Ann Thorac Cardiovasc Surg 2020; 26: 294–297
Online August 1, 2020
doi: 10.5761/atcs.nm.20-00128

New Method

A Novel Insertion Technique for the Extra-Long Montgomery T-Tube in Patients with a Large Mediastinal Tumor

Tatsuya Kato, MD, PhD, Aki Fujiwara-Kuroda, MD, PhD, Nobuyuki Shiina, MD, PhD, Masato Aragaki, MD, PhD, Hideki Ujiie, MD, PhD, Yasuhiro Hida, MD, PhD, and Kichizo Kaga, MD, PhD

The Montgomery T-tube is widely used to stent airway stenotic diseases. Conventional insertion methods can sometimes fail in the case of long-distance subglottic stenosis due to the flexibility of a T-tube made of silicon, which kinks when forced against resistance. Therefore, an alternative approach can assist in the insertion of an extra-long T-tube, especially when using a long proximal limb. We report herein the case of a patient with a large mediastinal tumor caused by neurofibromatosis type 1 in which airway obstruction was avoided through the use of a novel extra-long T-tube placement technique.

Keywords: Montgomery T-tube, airway management, tracheal stenosis

Introduction

Although a silicone T-tube is convenient and widely used for the management of obstructive airway disease, difficulties are often encountered in the insertion process, especially when placing the long proximal end of an extra-long T-tube. This may be due to the flexibility of the extra-long T-tube. Some modifications of the insertion technique have been introduced using rigid bronchoscopy or suspension laryngoscopy[1,2]; however, these methods require the use of cumbersome maneuvers and skilled medical personnel. Therefore, the development of the below technique may be highly beneficial to patients as it allows healthcare practitioners to keep non-ventilated time during the procedure to a minimum.

A Case Presentation

This study reports the case of a teenage girl who had been receiving care for neurofibromatosis type 1 from her family doctor since childhood. She had experienced cardiopulmonary arrest (CPA) on several occasions as a result of airway obstruction by a large mediastinal tumor (**Fig. 1A**). On this occasion, she presented with a sudden onset of dyspnea and was intubated in the emergency room at a hospital in the neighborhood. She was then referred to the Hokkaido University Hospital for further management. Following cytoreductive surgery for the mediastinal stenosis around the trachea, she was extubated in the intensive care unit. However, on extubation, sudden obstruction of the subglottic portion of the trachea leads to dyspnea and suffocation, resulting in CPA. Re-intubation was immediately performed, and a tracheostomy was later performed surgically; she required mechanical ventilation for a month. T-tube insertion was considered in order to provide ambulatory management. Based on the

Department of Cardiovascular and Thoracic Surgery, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, Sapporo, Hokkaido, Japan

Received: May 11, 2020; Accepted: May 25, 2020
Corresponding author: Tatsuya Kato, MD, PhD. Department of Cardiovascular and Thoracic Surgery, Faculty of Medicine and Graduate School of Medicine, Hokkaido University, N15W7, Kita-ku, Sapporo, Hokkaido 060-8638, Japan
Email: katotatu7@msn.com

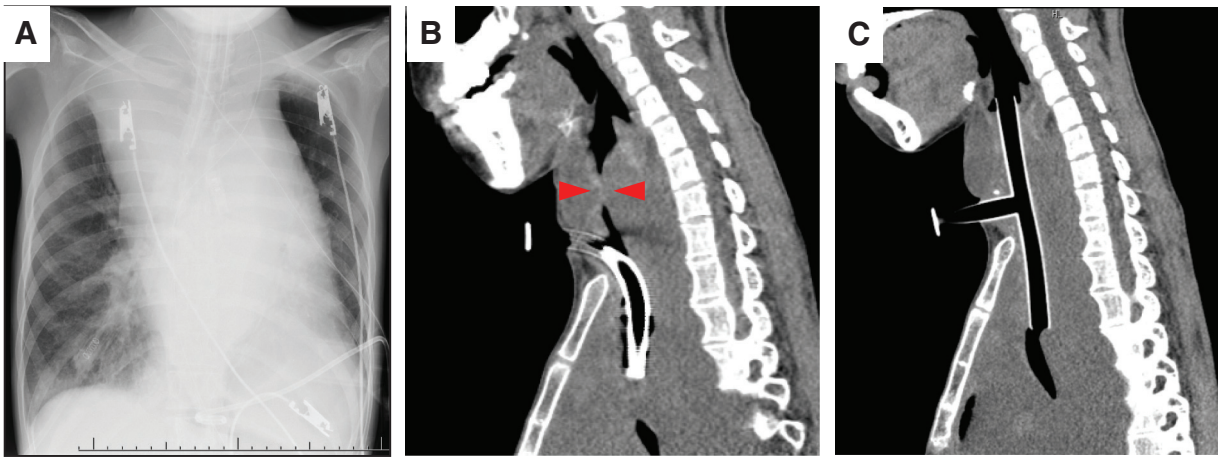

Fig. 1 (**A**) A chest X-ray showing a large mediastinal tumor caused by neurofibromatosis type 1. (**B**) A CT scan showing an extensive portion of subglottic tracheal stenosis as a result of compression by the large mediastinal mass (red arrowheads). (**C**) Extra-long T-tube insertion was performed in the stenotic portion of the trachea.

