The Montgomery T-tube: anaesthetic problems and solutions

A. Guha, S. M. Mostafa* and J. B. Kendall

Department of Anaesthesia, Royal Liverpool University Hospital, Prescot Street, Liverpool L7 8XP, UK

*Corresponding author

The Montgomery T-tube is a device used as a combined tracheal stent and an airway after laryngotraceal surgery. The device is used mostly in specialist centres for head and neck surgery, and therefore, many anaesthetists may be unfamiliar with its use. The Montgomery T-tube presents the anaesthetist with challenges both during its surgical insertion when acute loss of the airway might occur and also during induction of anaesthesia in patients who have such a tube in situ. Anaesthetists who are unfamiliar with the tube may have to resort to ingenious ways of coping with the problems of a shared airway with a T-tube, which does not have a suitable adaptor for a standard catheter mount, as well as controlling and maintaining ventilation through the device. Safe management of such patients requires careful planning. We describe the anaesthetic management of two cases to illustrate the problems associated with Montgomery tubes.

Br J Anaesth 2001; 87: 787–90

Keywords: equipment, Montgomery T-tube; anaesthetic management

Accepted for publication: July 13, 2001

© The Board of Management and Trustees of the British Journal of Anaesthesia 2001
The Montgomery tube was introduced in the mid-1960s to support the trachea following laryngotracheoplasty. In its original form, the device is an uncuffed silicone T-tube that is inserted with the long limb in the trachea and the short limb projecting through the tracheostomy stoma (Fig. 1A and B). The T-tube is supplied in sizes from 4.5 to 16 mm (external diameter). Smaller sizes (4.5–8 mm external diameter) are available for paediatric use.\textsuperscript{1} The tube is inserted into the upper trachea or larynx following trauma or surgery to serve as a means to maintain the tracheal airway as well as serving as a stent.

The tube itself is soft and misplacement of the upper and/or lower limbs during insertion can lead to an acute loss of airway control. In addition, there are difficulties in maintaining controlled ventilation as the extratracheal limb or the upper open end of the intratracheal portion of the tube has to be occluded to prevent loss of inspired gases and volatile agents used to ventilate the lungs. Furthermore, patients with Montgomery tubes in situ may present for surgery, commonly for laser application to the reconstructed airway to shave off granulomatous tissue. Unlike standard tracheostomy tubes, the Montgomery T-tube has the disadvantage of not taking standard catheter mount connectors. The anaesthetist, therefore, must devise ways of delivering volatile agents and carrier gases for general anaesthesia.

During the management of general anaesthesia for patients undergoing laryngotracheal surgery, anaesthetists may have to deal with patients who need insertion of a Montgomery tube, or deal with cases that have such a tube in situ. As these cases are rare, they may present difficulties for anaesthetists who are not familiar with the tube.

We describe two cases involving the Montgomery tube, and discuss their anaesthetic management.

**Case 1: insertion of Montgomery T-tube following tracheoplasty**

A 24-yr-old man sustained severe skin and airway burns in a petrol explosion. As a result, he developed a high tracheal stenosis, which required a tracheostomy to relieve the airway obstruction. He was otherwise fit and well, and had no other significant medical history. He was to undergo tracheoplasty and insertion of a Montgomery tube.

He received pre-medication with 10 mg of oral temazepam and was given 0.2 mg of glycopyrrolate i.v. before induction of anaesthesia. After pre-oxygenation and institution of non-invasive monitoring, inhalation induction of anaesthesia was carried out using sevoflurane in 100% oxygen through the tracheostomy tube. Atracurium 40 mg was used for muscle relaxation and to facilitate controlled ventilation of the lungs. In order to facilitate surgery, a size 6 mm cuffed microlaryngeal tube (Mallinckrodt Medical, Athlone, Ireland) was inserted easily into the trachea through the tracheostomy stoma after the removal of the tracheostomy tube. General anaesthesia was maintained with sevoflurane, nitrous oxide, and oxygen, and supplemented with i.v. fentanyl as required. During surgery, the patient was monitored using pulse oximetry, end-tidal carbon dioxide concentration, arterial pressure, and electrocardiogram. After an uneventful tracheoplasty, a size 4 laryngeal mask airway (LMA\textsuperscript{†}) was inserted into the trachea through the tracheostomy stoma after the removal of the tracheostomy tube. General anaesthesia was maintained with sevoflurane, nitrous oxide, and oxygen, and supplemented with i.v. fentanyl as required. During surgery, the patient was monitored using pulse oximetry, end-tidal carbon dioxide concentration, arterial pressure, and electrocardiogram. After an uneventful tracheoplasty, a size 4 laryngeal mask airway (LMA\textsuperscript{†}) was inserted in the usual manner and secured in place. The upper end of the LMA was blocked off and controlled ventilation continued using 100% oxygen through the microlaryngeal tube until the surgeon replaced it with a size 12 Montgomery tube in order to stent the tracheoplasty. Once in place, the extratracheal part of the Montgomery tube was occluded with a spigot.

