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Case Report

New approach to anaesthetizing a patient at risk of pulmonary aspiration with a Montgomery T-tube *in situ*

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We describe our airway management in a patient requiring emergency laparotomy with a Montgomery T-tube *in situ*. This uncuffed silicone T-tube acts as both stent and tracheostomy after laryngotracheal surgery, and entails various difficulties for the anaesthetist. Several anaesthetic techniques have been described for T-tube insertion. The management of patients with a T-tube *in situ*, at risk of pulmonary aspiration, has not been addressed. Below, we present some possible approaches to this problem and describe how we successfully carried out an awake fibreoptic intubation via the tracheal limb of the T-tube. This technique might be considered for patients in similar circumstances, but knowledge of relevant internal and external tube diameters, and appropriate tracheal tube size selection, is crucial.

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The Montgomery T-tube was introduced in the mid-1960s and is used to support the trachea after laryngotracheoplasty. It consists of an uncuffed silicone T-tube that is inserted with its long limb in the trachea and short limb projecting through the tracheotomy stoma (Fig. 1). The T-tube comes in tracheal sizes of 4.5–16 mm (external diameter) and has tapered ends to minimize injury to tracheal mucous membrane.[1 2] The T-tube's use is generally limited to specialized head and neck centres; therefore, many anaesthetists will be unfamiliar with this device. The T-tube poses many anaesthetic challenges, particularly with respect to the delivery of volatile agents and controlled ventilation. Our principal concern, however, was the protection of the patient's airway during induction.

Case report

A 36-yr-old man presented for emergency laparotomy with acute intestinal obstruction. Three years before, he had undergone an oesophagectomy with first a gastric and then colonic interposition for a leiomyoma. Both interposed viscera had failed and he was left with a salivary fistula from the isolated pharyngeal stump. He had also acquired a complete subglottic stenosis as a result of prolonged intubation, ventilation, and probable cuff injury. Continuity of the gastrointestinal tract was restored by a 'super-charged' free jejunal interposition graft, after which the patient no longer had a pharyngeal stump. His laryngeal injury was corrected by a cartilage graft through a laryngofissure, the repair being supported and stented by a Montgomery T-tube. The T-tube had been removed accidentally shortly after his discharge from hospital and re-inserted with some difficulty. Surgical details of this replacement have been reported elsewhere.[3]

One week before the events described below, a jejunal feeding tube was inserted under general anaesthesia for administration of supplementary enteral nutrition. At that stage, the patient was deemed to be at low risk of gastric regurgitation and he received an i.v. induction followed by ventilation through a laryngeal mask, with a spigot in the extratracheal limb of the T-tube. Anaesthesia and surgery on that occasion were uneventful.

On the ward before his laparotomy, the patient was retching intermittently and distended jejunum was visible in his neck. He was able to provide for inspection a Standard Safe T-Tube (Boston Medical Products, Inc., Westborough, MA, USA) identical to the one *in situ*. This had external (ED) and internal (ID) diameters of 15 and 13 mm, respectively. We established that the tracheal lumen would allow the easy passage of a Portex tracheal tube with a maximum ID of 6 mm (ED 8.2 mm) (Smiths Medical, Watford, UK). We also tested 15 mm tracheal connectors from a series of tracheal tubes to identify in advance the one which would fit snugly into the

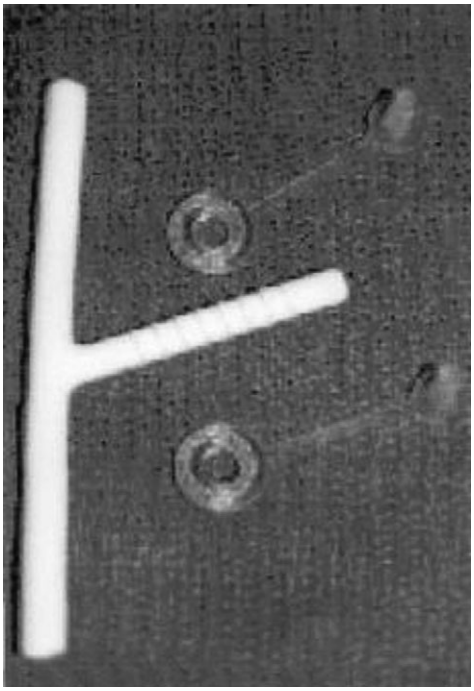

Fig 1 Montgomery® Safe T-tube with two plug/ring sets.

extratracheal lumen of the T-tube. The T-tube has the shortcoming of not taking a standard catheter connector.

Initially, we believed the best airway management option to be replacement of the T-tube with a cuffed tracheostomy tube before induction of general anaesthesia. We spoke to the otorhinolaryngological surgeon who had performed the tracheal reconstruction (M.G.). He advised that our proposal would leave the tracheal cartilage graft unsupported. When a similar manoeuvre had been attempted in the past, re-stenosis of the patient's trachea occurred within a fortnight. This necessitated two subsequent difficult tracheal dilations and re-insertion of the T-tube, all under general anaesthesia.