detailed measurement of the length of the stenotic portion using computed tomography (CT), an extra-long T-tube was ordered (Koken Co., Ltd., Tokyo, Japan). The length from the glottis to stenosis was approximately 5 cm, and the length of the normal distal trachea to the carina was 6 cm (**Fig. 2A**). The caliber of stenosis of the subglottic tracheal portion was less than 2 mm at the point of minimal diameter due to compression by the tumor (**Fig. 1B**). The stenosis did not involve the tracheostoma. The patient described in this study provided informed consent for the publication of this case report. Approval from the institutional review board is not needed for case reports.

Technique Description

A general anesthesia with spontaneous ventilation was performed on the patient. Insertion of an extra-long T-tube is known to be difficult as the flexibility of the T-tube complicates placement of the proximal end. Therefore, we developed a novel insertion technique as follows (described in **Fig. 2**). 1) Preparation: An adequate length of 1-0 silk suture was inserted through the proximal limb of the T-tube extending to the T-tube's stoma port. The 1-0 silk suture was then further inserted through a 12-Fr Nelaton catheter (**Fig. 2A**). 2) Connection to an airway exchange catheter: an airway exchange catheter was inserted by an anesthesiologist through the 6.5-mm internal diameter of the endotracheal tube. Intubation could be performed smoothly because the neurofibromatous tumor was soft and dilated easily at the first operation. The end of the airway exchange catheter was caught at the tracheal stoma by the first operator. The airway exchange catheter was then attached to the proximal portion of the 1-0 silk. The airway exchange catheter was then pulled back through the subglottic portion, and the attached 1-0 silk was caught at the mouth by an anesthesiologist. Ventilation had been available for the patient at this time, had it become necessary. However, ventilation was not required in this case (**Fig. 2B**). 3) Insertion of the distal limb of the T-tube under bronchoscope guidance by the first operator was performed (**Fig. 2C**). 4) Pulling the proximal limb of the T-tube and Nelaton catheter: a Nelaton catheter was passed through the proximal limb of the T-tube by pulling the 1-0 silk, to which lubricating oil had been applied. The Nelaton catheter and T-tube were then inserted together through the stoma port by the second operator. By pulling further on the 1-0 silk, the anesthesiologist extended the proximal end of the T-tube and Nelaton catheter toward the area of tracheal stenosis. Stretching the set of the T-tube with the Nelaton catheter assisted in the introduction of the proximal limb of the T-tube into the subglottic portion of the trachea (**Fig. 1C** and **2D**). The patient required periodic T-tube replacement every 3 months to maintain hygiene because the dried sputum frequently adhered to the T-tube. Moreover, optimal placement of the proximal limb of an extra-long T-tube was successfully performed on each occasion without bending by using this technique, and with experience, the procedure could be performed more rapidly.

Discussion

Some modifications of the insertion technique of a long T-tube have been described in the literature.

