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Emergency Airway Management in a Patient with a T-Tube Tracheal Stent

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□ **Abstract—Background: Abnormal anatomy complicates emergency airway management. In this case, we describe definitive airway management in a critically injured emergency department (ED) patient with a history of partial tracheal resection who had a Montgomery T-tube, a type of T-shaped tracheal stent, in place at the time of the motor vehicle collision. The Montgomery T-tube is not a useful artificial airway during resuscitation, as it lacks a cuff or the necessary adapter for positive pressure ventilation. Case Report: We describe a case of a 51-year-old man who required emergency airway management after a motor vehicle collision. The patient had a Montgomery T-tube in place, which was removed with facilitation by ketamine sedation and topical anesthesia. The patient was successfully intubated through the tracheal stoma after removal of the T-tube. Why Should an Emergency Physician Be Aware of This?: Emergency physicians must recognize the Montgomery T-tube, which resembles a standard tracheostomy tube externally, and have some understanding of how to manage a critically ill patient with this rare device in place. When a patient with a Montgomery T-tube in place requires positive pressure ventilation, the device may require emergent removal and replacement with a cuffed tracheostomy or endotracheal tube. © 2022 Published by Elsevier Inc.**

□ **Keywords——surgical airway; airway; T-tube; respiratory failure; tracheostomy**

Introduction

Emergency airway management remains one of the highest-risk but crucial procedures emergency physicians perform. Abnormal upper airway anatomy often complicates airway management in the emergency department (ED). In this case, we describe emergency airway management in a patient with a history of tracheal necrosis who presented with a traumatic brain injury after a motor vehicle collision, necessitating tracheal intubation and mechanical ventilation. This patient had a Montgomery T-tube, a T-shaped type of tracheal stent, that made managing this patient's airway extremely challenging.

Case Report

A 51-year-old man presented to the ED of an urban Level I Trauma Center after being in a high-speed motor vehicle collision. He sustained a traumatic brain injury, which led to agitation that interfered with his care. Paramedics reported that the patient had a "type of trach in his neck." On examination, the tracheostomy tube was identified as a Montgomery T-tube (Figure 1), a flexible silicone device used for tracheal stenting in the setting of complicated or abnormal tracheal anatomy. A brief chart review revealed that this patient had severe subglottic stenosis and cricotracheal resection complicated by tracheal necrosis requiring resection of 7 cm of trachea, with placement of a T-tube 36 months prior to keep the remaining tracheal tissue stented and allow for phonation.

The patient was spontaneously breathing but was not following commands, was gagging, and would wax and wane between agitation (swinging and providers and interfering with care) and depressed Glasgow Coma Scale

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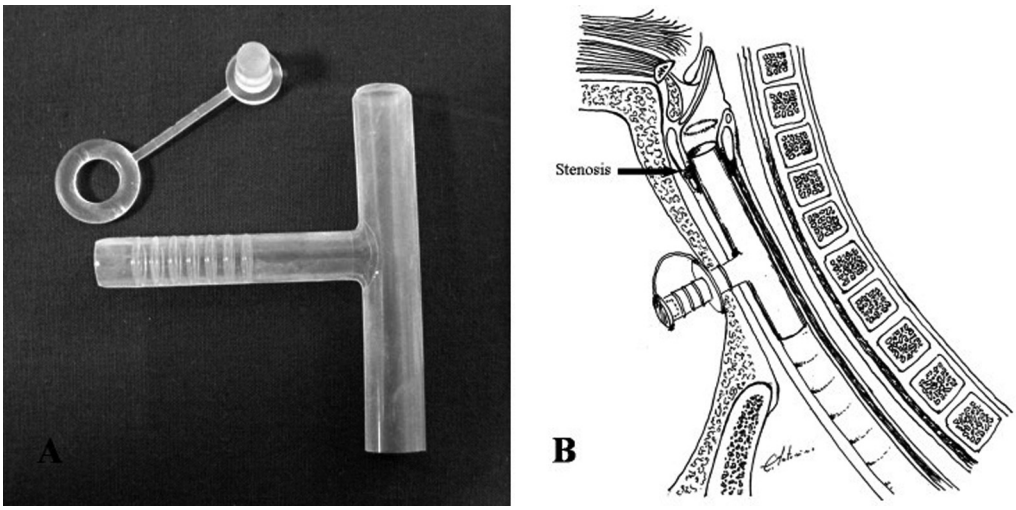