Given that, on this occasion, retention of our proposed tracheostomy tube would be required for postoperative ventilation, the otorhinolaryngologist believed the risks of re-stenosis and further tracheal surgery to be very high. With this in mind, and in view of the high risk of regurgitation and aspiration and the potential difficulty of airway management, we elected to perform an awake fibreoptic intubation.

The operating theatre was prepared accordingly and the procedure was conducted in the presence of a senior otorhinolaryngologist, prepared to intervene should the T-tube require emergency removal. A T-piece was attached to the connector in the extratracheal lumen of the T-tube and 10 litre min^{-1} oxygen was administered. Standard physiological monitoring was applied. A thoracic epidural catheter was inserted under local anaesthesia to allow optimal postoperative analgesia.

Local anaesthesia was administered to the upper airway and conscious sedation cautiously induced using an i.v. propofol infusion. All the tracheal tubes used in the procedure, and also the fibreoptic scope, were well lubricated. We decided not to lubricate the T-tube itself, as this would have involved the blind introduction of lubricant into the airway via the extratracheal limb. A 6 mm ID tracheal tube (8.2 mm ED), mounted on a 3.1 mm LF-DP tracheal intubation fibrescope (Olympus Optical Co. Ltd, Tokyo, Japan), was introduced nasally. With the extratracheal lumen of the T-tube held in place by the otorhinolaryngologist, the tip of the fibrescope passed easily through the intratracheal lumen of the T-tube. The tracheal tube could then be passed into the T-tube, but would not pass the distal end.

Being aware of the possible consequences of snagging and subsequent displacement of the T-tube, we did not advance the tracheal tube with sufficient force to displace the T-tube significantly, nor did we attempt the manoeuvre more than once. Instead, we changed the tracheal tube for a Portex 5 mm ID microlaryngeal tube (ED 7.3 mm) which passed through the entire T-tube in tracheal lumen easily. The cuff was inflated distal to the T-tube and an anaesthetic circuit connected. The correct position of the microlaryngeal tube was confirmed by capnography and auscultation.

Propofol 100 mg and rocuronium 40 mg were given. Direct laryngoscopy was performed for insertion of a nasogastric tube, whereupon the pharynx filled with foul-smelling fluid. The nasogastric tube was advanced into the jejunal graft and several hundred millilitres of the same fluid were aspirated. Anaesthesia was maintained with desflurane in oxygen and air and a laparotomy for intestinal obstruction and resection of adhesions was performed.

After operation, the patient was admitted to the intensive care unit and mechanically ventilated for 24 h. We realized that the risks of extubation were similar to those of induction, so an otorhinolaryngologist again held the T-tube in place during the procedure. The tracheal intubation fibrescope described above was inserted down the tracheal tube past the distal end. The tracheal tube was then withdrawn over the fibrescope as far as possible to enable re-intubation in the event of emergency. This was achieved without difficulty and the patient's subsequent recovery was uneventful in terms of his airway.

Discussion

Though the Montgomery T-tube usefully acts as both tracheal stent and tracheostomy, it presents various challenges for the anaesthetist. The non-standard fitting at the external opening of the extratracheal lumen requires modification with a tracheal tube 15 mm connector for attachment of an anaesthetic circuit. More problematic issues are the protection of the airway and the reliable administration of anaesthetic gases and controlled ventilation.

In a patient requiring general anaesthesia with a T-tube *in situ*, replacement of the device with a cuffed tracheostomy tube before induction would seem the most intuitive option. However, the otorhinolaryngologist who had originally inserted the T-tube in our patient was adamant that

removal should be considered only as a very last resort for the reasons described above.

While several authors have described anaesthesia for the initial insertion of the T-tube,[2 4–8] few have addressed the issue of anaesthetic induction in patients with a T-tube *in situ*. Some propose the use of an inhalation technique.[7] This is suitable when the risk of aspiration is low. The extratracheal lumen may be occluded and the gases administered via a face mask. Alternatively, the extratracheal route and a face mask may be used simultaneously by inserting a Y-connector into the anaesthetic circuit and using high gas flows.[7] Success is probably less likely when the extratracheal lumen alone is used for inhalation induction. This is because the open superior end of the T-tube's intratracheal lumen allows the entrainment of air during inspiration, with consequent dilution of anaesthetic gases.

For patients at low risk of aspiration, a number of methods have been proposed for controlled ventilation after insertion of a T-tube. Occlusion of the extratracheal lumen may be followed by i.v. induction of anaesthesia, with subsequent insertion of, and ventilation through, a laryngeal mask.[8] This was the technique used successfully in our patient for placement of a feeding jejunostomy.

