in prone position with no further monitoring.

Conclusion

From the results of above analyses, we can conclude that prone positioning in non- intubated COVID-19 patients with moderate hypoxemia is safe and beneficial in terms of improvement in hypoxia, oxygen demand and Spo₂/FiO₂ ratio.

Recommendations

We can recommend that this therapy can be safely used in hospital ICUs, isolation rooms and even in wards. This simple technique can be adapted particularly in pandemics when the hospital resources are limited or full because of large number of critically ill patients. Mild to moderate cases can be prevented to progress to severely ill cases and need of an ICU or bed with ventilator can be prevented, especially during a pandemic when the resources are quite limited.

Limitations

The limitations of this study were deviation from the standard protocols of prone positioning due to limitation on the part of individual patients like back pain, joint stiffness and morbid obesity etc. Moreover, no randomization and no control group could be there because of a retrospective study design.

Conflict of interest

The authors declared no conflict of interest.

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