Figure 1. Shown is the T-tube, a semi-rigid T-shaped tracheal stent most commonly used for tracheal lesions and provides comfort for patients with stenosis. It has no method to attach a resuscitator bag and no cuffs. This makes ventilation from above the device (with a bag mask device or supraglottic airway) ineffective. The T-tube must be removed with a clamp before an endotracheal or tracheostomy tube can be placed through the stoma and into the trachea. Depending on the stenosis, the short limb may extend caudally or cephalad. Image is from ref. (6): Gallo et al. (2012) as permitted by Creative Commons to "copy or redistribute the material in any medium or format."

score ([GCS] of 8, eye opening (E)1/verbal response (V)2/motor response (M)5). The decision was made to intubate for expected clinical course and aspiration risk. The providers did not think sedation alone without endotracheal intubation would be safe in this patient, given the gagging and the traumatic mechanism with a depressed GCS. The T-tube provided a conduit into the trachea but it does not have a cuff, which makes it impractical to apply positive pressure ventilation. Otolaryngology was not immediately available given the time of day. Given that the patient was spontaneously breathing, the emergency physician elected to use an awake approach to managing the airway. First, 2% lidocaine gel was applied to the trachea through the T-tube, which the patient tolerated well. We considered the orotracheal approach to be problematic due to his known subglottic stenosis. After the lidocaine had taken effect, a pediatric bougie (10 French, 70 cm, SunMed, Grand Rapids, MI) was placed through the extraluminal portion of the T-tube and into the trachea; a hard stop was felt as the coude tip of the bougie encountered a small-caliber distal airway. We administered intravenous ketamine 2 mg/kg for sedation, and prepared rocuronium 1.5 mg/kg. We attempted to remove the T-tube through the existing stoma, but the "T" shape made this impossible. We used a #22 blade scalpel to make a 1-cm incision extending from the inferior margin of the stoma. Using Kelly clamps to gain purchase on the silicone tube, we were then able to remove the T-tube over the bougie. Figure 2 demonstrates the T-tube after removal. A 6.0 cuffed endotracheal tube was then passed over the bougie, through the expanded stoma, and into the trachea.

Figure 2. T-tube after surgical removal and intubation. The provider is grasping the proximal intraluminal part.

Tracheal tube placement was confirmed with waveform capnography. At this time, rocuronium was administered. The tube was secured using twill tape and a chest radiograph was obtained.

The patient was diagnosed with a traumatic subarachnoid hemorrhage and was admitted to this intensive care unit. His blood ethanol was negative. After stabilization, Otolaryngology replaced the endotracheal tube with a Shiley^{TM} tracheostomy tube (Medtronic, Boulder, CO). He returned to the operating room with Otolaryngology on hospital day 9 for revision of his stoma and placement of a new T-tube. Due to the extent of tracheal resection and tracheal stenosis, the patient required the T-tube to main-

tain patency of the trachea both caudal and cephalad to the stoma. Endoscopic visualization demonstrated excoriated trachea with stigmata of recent bleeding and crusting. The new T-tube was placed without complication and there seemed to be no appreciable complications from the emergency intubation 9 days prior. He was discharged home on hospital day 11 fully neurologically intact.

Discussion

Emergency airway management remains one of the cornerstones of emergency medicine practice. It can be challenging to perform advanced airway management for patients with an existing surgical airway due to abnormal anatomy and differences between various tracheal devices. The most common issues with tracheostomy tubes include obstruction and dislodgement (1,2). A dreaded complication for patients with a tracheostomy is a tracheoinnominate fistula, which has a high mortality rate (2,3).

The most common tracheostomy devices include the Shiley and Bivona^{TM} (Smiths Medical, Dublin, OH) tracheostomy tubes (4,5). A less frequently used device is the Jackson^{TM} tube (Miltex Surgical, York, PA, USA). Although the rare Jackson tracheostomy tube does not have an inflatable cuff, many uncuffed tracheostomy tubes have an attachment point for a ventilator or bag valve device and allow for some degree of positive pressure ventilation. If tube obstruction or dislodgement is not present, managing a patient with one of these tubes is relatively straightforward, as the tube itself is considered a secure airway and it is possible to apply positive pressure ventilation using a ventilator or bag valve device.

The Montgomery T-tube, first introduced in 1965, is a T-shaped silicone semi-rigid airway stenting device that is used to support tracheal mucosa and keep the trachea patent after tracheal reconstruction or severe injury (Figure 1) (6). The proximal and distal portions are intraluminal, coursing cephalad and caudal in the trachea; the perpendicular portion exits the trachea via a stoma (7). There is no cuff, and the proximal and distal ends of the T-tube are not secured to the trachea.

