Use of a T-tube stent to treat a patient with tracheal stenosis

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When tracheal stenosis is unresectable, a T-tube stent may be indicated (see Figure 1). These stents are chosen as definitive treatment at only a few institutions around the nation, but any PA practicing in the hospital setting may encounter a patient with such a stent. The PA plays an important role in the management of patients with a T-tube stent.

CASE

A 70-year-old man was transferred from an outside facility to the University of Pittsburgh Medical Center with respiratory distress and stridor. While at home, he had developed increasing shortness of breath at rest with stridor. He had a history of two previous tracheostomies due to respiratory insufficiency, requiring prolonged ventilatory support following surgery. The last one was approximately 8 months ago, and decannulation has since been performed. CT performed outside the hospital revealed moderate tracheal stenosis.

On physical examination, the patient was relatively comfortable and not in acute distress. He had grossly audible inspiratory stridor. He had a well-healed tracheostomy incision on his neck. His chest was clear to auscultation with stridor. Use of accessory muscles was noted. Oxygen saturation was 92% on 4 L by nasal cannula.

Flexible bronchoscopy revealed a 1-cm area of tracheal stenosis just distal to the cricoid cartilage (see Figure 2). Dilation and laser excision were performed for temporary relief, but because of the patient's high risk for restenosis and his symptoms, further surgical intervention was necessary. He was not an ideal candidate for tracheal resection because of his history of recurring respiratory insufficiency requiring ventilatory support. Repeat intubation following tracheal resection results in frequent restenosis. A T-tube maintains a tracheostomy stoma, and a tracheostomy tube can easily be inserted in case of respiratory failure requiring ventilation. The treatment option chosen for this patient was a T-tube stent, and he elected to proceed with surgical insertion.

This procedure requires two operators—one to provide visualization via rigid bronchoscope and one to surgically insert

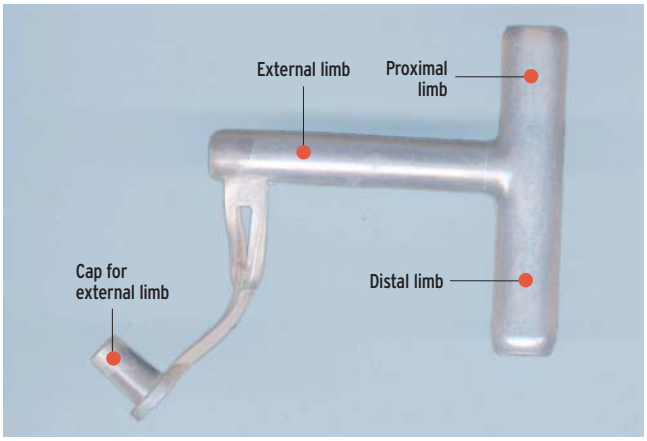

FIGURE 1. T-tube stent

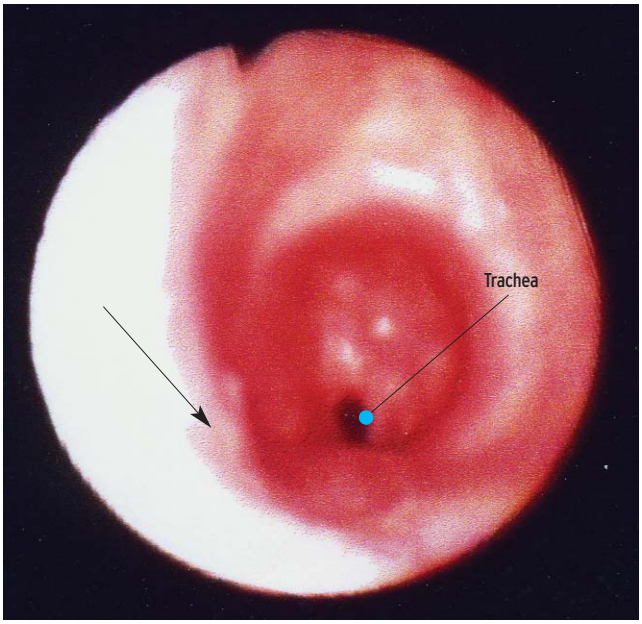

FIGURE 2. The distal edge of the endotracheal tube (arrow) is seen proximal to the tracheal stenosis. A narrowed opening of the trachea with surrounding stenosis is also seen.

