

Feature Article

A Prospective, Descriptive Study on Awake Self-prone in Hospitalized COVID-19 Patients

A Multidisciplinary Approach

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Purpose/Aims:

Healthcare workers internationally continue to look for innovative ways to improve patient outcomes and optimize resource utilization during the coronavirus disease 2019 (COVID-19) pandemic. Prone awake, nonintubated patients has been suggested as a potential intervention in critical care. The aim of this study is to provide a multidisciplinary approach to safely perform awake self-prone positioning in the acute care setting.

Design:

This is a prospective, descriptive study.

Method:

Patients with COVID-19 were screened and enrolled within 48 hours of a positive test. After approval from the primary team, patients were provided education materials by a multidisciplinary team on the self-prone intervention. Visual cues were placed in the room. Patients were requested to maintain a diary of hours of prone positioning. Patients' baseline characteristics, admission vitals, daily oxygen requirements, and level of care were collected.

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The authors report no conflicts of interest.

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DOI: 10.1097/NUR.0000000000000654

Results:

Of 203 patients screened, 31 were enrolled. No pressure-related injury or catheter (intravenous or urinary) displacement was identified. Eighty-one percent of patients spent less than 8 hours a day in prone positioning. Among patients enrolled, none required invasive ventilation or died.

Conclusions:

Awake self-prone can be performed safely in patients given a diagnosis of COVID-19 in the acute care setting with a multidisciplinary team.

KEY WORDS:

awake self-prone, COVID-19, multidisciplinary team

Acute viral infection caused by severe acute respiratory syndrome coronavirus 2 was designated by the World Health Organization as coronavirus disease 2019 (COVID-19).¹ This virus infects multiple organ systems but predominantly involves the respiratory system causing significant morbidity and mortality. Respiratory manifestations of COVID-19 infection can range from anosmia, sore throat, cough, dyspnea, pneumonia, acute hypoxic respiratory failure, and acute respiratory distress syndrome (ARDS).² Coronavirus disease 2019 is classified into 4 categories: (1) asymptomatic infection (polymerase chain reaction test positive without symptoms), (2) mild disease (polymerase chain reaction test positive, have symptoms but no or mild pneumonia), (3) severe disease (dyspnea, hypoxia, or >50% lung involvement on imaging within 24–48 hours) and (4) critical disease (respiratory failure, shock, or multiorgan failure).^{3,4}

Individuals with mild and severe symptoms of COVID-19 may require increased healthcare utilization. Resource limitation, lack of ventilators, and lack of intensive care unit (ICU) beds have led to several ethical dilemmas and triage conditions.⁵ Clinicians are looking for innovative ways to improve patient outcomes and prevent ICU admission during this unprecedented time. Prone positioning has been suggested as a possible intervention to address these concerns.⁶ Prone positioning was found to be an effective and efficient intervention in the treatment of intubated patients with ARDS.⁷ In the pre-COVID era, mortality with ARDS was 25% to 40% with evidence-based supportive therapy.^{8,9} A meta-analysis of 7 randomized controlled trials with 862 patients given a diagnosis of ARDS showed improved ICU mortality using prone positioning.¹⁰ The prone position was hypothesized to cause redistribution of inflammatory edema and reduction in patient self-inflicted lung injury.¹¹ A majority of critically ill hospitalized patients with COVID-19 had heterogeneous characteristics consistent with ARDS.¹² Inflammatory edema causing microatelectasis, worsening shunt fraction, and lung microthrombi were considered to be major pathophysiology.^{13,14}

Theoretically, prone positioning may have the same benefits in awake nonintubated patients, thus preventing or delaying ICU admission and/or intubation. Research is limited; however, in early data from China, researchers demonstrated a decrease in mortality and need for intubation in awake patients with ARDS when proning was used as an early intervention.¹⁵ Other reports demonstrated improved oxygenation with awake proning,^{16,17} but it was not always sustained with respiration. For both studies, patient tolerance with the prone position was a limiting factor in the duration of therapy. It is important to better understand details related to a multidisciplinary intervention of awake self-proning among patients given a diagnosis of COVID-19. The aims of this study were to describe the amount of time per day spent in prone position and to examine the following outcomes based on self-proning: adverse events (determined as intravenous or urinary catheter dislodgement and/or skin injury), level of care, need for intubation/mechanical ventilation, and mortality.

