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Early Self-Proning in Awake, Non-intubated Patients in the Emergency Department: A Single ED's Experience during the COVID-19 Pandemic

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Abstract

Objective: Prolonged and unaddressed hypoxia can lead to poor patient outcomes. Proning has become a standard treatment in the management of patients with ARDS who have difficulty achieving adequate oxygen saturation. The purpose of this study was to describe the use of early proning of awake, non-intubated patients in the emergency department (ED) during the COVID-19 pandemic.

Methods: This pilot study was carried out in a single urban ED in New York City. We included patients suspected of having COVID19 with hypoxia on arrival. A standard pulse oximeter was used

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to measure SpO_2. SpO_2 measurements were recorded at triage and after five minutes of proning. Supplemental oxygenation methods included non-rebreather mask (NRB) and nasal cannula. We also characterized post-proning failure rates of intubation within the first 24 hours of arrival to the ED.

Results: Fifty patients were included. Overall, the median SpO_2 at triage was 80% (IQR 69 to 85). After application of supplemental oxygen was given to patients on room air it was 84% (IQR 75 to 90). After 5 minutes of proning was added SpO_2 improved to 94% (IQR 90 to 95). Comparison of the pre- to post-median by the Wilcoxon Rank-sum test yielded P=0.001. Thirteen patients (24%) failed to improve or maintain their oxygen saturations and required endotracheal intubation within 24 hours of arrival to the ED.

Conclusion: Awake early self-proning in the emergency department demonstrated improved oxygen saturation in our COVID-19positive patients. Further studies are needed to support causality and determine the effect of proning on disease severity and mortality.

Background

Prolonged and unaddressed hypoxia can lead to poor outcomes in patients with respiratory compromise.[1] Boosting inspired oxygen (FiO_2) is an effective therapy in many hypoxic patients, however in patients with significant physiologic shunting, positive pressure may be required.[2] This is usually delivered by invasive or non-invasive ventilation (NIV). These types of interventions require resources that under normal circumstances are generally available, however become quickly limited in times of surge. Awake proning has been demonstrated to decrease intubation and improve outcomes in ARDS patients.[3]

In New York City, during the early stages of the COVID-19 pandemic, patients presented en masse with moderate to severe hypoxia. Some of these patients were distressed, quickly deteriorated and required endotracheal intubation. COVID-19 produced another group of patients whose pathophysiology confounded existing disease patterns, however. These patients had low oxygen saturations (SpO_2 <90%), but were not in significant respiratory distress and often appeared clinically well; this group has been informally referred to as *happy hypoxemics*. Because many of these patients were markedly tachypneic, had chest radiographic findings similar to acute respiratory distress syndrome (ARDS), had hypoxemia not responsive to supplemental oxygen, and because of infectious aerosolization fears around alternative oxygenation modalities, many of them were intubated early in their hospital course. Ventilator stockpiles and critical care resources were quickly depleted the result of widespread early intubation of patients with COVID-19 lung disease. Based on prior literature, with other causes of ARDS it was speculated that proning of awake patients would improve patient's oxygenation and prevent or delay intubation.[4] We sought to describe our preliminary experience with the use of early proning of awake, non-intubated patients with suspected or confirmed COVID-19 disease and its impact on oxygenation in the ED. Our primary outcome was median SpO_2 after supplemental oxygen and proning were applied in tandem.

Methods

Study design and setting

We conducted a observational cohort study of a convenience sample of patients at an urban, academic ED in New York City, USA between March 1st and April 1st of 2020. This study was approved by the Lincoln hospital institutional review board and ethics board.

The average annual volumes of the ED is approximately 175,000. The department generally performs about 40 to 50 intubations a month with the majority of intubations being performed by EM trainees under the direct supervision of an EM attending.

Selection of Participants

We included the first fifty consecutive adult patients (age ≥18 years old) who presented to the ED with hypoxia (SpO_2 <90%) and without resolution (SpO_2 >93%) despite supplemental oxygen and who were capable of self-proning during the early stages of the COVID-19 pandemic in March to April 2020. Patients were asked to self prone/change position. We excluded patients with DNR/DNI code status, in cardiac arrest, receiving non-invasive ventilation (NIV) or those who were intubated in the prehospital setting. All patients had documented SARS-CoV-2 infection, confirmed by nasal/oropharyngeal swab followed by positive reverse transcriptase polymerase chain reaction detection of viral nucleic acid.