the T-tube—and thus is ideal for a PA-surgeon team. Our patient was placed in the supine position, put under general anesthesia via endotracheal tube, prepped, and draped. We then made a 2-cm transverse incision over his previous tracheostomy scar located approximately 1-cm superior to the sternal notch and dissected down to the anterior trachea using electrocautery. Simultaneously, we inserted a rigid bronchoscope and put the patient on jet ventilation. A 21-gauge needle was passed into the trachea between tracheal rings 3 and 4 on a perpendicular angle and was visualized with the rigid bronchoscope to ensure proper positioning. An angiocatheter followed by a guidewire were both inserted into the trachea under direct visualization. After confirming proper positioning, we made a small, vertical stab incision at the guidewire insertion site and passed serial dilators. We removed the guidewire and inserted a 13-mm silicone T-tube stent by grasping the long arm with a Kelly clamp and positioning this arm through the tract inferiorly. Once this portion was positioned, the short arm was inserted and positioned superiorly with the aid of the Kelly clamp. Fine adjustments to the position of the superior end were made with grasping forceps via the rigid bronchoscope. We inspected the proximal and distal ends using the bronchoscope. Once we confirmed that the proximal end was below the vocal cords (see Figure 3), the distal end was above the carina (see Figure 4), and the airway was patent, the bronchoscope was withdrawn.

After the procedure was completed, the patient remained on jet ventilation through the external limb until anesthesia wore off. When he was breathing on his own, the external limb of his T-tube was plugged. He then received supplemental oxygenation via face mask.

After the surgery and a short stay in the recovery room, the patient was transferred to the thoracic floor. A tracheostomy tube was kept at his bedside in case of respiratory insufficiency requiring the T-tube to be taken out. Respiratory therapy worked with him, and he was soon tolerating oxygen by nasal cannula.

Patient and family education began immediately because proper care of the T-tube is imperative to prevent obstruction with mucus (see Table 1, page 31). The patient was told to keep the external arm of the stent plugged except when suctioning and irrigating. If the external arm remains unplugged, buildup of secretions and crusting of the T-tube occur. The patient was shown how to irrigate the T-tube with 2 to 3 cc of sterile normal saline and then to suction with a small-diameter sterile suction catheter aimed both superiorly and inferiorly. We have found it helpful to instruct patients using a mirror in front of the site of the stent. To irrigate and suction inferiorly, the external arm of the stent is angled upward to facilitate downward flow. To irrigate and suction superiorly, the external arm is angled downward. Patients and family are often afraid of causing damage to the airway or stent and will not suction as aggressively as they should. The PA can provide proper education and encouragement in this situation.

Irrigation and suctioning are done twice daily . The outer portion of the T-tube should be kept clean and free of any mucus and crusts (see Figure 5, page 31). This area can be gently cleaned with a cotton-tipped applicator moistened with hydrogen peroxide. In the hospital, we begin nebulizer

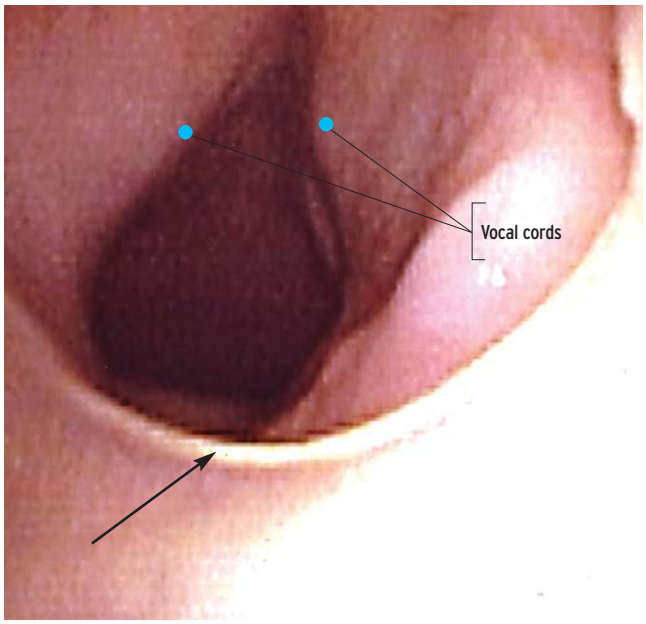

FIGURE 3. Bronchoscopy confirms that the proximal edge of the T-tube (arrow) is below the vocal cords.