METHODS

Study Design, Setting, and Sample

This was a prospective, descriptive study occurring in May to August of 2020 at a large, tertiary academic health center. Institutional review board approval was obtained. We assessed the feasibility and hurdles of using a multidisciplinary team, consisting of physicians, clinical nurse specialists (CNSs), bedside registered nurses (RNs), and physical therapists (PTs) to provide awake self-proning to nonintubated adults given a diagnosis of COVID-19 treated on medical-surgical units (with/without telemetry monitoring), progressive care units (PCUs), and ICUs.

Patient Selection

Eligible participants were identified through a daily hospital report of known positive COVID-19 tests and screened by the CNSs within 48 hours. Once eligible participants were identified, the attending physician was contacted for study enrollment. Exclusion criteria included patients on invasive ventilation at the time of screening, patients unable to perform prone positioning safely because of cognitive deficit, patients unable to provide consent, and patients with a physical disability or severe weakness. Patients who refused to review the education materials or were unable to lay prone because of hemodynamic reasons were also excluded from the study intervention.

Intervention

A multidisciplinary team of physicians, CNSs, and PTs participated in the intervention. Investigators approached eligible patients to participate in the study. If patients agreed, they were provided with educational materials and a patient diary to track proning time. The investigators reviewed the benefits of prone positioning and how to acquire and maintain the position safely. Registered nurses were educated on appropriate positioning of participants during enrollment and prescheduled staff meetings. Consent forms and education materials were available in both English and Spanish, and a phone interpreter was used for Spanish-speaking participants. After the initial patient-provider meeting, a PT was consulted for further education and expert mobility evaluation. The PT assessed in-bed mobility using the visual analog scale. If indicated, further strength screening was completed using the Kendall Manual Muscle Testing.

The first proning session occurred in a controlled and supervised setting after anchoring monitoring leads and intravenous tubing to minimize dislodgement. To confirm hemodynamic stability, vital signs, including oxygen saturation, were obtained before and directly after acquiring the prone position. The physical therapist provided instructions on acquiring the recommended swimmer's position and the use of pillows and blanket rolls to assist with comfort and maintenance of position.¹⁸ After the initial session, participants were encouraged by bedside staff to self-prone as tolerated and per team recommendation.

The study team recommended participants maintain the prone position intermittently for preferably more than 12 hours per day until discharge or return to baseline oxygen requirements. Because tolerance to prone positioning can be variable, participants were given the option to lie in a side-lying (lateral decubitus but >90° from supine) position as well. Proning instructions were kept in the room as a visual cue to maintain the position as long as tolerated.

Variables, Outcomes, and Measurement

Outcomes included number of hours per day spent in prone position, adverse events, level of care, need for mechanical

ventilation, and mortality. For this study, adverse events included intravenous or urinary catheter dislodgement and/or the development of pressure injuries. Data were collected for a maximum of 14 days, until hospital discharge or need for mechanical ventilation. Exploratory outcomes captured were median days of PCU, ICU, and overall hospital length of stay (LOS).

Variables captured included demographic data (sex, age, body mass index, comorbidities, race), physiological data (admission vitals, admission mode of oxygen delivery, daily mode of oxygen delivery), and barriers to maintaining prone position. Comorbid conditions included those known to place patients with COVID-19 at a higher risk for developing a severe illness: hypertension, diabetes mellitus types I and II, hyperlipidemia, stroke, transient ischemic attacks, chronic kidney disease, coronary heart failure, congestive heart failure, and obstructive sleep apnea.^{3,4} Admission vital signs captured from the first 24 hours included highest heart rate, lowest systolic blood pressure, highest fraction of inspired oxygen, and mode of supplemental oxygen delivery. Oxygen requirements were assessed at 7 AM and 7 PM.

