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Effect of Early Awake Prone Positioning on Oxygen Saturation in Moderate to Severe COVID-19 Patients; A Retrospective Study

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Abstract: SARS-CoV-2 has been classified as a pandemic by the World Health Organization. Respiratory problems are the most common complaint among those who have COVID-19, in ventilated individuals suffering from severe respiratory distress. The prone posture has historically been utilized to enhance oxygenation and reduce barotrauma. To see what would happen as an actual outcome treatment in COVID, awake proning is being tested for its potential to delay invasive ventilation while improving oxygenation and patient outcomes. As a net consequence, we performed a retrospective case study on non-intubated COVID-19 patients to see if awake proning with oxygen treatment was beneficial. ***Materials and methods:*** A retrospective observational study was conducted at Rajshahi Medical College Hospital, Rajshahi, Bangladesh from Nov 1 to Dec 31 2020. Our study included 75 patients (18 years or above) admitted with moderate and severe COVID-19 infection. Patients with hypoxemia (oxygen saturation <94%) or respiratory distress (≥30 breaths/min), or patients getting oxygen via Face Mask at 10L/min or Non-Rebreather Mask at 15L/mi were classified into the severe disease category. Patients were encouraged to continue different prone positions for 24 hours based on their comfort level and tolerance. Other COVID treatments were applied in accordance with the guidelines of the hospital. ***Results:*** The most common comorbid conditions were hypertension (78.61%), bronchial asthma (41.33%), and diabetes mellitus (40.00%). However, hypertension and more than one comorbidity (AOR -33.44, 95% CI 0.58 – 1912.87) are associated with increased mortality. The mean arterial oxygen saturation (SpO2) on admission was greater than 80%. P/f ratio in supine position was 86.47 ± 1.33 mm Hg before pronation and improved to 95.45 ± 1.53 mm Hg after pronation ($p = 0.001$). From the first to the fourteenth day, there was a noticeable difference. The average length of time spent was 14 days. ***Conclusion:*** Positioning patients awake and prone improved SpO2 and the P/f ratio significantly in the COVID-19 individuals diagnosed with improved clinical symptoms and reduced intubation rates.

Keywords: Awake-prone position, COVID-19, SARS-CoV-2

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INTRODUCTION

SARS-CoV-2, a new strain of coronavirus originating in China, has already been detected in over 200 countries worldwide. The WHO has classified this as a pandemic. (1) COVID-19 is predominantly a disease of the respiratory system, based on what I've read from CDC. COVID-19 symptoms range from mild flu-like sickness to severe respiratory distress enough to necessitate mechanical ventilation. (2) COVID-19 patients frequently have low oxygen saturation levels, necessitating employing extra oxygen. A condition known as "happy hypoxia" indicates the lack of symptoms such as dyspnea and tachycardia. (3) For a long time, intubated people suffering from ARDS have been encouraged to use prone ventilation as a recruitment technique. (4)

Posture yourself in the prone position while you are awake. Treatment, recently developed, has proven to have several advantages. This method enhances

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oxygenation while the requirement for intrusive breathing is minimized." (5) A high-flow oxygen treatment, there is evidence to suggest that sleeping in an awake-prone posture is a low-risk, simple-to-execute, and low-cost management. The method in non-intubated patients resulted from the worldwide pandemic straining many nations' resources. (6) To determine if awake-prone position treatment helps COVID-19 patients, we did retrospective observational research at Rajshahi Medical College Hospital.

MATERIALS AND METHODS:

This prospective, single-center study was placed at Rajshahi Medical College Hospital, Rajshahi, Bangladesh, from Nov 1 to Dec 31 2020. RMCH is one of the largest tertiary care hospitals with a designated COVID-19 treatment facility starting from May 16 2020. Our study included 75 patients (18 years or above) admitted with moderate and severe COVID-19 infection and received early prone positioning after admission as a part of their treatment strategy. Notably, patients with mild or asymptomatic COVID-19 infections, critical patients, and patients with incomplete data were excluded from our study. Patients with Facial injury, morbid obesity, and ongoing pregnancy were also eliminated from the study. COVID-19 infection was confirmed by a nasopharyngeal or oropharyngeal swab for SARS-CoV-2. Using real-time reverse transcription-polymerase chain reaction (RT-PCR). The seriousness of the illness was determined by National guidelines for the management of COVID-19 (version 7) established by the Ministry of Health and family welfare, Bangladesh.

