CRITICAL CARE

COMMENTARY

Trach tubes designed to maximize safety may increase risk to ventilated patients

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Abstract

Dual-cannulae tracheostomy tubes with low-pressure cuffs, such as the Shiley LPC, are widely regarded as inherently safer than single lumen tubes with low-volume cuffs. For the patient who undergoes tracheostomy for failure to wean from mechanical ventilation, however, the insertion of a tube that occupies a large amount of space within the trachea can delay subsequent efforts to liberate him from the ventilator. With an aim to promote more timely rehabilitation of ventilated patients, London Ontario's University Hospital has been inserting the Bivona TTS, a single lumen tube with an elastic cuff, during tracheostomy. This allows caregivers to better exploit the benefits of a functional upper airway early during the weaning process, which may reduce complications associated with prolonged mechanical ventilation. We urge clinical studies to determine how the choice of initial tracheostomy tube can affect rehabilitation strategies and important patient outcomes.

Guidelines have endorsed the position that a tracheostomy tube with an inner cannula and a low-pressure cuff is inherently safer than a single cannula tube with a low-volume cuff [1,2]. For patients who undergo tracheostomy for failure to wean from mechanical ventilation, however, design features intended to make tracheostomy tubes safer may complicate subsequent efforts to liberate them from the ventilator. Since prolonged mechanical ventilation also increases risk [3], it is uncertain that tubes of the first type afford these patients an overall safety advantage in an intensive care setting.

A dual-cannulae tracheostomy tube, such as the Shiley LPC (Covidien-Nellcor, Boulder, CO, USA), occupies a relatively large amount of space within the trachea when the cuff is deflated during ventilator weaning. Because of resistance to flow around this type of tube, patients so equipped often cannot tolerate having the tube capped with either a speaking valve or a solid cap. Early spontaneous breathing trials must then be conducted while the patient breathes through an open tube. An open tube short-circuits speech, and impairs the natural airway defenses of coughing [4] and swallowing [5]. Moreover, bypassing the upper airway may diminish the patient's ability to sustain spontaneous breathing, leading caregivers to overestimate ventilator dependence. Exchanging to a smaller or cuffless tube can remedy this problem, but is delayed until caregivers are confident the stomal tract is stable and the patient can either breathe spontaneously or be adequately ventilated through the new tube.

With an aim to facilitate more timely rehabilitation of ventilated patients, London Ontario's University Hospital has been percutaneously inserting the Bivona TTS tube (Smtih Medical, St Paul, MN, USA). Because of this tube's single lumen design and cuffless profile, even a size 8 tube (outer diameter 11 mm) can usually be capped during spontaneous breathing trials, thereby allowing caregivers to assess readiness for decannulation with the initial tube in place. When provided with a tube that has sufficient space around it, patients who had been struggling with a prolonged weaning process are sometimes able to remain off the ventilator indefinitely once the tube is capped. There are a number of reasons why restoring access to the upper airway can have such a dramatic effect.

Malposition of a tracheostomy tube, where the distal end is partly occluded by the tracheal wall, has been identified as an often overlooked cause of weaning failure [6]. If, from the outset, the patient was fitted with a tube that provided an optional airway around it, as well as through it, then malposition would not be as likely to obscure the patient's ability to resume spontaneous breathing. Moreover, partial closure of the larynx [7] and pursed lip breathing [8] mitigate airway obstruction, which may help the emphysematous patient breathe more easily through the upper airway, when the tube is capped, than through an open tube.

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In most cases, a patient with a Bivona TTS in place can begin speaking earlier during rehabilitation. The importance of speech is often discounted by intensive care personnel accustomed to caring for patients who have been rendered mute, but the ability to speak reduces patient stress and the need for sedation. Improved communication also assists caregivers to better meet patients' needs [4,9]. Both benefits can help avoid serious complications, and may improve the rate of recovery.

Studies have demonstrated a high incidence of tracheal damage from translaryngeal tubes (endotracheal tubes) equipped with high-pressure cuffs, so some caregivers express concern with the Bivona TTS's water-filled cuff. An endotracheal tube disables glottic function, however, while a tracheostomy tube preserves it. There is thus no requirement to maintain an occlusive cuff seal with a tracheostomy tube as there is with an endotracheal tube. A slight leak around the cuff can easily be compensated for by the ventilator, and, contrary to popular belief, a fully inflated tracheostomy cuff may increase the risk of aspiration [10]. If there is potential for a leak around the cuff, the patient can use flow from the ventilator to expel secretions from the airway [11]. In any case, cuff inflation is under our control, and a water-filled cuff need not be inflated to the point where excessive pressure is transmitted to the tracheal wall.

Cuff type is not the only factor to consider if we are to minimize injury to the trachea. A polyvinyl-chloride Shiley LPC tube may conform poorly to the patient's anatomy, especially with those who have thick necks, so high cuff pressure is sometimes required to make a seal sufficient for ventilation. In those instances, the cuff on a rigid curved tube like the Shiley LPC does not sit midline within the trachea, and either the arc or tip of this tube may be pressing against the tracheal wall [12]. In contrast, flexible silicone tubes like the Bivona TTS accommodate to a wider range of anatomies. With careful inflation, a hard cuff on a flexible shaft may make more even and gentle contact with the trachea than a low-pressure style cuff on a rigid tube.

Suprastomal damage may occur during percutaneous tracheostomy and result in severe stenosis, but its incidence may be reduced if smaller tubes, and less force, are used during the procedure [13]. It seems likely that a size 8 Bivona TTS tube could be inserted with less trauma than a size 8 Shiley LPC, given that the Shiley presents a 50% larger cross-sectional area than the Bivona (as calculated from circumferences measured around the compressed deflated cuffs).

Prolonged mechanical ventilation increases risk to the patient, and there is no evidence that the use of trachestomy tubes with inner cannulae and large-volume cuffs reduce overall mortality or morbidity. Since inserting such tubes during tracheostomy has the potential to delay rehabilitation of the ventilated patient, a review of this practice is in order. Researchers will hopefully be motivated to conduct clinical studies to determine how the choice of initial tracheostomy tube can affect the rehabilitation strategy and important patient outcomes.

Competing interests
The authors declare that they have no competing interests.

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