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Original Research Article

To study the effect of proning the patient on ROX index in Covid patients on HFNC

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A B S T R A C T

Background: The study aimed to determine the outcome of prone position on oxygenation by studying the ROX index of the COVID 19 patients.
Materials and Methods: This study was conducted as a prospective observational study on COVID 19 patients admitted in HDU and ICU requiring HFNC at Gandhi Medical College and Hamidia hospital Bhopal which is a tertiary COVID Centre, during the study period of 1 year. Detailed history was obtained and examination was done. Subjects who did not perform or did not allow prolonged proning were included as control. SpO2, RR, ROX index were assessed at baseline, at 30 min, hourly for 6 hours and at 12 hours to assess the improvement in oxygenation.
Results: A total of 60 COVID-19 confirmed cases were enrolled with mean age of 57.22±8.9 years. The two groups were thus comparable with respect to baseline variables. Mean SpO2, RR and ROX index significantly improved following prone positioning. The need for invasive mechanical ventilation was significantly higher in group 2 (30.8%) as compared to group 1 (8.8%), ($p<0.05$). Similarly, mean time to recovery of hypoxia was significantly earlier in group 1 (6.9±1.8 days) when compared to group 2 (8.2±2.3 days) ($p<0.05$).
Conclusion: Prone positioning is a simple and safe manoeuvre to improve oxygenation in COVID-19-associated hypoxemic respiratory failure. Prone positioning for longer duration reduce the work of breathing and improve the respiratory rate, SpO2 and FiO2 and ROX index. Also, prone positioning for prolonged duration is effective in obviating the need for invasive mechanical ventilation.

1. Introduction

The patients with deadly COVID 19 pandemic may present with mild/asymptomatic disease (not requiring hospitalization) to severe debilitated illness (requiring ICU admission).[1] The severe illness is noted in approximately 20% cases, of them approximately 85% patients require intensive care.[2,3] Though, overall the mortality rate of COVID 19 infection is low, mortality rate remains high in severe cases. According to a systematic review, mortality in ICU patients may range from 31.1% to 79%. The mortality rate may be much higher in patients requiring invasive mechanical ventilation.[4]

As the pandemic has drained all the healthcare resources (including oxygen, ventilators, healthcare workers), there is a need to conserve essential resources and doing maneuvers which improve oxygenation of the patients.[5,6] Among such maneuvers, prolonged proning for atleast 12 hours to 16 hours per day has been associated with reduction in oxygen requirement as well as mortality even in intubated patients with severe ARDS.[7] Thus early and prolonged proning can be effectively utilized with minimum resources to reduce the

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severity and need for invasive mechanical ventilation.[8]

The ROX (Respiratory rate-oxygenation) index is recently being used for predicting the severity of COVID 19 infection and need of invasive mechanical ventilation in such patients. ROX index is calculated as the ratio of SpO2/FIO2 to respiratory rate.[9,10] With this background, the present study was conducted to determine the outcome of prone position on oxygenation by studying the ROX index of the COVID 19 patients suffering from hypoxic respiratory failure being treated by HFNC.

2. Materials and Methods

This study was conducted as a prospective observational study on COVID 19 patients admitted in HDU and ICU requiring HFNC at Gandhi Medical College and Hamidia Hospital during the study period of 1 year i.e. from 1st May 2020 to 30th April 2021. After obtaining approval from the institutional ethics committee, 60 patients of RT-PCR-confirmed COVID-19 cases whose oxygen saturation (SpO2) on room air was less than 94% were included in the study. However, hemodynamically unstable, patients with altered sensorium; body mass index (BMI) >30 kg/m^2; pregnant females and intolerance to prone position were excluded.

Patients were initially stabilized and were put on Oxygen therapy using HFNC as per their requirement. Detailed history regarding baseline variables like age, residence, mode of infection, duration of illness, comorbidities, clinical features etc. Further, radiological involvement, and severity of illness were recorded. No sedation was given to the patients. Patients on HFNC were assisted in changing positions and placed in prone position using pillows using the protocol according to Sryma PB et al.[11] Following protocol was used for proning- First the patients were explained the procedure and it's benefits. Oxygen tubings were assessed with respect to their patency and length during the proning. Pulse oximeter monitoring was done throughout the length of hospital stay with the help of monitors. Patients were helped and assisted in changing the position. Prone position was maintained for a minimum of 2 hours at a stretch with a target duration of 8 hours/day. HFNC settings before and during the prone positioning were not changed.

Subjects who were not performing or did not allow prolonged proning were included as control.