According to the guidelines, patients were graded to have a moderate disease with clinical symptoms, radiological findings of pneumonia and respiratory distress with < 30 breaths /min. Room air has an oxygen saturation of 94%. The opposite is true for those who are suffering from hypoxia. (oxygen saturation <94%) or respiratory distress (≥30 breaths/min) or patients getting oxygen via Face Mask at 10L/min or Non-Rebreather Mask at 15L/mi were classified into the severe disease category. The awake proning protocol was adapted from ICS Guidance for Prone Positioning of the Conscious COVID Patient 2020. Firstly, the procedure, benefits, and risks of awake proning were discussed with the patients. They were placed in prone positions by physicians with the help of trained nurses in a medical ward setting. They were encouraged to continue different prone positions for 24 hours based on their comfort level and tolerance. Next, Finger oxygen saturations were measured at 30 minutes and 1 hour after the prone position session. The total length of awake prone positioning, individual number of hours, and type of positions were also recorded, along with necessary demographical data.

Here, the primary outcome was to explore the quantitative measurement of finger oxygenation respectively before, at 30 minutes, and 1 hour after prone positioning in moderate and severe covid-19 patients. Secondary outcomes were to assess whether the early prone positioning can avoid non-invasive or mechanical ventilation in severe patients by monitoring their outcomes for the next 14 days after leaving the medical ward. Moreover, we also determined the in-hospital mortality. Patients who could not adopt the fully prone position due to relative contraindications, whether right and left lateral positions to confer any benefit or not, were also an outcome of the essence.

STATISTICAL ANALYSIS

Frequency distributions were used to describe the descriptive data (percentage), mean ±SD, and median (min-max) where appropriate. As required, bivariate analysis was conducted using the Chi-square test, independent samples t-test, and Mann-Whitney U test. Repeated measure analysis of covariance (ANCOVA) controlled for the duration of oxygenation and severity of COVID-19 to analyze the effect of proning on patients' oxygen saturation. A regression modelling was done to find essential factors associated with the outcome of COVID-19 patients and assess the effect of proning on the outcome. As the binary outcome variable showed complete separation across some predictor variables, the traditional maximum likelihood would not converge. Therefore, we used Firth logistic regression to reduce the slight sample bias. Get around the problem of complete separation for our univariate and multivariable logistic model. SPSS version 26 and STATA version 16 were used for analysis in this study.

RESULT

This study comprised 75 patients, all of whom tested real-time RT-PCR positive for COVID-19. Among them, 46 patients were graded as severe, requiring oxygen therapy, and 29 were moderate cases. The mean (SD) age was 55 years (12) years, and the patients were categorized into four age groups ranging from 30 to more than 60. In our cohort, male patients outnumber female patients (59,78.67%) and have a higher death rate than females (p=0.049). The most common comorbid conditions were hypertension (78.61%), bronchial asthma (41.33%), and diabetes mellitus (40.00%). However, hypertension and more than one comorbidity (AOR -33.44, 95% CI 0.58 – 1912.87) are associated with increased mortality.

Most of our patients (46%) could tolerate all three positions (right, left, and supine). Most of them were prone positioned for a mean of 42 hours according to their need, comfort, and tolerance. The minimum number of hours of awake prone position practised by any patient was 8, and the maximum was 124 hours during the hospital stay. Interestingly, adopting only straight positions (AOR- 4.51,95% CI 0.10 – 193.92) and all three positions (AOR- 2.64, 95% CI 0.03 – 248.19) are associated with increased mortality. This may appear to be a contradiction! Most patients were initially treated with oxygenation through a nasal cannula, face mask, and partial non-rebreather Mask, along with prone positioning and a conventional treatment strategy. Four patients needed high-flow nasal cannula, and 13 were eventually shifted to ICU for mechanical ventilation. Both of these groups of patients have a higher death rate than the others. Undoubtedly, the estimated marginal means of oxygen saturation was decreased from baseline at 30 minutes after prone positioning but increased considerably one hour after proning. The later increase in saturation was higher in severe than moderate patients.

In subgroup analysis, Subsequent improvement in saturation percentage of oxygen before and after 1 hour of prone positioning was observed in patients with both moderate (P<0.001) and severe disease (P<0.001). To summarize, many patients had an ameliorated saturation percentage of oxygen after prone positioning and were successfully tapered off from oxygen therapy.

