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Journal of the Pan African Thoracic Society

Article in Press

Original Article

Awake prone positioning for COVID-19 patients at Eka Kotebe General Hospital, Addis Ababa, Ethiopia: A prospective cohort study

Yidnekachew Asrat[1], Dawit Kebede Huluka[1], Nebiyu Getachew[1], Hiluf Abate Abule[1], Hiruy Araya[2], Bethelehem Tadesse[2], Negussie Deyessa[3], Deborah A. Haisch[4], Neil W. Schluger[5], Charles B. Sherman[6]

[1]Department of Internal Medicine, College of Health Sciences, Addis Ababa University, [2]Department of Internal Medicine, Eka Kotebe General Hospital, [3]Department of Preventive Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia, [4]Department of Medicine, Weill Cornell Medical College, [5]Department of Medicine, New York Medical College, New York, [6]Department of Medicine, Warren Alpert Medical School at Brown University, Providence, Rhode Island, United States.

***Corresponding author:**
Dawit Kebede Huluka, Department of Internal Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia.

dndrda97@gmail.com

Received : 22 January 2021
Accepted : 27 March 2021
Published : 25 May 2021

DOI
10.25259/JPATS_3_2021

Quick Response Code:

ABSTRACT

Objectives: The objectives of the study were to evaluate the benefit of awake prone positioning in COVID-19 patients hospitalized at Eka Kotebe General Hospital, Addis Ababa, Ethiopia.

Materials and Methods: Consecutive patients with COVID-19 who require supplemental oxygen to maintain oxygen saturation of ≥90% during the month of October 2020 were enrolled. Structured questionnaires were employed to collect data. Admission oxygen saturation was recorded for each patient before and after their first proning session. Analysis of descriptive and comparison statistics was done using SPSS version 25.

Results: A total of 61 patients were included in the study. The mean age (+SD) for the cohort was 55.4 (+16.9) years. The average duration of proning was 5+2.5 h/session and 8+6 h/day. The average oxygen saturation before proning was 89% (SD 5.2) and 93% (SD 2.8) 1 h after proning ($P < 0.001$); supplemental oxygen requirements significantly decreased with prone ventilation, before proning: FiO_2 0.33 (+0.14) versus 1 h after prone ventilation: FiO_2 0.31 (+0.13) ($P < 0.001$). Oxygen improvement with prone ventilation was not associated with duration of illness or total prone position hours. When assessed at 28 days after admission, 55.7% ($n = 34$) had been discharged home, 1.6% ($n = 1$) had died, and 42.6 ($n = 26$) were still hospitalized.

Conclusion: Awake prone positioning demonstrated improved oxygen saturation in our oxygen requiring COVID-19 patients. Even though further studies are needed to support causality and determine the effect of proning on disease severity and mortality, early institution of prone ventilation in appropriate oxygen requiring COVID-19 patients should be encouraged.

Keywords: Awake prone ventilation, COVID-19, Ethiopia

INTRODUCTION

Globally, the COVID-19 pandemic has overwhelmed health-care systems, especially in low- and middle-income countries (LMICs) including Ethiopia.[1-3] The 20% of COVID-19 patients with significant respiratory involvement including acute respiratory distress syndrome (ARDS) can easily deplete critical care resources such as oxygen, mechanical ventilators, and intensive care unit (ICU) beds, resulting in poor outcomes.[4]

In this context, any therapeutic strategy that conserves such scarce medical resources and improves prognosis is warranted. Prone ventilation is such an intervention, having previously been shown to improve oxygenation and mortality in mechanically ventilated patients with ARDS.[5] Recently, the UK Intensive Care Society and the African CDC both advocated awake prone positioning as part of the standard of care for suspected or confirmed COVID-19 patients requiring an $FiO_2 \geq 28\%$.[6,7]

Despite these recommendations, there have been few large trials of prone positioning in awake hypoxic COVID-19 patients and none in Ethiopia. Case series and small prospective and retrospective cohort studies from various countries have shown favorable results with prone positioning. We describe our experience with awake proning at the Eka Kotebe General Hospital (EKGH), one of the COVID-19 treatment sites in Addis Ababa, Ethiopia.