If ventilation via the extratracheal lumen is preferred, it is necessary to prevent the escape of gases upwards through the superior end of the intratracheal lumen. A Fogarty or Shiley embolectomy catheter may be introduced via the extratracheal lumen of the T-tube and passed upwards in the intratracheal lumen. Inflation of the balloon then isolates the lower from the upper airway and allows controlled ventilation (Fig. 2).[1] This technique may be employed before induction. Alternatively, after induction, the upward escape of gases may be prevented by using a pharyngeal pack inserted orally[8] or a laryngeal mask with the lumen occluded.[6 8] Finally, i.v. induction may be followed by i.v. maintenance of anaesthesia and high-frequency jet ventilation via the extratracheal lumen.[2]

To our knowledge, there are no case reports on the management of a patient like our own—at high risk of aspiration with a T-tube *in situ*. We decided that neither a pharyngeal pack nor a laryngeal mask offered sufficient protection against aspiration. We considered whether we should pass a Fogarty catheter with the patient awake, as described above. In view of the anticipated requirement for postoperative ventilation, we felt that a more reliable airway was indicated and opted to pass a tracheal tube through the intratracheal lumen of the T-tube with the patient awake. This manoeuvre has been attempted by others in anaesthetized patients without direct vision. In one case, it was abandoned because of impending displacement of the T-tube.[4] In another successful attempt, a bougie was used to guide the tracheal tube from the mouth through the T-tube.[5]

At the time, we were unable to establish the exact internal diameter of the 15 mm ED Standard Safe T-Tube. The manufacturer has since been able to tell us, after checking the original blueprints. The information is not given on the tube itself, the packaging, the accompanying brochure, or the manufacturer's website. Despite this, we felt we could safely achieve awake fibreoptic intubation as the patient's spare T-tube allowed us to choose an appropriately sized tracheal tube in advance.

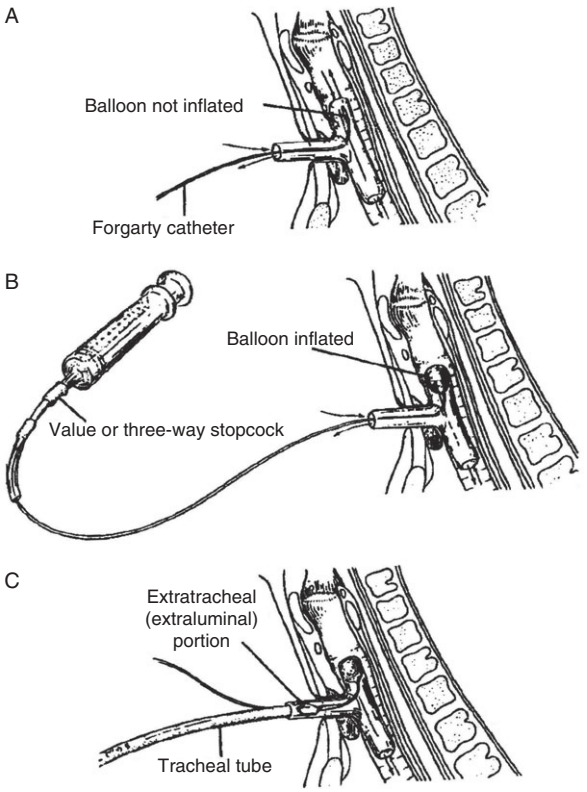

Fig 2 Sequence of steps for providing anaesthesia and airway control with the Montgomery T-tube *in situ*. (A) A Fogarty or Shiley embolectomy catheter is introduced via the extratracheal limb; (B) the embolectomy balloon is inflated to occlude the upper intratracheal lumen; (C) a tracheal tube positioned in the extratracheal lumen allows positive pressure ventilation to be applied to the lungs. Reproduced with permission from Montgomery.[1]

We reasoned that the bronchoscope would act as a guide for the tracheal tube as it passed through the intratracheal part of the T-tube. We were concerned about the risk of snagging the tracheal tube on the T-tube, and its potential consequences. We attempted to minimize this in a number of ways: first, by the copious use of lubricant; second, by the unprecedented use of a technique involving direct vision; third, by not attempting to overcome the obstruction encountered with the initial tracheal tube but exchanging it for a smaller one. Finally, an otorhinolaryngologist was present, both at induction and at extubation, to immobilize the extratracheal part of the T-tube and to assist should emergency removal of the T-tube be required.

There are many more published accounts relating to anaesthesia for T-tube insertion than to anaesthesia for patients with T-tubes already *in situ*. The majority of anaesthetists, working outside specialist centres, are more likely to encounter the second situation than the first.

Induction of general anaesthesia in patients at risk of pulmonary aspiration with T-tubes *in situ* is challenging. Under these circumstances, replacement of the T-tube before induction with a cuffed tracheostomy tube should be considered in the first instance. Although this manoeuvre may be performed carefully by an anaesthetist, it should be noted that the airway may be lost or obstructed during exchanges of this sort. Furthermore, subsequent re-insertion of the T-tube would definitely require general anaesthesia and a skilled otorhinolaryngologist.

In our patient, removal of the T-tube would have entailed the risk of significant complications. Anaesthetists in a similar situation may find our awake fibreoptic intubation technique useful. Selection of the size of the proposed tracheal tube must be based on full understanding and knowledge of the internal diameter of the T-tube *in situ* and the external diameter of the tracheal tube to be inserted. The effect of the tracheal tube cuff should not be ignored in this respect and the anaesthetist should be inclined to use a smaller tracheal tube than that expected to pass safely through the T-tube *in situ*. An otorhinolaryngologist familiar with the use and insertion of T-tubes should be present during the anaesthetic and at extubation.

Acknowledgements

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