Case Report

Repositioning a displaced tracheostomy tube with an Aintree intubation catheter mounted on a fibre-optic bronchoscope

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Although tracheostomy tube displacement is uncommon, the management is often difficult and the associated mortality is high. It is important to ensure that the airway is secure and then either replace or reposition the tracheostomy tube. This case report describes the use of an Aintree intubation catheter (C-CAE-19.0-56-AIC, William Cook Europe, Denmark) mounted on an intubating fibre-optic bronchoscope (11302BD1, Karl Storz Endoskope, Germany) to reposition a partially displaced tracheostomy tube.

Keywords: airway, complications; equipment, bronchoscope; intubation, tracheostomy

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The displacement of a tracheostomy tube can be a life-threatening emergency. It is important to rapidly secure the airway and then reposition or replace the tracheostomy tube. However, when replacement of the tube is attempted blind or facilitated using a guide such as an endotracheal tube (ETT) introducer, it can be difficult to distinguish the tracheostomy tract from the pre-tracheal tissues. Multiple attempts at repositioning may cause significant haemorrhage or disrupt the tract.1 These risks may be reduced if the guide to facilitate recannulation is placed into the trachea under direct vision.

We describe the use of an Aintree intubation catheter (AIC; C-CAE-19.0-56-AIC, William Cook Europe, Denmark) mounted on a fibre-optic bronchoscope (FOB; 11302BD1, Karl Storz Endoskope, Germany) to facilitate the repositioning of a partially displaced tracheostomy tube in a patient weaning from ventilatory support in the intensive care unit.

Case report

A 68-yr-old morbidly obese man with necrotic pancreatitis had a tracheostomy formed surgically for weaning from ventilatory support. The trachea was exposed by a horizontal skin incision and the thyroid isthmus was divided. A circular window was excised from the second and third rings of the anterior trachea and cannulated with a Bivona mid-range aire-cuf adjustable neck flange hyperflex tracheostomy tube (internal diameter 9.0 mm; Portex, USA). Seven days later, despite the use of tube ties around the neck, the tracheostomy tube became partially displaced, but allowed some airflow. Ventilatory support was increased (PEEP 7.5 cm

water, pressure support [PS] 22 cm water, \( F_{\text{I}O_2} \) 1.0) and oxygen was also supplied via a facemask with a reservoir bag.

Measured tidal volumes were significantly reduced at ~240 ml, but the blood pressure and heart rate remained stable. Saturations were maintained at 92% [arterial pH 7.25, \( P_{CO_2} \) 11.6 kPa, \( P_{O_2} \) 8.57 kPa, base excess (BE) 10 mmol litre\(^{-1}\)] with a ventilatory frequency of 40 bpm. In comparison, arterial blood gas saturations obtained before displacement of the tracheostomy tube with \( F_{\text{I}O_2} \) 0.45, PEEP 5 cm water and PS 14 cm water were pH 7.40, \( P_{CO_2} \) 7.5 kPa, \( P_{O_2} \) 14.5 kPa, BE 9 mmol litre\(^{-1}\).

Attempts at blind passage of suction catheters, an ETT introducer and an AIC (C-CAE-19.0-56-AIC, William Cook Europe, Denmark, French gauge 19) via the tracheostomy tube were unsuccessful. The tracheostomy tube was not removed because oxygenation was possible and there were concerns that the relatively immature tract could have been lost. Furthermore, the initial oro-tracheal intubation, performed under sedation, had been extremely difficult despite fibre-optic assistance.

In the presence of the consultant and registrar of the maxillofacial surgical team who had formed the tracheostomy and an anaesthetic registrar who was prepared for oro-tracheal intubation, the patient was lightly sedated with propofol. Muscle relaxants were not used because oxygenation was maintained with spontaneous ventilation and removal of the tracheostomy tube and occlusion of the stoma would have been required for effective manual ventilation.
A bronchoscopy swivel elbow (1898 Swivel Elbow 22M/15F-15M with ‘sealaround’ cap 7.6 mm, Intersurgical, UK) was attached to the tracheostomy tube and connected to the ventilator tubing. A consultant anaesthetist then passed an FOB (11302BD1, Karl Storz Endoskope, Germany, outer diameter 3.7 mm; length 65 cm) into the tracheostomy tube.

