CASE REPORT

Novel modification of tracheostomy tube to allow speech and manage tracheal stenosis

Michael de la Cruz,¹ Shaheen Islam,² Rebecca Cloyes²

¹Department of Pulmonary Critical Care, Ohio State University Wexner Medical Center, Columbus, Ohio, USA

²Department of Interventional Pulmonology, Ohio State University Wexner Medical Center, Columbus, Ohio, USA

Correspondence to

Dr Michael de la Cruz,
Michael.deCruz@OSUMC.edu

SUMMARY

Mid-tracheal, postintubation stenosis can be managed with an extended length tracheostomy tube to bypass the stenotic area. However these extra-long tracheostomy tubes are not fenestrated, and when the stenotic tracheal lumen sits against the tracheostomy tube, phonation is not possible as there is no translaryngeal airflow. A 59-year-old man developed distal tracheal stenosis following a prolonged intubation and tracheostomy after a motorcycle accident. He eventually required an extra-long tracheostomy tube to bypass the stenotic region. We modified a silicone tracheostomy tube by creating a fenestration on its posterior wall. This relieved the obstruction while still allowing phonation and speech.

BACKGROUND

Tracheal stenosis may occur secondary to excessive endotracheal tube cuff pressure, excessive tracheostomy cuff pressure, after traumatic intubation or after prolonged intubation (which results in granulation tissue formation).

A proximal or mid-tracheal stenosis can be bypassed with a tracheostomy tube (TT), and often requires an extra-long TT depending on the location of the stenosis.

A fenestrated TT allows phonation by allowing translaryngeal air flow through TT. At present, fenestration is not available with extra-long TT.

We present a case where a fenestration was created on an extra-long silicone TT to allow phonation while still bypassing the stenosis. This perhaps emphasises the need for future commercial development of similarly modified TTs.

CASE PRESENTATION

A 59-year-old man was involved in a motorcycle accident about 5 years ago. He sustained a C1–C2 fracture and required a tracheostomy with placement of a standard size, cuffed TT. Subsequently, a cuffless regular TT was placed. After about a year, he developed stenosis at the distal end of this regular cuffless TT. He underwent multiple bronchoscopic procedures to open the stenotic area with laser, cryotherapy and balloon dilation (figure 1). Bronchoscopic therapies would provide temporary relief with recurrence of stenosis after every 4–6 weeks (figure 2). At this point, an extra-long TT with a longer distal end was inserted to traverse the stenosis (figure 3). This longer TT provided long-term relief, but it did not allow air flow through his vocal cords for phonation. He could not be decannulated because of recurrent stenosis. For about 2 years he used an electrolarynx

Figure 1 The patient's tracheal stenosis seen via bronchoscopy.

(figure 4),¹ a device usually used by patients with laryngeal cancer after laryngectomy. However, the speech produced was still poor, and his inability to communicate was a source of much distress to the patient.

TREATMENT

To help the patient speak and regain his phonation, we decided to modify a Moore extra-long, cuffless TT (Boston Medical Products). This tube is long

Figure 2 Bronchoscopic image showing the distal tracheal stenosis.

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Figure 3 Bronchoscopic view showing the XLT tracheostomy tube passed the stenotic region.

Figure 5 Bronchoscopic view of the Moore tracheostomy tube (with distal white edge in view) bypassing the stenotic region.

enough to bypass his distal stenosis (figure 5), yet soft enough (made of silica) to allow us to cut a 0.8 cm×0.4 cm hole (fenestration) using a scalpel (figure 6). This allowed translaryngeal airflow through the vocal cords. The hole was cut 5 cm from the flange, and when in place, was sitting appropriately facing the subglottic trachea (figure 7). The inner cannula was kept intact. The patient was able to speak by occluding this modified TT with his finger.

OUTCOME AND FOLLOW-UP

As no fenestration was cut in the inner cannula, it needed to be removed each time the patient wanted to speak. At his next follow-up appointment we found that the patient had cut the inner cannula himself (figure 8). However as this component of the Moore TT was soft and somewhat delicate, there was concern that it may become worn out over time. The patient then agreed to use only a fully intact inner cannula. Despite this, the patient's quality of life had greatly improved with the use of this modified tube. We have been following him with

periodic bronchoscopies and changed his TT once in the past 6 months since the modification.