Data Collection

Demographic data, physiological data, LOS, level of care, and documented adverse events were captured from the electronic medical record. Time spent in prone position was recorded as the number of hours per patient day (<4, 4–8, 8–12, 12–16, or >16 hours per patient day). Data were collected daily from the nurse and patient diaries. Recorded values were verbally verified with the study participant and reconciled. For those participants who did not reach the proning goal, they were queried regarding barriers to proning. All data were obtained after study enrollment. Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at Indiana University.^{19,20} REDCap is a secure, Web-based software platform designed to support data capture for research studies, providing (1) an intuitive interface for validated data capture, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for data integration and interoperability with external sources.

Statistical Analysis

Descriptive statistics were used to analyze the data. Categorical variables included counts and percentages. Median and interquartile range (IQR) were calculated for continuous variables because of the lack of normal distribution of these variables.

RESULTS

Of the 203 patients screened, 31 participants were successfully enrolled (Figure 1). Median (IQR) age was 55 (27–80)

years. More participants were female (n = 19, 61%), were Black/African American (n = 18, 58%), had at least 1 comorbidity (n = 25, 81%), and were obese (median [IQR] body mass index, 33.70 [29.13, 36.80]). At admission, vital signs that reflected respiratory compromise as low-grade fever, tachycardia, and low oxygen saturation on pulse oximetry were common (see Table 1). More than 80% of patients required supplemental oxygen on admission, and many patients (n = 22, 71%) stayed on nasal cannula during the hospital stay.

Participants were monitored for a total of 218 patient days. Patients spent a median (IQR) of 4.22 (2.46–6.75) hours per patient day for a period of 14 days in a self-prone position (Table 2). The average number of hours per day spent in prone position reduced progressively during the hospital stay, with highest being on day 0 (day of enrollment) and day 1 (Figure 2). A majority of participants (74%) in our study maintained self-proning for less than 8 hours per day. Eight patients (26%) achieved a minimum of 12 hours in prone position for 2.25 days. The most commonly reported barriers to proning were physical discomfort and standard layout of patient room. For example, most television sets were mounted on the wall at the end of the bed, preventing participants from being able to view the television in the prone position. Other barriers were unanticipated interruptions, mealtimes, and not recording nocturnal hours.

No intravenous or urinary catheter dislodgment, pressure injuries, intubations, or arrests/deaths occurred during the intervention period. Five participants were transferred to the ICU for closer monitoring during the 14-day study period, but there was no evidence that self-proning contributed to the upgrade in level of care. Of the 5 participants who transferred to the ICU, prone position time in hours was less than in participants who did not transfer (Figure 2). Two participants began their hospital stay in the ICU for monitoring purposes. Median (IQR) hospital, ICU, and PCU LOS were 7 (4–9), 2.5 (1.25–8.75), and 4 (2–6) days, respectively.

DISCUSSION

Among patients given a diagnosis of COVID-19 who were awake, nonintubated, and hospitalized with respiratory symptoms, self-proning was feasible when using a multidisciplinary team approach. Self-proning may decrease the use of ICU beds as well as prevent intubations and is a simple intervention performed independently by patients. Considering that evidence supports respiratory benefit for patients that prone at least 3 hours per day,¹⁷ self-proning was feasible for study participants who had only more than 4 median hours per patient day. In addition, safety was established, because participants experienced no adverse events during the study. Similar to our study, adverse events such as catheter dislodgement and pressure injuries were