The tracheostomy tube was in the pre-tracheal space. The inflated cuff, which held the distal end of the tube rigidly in place, had almost completely obstructed the tracheostomy tract and had herniated into the trachea. The tube could not be manipulated without high risk of losing the airway.

Although the FOB could enter the trachea it was not sufficiently stiff to reposition the tube. However, the trachea was successfully cannulated by advancing the Aintree intubation catheter (AIC) mounted on the fiberoptic bronchoscope (FOB) into the trachea via the bronchoscopy swivel connector attached to the tracheostomy tube. When the AIC was positioned adequately within the trachea the FOB was removed, allowing ventilation of the lungs via the AIC. The cuff was deflated and the tracheostomy tube was then guided over the AIC into the trachea.

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Although the FOB could enter the trachea it was not sufficiently stiff to reposition the tube. However, the trachea was successfully cannulated by advancing the AIC (internal diameter 4.7 mm; length 56 cm) mounted on the FOB and held in place by a tube holder (CF-1101, Karl Storz Endoskope, Germany) through the tracheostomy tube (Fig. 1). When the AIC was positioned adequately within the trachea the FOB was removed, allowing oxygenation via the AIC. The cuff was deflated and the tracheostomy tube was guided over the AIC into the trachea. The position of the tube was then confirmed at 5 cm from the carina using the FOB. There was no bleeding from the tracheal stoma. The procedure was completed within 90 s and did not compromise the patient further.

When mechanical ventilation was reinstated oxygen saturations of 100% were achieved with tidal volumes more than 700 ml and a ventilatory frequency of 14. The tracheostomy was then tied securely around the neck to prevent decannulation before the propofol was gradually weaned. The PEEP was reduced to 5 cm H2O and tidal volumes of 450 ml were produced with a PS of 14 cm H2O. Arterial blood gases confirmed adequate ventilation (pH 7.57, Pco2 5.37 kPa, Po2 42.4 kPa, Fio2 1.0 and BE 11.7 mmol litre⁻¹).

**Discussion**

Although the incidence of tracheostomy tube displacement is only ~1.5% the associated mortality is very high.1,2 Factors that influence management include the following:

1. The indication for the tracheostomy, in particular whether the upper airway is patent.
2. When the tracheostomy was formed.
3. The technique used to form the stoma.
4. Whether stay sutures are present.
5. Whether the tube is partially or completely displaced.

If the upper respiratory tract is obstructed and oxygenation is not possible the tracheostomy must be recannulated immediately. A guide passed via the stoma or partially displaced tube may facilitate recannulation.

If the upper respiratory tract is patent, supply oxygen via a facemask. If oxygenation can be maintained and the patient is not compromised, the tracheostomy tube should be replaced as soon as possible to preserve the tract.3 Prepare for oro-tracheal intubation if the tract is not well defined or the tracheostomy cannot be recannulated easily.

In this case ventilation was difficult but oxygenation was adequate. It was important to secure the airway quickly and oro-tracheal intubation was considered. However, the tracheostomy was performed for weaning ventilatory support. Oro-tracheal intubation usually requires heavy sedation and administration of muscle relaxants, which can be detrimental to weaning. Only minimal increase in sedation was required for the manipulation of the tracheostomy tube described in this case. Spontaneous ventilation was maintained throughout and the progress of the patient was not compromised.

Tracheostomy tube displacement within 72 h of formation can be particularly challenging as the tract is not established and may be lost if the tube is removed.1,4 During this period, it is recommended that the airway should be secured by oro-tracheal intubation before replacement is attempted by an individual experienced at performing tracheotomy. The tracheostomy matures over 10–14 days1,5 and tube displacement after this time may be easier to manage. Regardless, if the patient is ventilated, an anaesthetist should be present and prepared for oro-tracheal intubation should difficulty arise. However, oro-tracheal intubation can be difficult after tracheostomy and prior fiberoptic inspection of the trachea has been suggested.6

The technique used to form the tracheostomy affects the risk of tube displacement and the ease of recannulation.
For example, the thyroid isthmus may be retracted or divided. An intact isthmus may descend, obstructing the tracheostomy if the tube is displaced. The tracheal portal is usually between the second and fourth cartilage rings of the trachea. The risk of displacement is increased if the tracheostomy is too low or not in the midline.

