Awake prone positioning in COVID pneumonitis: A useful physiology-based approach in resource-limited settings

As of August 2, 2020, there are more than 16 million COVID-19 cases in 214 countries worldwide with 684,894 deaths. This pandemic has placed a severe strain on intensive care units (ICUs) with demand outstripping capacity, most notably in the Lombardy region of Italy; NY, USA; and now various places in India. At the start of the pandemic, particularly due to concerns regarding infection risk due to the aerosol-generating procedures (AGPs) such as continuous positive airway pressure (CPAP) and high-flow nasal oxygen (HFNO), and no proven mortality benefit compared to low-flow oxygen, early intubation and mechanical ventilation with high positive end expiratory pressure was the preferred approach. However, mechanical ventilation has led high mortality rates from 45% to 88% in patients requiring mechanical ventilation.\[1,2\]

We, therefore, used low-flow oxygen in conjunction with awake self-prone positioning as a strategy to treat COVID-19 patients with acute respiratory failure. Retrospective observational cohort data from patients admitted via respiratory assessment unit and deemed suitable for escalation to ICU but did not need immediate intubation were included in the study. Patients unable or not willing to lie in prone position were excluded from the study. Prone positioning was commenced in the presence of hypoxemic respiratory failure once patients were unable to maintain oxygen saturation (SpO\(_2\)) of >92% on at least fraction of inspired oxygen (FiO\(_2\)) 40%.

A total of 84 patients were admitted to the ICU [Figure 1]. Awake self-prone positioning was performed in 12 patients (10 males), who were admitted with COVID pneumonia [Table 1]. Nine patients were proned when they needed 40%–60% oxygen in the respiratory ward, with two needing mechanical ventilation. Three patients whose oxygen requirements increased rapidly were moved to the ICU and proned there as a last resort, with one avoiding intubation. Prone positioning times
ranged from one episode of 2 h (followed by intubation) to multiple sessions ranging from 30 min to a few hours at a time – particularly overnight. Patients mostly preferred lateral position. Preproning SpO₂ ranged from 85% to 92%, with a significant improvement of 5%–10% on proning. They experienced desaturation on reverting to a supine position.

Overall, 33% of the patients needed mechanical ventilation and 75% survived the illness.

In a small observational study without a control group, we demonstrate that in a carefully selected patient group, awake prone positioning does improve oxygenation. Moreover, only 33% of the patients needed mechanical ventilation. It is also safe to do so in general respiratory ward setting with appropriately trained nursing staff and monitoring in situ. This intervention was acceptable to most patients who persisted with intermittent awake prone and/or lateral position for days. Moreover, we managed most patients with SpO₂ monitoring and avoided arterial blood gases as much as possible. Prone positioning improves ventilation/perfusion (V/Q) matching and survival in patients with moderate-to-severe acute respiratory distress syndrome (ARDS) who need mechanical ventilation.[3]

In the context of COVID-19 pneumonia, observational studies reported that awake self-prone positioning used in emergency departments[4] and in conjunction with HFNO[5] led to a reduction in the need for mechanical ventilation.

Two further small observational studies involving 24 and 15 patients have also reported that awake prone positioning in patients with COVID pneumonia led to improved oxygenation.[5] In one of them involving patients with mild-to-moderate ARDS, prone positioning was instituted after failure to respond to continuous positive airway pressure (CPAP) 10 cm, and it led to improvement in oxygenation (estimated PaO₂:FiO₂, 100–122) and respiratory rate of 28 to 24 breaths/min.

Taken together, these suggest that there is a significant amount of V/Q mismatch in patients with COVID. Hence, awake prone positioning helps improve this V/Q mismatch when used as a stand-alone intervention or when added to those already receiving CPAP, which is an AGP. Awake prone positioning could also be used in places and situations where health-care resources are limited.

Around 66% of patients with COVID pneumonia experience lung injury with high compliance and high (V/Q) mismatch. In only a third of the cases, this progresses to ARDS.[6,7] Awake prone positioning could therefore improve V/Q mismatch and potentially reduce the need for AGPs such as CPAP or HFNO. This is important as in patients with patchy infiltrates and high lung compliance, application of positive pressure could potentially lead to worsening of lung injury. In addition, use of mechanical or noninvasive ventilation is associated with high mortality in COVID pneumonia.[8]

In conclusion, suitable hypoxemic patients with patchy pneumonia should have an early trial of prone positioning under close observation when they need >40% of oxygen, possibly earlier, to maintain SpO₂ of >92%. This could help treat patients where V/Q mismatch is the main problem. CPAP/HFNO could be added where lung recruitment is essential. This physiology approach could lead to a reduction in need for mechanical ventilation. Late prone positioning should be avoided or should be restricted to ICU setting.

Awake prone positioning is easy to use but like CPAP, it is not a proven therapy in COVID pneumonia. With various thoracic societies advocating the use of awake prone

| Study Parameter | Characteristics |
|-----------------|-----------------|
| Suitability criteria | Hypoxic respiratory failure, patchy bilateral consolidation RR<40 breaths/min No need for immediate mechanical ventilation |
| Total number | 12 (10 males) |
| Mean age (years) | 56 (28-82) |
| Background conditions | 1 TIA, 2 MI, 2 HT, 1 asthma, and 2 obese |
| Mean maximum CRP (range) | 268 (145-507) |
| Mean lowest lymphocyte count | 0.7 (0.25-1.3) |
| CXR changes | Patchy bilateral 9 Diffuse 1 Large consolidation 1 unilateral 1 bilateral |
| Progression of CXR change | CT 10 |
| Mean time from admission to maximum oxygen requirement | 94 h (20 to 224 h) |
| Oxygen requirement at proning | 40% (1), 60% (8), and 15 LPM via nonrebreathe mask (3 of which 1 declined intubation, 2 intubated-all survived) |
| Maximum oxygen requirement | 60% (2) and 15 LPM (10) |
| Days in hospital after requiring maximum oxygen | 12 |
| SpO₂ prior to proning | 85%-92% |
| Arterial carbon dioxide prior to proning | Available in 6 patients-4.1-5.1 kPa |
| Improvement in SpO₂ | 5%-10% |
| Duration of proning session | 30 min to few hours |
| Total duration of proning | 2 to 5 days |
| Adverse events | Oxygen disconnection with temporary desaturation in 2 patients |
| Admission to ICU | 19 |
| Mechanical ventilation | CPAP 1 patient-subsequently ventilated |
| Mean length of stay (range) | 16 days (8-29) |
| Outcome (%) | 3 (25%) died 7 (58%) discharged 2 (17%) awaiting discharge |

ICU: Intensive care unit, CPAP: Continuous positive airway pressure, CT: Computed tomography, CXR: Chest X-ray, MI: Myocardial infarction, TIA: Transient ischemic attack, HT: Hypertension, PE: Pulmonary embolism, CRP: C-reactive protein, LPM = liter per minute, RR: Respiratory rate, SpO₂: Oxygen saturation, FiO₂: Fraction of inspired oxygen
It is important that this is tested head to head or as a sequential strategy in randomized controlled trials. Our study demonstrates the feasibility of this approach.

This is particularly important now as prone positioning, if proven to work, could save lives in all situations including resource-limited countries.

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Conflicts of interest
There are no conflicts of interest.

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