Review

Pro/con clinical debate: Tracheostomy is ideal for withdrawal of mechanical ventilation in severe neurological impairment

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Abstract

Most clinical trials on the topic of extubation have involved patients outside the neurological intensive care unit. As a result, in this area clinicians are left with little evidence on which to base their decision making. Although tracheostomies are increasingly common procedures, they are not without complications and costs, and hence a decision to perform them should not be taken lightly. In this issue of *Critical Care* two groups debate the merits of tracheostomy before extubation in a patient with neurological impairment. What becomes very clear is the need for more high quality data for this common clinical problem.

Keywords brain injury, intubation, neurosurgical intensive care, tracheostomy, weaning

The scenario

You work in the neurological intensive care unit (ICU) and you are managing a patient who suffered a subarachnoid bleed and, despite appropriate therapy, is left with significant neurological impairment. You have weaned the patient appropriately on the ventilator and you feel that they are strong enough to tolerate extubation. You worry that, given their severe neurological impairment, they may not be able to protect their airway upon extubation, and as such you consider the merits of tracheostomy.

Pro: Tracheostomy is ideal for withdrawal of mechanical ventilation in severe neurological impairment

Luciana Mascia, Eleomore Corno and Pier Paok Terragni

During the early phase after acute brain injury, patients with impaired consciousness may require mechanical ventilation to protect their airway, treatment for intracranial hypertension, and ventilatory support to treat pulmonary complications. After the acute phase, and once satisfactory weaning parameters have been achieved, the patient's impaired level of consciousness and inability to protect their airway represent strong reasons why extubation should be delayed [1]. These patients might benefit from continued intubation through prevention of aspiration and because of their limited ability to clear secretions, but it has been shown that prolonged intubation in traumatic brain injury is associated with a high incidence of pneumonia [2]. Conversely, early tracheostomy after trauma reduces ICU length of stay and number of ventilator days, and reduces the incidence of ventilator-associated pneumonia [3–5]. Koh and coworkers

GCS = Glascow Coma Scale; ICU = intensive care unit.

[6] confirmed that patients undergoing early elective tracheostomy had shorter ICU stays than did patients who were given extubation trials before tracheostomy. Kluger and colleagues [7] reported a lower incidence of pneumonia when early tracheostomy was performed in brain-injured patients. Nowak and coworkers [8] identified an increased risk for severe tracheal complications in brain-injured patients who had been intubated for more than 14 days.

The critical issues in developing effective ventilatory management strategies in acute brain-injured patients remain the identification of those patients who are more likely to require long-term ventilatory support and determination of the optimal timing for tracheostomy.

Major and coworkers [9] suggested the utility of daily assessment of objective scores such as Glasgow Coma Scale (GCS) and Simplified Acute Physiology Score; scores on these scales of below 7 and greater than 15, respectively, on day 4 had a high positive predictive value for identifying those head-injured patients who required tracheostomy for prolonged airway protection. Similarly, Namen and coworkers [10] found that a weaning protocol for head-injured patients should always include a neurological assessment using the GCS; a score greater than 8 on the GCS was most accurate in predicting successful extubation without need for reintubation, and avoiding pneumonia and tracheostomy.

Qureshi and coworkers [11] reported that, in patients with infratentorial lesions, an aggressive policy regarding tracheostomy is justified because of the low rate of successful extubation, and that a that tracheostomy should be performed on day 8 because of the low probability of subsequent extubation or in-hospital death. Selection of this subgroup of patients for tracheostomy is justified because infratentorial lesions located in the cerebellum and brainstem may be associated with damage to the primary neural respiratory centres (which are involved in coordinating respiration), to the lower cranial nerve nuclei (which are responsible for protective airway reflexes), and to reticular activating pathways (which are responsible for impairment in the level of consciousness and consequently for reduced protective airway reflexes).

Although early tracheostomy may reduce the length of ICU stay and pulmonary morbidity [12], the first 7–10 days after acute brain injury coincide with the greatest incidence of intracranial hypertension; the appropriate timing for tracheostomy in these patients must be considered in view of the risk for severe intracranial hypertension. Stocchetti and coworkers [13], in a randomized control trial comparing three tracheostomy techniques, included patients ventilated from 4 days but excluded patients with unstable intracranial pressure requiring active treatment.

