Tracheal rupture after endotracheal intubation - a case report

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ABSTRACT

Tracheal rupture is a rare condition associated with high morbidity and mortality. Iatrogenic tracheal injury is also very rare and can occur as a serious complication after endotracheal intubation. We report a case study of tracheal rupture of patient with a history of rheumatoid arthritis and corticosteroid treatment during surgical procedure with orotracheal intubation in a supine position. Lesions were healed after conservative treatment without stenosis, signs of mediastinitis or local infection. Patient was able to undergo three other surgical procedures during the next 8 month without any other complications connected to endotracheal intubation.

Keywords: endotracheal intubation, haemoptysis, respiratory insufficiency, tracheal rupture

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Introduction
Tracheal rupture is a rare condition, most commonly caused by head and neck injury. Iatrogenic injury is also very rare and is usually caused by endotracheal intubation, tracheostomy, bronchoscopy or esophagectomy [1]. Tracheal lacerations can occur as a serious complication after orotracheal intubation and have a high associated morbidity and mortality [2]. The origin of rupture is usually multifactorial with important factors being mechanical and anatomical among others [1, 2]. For example, women are statistically more predisposed than men. Further risk factors include a poor general and medical condition, short stature and the use of corticosteroids [2, 3]. Diagnosis is based on a high level of clinical suspicion after presentation of classic symptoms: subcutaneous emphysema, respiratory insufficiency and haemoptysis. On computed tomography of the chest pneumomediastinum communicating with the tracheal lumen, pneumothorax and subcutaneous emphysema can be seen [4]. Diagnostic confirmation, which is made by bronchoscopy, can determine the site and size of the rupture prior to traditional treatment via surgical repair. While many authors now advocate conservative treatment whenever permitted by the size and site of the lesion and state of the patient [1], stent placement has also been described in a few case reports as a novel treatment option [5]. We report a case study of patient with tracheal rupture after endotracheal intubation and the subsequent successful conservative treatment.

Case report
A 67-year-old women with a history of rheumatoid arthritis and corticosteroid treatment underwent elective surgery at the Department of Neurosurgery of our hospital due to magnetic resonance documenting spinal canal stenosis at a level of L3/4 and L4/5 and a vertebral body fracture of L3. Her history also included bilateral arthrosis of the knee and hip, osteoporosis, stenosis of internal carotid arteries, 50% on the right and 30% on the left, arterial hypertension, antral gastritis and diverticular disease of the sigmoid colon. She underwent a cholecystectomy and hysterectomy.

The surgical procedure - decompressive laminectomy of L3, partial laminectomy of L4 and kyphoplasty of L3 was performed under general anaesthesia with oroendotracheal intubation in a supine position. After successful intubation and surgery, the patient was extubated in the operating theatre before observation in the recovery room. After 2 hours, she was transported to a standard room of the Department of Neurosurgery. In the afternoon, about 3 hours after surgery, and after severe coughing, the patient presented with progressive subcutaneous emphysema, dysphonia and dyspnoea. Auscultation revealed crackling crepitus and decreased breathing sounds on the left side. Due to the development of respiratory failure, the patient was transferred to the Department of Anaesthesiology and Intensive Care.

After admission, vital functions were monitored and oxygen was applied through a facial mask. Administration of ampicillin-sulbactam (12g per day) was started as empiric antibiotics. Chest radiography was carried out which revealed pneumomediastinum and pneumothorax on the left side. Fibreoptic bronchoscopy was performed by a bronchologist. The bronchoscopy revealed a laceration of the posterior tracheal wall with the posterior wall protruding into the tracheal lumen without detection of significant rupture. After the bronchoscopy, computed tomography was performed of the chest, which showed extensive pneumomediastinum, subcutaneous emphysema and bilateral pneumothorax (Fig.1). A bilateral chest tube was placed at the level of the fifth intercostal space in a midaxillary line and connected to active suction. 3 hours after pleural drainage, chest radiography showed reinflation of both lungs with no pneumothorax. 4 days after injury, fibroptic bronchoscopy was repeated revealing healing of the laceration, smaller protrusion of
the posterior tracheal wall, and no evidence of significant rupture. Also, otorhinolaryngological examination did not show any injury. During all hospitalisation in the Department of Anaesthesiology and Intensive Care, the patient was conscious, co-operating, afebrile, haemodynamically stable, and breathing spontaneously. Chest tubes were on active suction with air-leak from the left tube. Levels of inflammatory markers decreased, and the procalcitonin level was normal. The patient was fed perorally. 7 days after admission, the intubated patient was transferred to the ICU of II Department of Surgery whereupon the air-leak was stopped and the chest tubes removed. 12 days after injury, fibreoptic bronchoscopy showed the complete healing of the tracheal wound. The next day, the patient was discharged from ICU. During the next 8 months, this patient underwent three other neurosurgical procedures under general anaesthesia without complication during or after endotracheal intubation.

![Bilateral pneumothorax, pneumomediastinum and subcutaneous emphysema.](image)