The Montgomery T-tube has been used in specific applications in otolaryngology. These include tracheal stenosis, necrosis, and surgical reconstruction of complicated tracheal anatomy (7–9). In this patient's case, he suffered from severe subglottic stenosis complicated by tracheal necrosis, which required resection of 7 cm of tracheal tissue. The T-tube was preventing further stenosis and dynamic upper airway collapse. It should also be noted that the T-tube is held in place with friction alone and is not sutured or secured in any other way. In addition to otolaryngology, it should also be noted that a number of interventional pulmonary physicians also place and manage T-tubes.

The challenging attributes of the T-tube during emergency airway management are fourfold: First, there is no adapter to connect a bag valve device or ventilator to the tube. Second, the device has no tube cuff, so even if a bag adapter was present, ventilation would likely not be effective. Third, the T-shaped tube travels both into the upper trachea and lower trachea; thus, even if you could connect a bag to the external limb of the device, and if the lower limb had a cuff, administering positive pressure to the device would result in ventilation upward into the trachea and upper airway (as well as some into the lower airways). Fourth, it can be difficult to remove the tube through the stoma, as it tracks both cephalad and caudal in the trachea.

Prior literature on the T-tube and emergency intubation is scarce. A letter to the editor by Touma et al. describes management of cardiopulmonary arrest in a patient with a T-tube (10). Challenges feared by our treatment team were encountered by their team: despite being able to occlude the extraluminal portion of the T-tube, bagging via bag valve mask proved difficult. They attempted to secure a resuscitator bag to the extraluminal portion of the T-tube, but ventilation was poor because delivered breaths were transmitted to the oropharynx through the proximal portion of the tube. Similar to our case, they were ultimately able to remove the tube with steady pressure using a Kelly Clamp, and placed an endotracheal tube into the stoma.

When an emergency physician must ventilate a patient with a T-tube, the patient's underlying respiratory status can dictate management. Providers must balance the risks of losing a patent airway vs. significant, potentially irreversible damage to an already abnormal airway. In most cases the tube must be removed and replaced with a tracheostomy tube or endotracheal tube. The replacement tube can be inserted through the stoma, or inserted using normal orotracheal intubation, if patient anatomy allows. In an apneic patient, it may be beneficial to attempt to ventilate with a bag mask device or supraglottic airway while attempting to occlude the extraluminal limb of the tube (11). Montgomery initially described insertion of a Fogarty catheter in the superior aspect of the T-tube to occlude retrograde gas flow and placement of an endotracheal tube in the extraluminal portion (12). This ventilation (above the device), however, may provide little to no gas exchange due to abnormal patient anatomy or air leak around the device. There is at least one case report of providers being able to perform orotracheal intubation on a patient with a T-tube. They were able to pass a 6.5-mm internal diameter cuffed endotracheal tube over a fiberoptic scope through the T-tube and inflate the cuff distal to the extraluminal portion (13). This allowed the T-tube to remain in situ. Varying T-tube size and patient anatomy make this method application only in certain scenarios.

Without the benefit of medical record review or patient history, it may be difficult to identify a Montgomery T-tube in situ. A key distinguishing feature from traditional tracheostomy tubes is the soft silicone material T-tubes are made of. There is also no way to attach a bag valve attachment to it; the T-tube must be removed or modified prior to ventilation.

In a spontaneously breathing patient, such as in the present case, anesthetizing the airway using topical lidocaine and administering a sedative such as ketamine facilitates spontaneous breathing during the procedure (14,15). The T-tube can then be removed with a clamp; an incision extending from the stoma may be necessary to allow removal of the device. In the present case, due to unfamiliarity with the T-tube and the patient's surgical history and airway anatomy, we opted to place a pediatric bougie (10 French, 70 cm/SunMed) through the T-tube prior to removing it. In retrospect, the bougie was probably not necessary because the stoma was matured and likely would accept a small endotracheal tube or a tracheostomy tube without false passage.

In some cases, removal of the T-tube through the stoma will be very difficult. In the present case, we made a 1-cm incision at the inferior margin of the stoma, which allowed the T-tube to move downward enough to remove the upper segment. The proximal segment was shorter than the distal in our patient, so manipulating the entire T-tube downward enabled removal of the proximal segment, and then removal of the lower portion (7). The T-tube is semi-rigid, and was deformed with pressure, which aided in its removal. The proximal and distal limbs can be asymmetric because the T-tube is trimmed to fit varying patient anatomy, so the removal method may vary, depending on which end is longer.

Why Should an Emergency Physician Be Aware of This?

The Montgomery T-tube is a device that at first glance looks like a traditional tracheostomy tube, but may make airway management significantly more difficult. Emergency physicians should be aware that this device exists, that it is not possible to apply positive pressure through it, and that emergency airway management usually requires its removal before a definitive airway can be placed.

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