Effect of Prone Positioning As Modality for Improvement in Bedside Oxygen Saturation in Awake Non-Intubated COVID-19 Patients and Its Relationship With High Resolution CT Chest Severity Score

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ABSTRACT

Objective: To evaluate the effectiveness of awake proning on bedside oxygen saturation in non-intubated severe COVID-19 cases and its association with high-resolution CT chest severity score.

Study Design: Prospective observational study.

Place and Duration of Study: Pak Emirates Military Hospital Pakistan, from Jun to Jul 2020.

Methodology: This study was conducted on 150 laboratories confirmed SARS-CoV-2 infected cases with moderate to severe category pneumonia, requiring supplemental oxygen but not mechanical ventilation, admitted in the High Dependency Unit of the Military Hospital. Bedside oxygen saturation was recorded via pulse oximeter before and after proning of 10 minutes to evaluate whether oxygen saturation increased, decreased or remained the same post proning.

Results: Out of 150 patients, it was observed that 67 (45%) patients showed 2% increase of oxygen saturation over 10 minutes of proning, 48 (32%) patients showed an increase of 1% while 20 (13%) patients showed an increase of 3%. It was also observed that 13 (14.7%) patients out of 88 patients, with HRCT severity score of >50% showed an increase of 3% compared to 7 (11%) patients out of 62 patients with HRCT severity score of <50%.

Conclusion: At least 60% of the patients showed an improvement of 2% or more after 10 minutes of proning, which concluded that awake proning in non-intubated patients may help improve oxygen saturation.

Keywords: Awake proning, COVID-19, HRCT chest severity score, Oxygen saturation.

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INTRODUCTION

COVID-19 is an ongoing global pandemic and a significant public health challenge. The SARS-CoV-2 virus causes a variety of symptoms, among which the most common symptoms are fever (83%), cough (82%) and shortness of breath (31%).[1] This disease causes pulmonary oedema, multi-organ failure and acute respiratory distress syndrome (ARDS) (17%).[1]

Prone positioning has been used in intensive care facilities in ARDS cases 2 and to prevent ventilator-induced lung injury.[3] The mechanism of prone positioning in improving oxygenation includes more homogenous oxygenation from dorsal to ventral lung area 4 and relieving dependent lung areas from heart-weight compression.[5] However, prone positioning in ICU patients on a ventilator is laborious and can lead to various complications.[6] The same principles are applied for non-intubated patients needing oxygen support.[7] This study evaluates the effectiveness of awake proning on bedside oxygen saturation in non-intubated severe COVID-19 cases.

The chest-CT-severity-score (CT-SS) is used to determine the extent of disease in lungs.[8] COVID-19 pandemic is challenging both for healthcare professionals and facilities, as several patients requiring intensive care facilities are overburdening the available resources worldwide. Pakistan is also facing shortages of beds and ventilators in intensive care units.[9,10]

Prone positioning can help improve oxygenation decrease in the disease progression, need for ventilation and ICU transfer, thus decreasing mortality. In such resource-limited conditions, it proves to be a low-cost manoeuvre with low risk for severely strained intensive care facilities.

METHODOLOGY

This prospective observational study was conducted among non-intubated severe COVID-19 cases admitted to Pak Emirates Military Hospital, Rawalpindi from Jun to Jul 2020.

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Both males and females and ages ranging between 25-85 years were included in this study. Informed consent of all the patients and approval from the Institutional Review Board (IRB # A/28/ 150/2020). These cases were laboratory-confirmed COVID-19 positive, using reverse transcription-polymerase chain reaction (RT PCR) on nasopharyngeal and oropharyngeal swabs samples.

Inclusion Criteria: Severe adult COVID-19 cases (not intubated) admitted in the High Dependency unit with clinical signs of pneumonia (fever, cough, dyspnea, tachypnea) and any one of the following sings: respiratory rate >30 breaths/min; severe respiratory distress; or SpO2 <90% on room air 11 were included in the study.

Exclusion Criteria: Patients with acute respiratory failure requiring intubation having progressive acute hypoxemic respiratory failure, failing to respond to standard oxygen therapy, even when maximum flow rates of 10-15 L/min of oxygen were delivered via a facemask with reservoir bag 11 were excluded from the study. Pregnant females, patients with heart failure, hemodynamic instability, COPD, cervical spondylosis, abdominal pathologies, altered level of consciousness and critical COVID-19 cases (those with signs of sepsis or septic shock) 11 were also excluded from the study.