Methods of Measurement

Vital signs were obtained from the cardiac monitor (Philips IntelliVue, Philips USA) in real time. SpO_2 was measured through standard finger oximeters (Covidien Oximax, Covidien, USA). Hypoxemia was defined as an SpO_2 <90%.

Outcomes

The primary outcome was the change in $SpO_{2,}$ determined prior to proning, after application of supplemental oxygen and after 5 minutes of proning without change in inspired oxygen. The secondary outcome was rate of patients who were proned but then required intubation within 24 hours of presentation to the ED. A patient was deemed to have failed proning if they showed respiratory failure defined as persistent SpO_2 <90% in the setting of unresolved or worsening tachypnea with either accessory muscle use, altered mental status or hypercarbia on blood gas.

Analysis

The primary dependent variable was the SpO2 which was not normally distributed (P>0.1 by Shapiro-Wilk), necessitating the reporting of median values. For the clinical series we analyzed the data using descriptive techniques. We determined median SpO_2 prior to proning and after proning. We determined the proportion of patients achieving SpO_2 >93% with proning. We compared the pre to post median values using the Wilcoxon Rank Sum test. We also determined the proportion of patients that failed proning (using the explicit definition of respiratory failure) and required intubation. All analyses were performed using XLStat (Addinsoft, New York, NY).

Results

We included 50 patients in this convenience sample cohort, most with respiratory complaints leading to their visit to the ED. All patients were observed in the ED until admission to the floors. The median time observation of the cohort in the ED was 293 minutes (range 63 to 1620).

The median age of the cohort was 59 (IQR 50 to 68) with 60% of the group being male. Eighty percent of the cohort were tachypneic on arrival (RR >20). On arrival to the ER, over half of this cohort, 56% (28), had no supplemental oxygen being delivered (e.g. were on room air). Eighty percent of these patients arrived as "walk-ins" and 20% arrived by EMS. The remaining 44% (22) of these patients arrived to the ER with supplemental oxygen being provided, usually non-rebreather mask (n=8) or nasal cannula at approximately 5 liters per minute (n=14). The median SpO_2 of patients who arrived without supplemental oxygen was 75% (IQR 62 to 82) and for those patients with supplemental oxygen in place was 82% (IQR 72 to 85). Overall, the median SpO_2 at triage was 80% (IQR 69 to 85). This improved to 84% (IQR 75 to 90) after application of supplemental oxygen (non-rebreather mask [n=38] or nasal cannula at approximately 5 liters per minute [n=12]). After 5 minutes of proning was added the media SpO2 increased to 94% (IQR 90 to 95). Comparison of the pre- to post-median by the Wilcoxon Rank-sum test yielded P=0.001.

Thirteen patients (24%, 95% CI 14.6 to 40.3%) met the definition of respiratory failure plus clinical signs of respiratory distress within 24 hours of presenting to the ED and required endotracheal intubation. Of these thirteen patients that required intubation, 4 patients were intubated within 30 minutes of proning, 3 patients were intubated between 30 and 60 minutes after proning and the remaining 6 were intubated after 60 minutes of initiation of proning but within 24 hours. Of those patients that were not intubated within 24 hours (n=37), 5 subsequently were intubated (3 between 24 and 48 hours and 2 after 72 hours) as inpatients.

Limitations

This study is a non-experimental sequential case series that reports an association between proning patients with COVID-19 and improvement in oxygen saturation. Though the effect size is significant and consistent with existing models of physiologic shunt, causal inferences arising from descriptive studies can only be hypothesized, not concluded. The patients described come from a convenience sample presenting to a single hospital and therefore may not represent other populations or the population at large. All aspects of care were uncontrolled; therefore the effect seen may be due not to proning, but to an unrecognized alternative treatment. In order to make a strong claim to causality, proning should be studied in a prospective trial that randomizes similar patients to proning or not, and where other aspects of care are congruent in both arms. Lastly, though oxygen saturation contributes to patient-oriented outcomes such as endotracheal intubation, vitals signs are themselves a disease-oriented endpoint; attributing value to the treatment requires that it be measured against more important consequences such as duration of hospitalization or death.