The patient described in the scenario above appears to meet standard weaning criteria and has stable intracranial pressure but a low GCS score, indicating that he patient has impaired ability to protect his airway. We therefore believe that the patient should receive tracheostomy to reduce the length of ICU stay and the likelihood of pulmonary complications.

Con: Tracheostomy is not ideal for withdrawal of mechanical ventilation in severe neurological impairment

David Stather and Niall D Ferguson

The management of a brain-injured patient with satisfactory weaning parameters but a decreased level of consciousness is a common critical care scenario. The role of tracheostomy in this setting, however, has yet to be clearly defined. Tracheostomy has been shown to decrease the work of breathing [14], but this is not the issue in this scenario. Aspiration of oropharyngeal contents is common in neurologically impaired patients, but tracheostomy may not protect against aspiration [15]. A retrospective study of traumatic brain-injured patients [2] found a high incidence of pneumonia in those with prolonged intubation, probably because of a loss of normal upper airway defences caused by the presence of the endotracheal tube. Unfortunately, tracheostomy does not necessarily reduce the incidence of nosocomial pneumonia; in fact, the presence of a tracheostomy has been associated with a sixfold increased risk for developing ventilator-associated pneumonia [16]. Tracheostomy has been associated with decreased ICU and hospital mortality in observational cohort studies of mechanically ventilated patients [17,18]. This effect, however, is probably related to a selection bias created by the fact that patients needed to survive their first 10–20 days of ventilation in order to receive a tracheostomy. When the same observational data were examined in a matched case–control design, tracheostomy patients had longer ICU and hospital lengths of stay, and a lower ICU mortality, but importantly they had no decrease in hospital mortality [19].

Brain dysfunction can contribute to extubation failure in a number of ways, such as by decreasing the patient's ability to protect their airway and clear secretions. Namen and coworkers [10] found that a GCS score below 8 was associated with an increased likelihood of extubation failure in neurosurgical patients. Coplin and colleagues [1], however, found no relationship between extubation failure and GCS score. In that prospective observational cohort study, those investigators found that 39 out of 49 patients with GCS score of 8 or less, and 10 out of 11 patients with a GCS score of 4 or less tolerated extubation. In addition, they showed that brain-injured patients who had delayed

extubation developed more pneumonias, had longer lengths of stay, and incurred more hospital charges than did similar patients who were extubated promptly after meeting standard weaning criteria [1]. It is possible that tracheostomy could improve the outcome of brain-injured patients in whom upper airway obstruction or problematic secretions could cause extubation failure. Its utility in other patients with simple decreased level of consciousness is much less certain. For example, evidence-based guidelines for discontinuing ventilatory support do not include brain-injured patients in a list of populations who may derive particular benefit from early tracheostomy [20].

Returning to our scenario, if a plan for ongoing aggressive care has been made after appropriate consideration of prognosis and family discussions, then options from this point would include continuing orotracheal intubation, tracheostomy placement, or primary extubation. There is currently no clear evidence to suggest that performing a tracheostomy in this setting would improve outcome. Carefully planned prospective studies, both observational and interventional, that examine the need for and optimal timing of tracheostomy in brain-injured patients are needed to better address this common clinical question.

Utility and timing of tracheostomy in brain injured patients need to be assessed prospectively

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Although the need for and optimal timing of tracheostomy for brain-injured patients is a common clinical problem, no large randomized trials have unequivocally clarified whether this intervention improves outcome. While we await definitive answers, we should select subgroups of brain-injured patients who may benefit from this intervention. Because of his severe neurological impairment, the patient described in the scenario presented above could be a good candidate for trachestomy to protect his airways.

Con response: Prospective studies are needed to identify subsets of neurologically impaired patients who might benefit from tracheostomy

David Stather and Niall D Ferguson

The common theme underpinning both the argument presented by Mascia and colleagues and our own is the clear lack of rigorous, prospective data regarding the utility and optimal timing of tracheostomy in brain-injured patients. Even in the non-neurosurgical critical care population, there is insufficient and conflicting evidence regarding whether the timing of tracheostomy alters the duration of mechanical ventilation or extent of airway injury [21]. This paucity of data should not lead us to make definitive recommendations based on an incomplete understanding of the problem. Instead, we must recognize that further scientifically rigorous results are needed before this is important clinical question can be answered.

Competing interests

None declared.

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