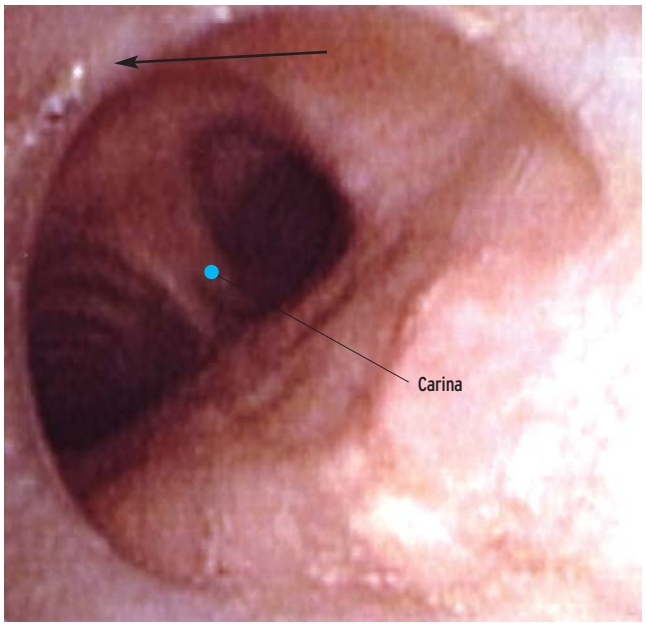

FIGURE 4. Inspection confirms that the distal edge of the T-tube (arrow) is above the carina.

TABLE 1. Caring for a T-tube

Irrigate with 2-3 cc sterile normal saline 2 or 3 times daily
Suction irrigation and secretions both inferiorly and superiorly
Nebulizer treatment with 1 cc of 10% acetylcysteine in albuterol 3 times daily
Keep external area around T-tube clean
Educate patient and caregivers properly prior to discharge
Coordinate nebulizer and suction machine for home use

treatments with albuterol and 1 cc of 10% acetylcysteine (Mucomyst) 3 times daily to keep secretions to a minimum.

Home care was ordered for the patient upon discharge, and home care coordinators arranged for the patient to have a suctioning device and nebulizer machine at home so that albuterol/acetylcysteine nebulizer treatments could continue. A tracheostomy tube was sent home with the patient in case of emergency. The patient returned to our facility approximately 2 weeks after discharge and underwent a flexible bronchoscopy to check the patency, fit, and location of the T-tube.

Nurses, patients, and caregivers must be instructed on the differences between a tracheostomy tube and a T-tube. Those who are unfamiliar with T-tube stents may easily confuse them with a tracheostomy tube (see Table 2, page 32). A T-tube allows for normal phonation and delivery of humidified air because the external limb is plugged, whereas with a tracheostomy tube, air is delivered from the outside, bypassing the mouth and pharynx, which humidify the air. Intubating a patient with a T-tube can be dangerous because it will cause the stent to migrate, which may cause further obstruction and require surgical removal. Patients cannot be mechanically ventilated through a T-tube as they can through a tracheostomy tube because air is lost through the laryngeal airway and mouth. If mechanical ventilation is necessary, the T-tube can be removed by grasping the exterior portion with the right hand, applying pressure with the left hand to the area above and below insertion, and then tugging forcefully. Once the T-tube is removed, the tracheostomy tube can be inserted through the stoma. PAs who encounter patients with a T-tube in place should reference the above instructions and educate those who are taking care of the patient (nurses, respiratory therapists) on proper care and management.

DISCUSSION

Treatment options for tracheal stenosis include tracheal resection, tracheostomy, laser therapy, a metal or silicone stent, or a T-tube stent. Surgical resection is preferred but is not always possible, depending on the patient's condition and the location, severity, and size of the tracheal stricture. Our patient was not a surgical candidate because of his history of recurring respiratory insufficiency requiring ventilatory support and the likelihood he would need such support in the future.

At our facility, laser therapy is reserved for short-term palliation only, as we have found that strictures treated with lasers are likely to recur. Tracheal or bronchial stents are available in many shapes and sizes, and are made of either metal or silicone; unlike T-tubes, they do not have an external component. Metal stents are not indicated for long-term use as they cause buildup of granulation tissue due to inflammation, which can cause recurrent stricture.[1] Because of tissue overgrowth, they are not easily removed. T-tubes are a satisfactory alternative to tracheal resection[2] and are preferred over interbronchial stents for tracheal stenosis as T-tubes have decreased rate of migration, allow for frequent irrigation and suctioning, are easily removed in case of acute obstruction, and maintain a tracheostomy stoma.[3]

The tracheal T-tube stent was first described by Montgomery in 1965.[4] The T-tube is indicated in cases of tracheal injury and stenosis caused by malignancy, burn injury, radiation, polychondritis, tracheomalacia, trauma, congenital malformation, tracheostomy, and prolonged ventilation via endotracheal tube.[3,5,6] A T-tube can be used both to maintain a tracheal airway and to support a circumferential collapse of the trachea, as in tracheomalacia. Areas of benign