MATERIALS AND METHODS

Study design

We conducted a prospective longitudinal cohort study of consecutive COVID-19 patients hospitalized during the month of October 2020.

Setting

EKGH is the premiere COVID-19 treatment site in Ethiopia and is located in the capital, Addis Ababa. It has a 600-bed capacity with 16 dedicated ICU beds.

Participants

All consecutive consenting patients admitted to the hospital during the study period who met the inclusion criteria of >18 years of age, conscious, cooperative, needing less assistance for the procedure, severe COVID-19 disease patients who were spontaneously breathing and requiring supplemental oxygen to maintain their SpO_2 above 90% were enrolled. Severe disease is defined as COVID-19 disease state where the SpO_2 is <90%. The exclusion criteria included the following: Patients who were intubated and mechanically ventilated, clinical suspicion of increased intracranial pressure, massive hemoptysis, life-threatening cardiac dysrhythmias, deep venous thrombosis on treatment for <2 days, facial injury, chest trauma or surgery (chest or abdominal) during the previous 2 weeks, cardiac pacemaker insertion in the past 2 days, anterior chest tube, unstable spine, femur or pelvic fractures, burns on more than 20% of the body surface, especially on the ventral surface, and second or third trimester of pregnancy.

Procedure

Data on sociodemographic, clinical manifestation, comorbidities, and outcome were collected from charts and patient interviews using structured questionnaires utilized by trained personnel. All patients were followed daily for adverse events and outcomes. A protocol derived from African CDC guidelines for awake proning of COVID patients was disseminated and followed by all attending hospital physicians during the study period. This document recommended awake proning for a conscious patient who required $FiO_2 \geq 28\%$ to achieve an SpO_2 of 92–96% (88–92% if risk of hypercapnic respiratory failure existed) [Figure 1]. However, we modified this indication for proning to include all patients who require supplemental oxygen to maintain oxygen saturation ≥90%. The patients were instructed on proning techniques by trained health-care professionals including nurses, general practitioners, residents, emergency physicians, internists, and pulmonary and critical care physicians. Eligible patients were advised to remain proned for as long as tolerated up to 16 h daily. They could use a pillow placed under the hips/pelvis if desired and rest in the lateral decubitus or supine position followed by repeat prone positioning. The protocol was terminated once the patient had been weaned to room air for at least 24 h or required intubated. Patients were allowed to assume the prone position on their own or with help from the health-care staff. Shortly after admission, oxygen saturations were recorded for each patient before and 1 h after first proning using an AnyView A8 oxygen saturation monitor. Outcomes were determined at 28 days after admission.

Statistical analysis

Data were checked for completeness, edited, coded, and entered into Epi data version 3.1 and exported to SPSS version 25.0 statistical software for cleaning and analysis. Continuous variables were reported as mean (standard deviations [SD]) or medians (interquartile range) and categorical data as frequency (%). We compared distributions of continuous variables between the two time points using the paired Student's *t*-test, considering SPO_2-1 versus SPO_2-2. We compared proportions of dichotomous variables between several study time points using McNemar's test for paired proportions. Comparison between groups was analyzed using the Pearson correlation and Chi-square tests.

Ethics

Ethical clearance was granted by the Institutional Review Board of EKGH. Written informed consent was obtained from all participants.