Discussion

COVID-19 is a novel disease arising from a novel pathogen, SARS-CoV-2.[5] Frontline physicians working in New York City have been confronted with unprecedented challenges around resource scarcity and disease infectivity, however the most enduring tribulation may be caring for patients who become critically ill and succumb to an illness that does not fit into existing models, does not respond to usual therapies, and for which there are no treatments established by rigorous science.

Clinicians managing the earliest cases of COVID-19 in China and Italy were faced with extraordinary levels of hypoxemia, and serious concerns that viral particles would be aerosolized during oxygenation therapies such as noninvasive ventilation and high flow nasal cannula.[6,7] This led to a recommendation that patients who do not adequately respond to low-flow oxygen therapies (such as conventional nasal cannula or venturi mask) be intubated without the usual trial of pressurized oxygen modalities.

The *intubate early* approach was adopted in the first wave of critically ill COVID-19 patients seen in New York City hospitals, but early outcomes data from overseas demonstrated shockingly high mortality for intubated patients, and the inevitability of resource scarcity, if early intubation was continued, caused clinicians to seek strategies to delay or prevent the initiation of mechanical ventilation in COVID-19 patients.[8]

Little was known of the pathophysiology of COVID-19 disease in the early days of the pandemic. An Italian described two patient subtypes that has framed management approaches across different phases of illness. [9]

The conventional alternatives to mechanical ventilation–NIV and HFNC–have been used successfully in COVID-19 but their implementation is hindered by several factors in addition to the aforementioned aerosolization concerns. For reasons presently not understood, COVID-19 lung disease patients frequently demonstrate hypoxia out of proportion to dyspnea or distress, diminishing the utility of perhaps the most important indicator of respiratory function: pulse oximetry.[10] Furthermore, COVID-19 patients requiring hospitalization often have huge oxygenation deficits, requiring very high oxygen flows that are difficult to maintain on awake patients who don't tolerate staying in one position and may inadvertently knock off their oxygen masks. Awake patients who are very ill with COVID therefore in some respects require a higher level of care than those on mechanical ventilation.

Maneuvers that can safely improve oxygenation without the need for additional resources are thus of immense value during a surge of COVID-19 patients.[11] Our experience suggests that the use of rotating or proning is a valuable tool in improving oxygenation and decreasing respiratory effort in many patients with moderate or severe COVID-19. Proning is simple (many patients can rotate or prone themselves, without assistance, is without cost, and utilizes no additional personnel or departmental resources. Some patients, when attempting to prone, benefit from the strategic placement of blankets or pillows.

Any COVID-19 patient with respiratory embarrassment severe enough to be admitted to the hospital should be considered for rotation and proning. Care must be taken to not disrupt the flow of oxygen during patient rotation, but we recommend proning regardless of oxygenation modality. Typical protocols include 30-120 minutes in prone position, followed by 30-120 minutes in left lateral decubitus, right lateral decubitus, and upright sitting position. Positioning is guided by patient wishes–salutary effects are generally noticed within 5-10 minutes in a new position; do not maintain a position that does not improve the patient's breathing and comfort. Healthcare providers that may be otherwise less active during the pandemic, such as physical medicine clinicians, may be mobilized to do "proning rounds" to great effect.

In conclusion, our series of patients with moderate to severe hypoxemia related to COVID-19 lung disease demonstrated an improvement in their SpO2 after being placed in prone position. Until further studies indicate alternative oxygenation strategies or specific treatments that address the underlying hypoxic insult, we recommend early and frequent use of patient proning, with the hope that it will delay or prevent intubation.

It is critical to re-emphasize that patients with COVID-19 may desaturate precipitously and dangerously when disconnected from their oxygen source; patients with high oxygen requirements who are managed with alternatives to mechanical ventilation require vigilant monitoring and frequent, careful reassessment.

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