Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Role of Noninvasive Ventilation in COVID-19 Respiratory Failure

Opposing authors provide succinct, authoritative discussions of controversial issues in emergency medicine. Authors are provided the opportunity to review and comment on opposing presentations. Each topic is accompanied by an Editor's Note that summarizes important concepts. Participation as at authoritative discussant is by invitation only, but suggestions for topics and potential authors can be submitted to the section editors.

Editor's Note: Determining optimal strategies for respiratory support in patients with COVID-19 can be challenging. In particular, our understanding of the role of noninvasive ventilation for COVID-19 pneumonia is evolving, and the overall benefits remain unclear. In this installment of Clinical Controversies, our discussants present opposing views on the use of noninvasive ventilation by comparing strategies that embrace noninvasive ventilation as opposed to strategies that restrict the use of noninvasive ventilation.

NONINVASIVE VENTILATION REDUCES RATES OF INTUBATION COMPARED WITH HIGH FLOW OXYGENATION IN PATIENTS WITH SEVERE COVID-19

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COVID-19, as a novel pathogen, has brought about unprecedented challenges and strained our health care system to the brink. Traditionally, acute hypoxemic respiratory failure is managed with oxygen therapy, though the optimal modality for oxygen delivery remains unclear. Before the COVID-19 pandemic, the High FLow Nasal Oxygen in the Resuscitation of patients with Acute Lung Injury (FLORALI) trial suggested that high flow oxygenation is the respiratory support of choice in patients with acute hypoxemic respiratory failure.[1] However, the ideal respiratory support for acute hypoxemic respiratory failure because of COVID-19 has yet to be defined.

Three randomized controlled trials have compared high flow oxygenation with various modalities of noninvasive ventilation (eg, continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BPAP) delivered through a face mask or helmet) at different stages of the COVID-19 pandemic.[2-4] Using a cohort of adult COVID-19 patients with oxygen saturations less than 94% and a fraction of inspired oxygen (FiO_2) of 40 mmHg, Perkins et al[2] performed an adaptive randomized controlled trial of conventional oxygen therapy versus high flow oxygenation versus CPAP. This study included a total of 1273 adults with acute hypoxemic respiratory failure among the 3 arms. However, 36.3% of the CPAP group compared with 44.4% of the high flow oxygenation group met the primary outcome of endotracheal intubation or 30-day mortality. This study, like FLORALI, was not originally designed to compare high flow oxygenation to noninvasive ventilation; however, a post hoc analysis demonstrated a difference of -10% (95% confidence interval [CI], -18% to -2%), a statistically significant difference favoring the use of CPAP. Despite being a post hoc analysis, an absolute difference of 10% should not be ignored. This difference, however, was entirely driven by an improvement in endotracheal intubation rather than mortality.

In another trial of 110 patients, Greico et al[3] compared helmet BPAP followed by high flow oxygenation to high flow oxygenation alone within the first 24 hours of ICU admission in patients with initial PaO_2/FiO_2 ratio <200 on FiO_2 0.24-0.60 mmHg through venturi mask. Although their primary outcome of a number of days free of respiratory support (including high flow oxygenation, noninvasive ventilation, and invasive mechanical ventilation) within 28 days of enrollment was not different between the groups, they again demonstrated a decrease in endotracheal intubation in the group that started on noninvasive ventilation. These studies contrast with Nair et al[4] who compared high flow oxygenation with BPAP in 109 adults with COVID-19 and a respiratory rate >24 beats/min and oxygen saturation less than 94% on 10 liters/min of venturi mask for 30 minutes or a respiratory rate >30 beats/min and oxygen saturation $<90\%$ on room air. This study found fewer instances of endotracheal intubation in the high flow oxygenation at 48 hours and 7 days compared with the noninvasive ventilation. A meta-analysis combining these 3 trials found the relative risk of high flow oxygenation compared with noninvasive ventilation on death was 0.92 (95% CI, 0.65 to 1.33).

However, high flow oxygenation fared worse for the combined end point of mortality or endotracheal intubation (relative risk 1.22 [95% CI, 1.03 to 1.45]).[5] Although Nair deviates from the other 2 studies, the meta-analysis demonstrates the benefit of a noninvasive ventilation strategy (CPAP by helmet, face mask, or BPAP). Although the respiratory rate and FiO_2 did not vary between groups, the patient effort may be reduced using BPAP, thereby mitigating self-induced lung injury.[6]

The clinical benefits of noninvasive ventilation may be underestimated by many trials, as most centers use facemask noninvasive ventilation, whereas helmet noninvasive ventilation may offer physiological proof of this noninvasive ventilation's benefits.[3,7] It is conceivable that the benefits of such an approach arise from a more reliable, evenly distributed positive pressure when compared with a face mask that requires a near-perfect seal around the mouth and nose to benefit the respiratory cycle.

Overall, noninvasive ventilation appears to reduce the risk of endotracheal intubation when compared with high flow oxygenation in the setting of COVID-19-related acute hypoxemic respiratory failure. Although there does not appear to be a difference between high flow oxygenation and noninvasive ventilation on mortality in such patients, the delay or altogether prevention of endotracheal intubation may confer benefits to both the health care system and the patient, such as sparing scarce resources (eg, ventilators, intravenous analgesics or sedatives) and prolonging the number of time patients can interact with their family. Furthermore, the use of noninvasive ventilation may have an additional benefit in the treatment of patients with moderate-to-severe COVID-19 and comorbidities that often benefit from noninvasive ventilation use (eg, chronic obstructive pulmonary disease and congestive heart failure). Based on these potential benefits, we feel that noninvasive ventilation, particularly by helmet BPAP when available, should be the first-line therapy for oxygen therapy in COVID-19-related acute hypoxemic respiratory failure.

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