Tables and Figures

Table 1: Characteristics of COVID-19 patients

Variable	Total (n=75)	Recovery (n=63)	Death (n=12)	p-value
Age, mean±SD	55.88 ±12.00	55.57 ±11.98	57.50 ±12.52	0.613
Age Group				
30 – 40	8 (10.67)	7 (11.11)	1 (8.33)	0.574
41 – 50	14 (18.67)	11 (17.46)	3 (25.00)	
51 – 60	17 (22.67)	16 (25.40)	1 (8.33)	
> 60	36 (48.00)	29 (46.03)	7 (58.33)	
Sex				
Male	59 (78.67)	47 (74.60)	12 (100)	0.049
Female	16 (21.33)	16 (25.40)	0	
Severity				
Severe	46 (61.33)	35 (55.56)	11 (91.67)	0.019
Moderate	29 (38.67)	28 (44.44)	1 (8.3)	
Comorbidities				
Hypertension				
Yes	59 (78.67)	47 (74.60)	12 (100.00)	0.049
No	16 (21.33)	16 (25.40)	0	
Diabetes Mellitus				
Yes	30 (40.00)	30 (47.62)	0	0.002
No	45 (60.00)	33 (52.38)	12 (100.00)	
Asthma				
Yes	31 (41.33)	26 (41.27)	5 (41.67)	0.980
No	44 (58.67)	37 (58.73)	7 (58.33)	
CKD				
Yes	12 (16.00)	5 (7.94)	7 (48.33)	<0.001
No	63 (84.00)	58 (92.06)	5 (41.67)	
Dengue				
Yes	15 (20.00)	8 (12.70)	7 (58.33)	<0.001
No	60 (80.00)	55 (87.30)	5 (42.67)	
Comorbidity				
One	23 (30.67)	23 (36.51)	0	0.012
Two or more	52 (69.33)	40 (63.49)	12 (100.00)	

p-value determined by independent samples t test and Chi-square test

Table 2: Characteristics related to intervention among patients

Variable	Total (n=75)	Recovery (n=63)	Death (n=12)	p-value
Proning position				
Only left or right	19 (25.33)	16 (25.40)	3 (25.00)	0.585
Only prone	21 (28.00)	19 (30.16)	2 (16.67)	
All three positions	35 (46.67)	28 (44.44)	7 (58.33)	
Duration of proning, mean±SD	42 (8 – 124)	32 (8 – 124)	78 (24 – 108)	0.001
Method of oxygen delivery				
Facemask	58 (77.33)	58 (92.06)	0	<0.001
High-flow nasal cannula	4 (5.33)	1 (1.59)	3 (25.00)	
Mechanical ventilation	13 (17.33)	4 (6.35)	9 (75.00)	

p-value determined by the Mann-Whitney U test and Chi-square test

Table 3: The partial pressure of oxygen before proning and 30 minutes and 1 hour after proning in COVID-19 patients (n=75)

Variable		SPO_2			
		Before proning	30 minutes after proning	1 hour after proning	p-value
Severe	Mean ±SD	86.76 ±1.33	85.35 ±7.12	89.26 ±7.18	
	Estimated mean* ±SE	86.76 ±0.19	85.35 ±1.04	89.26 ±1.03[b]	<0.001[!]
Moderate	Mean ±SD	93.76 ±0.44	94.24 ±0.83	95.45 ±1.53	
	Estimated mean* ±SE	93.76 ±0.07	94.24 ±0.11[a]	95.45 ±0.21[b]	<0.001[!]
Total	Mean ±SD	89.47 ±3.60	88.79 ±7.08	91.65 ±6.44	
	Estimated mean** ±SE	90.11 ±0.15	89.81 ±0.79	92.28 ±0.79	<0.001[!!]

Estimated marginal means after controlling for *duration of proning and ** duration of proning + severity
p-value determined by repeated measure ANCOVA using! duration as covariate and !!duration + severity as covariate + factor; p-value significant at <0.05 level in relation to before proning and [b]30 minutes after proning

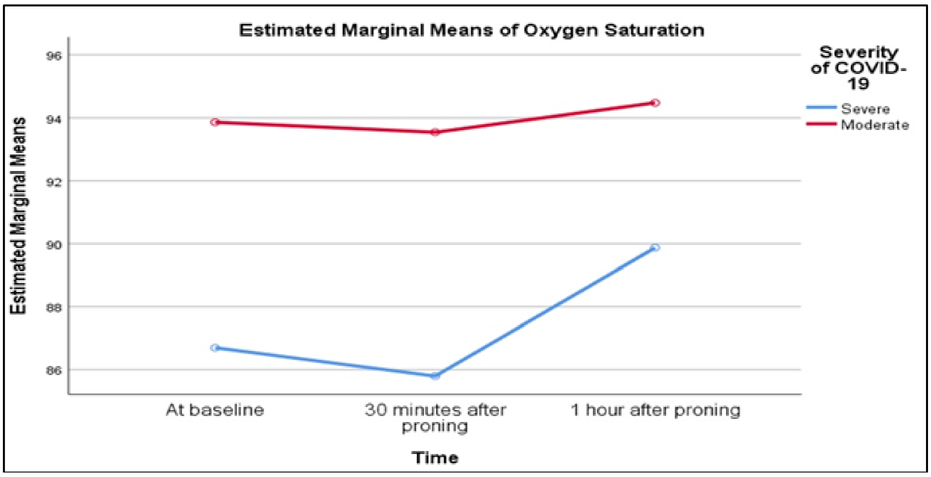

Figure 1: Estimated marginal means of oxygen saturation at three points in time.
Covariates appearing in the model are evaluated at the following values: dur = 43.97