ROX index was used bedside to assess the degree of hypoxemic respiratory failure (SpO2/FiO2% / respiratory rate, [breaths per min]). It was calculated at baseline and at 30 min, hourly for 6 hours and at 12 h to assess the improvement in oxygenation. In case of any worsening hypoxia with respiratory distress, patient was put on NIV as per the treating team. If the patient maintained SPO2 more than 93% on room air in supine position it was taken as recovery. All the patients were assessed during the hospital stay.

2.1. Statistical analysis

Data was compiled using MsExcel and analysed using IBM SPSS software version 20. Categorical variables were expressed as frequency and proportions whereas numerical variables were expressed as mean and standard deviation. Chi square was used to assess the association of categorical variables whereas difference in numerical variables were assessed using independent t test. One way ANOVA was calculated to assess the difference in mean respiratory rate, ROX index and SpO2 during various follow up within a group. P value less than 0.05 was considered statistically significant.

3. Results

A total of 60 COVID-19 confirmed cases fulfilling the inclusion criteria were enrolled, of them, 34 were enrolled in prolonged proning group (group 1) whereas 26 cases were enrolled in control group (group 2). Mean age of patients admitted with COVID 19 infection was 57.22±8.9 years and about 55% cases were males.Table 1

In present study, we observed no significant differences between patients of group 1 and group 2 in baseline variables. The two groups were thus comparable with respect to age, gender, comorbidities, duration of symptoms, severity of illness and oxygen supplementation ($p>0.05$). Table 2

Mean SpO2 was comparable between two groups throughout the observation period ($p>0.05$). However, over the observation period of 12 hours, mean SpO2 improved significantly in group 1 ($p<0.05$) but not in group 2 ($p>0.05$). Table 2

Mean respiratory rate in group 1 and group 2 at baseline were 28.2±3.5 and 27.8±3.9 per minute respectively. Respiratory rate at 12 hours was significantly better in group 1 (24.4±3.3/min) as compared to group 2 (26.7±2.7/min) ($p<0.05$). Prolonged proning significantly improved the respiratory rate over the period of 12 hours ($p<0.05$).

Though, ROX index was comparable between the groups at baseline ($p>0.05$), the difference in mean ROX between 2 groups was statistically significant after 30 minutes of proning and positive effect of prolonged proning could be observed in group 1 throughout the observation period ($p<0.05$).

The need for invasive mechanical ventilation was significantly higher in group 2 (30.8%) as compared to group 1 (8.8%), ($p<0.05$). Similarly, mean time to recovery of hypoxia was significantly earlier in group 1 (6.9±1.8 days) when compared to group 2 (8.2±2.3 days) ($p<0.05$). However, we documented no significant difference in mortality between two groups ($p>0.05$).Table 3

Table 1: Comparison of baseline characteristics of two groups

Variables		Group 1 (n=34)	Group 2 (n=26)	Total	P value
Age (years)	mean±SD	58.24±8.19	56.19±9.67	57.22±8.9	0.38
Gender	Male	19 (55.9%)	14 (53.8%)	33 (55%)	0.87
	Female	15 (44.1%)	12 (46.2%)	27 (45%)	
Comorbidity	HTN	7 (20.6%)	5 (19.2%)	12 (20%)	0.89
	Diabetes	12 (35.3%)	6 (23.1%)	18 (30%)	0.31
	Any	15 (44.1%)	8 (30.8%)	23(38.3%)	0.29
Duration of symptoms (days)	Mean±SD	6.9±2.7	7.1±2.4	7.0±2.6	0.77
Chest X-ray severity	<3	3 (8.8%)	2 (7.7%)	5 (8.3%)	0.88
	≥3	31 (91.2%)	24 (92.3%)	55 (91.7%)	
Oxygen supplementation	Conventional	26 (76.5%)	21 (80.8%)	47 (78.3%)	0.17
	HFNC	5 (14.7%)	3 (11.5%)	8 (13.3%)	
	NIV	3 (8.8%)	2 (7.7%)	5 (8.3%)	
Duration of proning on day1 (hours)	Mean±SD	7.9±3.2	-	NA	

Table 2: Comparison of vitals between and within the groups

Vital parameters		Group 1 (n=34)	Group 2 (n=26)	P value
SpO2	Baseline	92.6±2.2	92.8±2.1	0.72
	30 min	93.9±2.7	93.2±2.4	0.30
	6 hrs	94.5±3.1	94.1±2.8	0.61
	12 hrs	95.4±3.3	94.3±2.9	0.18
	P value	0.001	0.12	
Respiratory rate	Baseline	28.2±3.5	27.8±3.9	0.68
	30 min	26.6±2.4	27.1±3.3	0.49
	6 hrs	26.1±2.9	26.9±2.8	0.28
	12 hrs	24.4±3.3	26.7±2.7	0.005
	P value	0.002	0.63	
ROX index	Baseline	8.3±2.2	8.4±2.4	0.87
	30 min	10.3±2.5	7.9±2.3	0.001
	6 hrs	11.1±3.3	7.2±3.9	0.001
	12 hrs	12.3±3.6	6.85±3.3	0.001
	P value	0.001	0.26	

