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Awake Prone Positioning in SARS-CoV-2 (Covid-19) Non-Intubated Patients with Acute Respiratory Failure in Adult Population: A Literature Review

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ABSTRACT

Objective: This article aims to review the current evidence in Covid-19 patients with acute respiratory failure who required awake prone positioning as a therapeutic intervention.

I searched the literature on MEDLINE, PubMed, Cochrane Library, Google Scholar, and other databases. I found several studies that analyzed and shared the data regarding awake prone positioning in the Covid-19 patients, with duration ranging from 12-16 hours.

I found that the major criteria used included PaO2/FiO2 ratio, SpO2/FiO2, respiratory rate, heart rate. I also searched the suggested indications, contra-indications, complications, and outcomes of those patients.

Awake proning showed improvement in lung mechanics and oxygenation, but no benefit in outcome in the majority of studies.

Currently, the data is unclear to determine the overall benefit. Further controlled trials are needed.

Keywords: Covid-19, prone positioning, awake, major criteria, outcome, SARS-CoV-2

INTRODUCTION

Traditionally, the prone position has been proposed as a treatment of severe ARDS patients with hypoxemia. Its use started in the 1970s after a study done by Bryan in 1974 in the pediatric population showed benefits (1).

Several meta-analyses and systemic reviews have been published in Non-Covid patients, but all were done in intubated patients.

In 2011, a meta-analysis of 48 studies was done, which found that a statistically significant mortality benefit was found in patients with severe ARDS only (2).

In 2014, a systematic review of 11 trials determined that ventilated patients with lower tidal volumes, in combination with prone positioning, reduced mortality of about one additional patient in eleven (3).

The Large Observational Study to Understand the Global Impact of Severe Acute Respiratory Failure (LUNG-SAFE) looked at the use of prone position during the study period of 2014. At that time, proning was used for 7% of all ARDS patients and 14% of the most severe cases (4).

Guidelines have been published by The ESICM and Surviving Sepsis Campaign on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19) in 2020 (5). These recommended the use of proning (6).

Covid-19 pandemic has further increased the interest of the medical community to further study the effect of proning on the outcome of those patients as they develop severe pneumonia with ARDS. Hospitals have been overwhelmed with patients requiring invasive ventilation who failed non-invasive methods. This lead to a growing interest in awake proning protocols to avoid intubation and improve outcomes.

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Effects of body position on lung mechanics

The beneficial effects of proning in ARDS have several mechanisms (**7, 8**).

The most severely affected lung regions in ARDS are at the lower and the basal zones. They have the worse V/Q (Ventilation/Perfusion) mismatch or even shunt physiology in the most severe cases. In supine position, most of the oxygenated blood goes to these areas due to the gravity effect. However, ventilation is less affected by the gravitational force. This leads to severe oxygenation failure due to a reduction in the gas exchange, requiring a higher FiO2 and Peep (**9, 10**). Proning these patients has positive physiological effects on respiratory system mechanics (**11**).

In the supine position, the intra-abdominal compartment pressure exceeds five times the intra-thoracic cavity pressure, leading to decrease compliance of respiratory system (CRS) (**12**). It can further decrease with associated intra-abdominal sepsis. In the prone position, the weight of the body on the lungs and diaphragm is reduced, which improves the respiratory system compliance. There is a reversal of posterior alveolar atelectasis, over inflation of anterior alveoli, and V/Q mismatch when the patient is changed from supine to prone position

The risk of barotrauma is also reduced.

When patients are in the prone position, the drainage of secretions may be improved with decreased chances of ventilator-associated pneumonia.

Covid-19 and Proning

As the pandemic is worsening, severe ARDS in Covid-19 patients is similar to the "Classical" ARDS described in other conditions. It is the single most crucial pathology which determines the outcome.

Historically, proning has been done in the intubated patients. This practice is labour-intensive and requires trained nurses and other staff. Recent studies on Covid-19 proning have focused more on awake proning. The first study about proning benefits in awake non-intubated Covid-19 patients was done in China by Sun Q, Qiu H, Huang M, et al. (**13**). Several protocols have been developed since for awake proning Covid-19 patients. Awake proning is a relatively safe intervention, which has shown improvement in oxygenation in conscious patients who failed to improve with non-invasive ventilation (HFNC, BiPAP/CPAP). It can be easily used in patients admitted to the wards and even at home by trained family members.