**Figure 1:** Bilateral pneumothorax, pneumomediastinum and subcutaneous emphysema.

**Discussion**
The trachea commences at the level of the cricoid (at the level of sixth cervical vertebral body), bifurcates at the carina (at the level of fifth thoracic vertebral body) and contains incomplete cartilaginous rings. The posterior trachea, known as pars membranacea, is a fibrous wall. Post-intubation tracheal injuries are typically caused by longitudinal lacerations of the posterior wall, rarely extending into the main bronchi [6]. In the review of 56 described cases, the membranous portion of trachea was the site of injury in 98.2% of cases [2]. Tracheal rupture after endotracheal intubation is a rare occurrence. Incidence is estimated at between 0.05% and 0.37% of all orotracheal intubations performed. However, all the information available is based on case reports and small case series (and some cases, such as some short tears and those that resolve spontaneously are probably misdiagnosed [7].
There are multiple risk factors leading to this injury. The risk factors can be related to the patient, anaesthesiologist, endotracheal tube and intubation technique. Often, this appears to be caused by a combination of these factors [8]. Risk factors related to the patient include circumstances affecting tracheal anatomy which make the tracheal wall more vulnerable: female gender, advanced age, short stature, and chronic obstructive pulmonary disease [8]. Chronic use of corticosteroids can be associated with the weakening of membranes. Predilection toward female patients can be the result of problems with equipment selection as women tend to be shorter and improperly large tubes might often be selected for them. Female tracheal diameters can be smaller than those in males, and the membranous trachea is less firm, making them more vulnerable to cuff over-inflation [2]. There are many risk factors related to the anaesthesiologist, endotracheal tube and the method of intubation: difficult tracheal intubations that required many attempts; choice of inappropriately-sized tube; use of stylet inside the tube and stylet not being removed as soon as the tube tip passes the vocal cords; and the use of a double lumen endobronchial tube with direct trauma of the carina [8]. Over-inflation of the cuff of the tracheal tube can act as a distension force and can cause a cuff-induced rupture, which mostly leads to a clean, longitudinal tear in the posterior membranous part of the trachea. As cuffs are permeable to nitrous oxide and tend to expand during anaesthesia, monitoring cuff pressure during anaesthesia is recommended. Cuff pressure must be from 25 to 30 mm Hg [8]. Also, other mechanical factors such as repositioning the tube without cuff deflation, and significant coughing or head and neck movements during intubated can contribute to tracheal injury. The presented patient was also a female with a short stature and long-term corticosteroid use. Furthermore, the patient was shifted into a prone position after endotracheal intubation. The clinical manifestations of tracheal injury include subcutaneous emphysema, cough, pneumomediastinum, pneumothorax, haemoptysis, and respiratory distress. These symptoms usually develop during surgery, immediately or soon after extubation, though they can take several days to appear. Subcutaneous emphysema is not only the most common symptom, but also a protective factor, as its presence alerts to the possible existence of tracheal rupture, accelerating the procedures for its definitive diagnosis and the initiation of appropriate treatment [9]. Clinical suspicion of tracheal rupture must be followed by diagnostic confirmation. Fibreoptic bronchoscopy is believed to be the best method to confirm the diagnosis and to determine the location and extent of the rupture, helping to plan the therapeutic approach. It can also be used to reposition the tracheal tube or reintubate the patient if necessary [1]. Chest X-ray and chest CT can show soft tissue emphysema, pneumothorax, and pneumomediastinum. A delay in diagnosis could increase the risk of mediastinitis onset [9].

There is no consensus reached on the management of post-intubation tracheal injury, with early surgical intervention being the traditional mainstay of treatment [1]. Recommendation for surgical treatment assumes that tracheal perforation will otherwise result in mediastinitis or subsequent tracheal stenosis [10]. The current tendency is to decrease invasive surgical treatment for the benefit of conservative management [8]. There is agreement that surgical repair is possibly the best therapeutic option when rupture occurs during thoracic surgery (open chest surgery) in patients with transmural ruptures over 2 cm in length causing serious complications such as: pneumothorax and/or pneumomediastinum with progression of symptoms, respiratory instability, cartilaginous injury, the inability of non-invasive ventilation, or bridging the rupture with an endotracheal tube (injuries of the distal part of the trachea and/or main bronchus) [11]. While there are multiple options for surgical repair, some studies found that this treatment can lead to a rise in the risk of death, with mortality as
high as 71% [12]. Tracheal resection with end-to-end anastomosis is indicated for cartilaginous injuries. Ruptures of membranous parts are usually repaired by a simple suture via cervicotomty or right thoracotomy according to the localisation of the injury. In the future, minimally invasive techniques such as video thoracoscopy may also be indicated [1].

Authors of more recent publications consider conservative management to be the treatment of choice. Patients who are clinically stable, in spontaneous respiration with no respiratory difficulty, no oesophageal damage, minimal mediastinal collections with no signs of clinical progression (subcutaneous emphysema and pneumomediastinum), and no symptoms of infection should be managed conservatively. Conservative treatment is also indicated in at-risk patients that cannot undergo surgery. This management includes appropriate empirical antibiotic therapy, pleural drainage in cases of pneumothorax and patient monitoring. When mechanical ventilation is required to treat an underlying respiratory problem, management includes intubation with the cuff inflated distally to the area of rupture and tracheal aspiration [7]. Regular bronchoscopy is important to monitor the healing of the injury. This management usually leads to scarring of the tracheal injury without stenosis as it was in our patient. Some authors advocate a fibreoptic tracheobronchoscopy after 1 month to verify effective healing and the absence of tracheal stenosis [9].

Tracheal stenting for post-intubation tracheal injury can be indicated in injuries with the possibility of complete closure and sufficient distance from injury to the larynx. A combined stenting of the distal trachea and the main stem bronchi is possible with Y-stents. Stent extraction should be considered six weeks after placement as the risk of occurrence of granulation tissue rises after 3 months [13].

**Conclusion**

Post-intubation tracheal injury is a rare, but serious condition, carrying a high morbidity and mortality, and most commonly affecting women. Care must be taken when moving the head after intubation and when choosing the appropriate size of tube during intubation of short female patients. Early diagnostic suspicion with subsequent confirmation by bronchoscopy is essential. Treatment of this pathology is still controversial, and it must be individualised. There is, however, a clear tendency to increase conservative therapy of this condition. Our case report illustrates the effectiveness of conservative management of post-intubation tracheal injury. The lesion healed without stenosis, signs of mediastinitis or local infection.

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