Table 3: Comparison of final outcome between 2 groups

Outcome		Group 1 (n=34)	Group 2 (n=26)	P value
Mechanical ventilation required	Yes	3 (8.8%)	8 (30.8%)	0.03
	No	31 (91.2%)	18 (69.2%)	
Time to recovery of hypoxia (days)	mean±SD	6.9±1.8	8.2±2.3	0.02
Final outcome	Discharge	32 (94.1%)	21 (80.8%)	0.11
	Death	2 (5.9%)	5 (19.2%)	

4. Discussions

The basic pathology of COVID 19 infection is development of severe ARDS. The disease may begin as mild illness with flu like symptoms and as the infection progresses, the patient may develop severe illness with characterized by decreased oxygen saturation, acute lung injury and ultimately Acute Respiratory Distress Syndrome (ARDS).[12] ARDS is characterized by acute and diffuse damage to alveolar capillary barrier, increased vascular permeability, reduced lung compliance leading to hypoxemia.[13] Early and prolonged proning is advised in intubated patients with ARDS to improve oxygenation.[14] During supine position, heart and abdominal viscera compress the posterior parts of lungs, leading to increase in dorsal pleural pressure whereby decreasing transpulmonary pressure. However, in patients with ARDS, this phenomenon is further exaggerated due to increase in weight of lungs, further mismatching ventilation/perfusion (V/Q) ratio.[15]

In present study, a total of 60 patients were enrolled and of them, prolonged proning was encouraged in 34 patients. In present study, we observed no significant differences between patients of group 1 and group 2 in baseline variables. The two groups were thus comparable with respect to age, gender, comorbidities, duration of symptoms, severity of illness and oxygen supplementation ($p>0.05$). Our study documented significant improvement in mean SpO2 as well as respiratory rate in patients practicing prolonged proning over the period of 12 hours as compared to baseline ($p<0.05$). However, the mean SpO2 as well as respiratory rate improved in control group also, but the difference was statistically insignificant ($p>0.05$). The effect of proning on improvement of vitals have been documented by Sryma et al in which the authors documented significant improvement in patients after 12 hours of proning ($p<0.05$).[16] Daniel et al recommended the proning position even in non intubated patients to improve their outcomes.[14] The improvement in outcome as a result of proning in COVID-19 hypoxemic respiratory failure has been shown in various studies.[17–19] These studies demonstrated the improvement in PaO2/FiO2 ratio and the respiratory rate among patients even after proning for short period of time. However, few studies documented reversal of PaO2/FiO2 ratio and the respiratory rate to baseline after supination.[19]

Prone position improve the lung oxygenation by different mechanism. Prone position improve respiratory mechanics; homogenize the pleural pressure gradient, the alveolar inflation and the ventilation distribution; increase lung volume and reduce the amount of atelectatic regions. Also, it helps in drainage of secretions as well as reduce ventilator-associated lung injury. All these effects of prone positioning help in improving the ventilation perfusion mismatch seen in respiratory failure and thereby improve oxygenation.[16,20]

The ROX index is a simple tool, which is used bedside, reflect the work of breathing.[16] In our study, prone positioning was significantly associated with improvement in ROX index. Our study findings were supported by findings of Sryma et al.[16] Finally the outcome was significantly better in prone group as compared to controls in terms of need for invasive mechanical ventilation and time to recovery of hypoxia. However, we documented no significant difference in mortality between two groups ($p>0.05$). Similarly, Koeckerling et al documented that prone position may slow the respiratory deterioration in severe COVID-19 patients requiring oxygen supplementation or NIV. Also this positioning might be helpful in reducing the need for invasive mechanical ventilation.[21] Ding et al also documented significant improvement in P_{aO2}/F_{IO2} and reduced need of invasive mechanical ventilation in severe cases following awake proning. Sryma et al also documented significant improvement in mean ROX in cases undergoing prone positioning and low need for invasive mechanical ventilation.[16]

The study had certain limitations, the sample size was small, and patients were recruited in two groups based upon their consent of maintaining prone positioning. Thus non randomized sampling was used. However, the comparability in baseline variables between two groups were ensured.

5. Conclusion

Prone positioning is a simple and safe manoeuvre to improve oxygenation in COVID-19-associated hypoxemic respiratory failure. Prone positioning for longer duration reduce the work of breathing and improve the respiratory rate, SpO2 and FiO2 and ROX index. Also, prone positioning for prolonged duration is effective in obviating the need for invasive mechanical ventilation.

6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

7. Source of Funding

None.

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