Noninvasive Ventilation in Unplanned Endotracheal Extubation: Just a Little Help From My Friend?

Unplanned extubation is a rather common issue in the ICU. Surprisingly, as documented in this issue of the Journal by Kudela et al,[1] only a relatively small portion of subjects require re-intubation. This may mean that many individuals remain intubated longer than necessary. The main reasons for placing an endotracheal tube are to protect the airways and to support the failing lung and/or the respiratory pump. In the former, immediate re-intubation is necessary in the case of unplanned extubation.

Kudela et al[1] investigated the effects of noninvasive ventilation (NIV) on the outcomes of subjects who are self- or accidentally extubated. Their retrospective single-center study concentrated on ventilation methods supporting the subjects, switching from an invasive method to a noninvasive one. Their study is intriguing because it raises several considerations, not only concerning unplanned extubation, but the whole process of weaning from mechanical ventilation.

Some details can make important outcome differences in the care of mechanically ventilated patients, such as ventilator settings that can result in under- or over-assistance of the diaphragm,[2] judicious use of sedation[3] and medical therapy, the use of care bundles to prevent infections,[4] and the prompt recognition of weanability through the use of appropriate tests.[5] These tests are not always timely in real-life settings, so the discontinuation of mechanical ventilation may be delayed. As recently highlighted,[6] among other variables, clinician-related barriers (eg, reluctance to follow protocols), protocol-related barriers (eg, lack of confidence in evidence supporting protocols or guidelines), and ICU contextual barriers (eg, lack of interprofessional team support and training) are the main reasons why patients may remain ventilated for longer than necessary.

Once a patient is abruptly disconnected from ventilatory support, it is much more difficult to predict who should undergo immediate re-intubation and who can instead be liberated from the ventilator. This holds particular importance because the time elapsed between unplanned extubation and re-intubation is strongly associated with death.[7] In the study by Kudela et al,[1] only 20% of subjects needed to be reconnected to the ventilator within minutes, while the large majority were reconnected in the first 24 h, a time frame that has been shown to be associated with a mortality rate of $> 30\%$.[7]

The use of NIV has been addressed recently in the

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European Respiratory Society/American Thoracic Society (ERS/ATS) guidelines,[8] which define the use of NIV in critically ill patients. These guidelines recommend the use of NIV to treat postoperative acute respiratory failure in surgical patients and to prevent postextubation respiratory failure in high-risk patients; they also underscore the need to specifically address the use of NIV in case of unplanned extubation because data in this setting are scarce and yield contradictory results.

In their study, Kudela et al[1] tried to elucidate the issue, dividing the subjects who experienced unplanned extubation into 3 groups, according to their clinical practice: a no NIV group (ie, subjects deemed not indicated for ventilatory support by the attending physician), a rescue NIV group (ie, subjects who did not receive NIV to treat overt postextubation respiratory failure), and a prophylactic NIV group. The last group included subjects affected by COPD or other chronic severe respiratory impairment, chronic cardiac failure, elderly subjects, and some subjects with prolonged use of mechanical ventilation.

Overall, the re-intubation rates were 25.8%, 10%, and 64.3% for the no NIV, prophylactic NIV, and rescue NIV, respectively, leading to a statistically insignificant difference between subjects with no NIV and all NIV subjects. The authors concluded that NIV did not reduce the rate of re-intubation in subjects with acute respiratory failure following unplanned extubation and, in particular, that prophylactic NIV in this setting was not associated with a better outcome with respect to the no-NIV groups. The authors should be con-

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gratulated for having assessed an important issue, which was, in our view, still an open question.

First of all, the study showed that the use of NIV probably should be banned in patients who show overt respiratory failure after unplanned extubation, confirming what was already known from a few randomized controlled trials performed after planned extubation.[9,10] The comparison between the use of prophylactic NIV and no use of NIV is, however, trickier. Contrary to what was reported by Kudela et al,[1] our group[11] and others[12,13] gathered data from large randomized controlled trials and have shown that the application of NIV in high-risk patients (defined with criteria similar to what was used by Kudela et al[1]) significantly reduced the need of re-intubation after a planned extubation.

Despite the fact that the authors have correctly tried to minimize the bias of this retrospective study, using data collected prospectively, the sample size of the trial remains quite small, so the trial is prone to type-2 error. From a purely clinical point of view, a 26% re-intubation rate versus 10% for the no NIV and prophylactic NIV groups, respectively, may be relevant despite a statistically insignificant difference.

It is, however, important to recognize the clear difference between the 2 groups, especially concerning the reason for intubation: only 24% of the no NIV group and 50% of the prophylactic NIV group were ventilated for respiratory reasons, while 45% and 20%, respectively, were ventilated for neurological issues. Troché and Moine[14] showed that subjects with respiratory and cardiac problems required more prolonged ventilation than those with neurological problems. Respiratory failure in patients with persistent hypercapnia and heart failure are primary causes of postextubation failure, accounting for about 40% of cases, and are associated with a mortality rate that can exceed 30%.[7]

In patients passing a weaning trial, the preventive use of NIV have been shown to reduce the re-intubation rate with respect to not using NIV from about 25% to 10%, results that are very similar to those obtained by Kudela et al.[1] The authors correctly recognized the issue in the discussion, stating that "it is also logical to provide prophylactic NIV following unplanned extubation in patients who would have been placed on this modality following a planned extubation."

Respiratory failure was by far the most frequent reason for re-intubation in the whole group of subjects ($n = 30$), followed by shock ($n = 2$) and neurologic impairment ($n = 3$). The majority of these subjects with respiratory failure were affected by de novo respiratory failure, where the use of NIV is still debatable, and therefore the ERS/ATS guidelines[8] did not make any recommendation. In such patients, one of the problems is the risk of ventilator-induced lung injury during NIV.[15] Kudela et al[1] claimed that they set the ventilator to obtain a tidal volume (V_T) of 6–8 mL/kg ideal body weight, which may be considered an appropriate range. We know, however, that breathing patterns may be quite varied, especially in patients with respiratory distress (ie, the group undergoing rescue NIV), and therefore it is likely that higher V_T values were obtained after the initial setting.

During NIV, the expired V_T is the sum between the set V_T and the effort generated by the patient. In the study by Kudela et al,[1] the initial level of pressure support was set to 8 cm H_2O and was adjusted during the time course, but it may be that this value was not increased often due to the subject tolerance, and therefore V_T was mainly driven by the strenuous effort generated by the subjects. One way to reduce this work load may be to judiciously sedate the patients to reduce their effort and increase the level of ventilatory assistance. This was not the case in the present study because only 1 subject received sedation after unplanned extubation; this may also explain the high percentage of subjects requiring re-intubation in the rescue NIV group.

In conclusion, the study results add a piece of knowledge about the problem of unplanned extubation and the use of NIV in the setting of unplanned extubation, calling for further randomized controlled trials. It could be interesting to also consider the use of high-flow nasal cannula as a potential treatment arm. Indeed, the trial highlights the fact that when a patient is invasively ventilated in the ICU, a prompt assessment of weanability could avoid unnecessary prolongation of ventilation and the related deleterious consequences.

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