RESULTS

Recruitment of the study subjects is shown in [Figure 2]. There were 90 patients with moderate or severe COVID-19

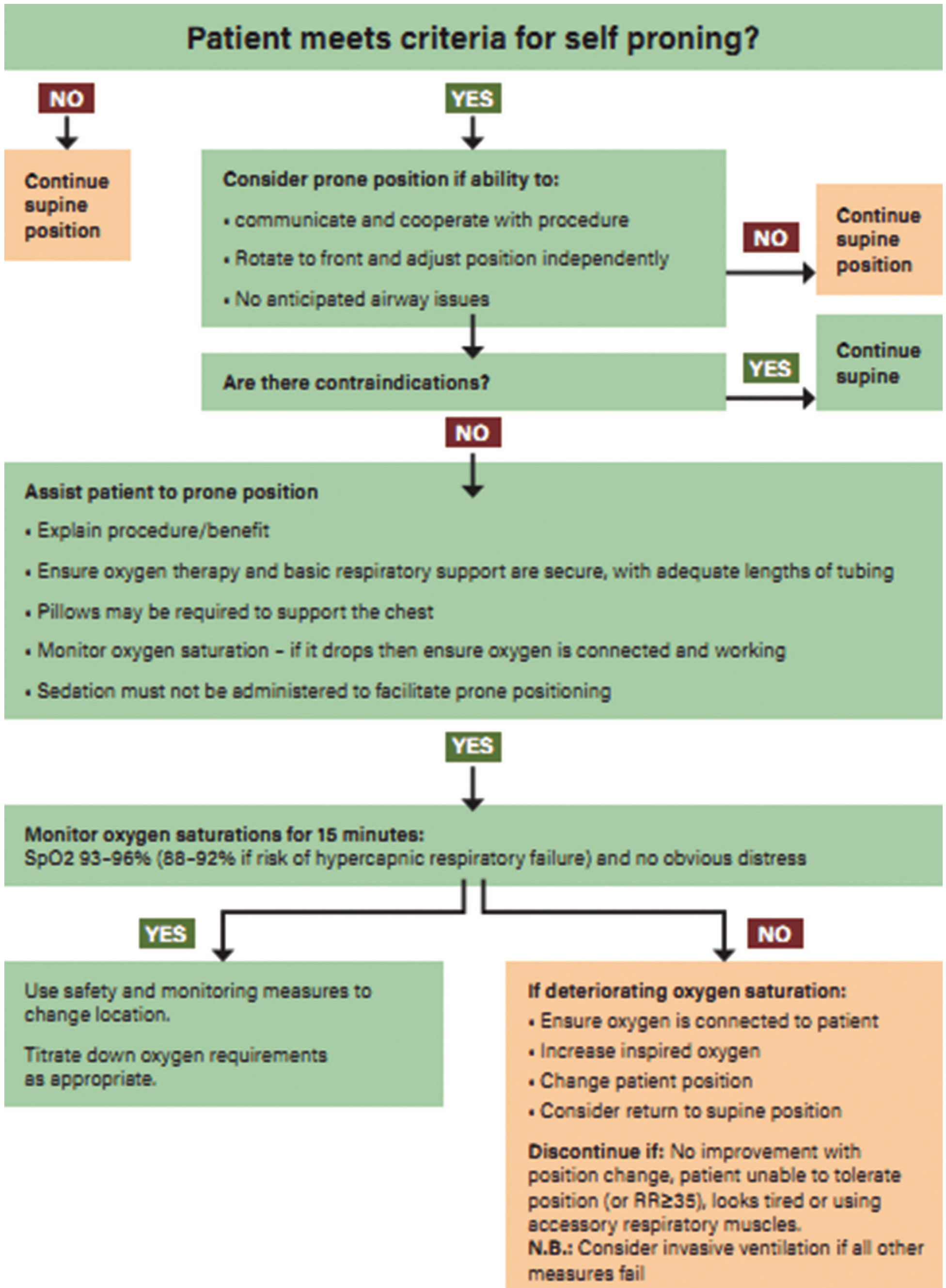

Figure 1: An algorithm taken from Africa Center for Disease Control and Prevention. N.B. We slightly modified the criteria for proning to include patients requiring supplemental oxygen to maintain oxygen saturation of ≥90%.

disease admitted to EKGH during the month of October 2020. Of these potential subjects, 15 were excluded per criteria and 14 had incomplete data. Thus, 61 patients were enrolled for study. Those not enrolled and those with incomplete data were similar to those completing the study with respect to baseline characteristics [Table 1].