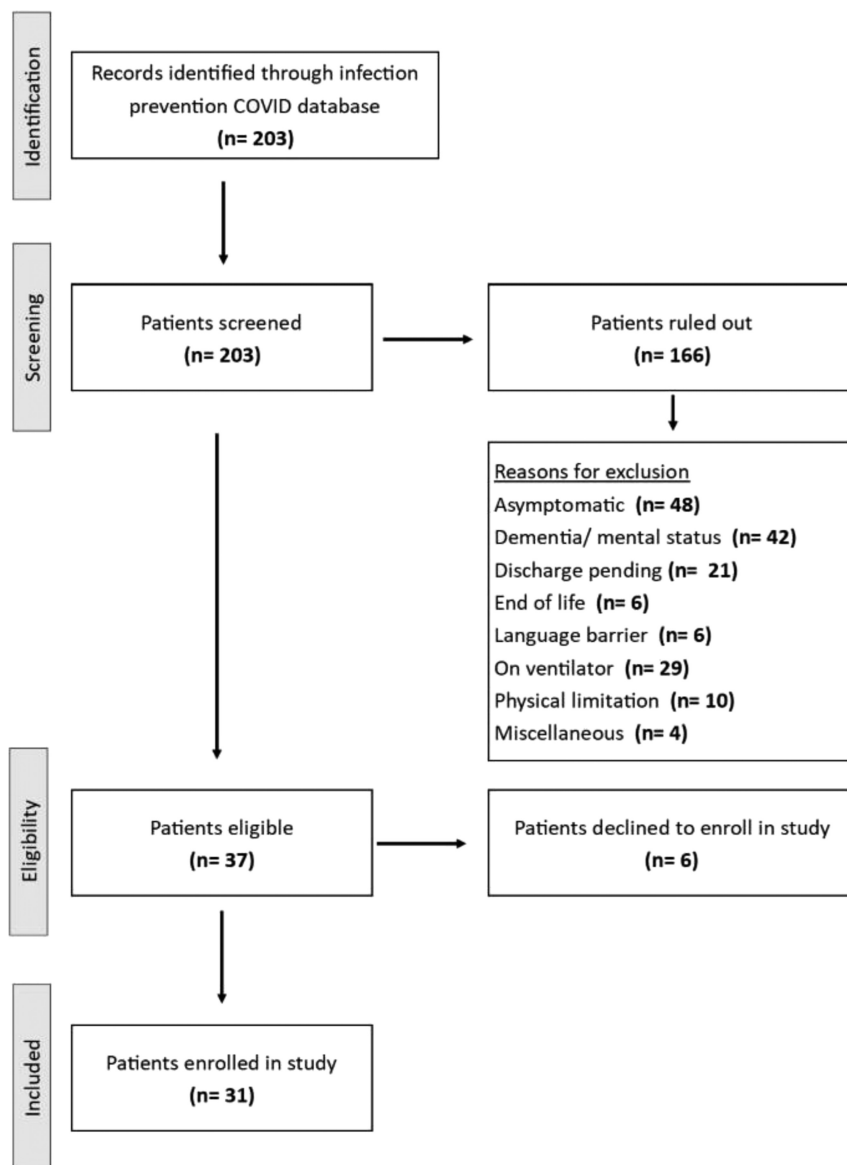


FIGURE 1. A total of 203 coronavirus disease 2019 (COVID-19) patients were screened during the study duration. One hundred sixty-six patients were excluded based on exclusion criteria. Thirty-one patients were enrolled for the intervention.

not reported in other studies,^{16,17} and some found improvement in rates of intubation and mortality.^{21–23} Conversely, Padrão et al²⁴ found the prone positioning had no impact on the intubation rates in their participants. Although this was not a comparative study with a control group, we examined ICU utilization of participants. No other studies were found that discussed level of care escalation during awake self-proning.²⁵ Only 23% of study participants required ICU level of care during hospitalization. Our study adds to the literature as further support that self-proning may safely assist in avoiding intubation and increased level of care.

