Review Article

Evolutional trends in the management of tracheal and bronchial injuries

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Abstract: Tracheal and Bronchial injuries are potentially life threatening complications which require urgent diagnosis and therapeutic intervention. They typically occur in association with blunt and penetrating chest trauma although they are increasingly being encountered in patients following endobronchial intervention and percutaneous tracheostomy insertion. Their precise incidence is unknown. Presenting features include dyspnoea, stridor, respiratory and haemodynamic compromise, haemoptysis, surgical emphysema, pneumothorax and persistent significant airleak. There may be other additional injuries to consider in trauma patients with large airway injury. Familiarity with the diagnosis and management of large airway injuries is important for medical teams engaged in emergency medicine, thoracic surgery and medicine, anaesthesia and intensive care. Although early surgical intervention is the mainstay of treatment, endobronchial manoeuvres to seal defects are receiving increasing attention particularly for patients with medical co-morbidities which may contraindicate formal surgery or transfer or where local surgical expertise is not available.

Keywords: Tracheal and bronchial injury; blunt and penetrating trauma; iatrogenic injury

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Introduction

Tracheal and tracheobronchial injuries are rare, but serious consequences of blunt trauma, penetrating wounds and iatrogenic injuries associated with endotracheal intubation and mechanical ventilatory support and with endobronchial intervention including airway dilatation (1-3).

The incidence of these complications is not known, although a study reported a total of 1,033 tracheal injuries over a 5-year period in Germany (1). A total of 429 of these were non-iatrogenic (blunt trauma 276, penetrating wounds 94, bullet wounds 16, other aetiologies 43) and 604 of these injuries were iatrogenic (endotracheal intubation/mechanical ventilation 372, dilatational tracheostomy 181, endoscopic interventions 51). Another study reviewed the world literature on blunt intrathoracic tracheobronchial injuries and identified 265 patients (4).

Blunt trauma is a major cause of death from thoracic trauma (4). Although it is believed that over 80% of patients who sustain blunt traumatic tracheal or bronchial injury die before arriving at hospital (5,6), post-mortem findings suggest an incidence of 2.8% of tracheobronchial injuries in patients who die following blunt chest trauma (7). Often, the right main bronchus is affected more than the left perhaps as a consequence of relative protection of the left main bronchus afforded by the aorta (8).

Tracheobronchial injuries can be transverse between tracheal rings or may be longitudinal or spiral across the membranous portion of the trachea and main bronchi or indeed may present with a combination of both type of injuries (9).

Typically, in iatrogenic injuries, a longitudinal running defect in the posterior wall is encountered (1,10-13). This may be more common, in my opinion, when a bougie is employed for patients when endotracheal tube insertion is difficult.

It is appreciated that although tracheobronchial injuries are rare, the number of patients who sustain these injuries

Table 1 Causes, presentation and diagnosis of tracheal and bronchial injury

Aetiology
Thoracic trauma
Blunt
Often within 2.5 cm of carina
High mortality
May be associated with posterior dislocation of sternoclavicular joint
Penetrating
Bullet and knife wounds
Iatrogenic
Percutaneous tracheostomy
Endotracheal intubation
Mechanical ventilation
Dilatation of stricture
Endobronchial laser therapy
Clinical presentation
Clinical features
Dyspnoea
Stridor
Haemoptysis
Subcutaneous emphysema
Tension pneumothorax
Persistent or large air leak
Flail chest
Diagnosis
High index of suspicion depending on the nature of the insult
Chest radiography
Thoracic CT (to include trachea)
Bronchoscopy

will be encountered more frequently in clinical practice. This will reflect the increasing numbers of patients who sustain traumatic injuries in the community who survive to hospital admission, thanks to improved pre-hospital medical care. Furthermore, with the expanding development of percutaneous tracheostomy techniques in intensive care units and the expansion of endobronchial intervention services worldwide, it is likely that further iatrogenic injuries will occur (14,15). Therefore, familiarity with techniques to successfully manage these patients among Surgical, Emergency Medical and Intensive Care Teams and Anaesthetists is becoming increasingly important.

Diagnosis

It is important to have a high index of suspicion for tracheobronchial injuries among patients who have sustained thoracic injury (blunt on penetrating) or who may have experienced iatrogenic injury at the time of endotracheal intubation/mechanical ventilation or following large airway intervention (*Table 1*).

Typical clinical features will include stridor, dyspnoea, haemoptysis, subcutaneous emphysema, tension pneumothorax and persistent or large air leak, which will mandate the deployment of one or more chest tubes or indeed urgent surgical intervention. The patient may have a flail chest.

Routine investigations include chest radiography, thoracic CT scan (to include the trachea) and bronchoscopy. In patients who have non iatrogenic traumatic injury it must be appreciated that other injuries may co-exist, e.g., to the oesophagus, lung parenchyma, heart and great vessels, brain, abdomen etc. Injuries are diagnosed and prioritised and several teams may be involved in patient management.