The mean age (SD) for the cohort was 55.4 (+16.9) years; 44% (n = 27) were older than 60 years of age. Men comprised 64% (n = 39) of the group. Cough 79% (n = 48), shortness of breath 67% (n = 41), fever 23% (n = 14), and gastrointestinal symptoms 16% (n = 10) were the most frequent presenting symptoms. Hypertension 26% (n = 16), diabetes mellitus 18% (n = 11), and cardiac disorders 8% (n = 5) were the most common comorbidities; no identified comorbidities were determined for 33% (n = 20) of the participants. The mean duration (+SD) of illness before the use of prone ventilation was 9.3 (+4.4) days. The average duration of proning was 5 (+2.5) h/session and 8 (+6) h/day [Table 2].

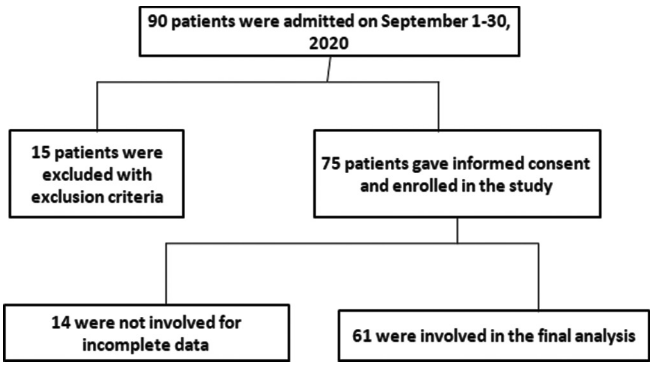

Figure 2: Patient entry into the study.

Mean (SD) values for vital signs at presentation were as follows: Blood pressure 130.1/76.1 (14.7/9.3), pulse rate 93.4 (16), respiratory rate 26.6 (6.3), and peripheral oxygen saturation 88.9% (5.2). Laboratories at presentation were notable for mild lymphopenia (996.3 + 584 u/L) and mild transaminase elevations (aspartate aminotransferase 44 + 28.4 u/L and alanine aminotransferase 62.8 + 46.5 u/L) [Table 3].

There was a statistically significant improvement in oxygenation with prone positioning. The average oxygen saturation before proning was 89% (SD 5.2) and 93% (SD 2.8) 1 h after proning ($P < 0.001$); supplemental oxygen requirements significantly decreased with prone ventilation, FiO_2 0.33 (0.14) pre-proning versus FiO_2 0.31 (0.13) after 1 h of prone positioning ($P < 0.001$). Prone positioning was associated with significant reductions in respiratory rate, 26.9 (6.6) versus 24.0 (4.2), $P < 0.001$, and pulse rate, 93.4 (16.1) versus 84.7 (14.7), $P < 0.001$ [Table 3]. Improvement in oxygenation with prone positioning was not associated with duration of illness (i.e., before vs. after 5 days of illness) or total prone position hours.

Prone positioning was well tolerated. Only 29% ($n = 18$) of the cohort terminated proning before improvement was documented. Reasons for discontinuation included discomfort (55.5%, $n = 10$), lack of cooperation (27.8%, $n = 5$), and altered mentation (4.9%, $n = 3$) [Table 4].

When assessed at 28 days after admission, 55.7% ($n = 34$) had been discharged home, 1.6% ($n = 1$) had died, and 42.6 ($n = 26$) were still hospitalized. Of the 61 patients, 37.7% ($n = 23$) no longer required supplemental oxygen and 4.9% ($n = 3$) had required invasive mechanical ventilation during hospitalization [Table 5]. There was no significant correlation between final outcome and improvement in oxygenation after the first proning. Moreover, there was no significant difference with comorbidity between those who improved and were discharged and those who were still in hospital at day 28.

Table 1: Selective baseline characteristics of studied and excluded participants.