\textsuperscript{†}LMA is the property of Intavent Limited.
The anaesthetic breathing system was connected to the LMA using a standard catheter mount, and ventilation continued thereafter using the LMA. The safe and appropriate position of the upper intratracheal part of the Montgomery tube was then confirmed with a fiberoptic laryngoscope inserted through the LMA. The procedure was uneventful with satisfactory ventilation maintained throughout the operation.

At the end of the procedure, residual neuromuscular block was antagonized with neostigmine (2.5 mg) and glycopyrrolate (0.5 mg). The spigot was removed from the extratracheal portion of the Montgomery tube, and the LMA removed with the patient awake. The patient could thus breathe through both parts of the Montgomery tube.

Case 2: anaesthesia for laser application to the trachea in a patient with a Montgomery tube in situ

A 31-yr-old male had previously been mechanically ventilated in an intensive care unit for a month with the aid of a tracheal tube following a head injury and evacuation of a subdural haematoma. He subsequently had to undergo a laryngotracheoplasty and insertion of a Montgomery tube to treat laryngotracheal stenosis. He presented to us for laser excision of laryngotracheal granulomatous tissue with the Montgomery tube in situ.

Due to a compromised upper airway, an inhalation technique for induction of general anaesthesia using sevoflurane in 100% oxygen was chosen. A modified breathing system was used to anaesthetize the patient (Fig. 2). It consisted of a lightweight Bain’s circuit carrying fresh gas and volatile agent to a Y-piece connection. One end of the Y-piece was connected to a facemask, the other end of the Y connection was attached to the extratracheal part of the Montgomery tube via a long catheter mount, using a suitable tracheal tube connector. A high fresh gas flow was used to compensate for the altered breathing system and to aid carbon dioxide elimination.

Following successful induction of anaesthesia, the Montgomery tube was removed and a size 6.5 mm cuffed tracheal tube covered with laser protection tape (Laser-Guard, Xomed Surgical Products Inc., Jacksonville, USA) was inserted through the tracheostomy stoma. Once the airway was secure, mechanical ventilation was carried out with the aid of atracurium to facilitate neuromuscular block. Anaesthesia was maintained with a mixture of air, oxygen, and sevoflurane. The rest of the procedure was uneventful. A tracheostomy tube was reinserted at the end of the procedure through the pre-existing stoma and ventilation continued. The patient was allowed to wake up after reversal of residual neuromuscular block using neostigmine (2.5 mg) and glycopyrrolate (0.5 mg).

Discussion

The Montgomery T-tube consists of an intratracheal part with tapered ends to minimize injury to the tracheal mucous membrane. The extratracheal stem of the T has a plug that can be used as a spigot, thus allowing normal respiration via the intratracheal part through the larynx. The tube can be used in acute tracheal injury, as a stent after tracheal reconstruction, and as a substitute for the non-reconstructible cervical trachea. Due to the variable internal diameter and thickness of the tube itself, it can be difficult to predict the size of a standard 15 mm tracheal tube connector that will fit the extratracheal portion of the Montgomery tube. Therefore, a range of 15 mm connectors should be available, and it is advisable to liaise with the surgical team to obtain prior information regarding the approximate size of the Montgomery tube that they wish to use.

There are a few reports about the anaesthetic management of patients who need Montgomery tube insertion. However, there are no reports regarding the management of patients who present for anaesthesia with a Montgomery tube in situ.

Insertion of the Montgomery tube and airway control

The standard method of inserting the tube is to grasp it with curved haemostatic forceps and place the long intratracheal portion through the tracheostomy. The extratracheal lumen is then tugged anteriorly to straighten the tube in the trachea, and thus position the upper intratracheal limb. However, during this time the airway is not fully under control until the tube is secured in position. During insertion the tube can become misplaced or kinked below the junction of the extratracheal portion with the intratracheal part, leading to complete airway obstruction. In such cases, the Montgomery tube should be removed and reinserted appropriately. Previous descriptions of methods to overcome these problems are either too complicated or do not ensure correct placement of the Montgomery tube.