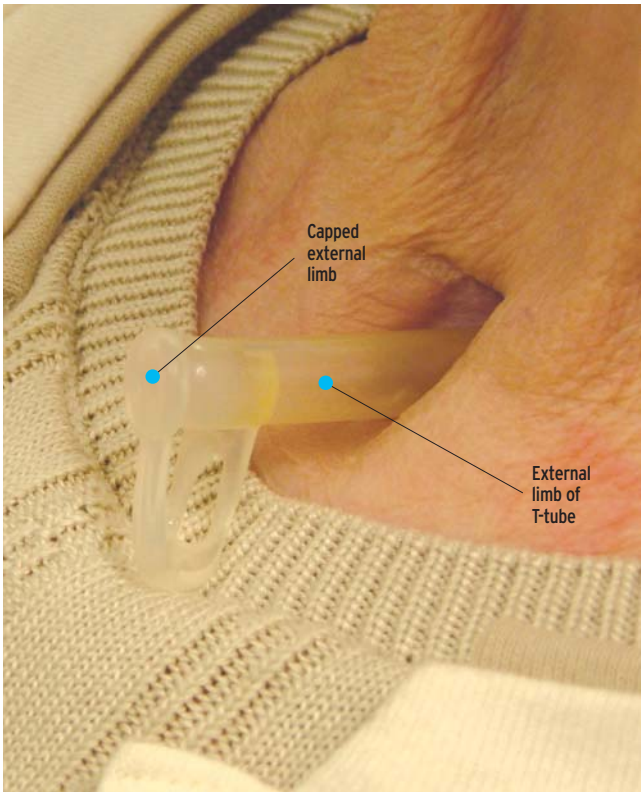

FIGURE 5. The T-tube stent in place

TABLE 2. Comparison of T-tube stent with tracheostomy tube

	T-tube stent	Tracheostomy tube
Ability to ventilate through device	No	Yes
Need for tracheal stoma	Yes	Yes
Allow for normal phonation without special device	Yes	No
Allow for normal passage of humidified air	Yes	No
Require routine changing	No	Yes
Have both a superior and inferior limb	Yes	No

stenosis occur most frequently at the site of tracheostomy or at the site of the cuff of the endotracheal tube.[7]

T-tube stents are made of silicone, a smooth material that prevents excessive sticking of dried mucus. The edges are slightly curved, which decreases the amount of trauma to the trachea. The unique feature of the T-tube is its external limb, which prevents migration and allows easy access for irrigation and suctioning to keep the lumen patent. These stents are extremely flexible and less likely to cause damage to the tracheal mucosa.[5]

Proper sizing is important when choosing a T-tube. Careful measurement of the affected area, as well as of the distance from the affected area to the vocal cords and to the carina, can be done using rigid bronchoscopy and with radiologic imaging. The stent can be inserted either way, but the shorter arm is intended to be directed superiorly as the distance from the location of tracheotomy is usually shorter than the distance to the carina. Custom made T-tube stents are available and can be ordered through the manufacturer.

T-tubes are well-tolerated and can be left in for years, if cared for properly.[5,8] The formation of granulation tissue is a common complication associated with T-tubes,[9] but we have found that proper and regular care can help to prevent this. The major disadvantages of a T-tube are the need for a tracheostomy stoma and the cosmetic appearance of the external limb, which is undesirable for some patients.

CONCLUSION

The patient in this case was a 70-year-old male with symptomatic tracheal stenosis that was not amenable to surgical resection. A T-tube tracheal stent was chosen as definitive treatment. T-tubes are particularly useful in patients who have respiratory disorders. Physician assistants caring for a patient with unresectable tracheal stenosis should consider referral to an institution that specializes in T-tube stent placement. Knowledge of what a T-tube is and how it is maintained is essential for PAs working in thoracic surgery and for those working in the hospital setting. JAAPA

Julie Schrader and **Peter Ferson** work at the Heart, Lung, and Esophageal Surgery Institute in the Divison of Thoracic Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania. Julie Schrader assists in surgery, manages the inpatient service, and sees patients in clinic. Peter Ferson is Professor of Surgery at UPMC and serves as Chief of Thoracic Surgery at the Pittsburgh VA Hospital. The authors have indicated no relationships to disclose relating to the content of this article.

Steve Wilson, PA-C, department editor

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