Variables	Study group (n=61)	Excluded (n=29)	*P*-values
Age in years, mean (SD)	55.4 (16.8)	56.7 (20.2)	0.618
Sex			
Male, f (%)	39 (64)	18 (62)	0.864
Female, f (%)	22 (36)	11 (38)	
DM, f (%)	13 (21)	5 (17)	0.652
Hypertension, f (%)	18 (30)	10 (34)	0.634
SpO_2 at admission, mean (SD)	88.9% (+5.2)	89.1% (+8.5)	0.546

Table 2: Baseline sociodemographic and clinical characteristics of patients completing the study.

Variables	Result (n=61) (%)
Age (years)	
≤29	2 (3.3)
30–39	10 (16.4)
40–49	14 (23)
50–59	8 (13.1)
≥60	27 (44.3)
Sex	
Male	39 (64)
Female	22 (36)
Comorbidities	
Hypertension	18 (30)
Diabetes mellitus	13 (21)
Cardiac disorders	5 (8)
Respiratory disorders	5 (8)
Others	6 (10)
None	20 (33)
Symptoms of presentation	
Cough	48 (79)
Dyspnea	41 (67)
Fever	14 (23)
Gastrointestinal symptoms	10 (16)
Duration of illness before presentation in days, mean (SD)	9.3 (+4.4)
Time from admission to first prone ventilation in hours, mean (SD)	2.4 (+0.2)

DISCUSSION

Our prospective cohort study, one of the first in a similar setting, found that awake prone positioning in 61 patients with moderate or severe COVID-19 disease improved oxygenation and respiratory parameters. In addition, we showed that awake proning was well-tolerated and associated with few side effects. To the best of our knowledge, this is the first study of its kind conducted in Ethiopia or other LMIC and only one of several published on awake proning in moderate or severe COVID-19 patients.

Table 3: Admission vital signs and laboratory values.

Variable	Result
Blood pressure, mean (SD)	130.1/76.2 (+14.7/9.3)
Pulse rate, mean (SD)	93.4 (+16)
Respiratory rate, mean (SD)	26.6(+6.3)
SPO_2, mean (SD)	88.9% (+5.2)
White blood cell count in $10^3/\mu L$, mean (SD) (laboratory reference)	8.3 (+3.1) (4-6)
Absolute lymphocyte count in/μL, mean (SD) (laboratory reference)	996.3 (+584) (900–2900)
PLT, $10^3/\mu L$, mean (SD) (laboratory reference)	244.7 (+103.6) (150–400)
Aspartate aminotransferase in U/L, mean (SD) (laboratory reference)	44 (+28.4) (15–37)
Alanine aminotransferase in U/L, mean (SD) (laboratory reference)	62.8 (+46.5) (14–43)
Creatinine in mg/dl, mean (SD) (laboratory reference)	1 (+0.4) (0.55–1.3)
Sodium in meq/L, mean (SD) (laboratory reference)	137.5 (+4.1) (135–145)
Potassium in meq/L, mean (SD) (laboratory reference)	4.17 (+0.66) (3.5–5.1)

Table 4: Vital signs and oxygenation before and 1 h after prone ventilation.

Parameters	Before proning	1 h after proning	*P* value
SPO_2 in %, mean (SD)	88.9% (+5.2)	92.3% (+2.8)	0.01
O_2 support, FiO_2, mean (SD)*	0.33 (+0.14)	0.32 (+0.13)	0.01
Respiratory rate, mean (SD)	26.9 (+6.6)	24 (+4.2)	0.01
Pulse rate, mean (SD)	93.4 (+16.1)	84.7 (+14.7)	0.01

*We use the formula of adding 4% for every liter per minute of oxygen flow support above 20%

Table 5: Patient outcomes on discharge or at 28 days of follow-up care.

