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CASE REPORT

Conservative management of a major post-intubation tracheal injury and review of current management

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Abstract Tracheal rupture represents a rare but serious complication of intubation. We discuss a case of a major post-intubation rupture. After investigation with CT scan tracheoscopy and bronchoscopy a low tracheostomy was formed protecting the rupture from pressure changes associated with ventilation. The patient was managed with minimal surgical intervention, low tracheostomy with antibiotic cover and monitoring in the intensive care unit for 24 h before being woken and moved to a ward after 48 h. The patient made a full and uncomplicated recovery and was discharged 2 weeks after the original injury. Most of the literature on the subject is made up of review of case reports that conclude management of such a major tear must be with surgical repair. This however confers significant morbidity and an associated high mortality. We suggest an alternative management protocol.

Keywords Trachea · Rupture · Intubation · Tracheostomy · Surgical emphysema

Case report

Our case involves a 54-year-old woman who underwent a gynaecological procedure; all her previous surgery had been pelvic or abdominal. It is noted that in the previous 5 years she had had three uncomplicated general anaesthetics for related procedures.

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She was graded as an ASA grade 1 intubation and a bougie was not used during intubation with a size 8 endotracheal tube, post-operatively she was noted to have some facial swelling however her oxygen saturations were well maintained at 98%.

It was noted that her chest was clear. There was a delay in diagnosis by the attending team for 72 h, due to a misdiagnosis of an allergic type reaction, despite the tell tale presence of subcutaneous emphysema, until a CXR was ordered and revealed subcutaneous air in the mediastinum and around the pericardial region.

An urgent CT scan subsequently confirmed the presence of emphysema in the chest, upper arms and neck (Fig. 1).

The patient had an emergency tracheoscopy and bronchoscopy, a nasal fibreoptic intubation under mild sedation with the ET tube placed low in the trachea to prevent further surgical emphysema from the positive pressure ventilation was performed. Subsequently a low tracheostomy was performed through the fourth tracheal ring. To ensure that the cuff was below the bottom of the tear a size 7.0 single lumen with an adjustable flange was inserted. The tube was placed using a flexible endoscopic guidance such that the lower half of the cuff was below the distal end of the tear hence protecting the tear from any pressure changes occurring during ventilation or later breathing. An NG tube was placed under direct vision for feeding (Fig. 2).

The patient was nursed on ICU and commenced on tazocin as per regimen for a nosocomial chest infection. She was carefully monitored both clinically and with regular inflammatory markers, especially with regards to the development of any lower respiratory

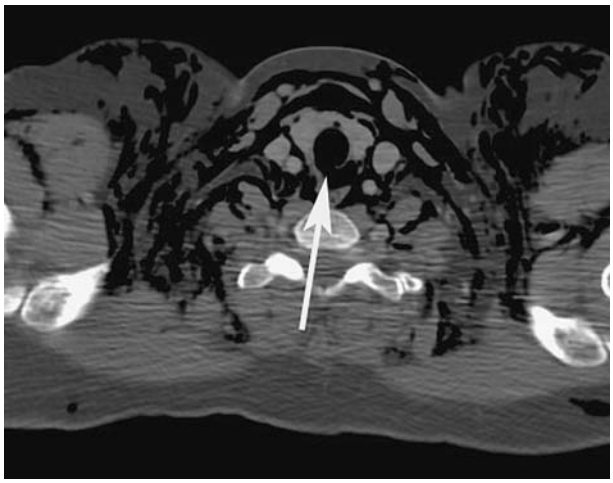

Fig. 1 A posterior tracheal tear, marked by *white arrow*, ran from C7/T1 5.6 cm to three tracheal rings above the carina. Extensive pneumomediastinum surrounding the heart and its vessels as well as small bilateral effusions with patchy consolidation

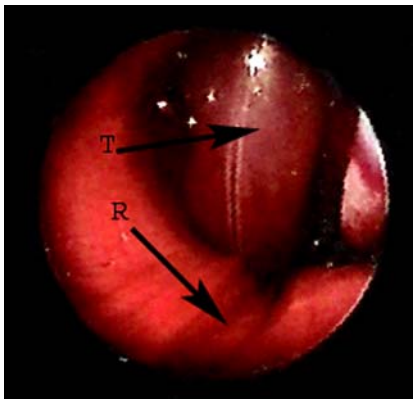

Fig. 2 Bronchoscopy revealed a full thickness tear through trachealis extending 5 cm measured at 4 cm above the carina as can be seen in the figure. *T* marks the tracheostomy tube, *R* the rupture in the trachea

tract infections or mediastinitis. She remained stable and an omnipaque swallow revealed no damage to the oesophagus and she was subsequently allowed to eat and drink. Her emphysema improved and resolved the first 24–48 h.

Four days later a CT of the chest revealed no obvious deformity to the posterior wall, so a further bronchoscopy under general anaesthetic was performed (Fig. 3).

