CASE REPORT

Unusual case of acute tracheal injury complicated by application of positive end expiratory pressure (PEEP)

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SUMMARY

Blunt neck trauma can be caused by a variety of injuries such as deceleration, road traffic accidents and crush injuries. The worst scenario is airway rupture. We report an unusual case of acute tracheal injury in a 34-year-old Irish man who presented with a history of strangulation while working with a tractor. On arrival, he had one episode of mild haemoptysis and reported pain around the base of the neck and voice hoarseness. His chest X-ray revealed pneumopericardium and CT of thorax showed airway oedema. After elective intubation, positive end-expiratory pressure (PEEP) of 5 cm H₂O caused deterioration in his clinical condition with increasing surgical emphysema and rise of carbon dioxide partial pressure (PaCO₂), which was completely reversed after stopping PEEP. This case shows how PEEP and intermittent positive pressure ventilation can worsen air leak and compromise stability in patients with acute tracheal injury.

BACKGROUND

Blunt trauma to the neck can be caused by a variety of injuries such as deceleration, road traffic accidents and crush injuries. The worst scenario is airway rupture.¹ The posterior membranous trachea² is the most common site of rupture that leads to pneumomediastinum, which can result in cardiac tamponade.

Acute airway obstruction occurs more rapidly with cricoid injuries because its complete ring does not allow room for an expanding haematoma or other mass effect without airway compromise. Airway obstruction may also follow temporary laryngospasm originating from nociceptive reflexes triggered during the transmission of force to the cervical ganglion. Although this is usually temporary, it can lead to cardiopulmonary arrest.²

Tracheobronchial rupture occurs in about 0.34–1.5% of all neck trauma³ and is 10 times more common in adults. Tracheal rupture presents with symptoms of dysphagia, dysphonia, dyspnoea, stridor, haemoptysis and anterior neck pain. Clinical signs include tenderness, loss of thyroid cartilage prominence, cyanosis, subcutaneous and mediastinal emphysema, pneumothoraces and respiratory distress.⁴

Diagnosis requires a high index of suspicion and diagnostic investigations include chest X-ray (CXR), CT neck and thorax, which may show the presence of pneumomediastinum. Flexible or direct laryngoscope can reveal the site of the tracheal tear. Alternatively, the tear may be detected on a

bronchogram.⁵ The most important aspect of care in such injuries is establishing a secure airway.⁶

CASE PRESENTATION

A 34-year-old Irish man presented to the accident and emergency department of a regional hospital with a history of strangulation while working with a tractor. A woollen scarf, which was wrapped around his neck became entangled within the tractor drive and tightened the scarf around his neck leading to strangulation. His wife, who was present at the site, freed him and brought him immediately to hospital. The total time interval from injury to hospital presentation was 30 min.

On arrival, he reported pain around the base of his neck, voice hoarseness and experienced one episode of mild haemoptysis. He was fully conscious with a Glasgow Coma Scale of 15, heart rate 86 bpm, blood pressure 156/65 mm Hg, respiratory rate 16 breaths/min and he maintained an oxygen saturation of 95%, breathing spontaneously on room air. On examination there was circumferential bruising around the base of his neck and surgical emphysema. Auscultation of the chest was otherwise normal. Portable CXR (figure 1) showed pneumopericardium.

The working diagnosis was that of blunt tracheal injury and the patient was considered to have a high probability of developing airway obstruction. Hence a decision was made to protect his airway by elective endotracheal (ET) intubation. This was performed without difficulty using a size 8.0 mm ET tube (Portex) with sedation of propofol (Diprivan 1%, B. Braun) and remifentanyl (Ultiva, GSK).

Figure 1 Chest X-ray—air in pericardium. Arrow showing the pneumopericardium on the left side.

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Figure 2 CT of the thorax. Arrow revealing the snugly positioned endotracheal tube.

Mechanical ventilation was started with a tidal volume of 8 mL/kg and a positive end-expiratory pressure (PEEP) of 5 cm H₂O. Moreover, he was started on intravenous dexamethasone 8 mg six hourly and empirical broad spectrum antibiotics (co-amoxiclav and metronidazole) to prevent mediastinitis.