Cooper and others used a rigid bronchoscope after the tracheal stoma had been created. A tape was threaded through the T-tube, and visualized through the bronchoscope after being passed through the tracheal stoma. A long forceps was then used to pull the tape superiorly and railroad the T-tube over it. This method is complicated and does not ensure adequate ventilation during the procedure.
Chonchubhair and colleagues\(^1\) used a technique in which neuromuscular block was antagonized at the end of operation thus establishing spontaneous respiration. A gum elastic bougie was inserted through the tracheal tube. The bougie was then visualized and delivered through the tracheal stoma to the exterior. The T-tube was then railroaded into the trachea over the bougie. Once in place, the tracheal tube was advanced through the Montgomery tube, recommencing anaesthesia through the tracheal tube. This method suffers from several drawbacks. Although there is a continued presence of a tracheal tube during the insertion of the T-tube, ventilation is discontinued. There is a further risk of dislodging the T-tube and injuring reconstructed tissue during the process of advancing the tracheal tube through it and indeed, during extubation. Sichel and colleagues\(^5\) have described a variation of this technique, using a nasogastric tube to railroad the T-tube.

Hypoventilation and air dilution of anaesthetic gases, because of the open intratracheal upper end of the Montgomery tube, were recognized by Montgomery.\(^1\) He suggested passing a Fogarty embolecomy catheter through the extratracheal lumen up to the upper stem of the T-tube and occluding the open upper end by inflating the balloon of the catheter. A suitably sized tracheal tube could then be placed in the extratracheal lumen of the T-tube adjacent to the catheter, and ventilation continued.

In order to deal with the above problems during insertion of the tube, continuous i.v. anaesthesia and insufflation of oxygen into the lungs using a fine catheter can be used. The technique we described above offers safety and avoids the cumbersome use of catheters and railroading devices. As an LMA is inserted prior to the Montgomery tube’s insertion, the airway is always under the control of the anaesthetist. Furthermore, our management of the airway does not interfere with the surgical reconstruction. Therefore, even if technical difficulties or a delay in the insertion of the Montgomery tube is encountered, the patient’s safety is not put at risk. Uchiyama and Yoshino\(^6\) have used a technique similar to the one we describe, with an important difference. They occlude the top end of the LMA, thus employing it as a means of upper airway occlusion, while ventilation continues via the extratracheal portion of the Montgomery tube. Our method not only provides a means to ventilate the patient’s lungs, but also allows us to use a fiberoptic laryngoscope placed via the LMA to visually confirm the correct position of the Montgomery tube.

**Anaesthesia with an in situ Montgomery tube**

The main problem with a patient with an *in situ* Montgomery T-tube is the uncertainty regarding the volume of air passing across the tracheal stoma and that passing via the upper laryngeal end of the tube and through the larynx. Administration of a neuromuscular blocking agent at induction of anaesthesia and attempts to control ventilation under these circumstances would, therefore, be hazardous until and unless the airway is secured.

Inhalation induction of anaesthesia remains the method of choice in such patients. However, it is also necessary to supply the patient with the same composition of fresh gas flow and a volatile anaesthetic agent at both the extratracheal and laryngeal ends to prevent air dilution. We have found no description of the anaesthetic management of such patients in the literature.

We prefer to anaesthetize such patients by using a modified breathing system. A Bain’s breathing system is used, and a Y-connector placed at the end of the ‘circuit’ splits the fresh gas flow into two streams: one to the Montgomery tube, and the other to a standard anaesthetic face mask (Figure 2). A fresh gas flow at a rate of 50 ml kg\(^{-1}\) min\(^{-1}\) is added empirically to the standard fresh gas flow requirements for the Bain’s system to make allowances for our alteration. The addition of the facemask to deliver anaesthetic gases compensates for any leak around the laryngeal port of the Montgomery tube. Once the patient is anaesthetized, the Montgomery tube can be removed with gentle traction, and an appropriate laser protected tracheal tube is inserted through the tracheal stoma. If the Montgomery tube needs to be reinserted at the end of the operation, our earlier method of using an LMA is followed.

We have used these techniques for several years with good results and no adverse effects. As these patients are unlikely to present frequently, an anaesthetist who is not familiar with the Montgomery tube may be faced with difficulties. We hope that the management of these patients, which we have described above will improve safety. We also strongly suggest detailed discussions with the surgical team to avoid potential problems when dealing with a shared airway.

**Acknowledgements**

We wish to express our thanks to Professor A. Jones and Mr S. Jackson of the Department of Head and Neck Surgery at the Royal Liverpool University Hospital for allowing us to publish data relating to patients under their care.

**References**