DISCUSSION

Tracheal stenosis can occur secondary to a number of malignant and non-malignant processes.² In our patient, it developed from consistent friction of the distal end of the standard TT against the tracheal wall. There are various TTs that can be used to bypass the stenosis. These tubes are inserted through the tracheostomy stoma in the anterior neck into the trachea, and they keep the stoma and trachea from closing (figure 9).³ There is an inner cannula that acts as a liner and can be removed for cleaning (figure 10).³ Some TTs have a cuff. This is a balloon around the outer cannula that when inflated seals off the space between the tracheal wall and the outer cannula to allow the use of ventilator (figure 11).⁴

Patients with thick necks or distal stenosis require extra-long (XLT) TT. These tubes are extended either proximally or distally (figure 12).⁵ Our patient had a distal stenosis, and therefore

Figure 4 Electrolarynx. This particular image belongs to N.R. Enterprises and was taken from their website.

Figure 6 An outside and interior view (via bronchoscope) of the Moore tracheostomy tube with customised fenestration.

Figure 9 Tracheostomy with tracheostomy tube in place.

Figure 7 View of the customised fenestration with the Moore tube in place.

Figure 10 Components of a tracheostomy tube.

Figure 8 The patient's self-made fenestration of the inner cannula. Both external and internal views.

Figure 11 Tracheostomy cuff.

This diagram illustrates how the proximal, radial and distal measurements are determined for proper sizing.

FULL OR THICK NECK

Choose Shiley XLT with proximal extension (XLTCP or XLTUP).

LONG TRACHEAL ANATOMIES, TRACHEAL STENOSIS OR MALACIA

Choose Shiley XLT with distal extension (XLTCB or XLTCU).

Figure 12 Diagram of distal and proximal XLT tracheostomy tubes. The image belongs to the Covidien Company and was taken from their website.

required the use of a distal XLT TT. The drawback of these tubes is they do not come in a fenestrated variety to allow for speech.

Fenestrated TT have holes (fenestrations) in the outer cannula (figure 13).⁶ This directs some air flow from the lungs through

the TT up towards the oropharynx and out the mouth. These TTs can be used to test how patients would do when breathing normally and coughing up secretions on their own. The diverted air also flows through the vocal cords to allow for phonation (figure 14).⁶

Figure 13 Fenestrated tracheostomy tube.

Figure 15 Photograph of the Moore tracheostomy tube used.

Figure 14 Airflow through a fenestrated tracheostomy tube.

Figure 16 Moore tracheostomy tube, made of soft silicon material, can be easily bent, cut, and customised.

In our case, the use of the Shiley distal XLT TT (Covidien Company) maintained patency of the distal tracheal stenosis and improved symptoms of dyspnoea; however, the lost ability for speech was quite upsetting to the patient. To solve this problem we incorporated a Moore TT (figure 15). This is a long and flexible silicon tube. Owing to its length, it can be used to provide relief in mid-tracheal stenosis. In addition, its silicon outer cannula can conform to individual anatomies and is more comfortable for patients. This soft material was ideal as it could be easily cut and customised (figure 16) as described above.

Patients with tracheal stenosis are not uncommon, and they often require the use of extended length TTs. However, patients using these longer tubes may lose their ability to talk which can be very distressing. In order to improve the quality of life of

these patients, future production of fenestrated extra-long TTs are needed. Until they are manufactured, a Moore TT customised as above is a suitable alternative.

Learning points

- ▶ Tracheal stenosis is a complication that can occur after traumatic, prolonged intubations or as a complication of long-term use of tracheostomy tube (TT).
- ▶ A tracheal stenosis in the midtrachea or distal trachea can be bypassed with a longer TT.
- ▶ Speech is a very important means of communication for patients, and can be lost depending on the type of TT used. Currently, there are no extended length tubes that are fenestrated to allow for speech, and there is a need for future development of such tubes. Until then, modification of a Moore TT can be used as an alternative.

Contributors The patient was first attended by SI and RC and then by MDLC. All the authors were involved in the writing of the case report.

Competing interests None.

Patient consent Obtained.

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REFERENCES

- 1 N. R. Enterprises. <http://nrenterprisesindia.org/index.htm>
- 2 Ernst A, Feller-Kopman D, Becker HD, *et al.* Central airway obstruction. *Am J Respir Crit Care Med* 2004;169:1278.
- 3 <https://patienteducation.osumc.edu/Documents/tubes.pdf>
- 4 <https://patienteducation.osumc.edu/Documents/cuffs.pdf>
- 5 Covidien Shiley XLT Extended-Length Tracheostomy Tubes Brochure. <http://www.covidien.com/imageServer.aspx/doc224582.pdf?contentID=23691&contentType=application/pdf>
- 6 <https://patienteducation.osumc.edu/Documents/fenestr.pdf>

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