Physical discomfort with the prone position was the primary factor in participant compliance, which is similar to

other studies.^{21,26,27} Previous publications noted limitations in maintaining the prone position^{15,17,22}; however, in this study, researchers identified specific contributing factors not previously identified such as room layout and various interruptions. The findings of this study offer additional information regarding barriers to awake self-proning in the acute care setting and considerations when implementing this intervention.

A multidisciplinary approach in healthcare settings improves outcomes, increases patient satisfaction, and reduces adverse events.²⁸ Maintaining and addressing compliance with the prone position required communication and collaboration between the multidisciplinary team (RNs, CNSs, providers, and PTs) and participants. Participants were given

Table 1. Participant Characteristics

	Label	Results (n = 31)
Demographics		
Age, y	Median (IQR)	55 (43.5–63.5)
Sex		
Female	n (%)	19 (61)
Male	n (%)	12 (39)
Race		
White/Caucasian	n (%)	7 (22.5)
Black/African American	n (%)	18 (58)
Hispanic/Latino	n (%)	6 (19.3)
Body mass index (n = 30), kg/m ²	Median (IQR)	33.70 (29.13–36.80)
History of comorbidities		
Hypertension	n (%)	20 (64.5)
Diabetes	n (%)	15 (48.4)
Hyperlipidemia	n (%)	5 (16.1)
Stroke/transient ischemic attack	n (%)	0
Chronic kidney disease	n (%)	7 (22.6)
Coronary artery disease/congestive heart failure	n (%)	2 (8)
Obstructive sleep apnea	n (%)	6 (24)
Admission vitals		
Lowest systolic blood pressure, mm Hg	Median (IQR)	99.00 (92.5–106.5)
Highest heart rate, beats per minute	Median (IQR)	110 (94.5–118.5)
Highest respiratory rate, per minute	Median (IQR)	30 (24–33)
Highest temperature, °C	Median (IQR)	38.3 (37.60–39.20)
Lowest pulse oximetry, %	Median (IQR)	91 (87–92.5)
Mode of oxygen delivery on admission		
Room air	n (%)	6 (19.35)
Nasal cannula	n (%)	22 (70.96)
Ventimask/nonrebreather	n (%)	1 (3.22)
Heated high-flow nasal cannula	n (%)	2 (6.45)
Highest fraction of oxygen on admission, % oxygen	Median (IQR)	28 (28–38.5)
Highest level of oxygen delivery during the hospitalization		
Room air	n (%)	6
Nasal cannula	n (%)	22
Venturi mask/nonrebreather	n (%)	1
Heated high-flow nasal cannula	n (%)	2

Abbreviation: IQR, interquartile range.

education on the benefits and proper technique of prone positioning, and CNSs rounded daily on participants to provide support and address barriers to compliance. Team members adjusted the layout of the room to overcome an inability to view television. Nurses and PTs were in a unique position to advocate for the prone position because they routinely

assessed patients' physical status and mobility function. After the initial mobility assessment and intervention, PTs were available to evaluate and assist with limitations related to body habitus or kyphosis, and they guided RNs on the use of pillows and towel rolls to improve comfort and alignment. Similar to our research, in 1 report, PT team members provided

Table 2. Results and Outcomes

Outcomes	Label	Results
Proning hours per day Patient days ^a	Median (IQR)	4.22 (2.46–6.75)
< 4	n (%)	108 (49.5)
4–8	n (%)	70 (32.1)
8–12	n (%)	23 (10.5)
12–16	n (%)	11 (5)
> 16	n (%)	6 (2.7)
Transfer to the ICU	n	5
Days to increase in level of care, n		
Floor to PCU (2)	Median (IQR)	1 (1–1) d
PCU to ICU (5)	Median (IQR)	2 (1–3) d
Days to improvement in level of care	Median (IQR)	5 (1.5–7) d
Adverse events		
Catheter dislodgement (intravenous and/or urinary)	n	0
Pressure injury	n	0
Mortality	n	0
Intubation	n	0
Exploratory, n		
Length of stay (LOS)		
Overall hospital LOS (31)	Median (IQR)	7 (4–9) d
ICU LOS (7)	Median (IQR)	2.5 (1.25–8.75) d
PCU LOS (15)	Median (IQR)	4 (2–6) d

Abbreviations: IQR, interquartile range; ICU, intensive care unit; LOS, length of stay; PCU, progressive care unit.

