

## Judicious Use of Noninvasive Ventilatory Modalities for Severe Pneumonia/ARDS

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In our recent pro/con on noninvasive ventilatory therapies to treat hypoxemic respiratory failure due to severe pneumonia/ARDS (PNA/ARDS), Dr Gregoretti and my colleagues and I seem to agree that this is a “hot topic” and that we must be very cautious because misapplication of these techniques can be harmful (such as when they lead to excessive tidal volumes) or even lethal (if we delay a needed intubation for too long, for example). We also agree that we don't know enough about who should get what modality, when, or what is the best interface, and that considerably more work needs to be done to address these questions.

We disagree on Dr Gregoretti's final suggestion; that we should consider NIV for early extubation of patients with hypoxemic respiratory failure to reduce the complications of prolonged invasive mechanical ventilation. This approach has been shown to be effective in patients with hypercapnic respiratory failure, especially that due to COPD (1). But these patients are well known to respond favorably to upfront NIV when they present with respiratory failure, in contrast to those with PNA/ARDS. Furthermore, early extubation of those with hypoxemic respiratory failure is likely to face the same challenges as those faced upfront; high pressures to facilitate oxygenation that promote leaks and mask discomfort, high minute volumes that make synchronization difficult and the risk of profound oxygen desaturations if the mask becomes dislodged.

One of the biggest challenges facing NIV, especially with hypoxemic respiratory failure, is mask intolerance. Most patients are unable to tolerate the mask continuously, meaning that there may be lengthy periods of time off NIV. In the Frat et al. (2) study comparing high flow nasal therapy (HFNT) with NIV and standard oxygen, patients in the NIV group received an average of only 8 hours of NIV therapy on each of the first 2 days. This means that severely hypoxemic patients are without the benefit of higher positive end expiratory pressures (PEEP) for these periods off NIV, often precipitating severe hypoxemia and the inevitability of invasive mechanical ventilation. The study by Patel et al. (3) on helmet ventilation for (PNA/ARDS) raises the possibility that such patients could still be managed with the helmet which could enhance tolerance, but their data must be replicated in other studies at other centers before their approach can be recommended.

It should be acknowledged that there appears to be a role for HFNT in patients with postextubation hypoxemic respiratory failure. Several studies have shown that HFNT can reduce intubation rates compared to standard oxygen in the postextubation setting (4-7), even in patients at “low risk” of needing reintubation (7). One study showed noninferiority of HFNT compared

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to NIV in “high risk” postextubation patients (6). By virtue of its much better tolerability compared with NIV, enabling most patients to use it 24/7, as well as its superior oxygenation and humidification capabilities compared to standard oxygen (8, 9), HFNT is being used increasingly in this setting. It should also be kept in mind that HFNT in these studies was used mainly as a way to prevent escalation of therapy to intubation rather than as a therapy for established severe hypoxemic respiratory failure.

In his brief editorial commentary on the topic (10) that accompanied our prior discourse (11), Associate Editor Cakar posed some important questions about use of noninvasive modalities for patients with PNA/ARDS and we would like to offer our opinions:

- 1) Which ARDS patients should receive non-invasive mechanical ventilation (MV)?  
A select few. Patients with single organ system failure (respiratory) who are otherwise medically stable (SAPS II score <34, for example, as used by Antonelli et al. (12)) without other usual contraindications for NIV might be considered for a trial. If after an hour there has been insufficient improvement in  $\text{PaO}_2/\text{FIO}_2$  (ie < 175 (12)), then prompt intubation should be seriously considered. For the foreseeable future, invasive mechanical ventilation will be the mainstay for hypoxemic respiratory failure due to PNA/ARDS and should be considered the default mode.
- 2) When should non-invasive MV be used in ARDS?  
Relatively early and sparingly. When patients cannot be adequately oxygenated by nasal cannula oxygen flow rates of up to 6 L/min, we opine that HFNT, by virtue of its greater comfort and effective oxygenation compared to standard higher flow mask oxygen, should be the next choice. If HFNT fails to adequately oxygenate, NIV, by virtue of its ability to apply greater PEEP than HFNT, would be a consideration prior to intubation. However, we would be concerned about the risk of delayed intubation and would generally recommend prompt intubation. In the Frat study (2), 26 patients in the standard oxygen group and 14 in the HFNT group were switched to NIV when they had “signs of persisting or worsening respiratory failure”, 19 (73%) and 9 (61%), respectively, subsequently required intubation, underlining the high risk of NIV failure in this situation.
- 3) Which mode and interface should be used during non-invasive MV in ARDS?  
Pressure limited modes such as “bilevel” consisting of a higher inspiratory positive airway pressure (IPAP) and lower expiratory PAP (EPAP), pressure support ventilation and pressure control ventilation have all been used to support ventilation and oxygenation in PNA/ARDS patients with varying rates of success and we use them for that application. Earlier studies have supported the use of a full face mask over a nasal mask for NIV (13, 14), and the more recent Patel study (3) suggests that the helmet may be more successful than the full face mask. Evidence is insufficient to support a recommendation for any particular mode or mask, however.
- 4) How can we prevent intubation delay in patients with ARDS during usage of non-invasive MV?

Vigilant monitoring in an ICU and prompt proactive intubation. Patients with progressive severe respiratory failure and/or multi-organ dysfunction, especially in the presence of septic shock are not candidates for noninvasive approaches and should be promptly intubated. Patients who are sufficiently stable to try NIV as per the criteria in #1 above should be monitored closely and if oxygenation fails to improve sufficiently within the first hour of NIV, intubate.

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