All the patients underwent HRCT chest imaging by Toshiba Alexion 16-slice CT scan system. A consultant radiologist blinded to the clinical and laboratory indicators reviewed each HRCT and chest CT severity score was calculated. Informed consent was taken from the patients. We asked these patients to lie on their stomachs with arms positioned at the side and face placed on either side. There was no restriction for any adjustment in position or use of a pillow under the hips/ pelvis for the patient's comfort. Oxygen saturation was measured using a SpO2 probe attached to a cardiac monitor (Trionara Vitus 4+). Oxygen saturation was recorded before proning and 10 minutes after proning. Patients were encouraged to continue proning for at least 3 hours, depending on their tolerability. Since the patients were conscious and were allowed to adjust their position in case of any discomfort, no adverse events were recorded during the study.

Statistical Package for Social Sciences (SPSS) version 21 was used for the data analysis. Quantitative variables were summarized as mean ± SD and qualitative variables were summarized as frequency and percentages. Chi-square test was applied to find out the association. Five levels were formed based on the percentage change in the oxygen saturation from 1-5% during pronation. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

Out of 150 patients, 115 (76.67%) were males and 35 (23.33%) were females. In terms of HRCT severity score (SS), 62 patients (41.33%) had HRCT-SS less than 50% and 88 patients (58.67%) had HRCT-SS score of greater than 50%.

When assessing overall variation in oxygen saturation, it was observed that 67 (45%) patients showed 2% increase of oxygen saturation over 10 minutes of proning, 48 (32%) patients showed an increase of 1% while 20 (13%) patients showed an increase of 3%. Furthermore, 11 (7.3%) treated patients showed no response to the proning. During this intervention, no decrease in oxygen saturation was observed in all the patients (Figure).

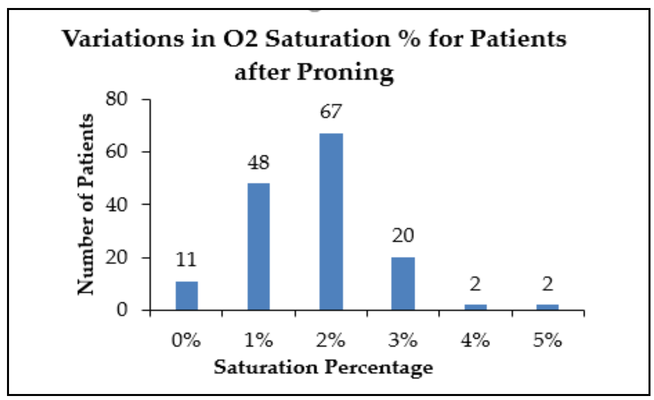

Figure: Summary of variation in O2 saturation for COVID-19 patients after prone position.

Table-I showed the oxygen requirement of patients and variation in oxygen saturation after proning. Pearson chi-square test revealed that the oxygen requirement of patients had a statistically significant relationship with the percentage change in oxygen saturation due to proning ($p<0.05$). It showed that patients requiring higher oxygen exhibited little response towards proning. 4 out of 6 patients on 15 L of oxygen showed only 1% increase of oxygen saturation after 10 minutes of proning. However, for patients with a low oxygen requirement of 2L, it was observed that out of a total of 35 patients, 15 patients (42.9%) showed 2% increase, 14 patients (40%) showed an increase of 1% and two patients (5.7%) showed an increase of 3%. Furthermore, it was also observed that at least 60% (91 out of 150) treated patients showed an improvement of 2% or more.

It was observed that 13(14.7%) patients out of 88 patients with HRCT severity score of >50% showed an increase of 3% compared to 7 (11%) patients out of 62 patients with HRCT severity score of <50%. Oxygen requirement of patients had a statistically significant relationship with the percentage change in oxygen saturation due to proning. [*p*<0.05 (0.002 for HRCT score <50% and 0.001 for HRCT score >50%)] as shown in the Table-II.

minutes of awake proning. However, 13 patients (24%) failed to improve or maintain their oxygen saturation and required ventilatory support within 24 hours.

Several studies showed improvement in gas exchange with awake proning in non-intubated COVID-19 patients on Oxygen support.[16-20] However, no information on the correlation of HRCT severity score and variation in oxygen saturation after proning is provided. Statistically, no significant difference was

Table-I: Oxygen requirement of patients and variation in oxygen saturation after proning (n=150).