The cuff was deflated although the tracheostomy was kept in situ in case of a worsening in her condition. The patient was kept ventilated for 24 h before being woken and moved off the intensive care unit (Fig. 4).

After a further 7 days the patient was decannulated after having her tracheostomy downsized to a size 6 fenestrated and subsequently capped of for 24 h.

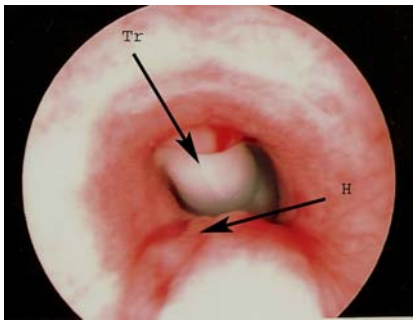

Fig. 3 As can be seen above there is already intact mucosa. *H* marks the healed tracheal tear

This was uneventful and so she was sent home 2 days later after suturing over her tracheostomy site.

Two months later on review she remained clinically well with no signs of any respiratory problems, it was therefore felt a further bronchoscopy was not indicated.

Discussion

Tracheal laceration is a rare but potentially catastrophic event. In the majority of cases published in the literature the cause has been put down as induced tracheal rupture by means of over distension of the cuff [1]. When this trauma is intubation-related, it may occur in the context of an emergency intubation [2] and has been associated with the use of double-lumen tubes [3] and the use of bougie-assisted intubation has been reported [4].

Intubation-related tracheal rupture occurs in the posterior tracheal wall and it is postulated that this is the result of balloon hyperinflation rather than direct trauma from the tube to the tracheal wall. Direct damage by the tube is not a likely aetiology as it has been demonstrated that when the tube is entering the trachea it will press against the anterior or the lateral wall not the posterior wall [5]. The mechanism of injury explains the location of rupture: the trachea is reinforced on three sides by its cartilaginous rings so the majority of expansion will be in the posterior direction potentially causing a tear. Similarly, it is felt that dissection and mobilisation of the oesophagus can result in loss of posterior tracheal supportive structures and patients undergoing oesophageal surgery are at a higher risk of tracheal rupture [6].

If the patient is then noted to be coughing, as was the case with our patient, then the forces being conveyed through the posterior wall are even greater and we believe a contributing factor. Use of nitrous oxide, which can increase the pressure in the cuff, is another