^aPatient days: total number of patients × total number of days proning intervention was measured in the study population.

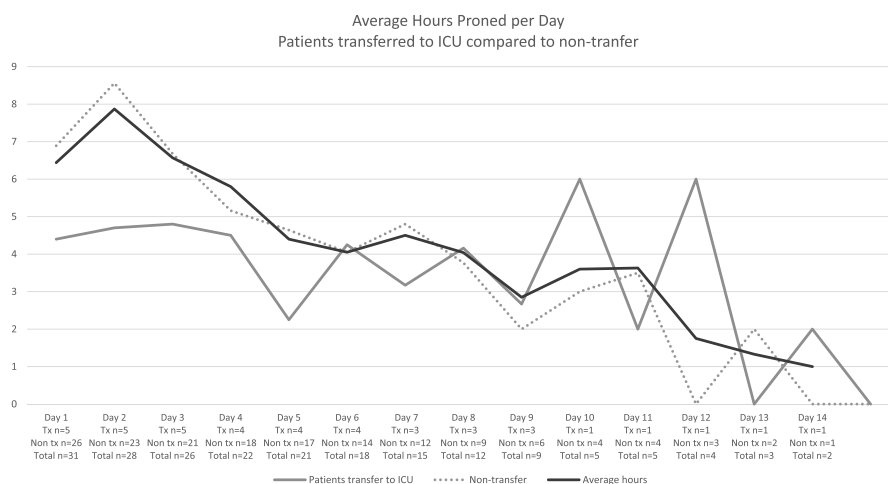


FIGURE 2. Average number of hours per day in prone position was maintained by patients from the day of enrollment; comparing patients transferred into the intensive care unit (ICU) with patients who did not transfer (x-axis, days from enrollment [day 1 to day of enrollment]; y-axis, hours per day).

quality, focused interactions, support, and tools needed to successfully perform the intervention.^{29,30} No other studies were found that used a multidisciplinary approach to proning.

LIMITATIONS

Several limitations were identified during this study. This is a single-center study with a small sample size and a single intervention arm with no control arm to compare outcomes. The study was not powered to assess the exploratory outcomes. On the basis of our descriptive design and other study features, findings may not be generalizable to other sites. The number of proning hours was collected through self-reporting by participants. Although diaries were provided at the bedside, many did not complete them, and it is unknown whether actual hours of proning varied from what participants self-reported. Researchers attempted to validate self-reported hours by comparing data with hours observed by RNs. In addition, participants were required to be able to independently move into the prone position, which limited eligibility. Although all participants were mobile, investigators realized after initiating the study that some participants had unique challenges to proning that decreased their desirability for adhering to the intervention. The number of eligible participants further decreased as the study progressed because of fewer hospitalized patients given a diagnosis of COVID-19. Finally, treatment guidelines for COVID-19 evolved during this time; therefore, it is difficult to compare our results with those at the beginning of the pandemic.

Recommendations for Future Research

To our knowledge, this is the first study involving the collaboration of a multidisciplinary team of providers, RNs, CNSs, PTs, and patients in the initiation of awake self-prone positioning. Comparative research that is powered to assess high-risk, infrequent outcomes is needed to truly understand the clinical benefit, safety, and efficacy of the use of the intervention in patients with potential respiratory compromise in COVID-19. In addition, barriers to patient participation in self-proning, including room layout, television placement, interruptions, and comfort, need to be examined and addressed.

CONCLUSION

Awake self-proning is a very low-cost, potentially high-yield intervention that can be introduced safely and effectively with support of a multidisciplinary team. In our descriptive study, we successfully implemented a patient-guided therapy in the acute care setting.

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