Variables	Frequency (%)
Maximum support	
Intranasal oxygen	40 (65.6)
Face mask oxygen	16 (26.2)
Non-invasive positive pressure ventilation	3 (4.9)
Intubated	2 (3.3)
Outcome	
Discharged	34 (55.7)
On room air	23 (37.7)
Intubated	3 (4.9)
Died	1 (1.6)

Prone positioning has been shown to be beneficial in one large randomized controlled trial in intubated patients in the ICU[5] however, evidence for awake proning has been limited to a few studies before the COVID-19 pandemic.[8-10] Valter and colleagues reported on four patients with hypoxic respiratory failure in whom awake prone positioning rapidly increased oxygenation and allowed the avoidance of intubation.[8] Feltracco and coworkers reported on five recipients of lung transplants who successfully underwent awake prone positioning with non-invasive ventilation with resolution of refractory hypoxemia.[9] Scaravilli and co-investigators conducted a retrospective study on 15 non-intubated patients with hypoxic respiratory failure and found prone positioning to be feasible in 95% of cases and associated with significant improvement in oxygenation.[10]

There have been only limited small retrospective and prospective cohort investigations in the era of COVID-19.[11 -20].

African CDC recommends applying prone positioning for a minimum duration of three hours per day, up to a maximum of 18 hours per day if tolerated by the patient. The average duration of proning in our study was 5 (+2.5) hours per session and 8 (+6) hours per day which is well above the recommended time limit. Even though prolonged duration of proning is associated with improved outcome, awake patients cannot tolerate prolonged proning more than 2 to 3 hours.[21, 22]

Our results are similar to other cohort studies done in the era of COVID-19. Ding and colleagues evaluated the effect of adding awake prone positioning to high-flow nasal cannula oxygen and non-invasive ventilation in 20 patients with moderate-to-severe ARDS. They found that the addition of prone positioning contributed to avoidance of intubation in 11 of 20 patients, and a higher PaO_2/FiO_2 ratio in patients who avoided intubation.[16] Caputo and co-investigators applied prone positioning to patients with COVID-19 in the emergency department and showed a significant improvement in peripheral oxygen saturation.[10] Sartini and co-workers applied prone ventilation to CPAP in COVID-19 patients on the medical wards and also documented a significant increase in oxygenation.[17] By contrast with these reports, Elharrar and colleagues found that oxygenation during prone positioning improved in only six (25%) of 24 participants.[18]

Two of the more significant studies on prone positioning in COVID-19 patients include a large prospective study done by Coppo and his collaborators of 56 patients which showed that prone positioning was feasible in 84% of patients and was associated with significant improvement in oxygenation.[19] The other study was done by Ferrando and associates showing that awake proning could delay intubation in those with acute respiratory failure but did not change mortality or the rate of intubation.[20]

Since 29% of patients has discontinued mainly for discomfort, the health care providers should be trained so that they will advise and assist the patients properly with frequent monitoring of patients for early identification of improvement and deterioration. Guidelines recommends detailed explanation to the patient, trying alternative lateral and semi-prone positions, low doses of anxiolytics in anxious patients may be considered to improve tolerance.[23]

The strengths of our study are the relatively large sample size, prospective study design, and adequate follow-up of study subjects. Some of the limitations include single center investigation, delay in prone positioning after symptom onset of 9.4 (+4.8) days, analysis of only the initial oxygen change with prone ventilation rather than the average change over the total period of observation, and the lack of ability to predict favorable outcome. Given the design of the study with no control arm, it is difficult to attribute the improvement in oxygenation to awake proning alone.

CONCLUSION

Awake proning of selective patients with severe COVID-19 disease improves oxygenation and respiratory parameters. Even though further studies are needed to support causality and determine the effect of proning on disease severity and mortality, early institution of prone positioning in appropriate oxygen requiring COVID-19 patients should be encouraged.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Huluka DK, Asrat Y, Getachew N, Abule HA, Araya H, Tadesse B, *et al*. Awake prone positioning for COVID-19 patients at Eka Kotebe General Hospital, Addis Ababa, Ethiopia: A prospective cohort study. J Pan Afr Thorac Soc 2021;2(2):101-7.