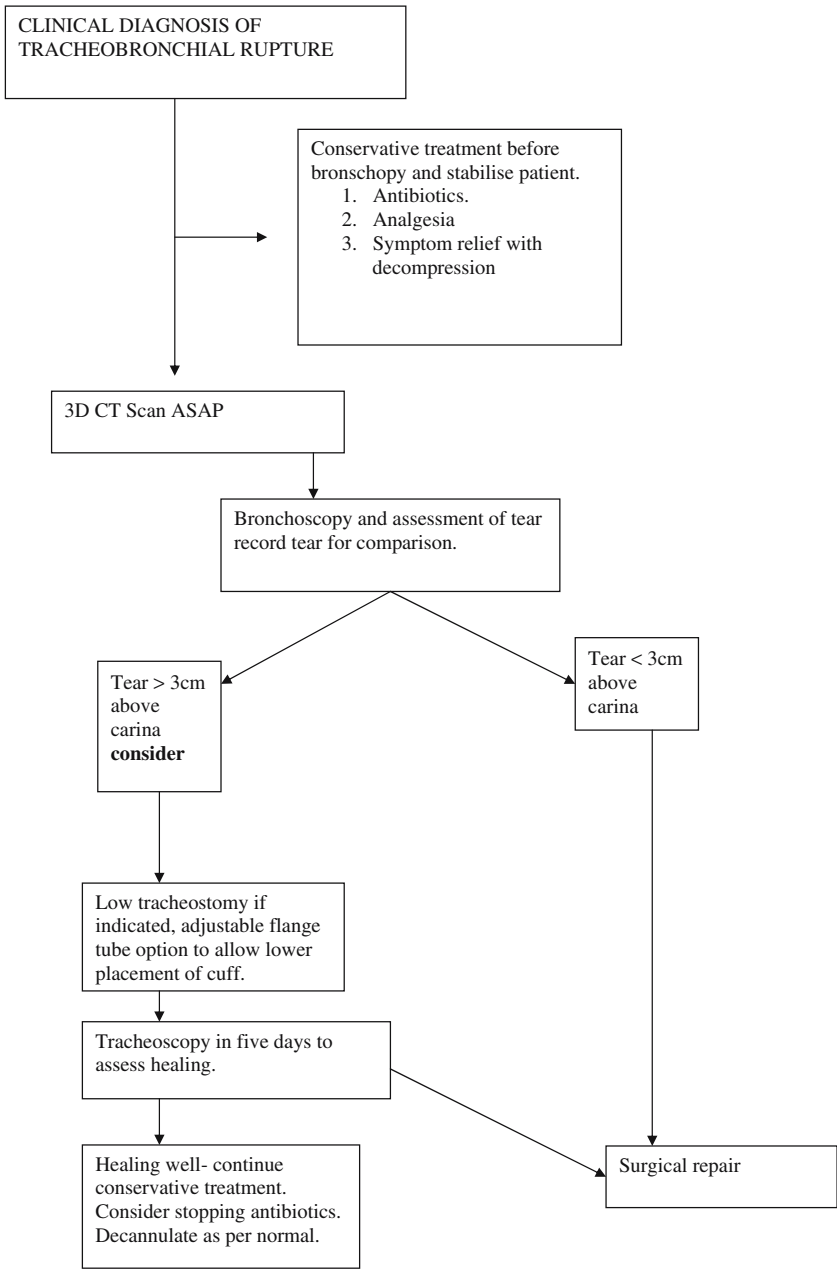

Fig. 4 Algorithm for treatment of tracheal rupture injuries

independent risk factor. A recent study has shown that even in laryngeal masks pressures can be increased up to 250% within 5 min of using nitrous oxide [7].

Current guidelines in the UK would suggest however that a size 8.0 tube is larger than that recommended for elective cases [8]. However at assessment it was felt that this was appropriate, nevertheless this is a factor that must be also taken into account when considering the aetiology of this injury.

Recognition and diagnosis are more difficult when tracheal trauma occurs during an otherwise straightforward, grade 1 intubation, in the context of an elective procedure. In our case this probably contributed to the delayed diagnosis and management.

Many of the clinical signs described with tracheal laceration include: a persistent air leak around the endotracheal tube despite adequate cuff pressures, subcutaneous emphysema over the neck and chest, mediastinal emphysema, difficulty ventilating the lungs, cyanosis and signs of pneumothorax [3].

Currently in the literature various authors have suggested absolute indications for surgical repair. Postintubation membranous trachea ruptures have been repaired successfully directly by continuous or interrupted, fine, absorbable sutures. Often this repair is reinforced by a number of methods including using pericardium, pleura, muscle, mediastinal fat pad or azygous vein. These procedures are lengthy and have a

high mortality rate reported as high as 42% [9], however, the author accepts that underlying disease and cause should be considered when taking these figures into consideration.

The longest rupture that has been reported to be treated conservatively is 2 cm [2]; anything longer has been surgically repaired. Fan et al. [10] have suggested that any tear larger than 4 cm must be surgically repaired immediately. Our patient had a tear of 5.8 cm, however, an intact trachea of 4 cm above the carina, with no signs of respiratory compensation. She did have severe surgical emphysema and pneumomediastinum (as evidenced on CT scan). She was treated in a less invasive way by having a tracheostomy done to protect the tear from changes in airway pressures. She was however only kept sedated for 24 h as opposed to the 2 weeks if she had had an endotracheal tube in situ. She was given intravenous nosocomial antibiotics (tazocin) prophylactically and ultimately made an uncomplicated recovery and was discharged within 2 weeks.

Previous authors have suggested that length of rupture is the important factor [3]. We would suggest that the determining factor as to whether to treat conservatively is whether it is possible to place a tracheostomy tube below the area of rupture hence providing a safe airway and allowing ventilation with high pulmonary pressures i.e. if there is a long enough piece of intact trachea (minimum 3 cm). If this can be done then the tear has a chance to heal and it is possible to stabilise the patient. We did this by using an adjustable flange tracheostomy tube and a low window cut in the trachea utilising a flexible fibre optic endoscope to allow us to position the end of the tube below the tear but the end of the tube above the carina.

Then at a second look after 5 days it will be easy to determine whether the trachea is healing, as it clearly was in our patient, or not and further management can be taken from here in a more planned manner in a stabilised patient.

Her severe pneumomediastinum and surgical emphysema settled within 24 h of the tracheostomy being sited. Although this was a single case it does question whether all these cases need to be treated aggressively with corrective surgery and whether length of tear or presence of pneumomediastinum or emphysema is the most important parameter in deciding whether to perform a surgical repair as has been suggested.

When we performed a bronchoscopy on our patient a longitudinal tear was immediately obvious as can be seen in Fig. 2. However what is also clear is that there is no prolapse of oesophagus or fat into the trachea. We believe that this is another important factor in that this will (a) compromise the airway, (b) interfere or stop healing.

Conclusion

In the absence of infectious complications or ventilation problems in tears 3 cm above the carina where it is possible to inflate a cuff a conservative approach is an option. This decision however should only be made in the above circumstances and the final decision on either surgical or conservative management should be based on rigorous investigation in the form of clinical, radiological and bronchoscopic findings.

We have only managed a single patient in a conservative manner however it does suggest that the "absolute" guidelines currently being suggested should be revised.

Subsequently 2 months after being treated the patient has made a full recovery.

Given our findings we suggest a different approach to assessing the tracheal damage and patient factors which we believe will allow more patients to be treated in a less invasive manner and hence reduce the need to perform surgery with a high mortality and morbidity.

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