Further radiological examination in the form of neck (figure 2) and thorax (figure 3) CT demonstrated airway oedema tightly surrounding the ET tube. It also confirmed the presence of pneumomediastinum but there was no obvious perforation of the tracheal wall. In the intensive care unit, a gastroscopy was attempted to rule out an associated oesophageal injury but the oropharynx was found to be swollen and oedematous so the procedure was abandoned.

In the following 6 h, the patient's condition deteriorated with worsening surgical emphysema extending to the face and upper chest (figure 4). The ventilation status also deteriorated with a rise of carbon dioxide partial pressure (PaCO₂). A follow-up neck and thorax CT was performed (figure 5). The obvious change in the repeat CT was the presence of air around the ET tube, and a worsening of the pneumomediastinum, which correlated with a clinical appearance of worsened surgical emphysema.

Figure 3 CT of the thorax. Arrow indicating the pneumomediastinum on the right side of the upper part of the lungs but integrity of the trachea was deemed to be normal.

Figure 4 Surgical emphysema around the face and upper part of the chest.

The mechanical ventilation appeared to have worsened the clinical picture and PEEP was presumed to be the cause of the increased air leak at a probable small tracheal injury site. Hence the PEEP was stopped and mode of ventilation changed from intermittent positive pressure ventilation to spontaneous breathing mode.

OUTCOME AND FOLLOW-UP

The surgical emphysema began to resolve over the next 12 h (figure 6) and the patient remained stable and recovered completely on conservative management. He was extubated 3 days later and discharged home on day 14. Bronchoscopy at 3 months showed no sequelae and at 6 months clinic review he was well without any residual symptoms.

DISCUSSION

The management of tracheal tear depends on tear size. Small tears (<2 cm) can successfully be treated conservatively but in some cases large tracheal defects can also recover uneventfully under conservative treatment even if they are receiving spontaneous ventilation therapy.¹ Primary repair is indicated in large tears⁷ and emergency surgery mandatory if pulmonary function is compromised. In this instance, primary anastomosis should be performed ideally within 48 h to minimise the risk of infection and stricture formation.⁸

So, the decrease in mortality and long-term morbidity depends on early diagnosis of this medical emergency.⁷ Although endoscopy is recognised as the modality of choice for

Figure 5 Air leakage around the endotracheal neck tube (arrow).

Figure 6 Surgical emphysema improved in the next 12 h after stopping the positive end-expiratory pressure.

the diagnosis of tracheal tears,⁹ it was unfortunately not possible in this case due to significant oropharyngeal swelling and oedema. Luckily, despite carrying a sensitivity of only 85% and its limited localisation when compared with tracheoscopy,¹⁰ CT was at least able to exclude major tracheal rupture, hence allowing us to manage the patient conservatively.⁸

This case is unique because of the unusual mechanism of injury and the fact that conservative management in the form of

PEEP aggravated pneumomediastinum and surgical emphysema (figure 5), and led to a rise in PaCO₂. Interestingly, PEEP, employed since 1969 for the treatment of acute respiratory insufficiency,¹¹ is known to produce interstitial emphysema and pneumomediastinum when more than 11.5 Torr (15 cm H₂O) is used.¹² However, in this case, only about half of that setting was applied (5 cm H₂O).

Unlike recent studies, which showed a 3–15 h time lag between tracheal injury and appearance of surgical emphysema,⁹ our patient had clinically detectable emphysema only after 30 min of injury; and in line with the published literature,⁹ our patient was given empirical broad spectrum antibiotics to prevent mediastinitis.

Competing interests None.

Patient consent Obtained.

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Learning points

- Upper airway rupture is a life-threatening condition and needs immediate intervention in the form of endotracheal intubation.
- Delay in intubation could result in an increased swelling and complete occlusion of the airway.
- Even low positive end-expiratory pressure (PEEP) settings and intermittent positive pressure ventilation in such cases can precipitate further air leak and compromise stability of the patient. With appropriate sedation, a good outcome can be safely reached through spontaneous ventilation (without any need for PEEP).
- Patients with tracheal injury should be given empirical broad spectrum antibiotics to prevent mediastinitis.

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