Parameters	Study Groups						
Oxygen Requirement	Group A (0%) Change (n=11)	Group B (1%) Change (n=48)	Group C (2%) Change (n=68)	Group D (3%) Change (n=20)	Group E (4%) Change (n=2)	Group F (5%) Change (n=1)	*p*-value
1 L	1 (5.6%)	3 (16.7%)	10 (55.6%)	4 (22.2%)	-	-	0.001
2 L	3 (8.6%)	14 (40.0%)	15 (42.9%)	2 (5.7%)	1 (2.9%)	-	0.001
3 L	-	7 (53.8%)	4 (30.8%)	2 (15.4%)	-	-	0.002
4 L	1 (4.5%)	7 (31.8%)	10 (45.5%)	3 (13.6%)	-	1 (4.5%)	0.001
5 L	3 (27.3%)	2 (18.2%)	3 (27.3%)	2 (18.2%)	1 (9.1%)	-	0.004
6 L	1 (7.7%)	1 (7.7%)	10 (76.9%)	1 (7.7%)	-	-	0.001
7 L	-	1 (16.7%)	2 (33.3%)	3 (50.0%)	-	-	0.003
8 L	2 (20.0%)	3 (30.0%)	4 (40.0%)	1 (10.0%)	-	-	0.001
9 L	-	2 (66.7%)	1 (33.3%)	-	-	-	0.001
10 L	-	2 (22.2%)	5 (55.6%)	2 (22.2%)	-	-	0.001
12 L	-	2 (66.7%)	1 (33.3%)	-	-	-	0.001
13 L	-	-	1 (100.0%)	-	-	-	0.001
15 L	-	4 (66.7%)	2 (33.3%)	-	-	-	0.001

Table-II: HRCT severity score of patients and variation in oxygen saturation after proning (n=150).

Parameters	Study Groups						*p*-value
HRCT Severity Score	Group A (0%), Change (n=11)	Group B (1%) Change (n=48)	Group C (2%) Change (n=68)	Group D (3%) Change (n=20)	Group E (4%) Change (n=2)	Group F(5%) Change (n=1)	
<50%	6 (9.68%)	19 (30.65%)	28 (45.16%)	7 (11.29%)	1 (1.61%)	1 (1.61%)	0.002
>50%	5 (5.68%)	29 (32.95%)	40 (45.45%)	13 (14.77%)	1 (1.14%)	0 (0%)	0.001

DISCUSSION

The prone positioning has been found as a feasible treatment modality in awake, spontaneously breathing patients requiring oxygen support.[12] It has been proven to improve oxygenation significantly. This, in turn, can help reduce the need for intubation and thus help to reduce the shortage of high-cost ventilators. However, it has also been observed that this effect in oxygen saturation is lost when a position is reverted to supine.[13] Keeping in view the risk-benefit ratio, patients' oxygen saturation should be closely monitored during prone positioning to avoid any risk of delayed intubation.[14]

In our study, 92.7% showed improved oxygen saturation after 10 minutes of awake proning, while 7.3% showed no response to proning. When compared to a study conducted by Caputo *et al*,[15] 100% patients showed improvement in oxygen saturation after 5

observed between patients having HRCT scores <50% and >50% (*p*-value 0.21), indicating that improvement in oxygen saturation with proning was similar for patients of both groups irrespective of their HRCT severity score. Our study showed that improvement in oxygen saturation can be seen irrespective of the increase in oxygen requirement to inflamed lungs.

The study was aimed to observe the effect of awake proning on oxygen saturation in non-intubated patients. At least 60% of the patients showed an improvement of 2% or more after 10 minutes of treatment. Further studies are required to explore the potential benefit across the general population and its long-term effect on improving respiratory parameters and mortality.

LIMITATIONS OF STUDY

The patient-centric outcomes (mortality, intubation, etc.) were not considered in the study. The study was conducted at just one COVID centre among several hundred set ups. The sample population does not represent the effects of the treatment across the entire population. The study has focused on the effect of oxygen saturation in non-intubated patients; further prospective studies can include session-wise, within-day effects and between-days effects of proning. Instead of concentrating on the total sample size, the same population can be divided into age-wise groups. This can give us a better idea of this intervention in clinical practice. It will also help discern whether the treatment significantly affects certain age groups. In addition, prolonged treatment and its effect in reducing oxygen requirement, sustained effect after re-supination, delay or avoidance of intubation and consequently, its effect on respiration-related mortality still need deliberate exploration.

CONCLUSION

At least 60% of the patients showed an improvement of 2% or more after 10 minutes of proning, which concluded that awake proning in non-intubated patients may help improve oxygen saturation.

Conflict of Interest: None**.**

Authors' Contribution

UQ: Discussion, NA: Data collection, SN: Result and analysis, AQ: Data collection, AH: Data analysis, ASK: Data analysis.

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