The suggested indications of awake proning include hemodynamically stable patients, oxygen saturation less than 92, when the hypoxemia becomes refractory to simple oxygen therapy, SpO2/FiO2 ratio less than 315, PaO2/FiO2 ratio less than 300, a respiratory rate more than 30, heart rate more than 120, conscious and able to move in bed with minimal assistance, pregnancy 1st and 2nd trimesters while fetal status is being monitored (**14**, **15**).

There are several suggested contra-indications which include hemodynamic instability with MAP less than 65, Difficult airway, severe respiratory distress especially if hypercapnia with the possibility of immediate intubation unless mechanical ventilation is not available, low GCS, 3rd trimester of pregnancy, spinal diseases, raised intracranial pressure, acute abdomen, difficult airway. Proning should be avoided in patients with multi-organ failure (**15**).

Most studies did not report any major complications of awake proning. However, some reported complications include dislodgement of lines, devices, and drains. Facial edema, increase in intra-abdominal and intracranial pressures, related to nutritional difficulties, nausea, vomiting, anxiety, and intolerance. A concern has been raised that awake proning may delay intubation and mechanical ventilation in ARDS patients. This could lead to poorer outcomes (**15**).

If a patient develops cardiac arrest during awake proning, "Reverse CPR" should be performed till the patient can be safely changed back to supine position (**16**).

Several studies have been done to assess the impact of awake or self proning.

Around seven recent studies have been done which studied awake prone positioning in Covid-19 non- intubated patients. A study was done by Caputo. et al, showed a reduction in intubation by 64%. However, 36% of patients were intubated within 72 hours, and of these, 38% (n = 7) were intubated within the first hour. However, other studies have not shown any significant reduction in intubation rates. Most of those studies were limited by the fact that the duration of awake proning sessions was much shorter than compared to intubated patients with ARDS and no major trial has been done. Further studies and trials are required to determine a beneficial impact.

More than the duration of a single prone positioning course, multiple short prone positioning sessions might improve tolerance and lead to better outcomes. Use pillows to improve comfort, and trained staff should help to reposition if the patient has physical difficulty moving. Published data does not allow us to determine for which patients prone positioning may be beneficial, or the best duration and frequency of the prone positioning sessions (**17**).

Before starting the awake prone positioning, it is important to explain the procedure to the patient, and he should be reassured. This would improve tolerance. Secure all lines, devices, tubes, and drains. In patients with mild hypoxemia, it may be better to do "Assisted Proning" rather than "Self Proning", so the patient can conserve his energy and use it for breathing efforts.

The patient should be kept nil by mouth in case urgent intubation is needed and also to minimize the risk of aspiration in the prone position.

Monitoring of these patients is the most important aspect. Various recommendations have been suggested. One of them is the ROX index (Respiratory rate – OXygenation). It is the ratio of SpO2/FiO2 to RR. An improvement in the index is suggestive of fewer chances of intubation. (**18**) More experience is needed to assess this index in Covid-19 patients.

In contrast to awake proning, intubated patients have shown improved oxygenation and a reduction in mortality with moderate to severe ARDS.

Early vs. Late Prone Positioning

Early proning is done during the period when oxygen is supplied by simple methods like nasal cannula or face mask, while late proning is the period when a patient is using HFNC, CPAP or BIPAP.

The studies have shown variable results, but overall fail to demonstrate any benefit regarding "Early vs Late Proning". (**19**)

CONCLUSION

Awake-prone positioning has shown improvement in oxygenation, but any benefit after re-supination and impact on mortality and length of stay remains unclear.

Due to its relative ease of use, and low sides-effects, prone positioning for non-intubated patients has been widely applied and studied in Covid-19 patients, whether in medical wards or emergency rooms. Association with NIV or HFNC is suggested to improve the benefits of respiratory status.

It is encouraging to see the evidence showing improved oxygenation but more evidence is needed on clinical outcomes, such as mortality or intubation rates.

Studies failed to determine the best duration and frequency of prone positioning, and tolerance of prolonged sessions remains a concern.

Abbreviations:

PaO_2/FiO_2: Arterial oxygen partial pressure/fractional inspired oxygen

SpO_2: Oxygen Saturation by pulse oximeter

ARDS: Adult Respiratory Distress Syndrome

ESICM: European Society of Intensive Care Medicine

GCS: Glasgow Coma Scale

HFNC: High Flow Nasal Cannula

BIPAP: Bi-level Positive Airway pressure

CPAP: Continuous Positive Airway Pressure

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