Table 4: Univariate and multivariable fourth logistic regression analysis showing unadjusted and adjusted odds ratios of factors associated with death among COVID-19 individuals

Variable	Catgories	OR (95%CI)	AOR (95%CI)
Age		1.01 (0.96 – 1.07)	1.04 (0.84 – 1.30)
Sex	Female	Ref	Ref
	Male	8.68 (0.49 – 154.96)	0.06 (0.001 – 20.51)
Severity	Moderate	Ref	Ref
	Severe	6.15 (1.05 – 36.19)	16.01 (0.03 – 7906.48)
Comorbidity	One	Ref	Ref
	More than one	14.51 (0.82 – 256.36)	33.44 (0.58 – 1912.87)
Duration of proning		1.04 (1.02 – 1.06)	4.51 (0.11 – 193.92)
Position	Only left/right	Ref	Ref
	Only straight prone	0.60 (0.10 – 3.48)	4.51 (0.10 – 193.92)
	All three positions	1.24 (0.30 – 5.06)	2.64 (0.03 – 248.19)
Oxygenation through	Facemask	Ref	Ref
	High-flow nasal cannula	272.99 (9.12 – 7997.71)	724.55 (2.65 – 197643.9)
	Mechanical ventilation	246.99 (12.28 – 4966.57)	113.41 (1.66 – 7738.382)

The figure shows that the estimated marginal means of oxygen saturation decreased from baseline at 30 minutes after proning but increased considerably one hour after proning. The latter increase in saturation was higher in severe than moderate severity COVID-19 patients.

DISCUSSIONS

Severe hypoxemia typically accompanied by almost normal respiratory system compliance characterized by COVID-19 pneumonia, a particular illness. (7) This results in many patients experiencing an odd condition known as "happy hypoxia" or "silent hypoxemia. (8) Despite being hypoxemic, patients do not exhibit dyspnea or tachycardia and appear to be working

properly. Patients who are critically ill typically demand a lot of oxygen.
Invasive positive pressure breathing and high-flow oxygen treatment were also employed. ARDS can occur in some individuals, necessitating invasive ventilation. (9) To increase the chance of survival, employ any treatment that improves oxygenation and reduces lung damage. Early intubation was used to reduce breathing labour and prevent self-inflicted lung damage in these patients (P-SILI). (7,10) Later, it was discovered that this procedure had a significant rate of complications and death. (11,12)

There was also a shortage of resources and people during the epidemic, particularly in poorer countries. Classic ARDS patients know how important prone position ventilation is. (13) Because the gas is distributed evenly in the prone position, the ventilation-perfusion (VQ) mismatch is reduced. There is an improvement in oxygenation because the intrapulmonary shunt is lessened, and the atherosclerosis-affected lung regions are open enough for sufficient sputum drainage. (4,14) Additionally, the transpulmonary pressure gradient is decreased, resulting in less barotrauma. COVID-19 individuals were studied in emergency departments and hospital wards using awake prone posture to stabilize their blood oxygen levels. (15,16)

In moderately ill ARDS patients, studies have indicated that early use of prone posture with a high-flow nasal cannula (HFNC) can help to prevent intubation. (17,18) According to our findings, the median P/f ratio improved considerably from the supine to the prone position from the first to the tenth day. There are (59, 78.67%) more male patients in our sample than female patients, and males die at a greater rate (p=0.049) than females. 78.61% of patients had hypertension, 41.33% had bronchial asthma, and 5% had diabetes mellitus (40.00 percent). Regarding hypertension and comorbid conditions, the risk of death increases by 33.44 percent (95% confidence interval [CI] 0.58 – 1912.87].

The prone position was well-tolerated by most patients, who saw an improvement in their symptoms as a result. Furthermore, we are aware that additional COVID-19 treatments may have influenced the patient's overall health. (19,20) Hence, in COVID-19 patients, awake proning with high-flow oxygen treatment showed low-risk and low-cost rescue therapy that was simple to execute and tolerated.

CONCLUSION

Awake-prone positioning showed marked improvement in P/f ratio and SpO2 in COVID-19 patients, improving clinical symptoms and minimal complications. We reduced the intubation rates, which helped offload the resource and workforce burden on the healthcare system during a pandemic.

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