CASE REPORT

Dilation balloon rupture during percutaneous dilational tracheostomy: using Blue Dolphin kit

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SUMMARY

A 72-year-old man presented to the high dependency unit following an elective incisional hernia repair. He was extubated in the immediate postoperative period. Following established type 2 respiratory failure (secondary to hospital-acquired pneumonia), he required tracheal intubation and was ventilated in the intensive care unit (ICU). He failed extubation and subsequently had a percutaneous single-stage dilational tracheostomy fitted as indicated. During the tracheostomy, while inflating the dilation balloon (used to dilate the trachea), the balloon burst in the trachea, at a pressure of 3 atmospheres. Following this, the entire dilating unit and tracheostomy tube were removed; no debris was left inside the trachea as confirmed by bronchoscope (used throughout the procedure). He made good recovery and was discharged to a surgical ward. This case report summarises the indications for tracheostomy, and reports the rare event of balloon rupture and how to manage it within the ICU setting.

BACKGROUND

Percutaneous tracheostomy insertion is a common procedure within the intensive care unit (ICU) setting. It has been proven to be a cost-effective procedure with very low morbidity, even among high-risk patients.¹ A minority of anatomically difficult cases are referred for surgical tracheostomy.

The common indications for tracheostomy in ICU include:

1. Upper airway obstruction, trauma or infection in oral cavity, pharynx or larynx;
2. Airway protection against pulmonary aspiration;
3. Prolonged need for ventilatory support;
4. Minimisation of sedation, tracheobronchial toilet and weaning.

Percutaneous tracheostomy is widely accepted as the technique for insertion in the ICU. In view of the frequency of this procedure in the ICUs, we deemed it important to report on this unpublished event of dilation balloon rupture. It is pertinent to report such incidences to share insight and the learning points that can be taken from this episode.

CASE PRESENTATION

A 72-year-old man, with known severe chronic obstructive pulmonary disease, ischaemic cardiomyopathy and hypertension, presented to the high dependency unit following the repair of an incisional hernia. He had a history of heavy smoking and alcohol intake. He was assessed in the pre-operative anaesthetic clinic and was deemed to have a 30% risk perioperative for adverse events.

The patient refused to have the hernia repaired under regional anaesthesia and thus, a general anaesthetic was given. He was extubated in the immediate postoperative period in the post-anaesthesia care unit. During the first 2 days post-operatively, he became agitated and aggressive, and this is likely to be secondary to hospital-acquired pneumonia which resulted in respiratory failure. He went on to require endotracheal intubation.

Following failure to extubate twice, the decision to insert a tracheostomy was made. This decision took into account his poor cough and the increased requirement for tracheal suctioning due to copious amount of secretions. We used Blue Dolphin percutaneous tracheostomy kit (size 8 Cook medical). The patient remained tracheally intubated, sedated and ventilated during the procedure. The tracheal tube was pulled back to a position just below the glottis to allow access for tracheal puncture, and insertion of the needle and guidewire at dilation site.

Flexible fibre optic bronchoscopy was performed throughout the procedure to check the puncture site in the trachea, guidewire and the dilator. Once the trachea was visualised, the needle was inserted into the trachea. This needle was confirmed to be at optimal position within the trachea via visualisation with the bronchoscope. Subsequent to this, a guidewire was inserted as per protocol.² The dilational kit loaded with tracheostomy tube was inserted into the trachea. The dilating balloon was inflated after the black mark at the level of trachea was confirmed by bronchoscopy. At an atmospheric pressure of 3, the balloon ruptured while in the patient's trachea. The device was immediately removed and inspected (figure 1). The guidewire was left in trachea so as not to lose the track. There was no bleeding or loss of the airway as a result of the balloon rupture. The partially dilated tracheal hole was occluded externally with a sterile swab, while a new kit from a different batch was being obtained.

The trachea was thoroughly inspected with the bronchoscope to inspect for any debris. None was visualised and the balloon did not appear to have any missing areas.

A new tracheostomy set (size 9) from a different batch of Blue Dolphin kit was used over the guidewire, which was originally left in the trachea. The new balloon was inflated to an atmospheric pressure of 11 to dilate the trachea. The size 9 tracheostomy tube was inserted uneventfully.

The patient was ventilated for several days and was weaned off from ventilation to be decannulated of the tracheostomy tube.

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Figure 1 Ruptured dilation balloon. Though sheared completely into two, the entire unit was visible once removed from the trachea with no evidence of missing parts.

INVESTIGATIONS

Bronchoscopy at time of rupture and chest X-ray postprocedure.

TREATMENT

The tracheostomy kit was removed leaving the guidewire in situ to provide access to the trachea. Trachea and bronchi were inspected bronchoscopically for any debris. No debris was found. X-ray of the chest also did not show any debris. There was no obvious defect seen on the dilating balloon.

OUTCOME AND FOLLOW-UP

This patient continued to be managed for tracheostomy, without any problems relating to it. He was successfully weaned off the ventilator and was decannulated. He was later discharged to a surgical ward and subsequently to a local rehabilitation centre.

DISCUSSION

Single-stage and serial dilating techniques for percutaneous tracheostomy were associated with bleeding and injury to surrounding structures. It was considered desirable to have a technique that utilised tracheal dilation and tracheostomy tube placement in one single step.³ Pasquale Ciaglia developed such a technique in 2000, which was further refined by Michael Zgoda.⁴

The precedent of rupture of the dilator balloon is limited. During laboratory investigation by Zgoda, it was noted that a pinch point of the dilator balloon could form if one tissue layer was significantly stiffer than the others, creating a point of weakness.⁴ Indeed, when this occurred in one patient, the distal balloon segment formed a 'button' wedged within the trachea. A subsequent recovery method was then published, whereby the whole apparatus was advanced into the trachea to utilise the loading dilator to widen the stoma and remove the whole apparatus, leaving the guidewire in place.⁵

The only other incident found was an Food and Drug Administration (FDA) adverse event report, logged in 2009, noting a circumferential rupture occurring at 10 atmospheres which was stated to be due to 'unforeseen patient anatomical/physiological factors'. The resulting large blood loss was stopped by inserting a Blue Rhino device. No comment was made on further patient outcome.⁶ In our case, there was no evidence of anatomical abnormal factors that could have contributed to the balloon shearing. Our device was up-to-date. Since the balloon cannot be inflated prior to insertion into the patient, it is difficult to find out any manufacturing defects associated with it.

Bronchoscopy has been proven to be beneficial⁷ and certainly proved useful in finding any fragments of the balloon within the tracheobronchial tree.

Learning points

- ▶ Dilation balloon rupture should be a recognised risk.
- ▶ Bronchoscopy has an important and crucial role in percutaneous tracheostomy.
- ▶ Date checks should not be left out in the process.
- ▶ Inflation of the balloon before insertion would be beneficial; however, the manufacturers do not recommend this as it will not allow the balloon to fall back to its original position and shape. This can cause the pinch effect described earlier.

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Competing interests None.

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