Rigid and flexible bronchoscopy is used to confirm the diagnosis of the injury and to determine its extent and to define its anatomy. High-frequency jet ventilation or low tidal volume using a Sanders injector is given to minimise additional airway injury and subcutaneous emphysema while the airway injury is inspected and defined (10-13,16,17). While considering treatment strategies, the rigid bronchoscope is passed beyond the injury and a Bougie is deployed in the main bronchus. The rigid bronchoscope is removed and an endotracheal tube is inserted over the Bougie to ensure that it bypasses the defect. The position of the tube is then confirmed with a flexible bronchoscope. It may be necessary to consider deployment of a dual-lumen endotracheal tube depending on the location and extent of the airway injury.

Treatment options

Surgery

As these complications are rare, it is quite possible that the attending teams may not have the surgical capabilities to

manage these patients. Under such circumstances, prompt early discussion with Specialist Centres and urgent transfer if and when the patient is deemed suitable for surgical intervention should be made. However, it may be that the patients have other significant comorbidities which would render their tolerability of formal surgical intervention prohibitive or transfer may not be possible and therefore other avenues may have to be pursued.

Surgical approaches include thoracotomy, sternotomy, clamshell incision and cervical incision. For tracheal separation, previous authors have described passing the endotracheal tube across the lacerated trachea and completing the repair over the endotracheal tube and this has also been used for incomplete tears. For main bronchial lacerations, selective intubation of the non-injured main bronchus is usually performed and injuries are repaired completely. A variety of different techniques to surgically manage these patients has been described (1-8,18-21).

Techniques described for managing complete tracheal transection involve passing an endotracheal tube across the injured area and completing the repair over the tube. A dual lumen tube or selective intubation of the injured side can be used to manage patients with a main bronchial injury (18). The same approach has been used in both blunt and penetrating injuries. Primary repair with end to end anastomosis using non-absorbable (e.g., Prolene) suture is preferred for circumferential injury. Perioperative sepsis must be aggressively managed. Devitalised tissue is removed, primary closure without tension is performed and vascular supply to the wound edges is preserved as much as possible (19). Postoperative airway stenosis (18) or dehiscence may occur. Surgical mortality of 4–30% has been reported (18-21) and early surgical intervention (within two hours of trauma) may influence outcome (18). Mortality appears to be higher among patients with blunt rapture (18). However, these injuries are rare and not all surgeons have ongoing still in their management. Furthermore patients may have other diverse injuries within the confines of their trauma which may influence outcome. This must be borne in mind when considering the indications for, and outcomes of, surgery.

Endobronchial techniques

It is not always possible to perform primary surgical repair either because of coexistent comorbidities, multiple associated trauma injuries, patient instability to facilitate transfer or lack of local expertise. Under such circumstances, endobronchial manoeuvres are being increasingly explored. A rigid and flexible bronchoscope can be inserted into the airway and ventilatory support can be applied as described above. A covered expandable metallic stent can be inserted into the airway and an endotracheal tube (or if appropriate a tracheostomy tube) can be positioned to lie within the stent using a fiberoptic bronchoscope. The fiberoptic bronchoscope is passed through the endotracheal tube or the tracheostomy tube and is then inserted into the stent allowing for the definitive airway to be placed with confidence into the centre of the stent over the bronchoscope itself (22). We have had encouraging experience in managing patients in this fashion, where the stent has acted as a scaffold to promote tissue healing. Bronchial toilet is essential and antibiotic therapy is prescribed to provide prophylaxis against or to treat intercurrent infection with close ongoing communication with microbiologists and prospective microbiological surveillance.

For tears, less than 5 mm diameter, it may be possible to seal the defect by direct application of BioGlue (CryoLife Europa, UK) applied directly using pledgets (23).

Over the past 5 years, 10 patients were referred to our unit with traumatic or iatrogenic tracheal tears. All patients were managed by the cardiothoracic intensive care unit team. Formal surgical repair was contraindicated for each patient on account of significant medical co-morbidities. Five patients were treated with endotracheal stenting (3 patients) and with the application of Bio Glue (2 patients). Four (80%) of these patients survived. The other five patients had sustained a large tear (>2 cm length) and were managed conservatively. Three of these patients died of sepsis and 2 (40%) survived.

Conclusions

Although rare, it is believed that an increasing number of patients with tracheal and bronchial injuries will be seen in hospital as a consequence of improvement in prehospital medical care and the expansion in percutaneous tracheostomy insertions and large airway intervention techniques. Thus increasing awareness of the aetiology, diagnosis and management of patients with these complications is necessary for emergency medical and surgical teams, anaesthetists and these involved in intensive care. Traditionally surgical intervention has been the main management strategy but the encouraging results of endobronchial techniques suggests that such an approach

should be considered for all high-risk candidates with tracheal defects in the region of 1.5 cm or less.

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None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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