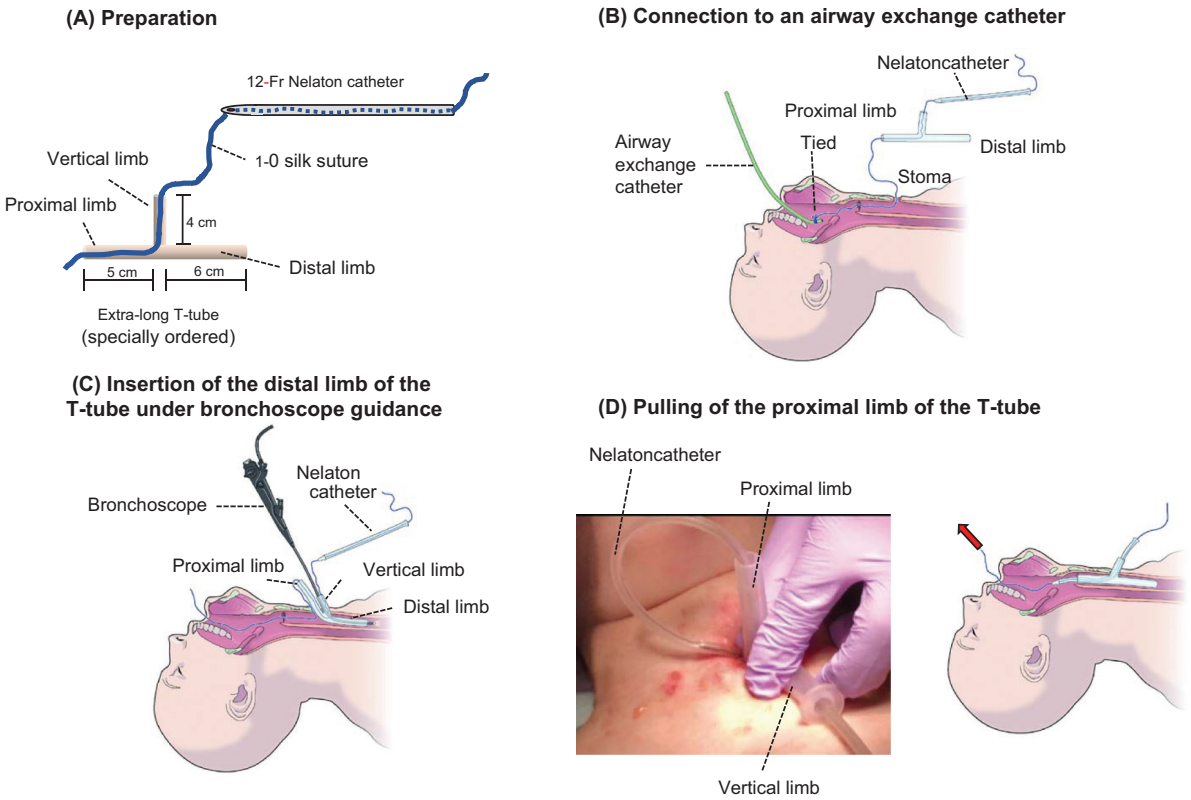

Fig. 2 (**A**) Preparation for this procedure. A 1-0 silk suture (40 cm, ×4, tied to each other) is inserted from the proximal limb of the T-tube to the vertical limb, and then is inserted through a 12-Fr Nelaton catheter. (**B**) Connection to an airway exchange catheter. An airway exchange catheter is inserted through the endotracheal tube or LMA, and its distal end is caught at the tracheal stoma. The airway exchange catheter is then tied to the aforementioned 1-0 silk and pulled through the subglottic stenotic portion. The end of the 1-0 silk is then caught at the patient's mouth. (**C**) Insertion of the distal limb of the T-tube under bronchoscope guidance. (**D**) Pulling of the proximal limb of the T-tube and the Nelaton catheter. A Nelaton catheter is passed through the vertical limb and through the proximal limb of the T-tube by pulling the 1-0 silk with the lubricating oil. Stretching the set of the T-tube with the Nelaton catheter assists in the introduction of the proximal end of the intraluminal limb through the subglottic lesion in the trachea. LMA: laryngeal mask airway

Pinedo-Onofre et al. introduced a modified insertion technique using umbilical tape in order to sustain proximal traction. This tape is placed in the direction of the tracheal longitudinal axis in order to ensure correct positioning of the T-tube.[3] However, it is difficult to keep the lumen of the proximal limb patent, especially in case of an extra-long T-tube because of its flexibility. Tedde et al. used a folded double nasogastric tube and a Foley catheter to assist in the introduction of the proximal end into the trachea.[4] However, it is difficult to maintain the patient's oxygen saturation due to the difficulty in providing consistent ventilation throughout the procedure.

This method has four advantages. 1) A long T-tube can be inserted without rigid bronchoscopy. 2) The bronchoscopic direct vision allows the long distal limb of the T-tube to place in the appropriate position in the trachea or main bronchus. 3) A long T-tube can be inserted within a short period of time, and this procedure can be performed with a minimal period of restricted ventilation. 4) This is a practical technique because Nelaton catheters are cheap and widely available in most hospital settings. With the Nelaton catheter guidance, the proximal limb of the T-tube inside the stenotic area is easily inserted and adjusted.

Conclusion

This procedure has improved the insertion safety when compared to alternate T-tube insertion techniques. Further, this technique has been proven to be successful in the insertion of an extra-long Montgomery T-tube in patients with a long-distance subglottic stenosis. The novelty of this study and the documentation of this new T-tube introduction method make this study relevant in the current

field, and this research has good applicability in the clinical setting. Further research is indicated in a wider variety of patient settings and degrees of tracheal obstruction.

Disclosure Statement

All authors have no conflicts of interest.

References

1) Cooper JD, Todd TR, Ilves R, et al. Use of the silicone tracheal T-tube for the management of complex tracheal injuries. J Thorac Cardiovasc Surg 1981; **82**: 559–68.
2) Shapshay SM, Beamis JF, Dumon JF. Total cervical tracheal stenosis: treatment by laser, dilation, and stenting. Ann Otol Rhinol Laryngol 1989; **98**: 890–5.
3) Pinedo-Onofre JA, Téllez-Becerra JL, Patiño-Gallegos H, et al. Subglottic stenosis above tracheal stoma: technique for Montgomery T-tube insertion. Ann Thorac Surg 2010; **89**: 2044–6.
4) Tedde ML, Rodrigues A, Scordamaglio PR, et al. A new technique for T-tube insertion in patients with subglottic stenosis. Eur J Cardiothorac Surg 2011; **39**: 130–1.