Surgical techniques commonly used to form the tracheal portal include a vertical incision or fenestration of the anterior trachea as described in this case. These stoma can be fashioned quickly and close soon after extubation. However, replacement of the tube can be difficult and the risk of traumatic replacement of the tube is increased.

The Björk flap is an anterior inverted U-shaped flap raised between the second and fourth tracheal rings. Inverting and suturing the flap to the lower skin edge provides a well-defined tract. This reduces the risk of displacement and facilitates replacement. However, fixation of the trachea to the skin edges can cause dysphagia and if the tube is displaced the Björk flap can obstruct the trachea preventing oro-tracheal intubation.

Stay sutures placed through the tracheal wall on either side of the tracheostomy may facilitate replacement of the tracheostomy tube. Upward and lateral traction on these sutures brings the tracheal hole closer to the surface. However, stay sutures may weaken the anterior trachea and cut out. If crossed or entangled, traction on stay sutures narrow the stoma, compounding airway obstruction. Thus, stay sutures should be taped to the skin of the neck and marked ‘left’ and ‘right’ and ‘Do Not Remove.’ These sutures are removed after the first tracheostomy tube change.

The tracheostome may be much smaller in patients who have undergone percutaneous tracheostomy. In the event of accidental decannulation within 2 weeks the airway should be secured by oro-tracheal intubation. Reinsertion of the tracheostomy tube will require either digital or instrumental repositioning of the tracheostomy tube and thus should be attempted by those experienced in performing percutaneous tracheostomy. When the tract has fully matured direct repositioning may be possible.

After replacement of a tracheostomy tube it is important to stabilize the patient and secure the tube to prevent recurrence. Prevention of displacement requires constant attention to the fixation of the tube particularly when the patient is moved or coughs.

Sedation, connection of the tube to the ventilator with flexible tubing, ties around the neck and suturing the flanges to the skin may reduce the risk of accidental decannulation. However, it is important to be prepared at all times. Tracheostomy sets of the same type in a range of sizes should be at the bedside. A source of oxygen, a suction device, suction catheters, a resuscitation bag with facemask, an ETT (a half size smaller than the outer diameter of the tracheostomy tube) and capnography should also be available. We suggest that an AIC and a FOB are added to this list for patients with a recently formed stoma in whom recannulation or oro-tracheal intubation is expected to be difficult.

The AIC is a disposable hollow ventilation/exchange catheter which can be used to facilitate the insertion of ETT or tracheostomy tubes with an internal diameter of at least 7.0 mm. It is supplied with a removable 15 mm Rapi-fit connector (William Cook Europe, Denmark), to allow additional ventilation during intubation.

An AIC can be mounted on a FOB with an outer diameter <4 mm and can be used to facilitate oro-tracheal intubation through a laryngeal mask airway. Although the use of this technique to replace tracheostomy tubes has not previously been reported, there are several advantages. The directional control of the FOB assists passage into the trachea and correct placement can be confirmed immediately. Thus the risks of losing the airway or forming a false passage in the pre-tracheal space are significantly reduced. However, clinicians must be familiar with the manipulation of an AIC mounted on a FOB. Lubricant, blood or secretions often obstruct the view but can usually be cleared by using the suction attached to the bronchoscope or removing and cleaning the scope. Experience can be gained by using this technique for routine tracheostomy tube changes.

While tracheostomy tube displacement is uncommon the associated mortality is high. Rapid repositioning is often required. Multiple attempts to blindly reposition the tube may disrupt the pre-existing tract and cause significant haemorrhage. Clinicians should be aware of the technique described in this report as it may rescue a partially displaced tracheostomy tube when blind passage of a guide is unsuccessful and other approaches would potentially compromise patient safety or recovery.

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