MASSIVE LIFE-THREATENING SUBCUTANEOUS EMPHYSEMA: A MANIFESTATION OF TRACHEOBRONCHIAL INJURY

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Abstract

Subcutaneous emphysema, a known complication of tracheobronchial injury (TBI), is usually a self-limiting condition, but occasionally, a massive one can become life-threatening. We present a patient with TBI who developed massive subcutaneous emphysema with bilateral pneumothorax causing hemodynamic instability. Upon arrival to the hospital, the patient required emergent intubation for impending respiratory collapse. Bilateral thoracostomy tubes were inserted, resulting in hemodynamic improvement. Emergent CT thorax showed a tracheal-oesophageal injury just distal to the cuff of the endotracheal tube (ETT) at the level of the third thoracic vertebra (T3). Despite surgical repair and intensive care, the patient succumbed after a week in ICU due to ventilatory failure. This case report highlights the importance of the initial management of TBI requiring rapid identification and airway management.

Keywords: Pneumomediastinum, Pneumothorax, Subcutaneous Emphysema, Tracheobronchial injury

Introduction

Tracheobronchial injuries (TBI) are rare but potentially life-threatening, with an incidence around 0.5 - 2%, in patients with chest and neck trauma, and 0.4% in blunt trauma cases (1). In the Advanced Trauma Life Support (ATLS) most recent edition, the 10th edition, TBI became one of the six life-threatening chest injuries that had to be excluded in the primary survey (2). In severe TBI, most victims died at the scene of the accident(3). However, with the advances in pre-hospital care and transportation, many now reach the emergency department (ED) for treatment(4). These patients may present with non-specific signs and symptoms for TBI, as their concomitant injuries may obscure the diagnosis leading to mismanagement and fatal outcomes from airway obstruction, tension pneumothorax, and ventilatory failure. Furthermore, failure to diagnose and institute appropriate treatment of TBI may also result in late complications such as airway stenosis and recurrent pulmonary infections (5). Therefore, once TBI is suspected, the treating physicians need to manage the airway correctly to prevent the acute complications that may result in an immediate fatality and follow with appropriate definitive repair to prevent the late sequelae (6).

Case report

A healthy young adult male, 19 years old, presented at our ED with sudden shortness of breath after a road traffic collision. The actual mechanism of the trauma was unknown. Upon arrival, he was restless and confused with a Glasgow Coma Scale of E4V4M5. He was tachypnoeic with a respiratory rate of 48 breaths per minute and oxygen saturation of 92% on room air. His blood pressure was 88/55 mmHg with a pulse rate of 110 beats per minute.

On examination, he had massive subcutaneous emphysema with significant crepitus extending from his face to the toes. There were no signs of obvious blunt neck injury or tension pneumothorax. The air entry was reduced over both lung fields on auscultation, but the trachea was still in the midline. The patient was intubated for impending respiratory collapse, and bilateral thoracostomy tubes were then inserted. A chest X-ray (CXR) post thoracostomy

showed bilateral pneumothorax with fractures of the 3rd to 6th left ribs and massive subcutaneous emphysema (Figure 1).

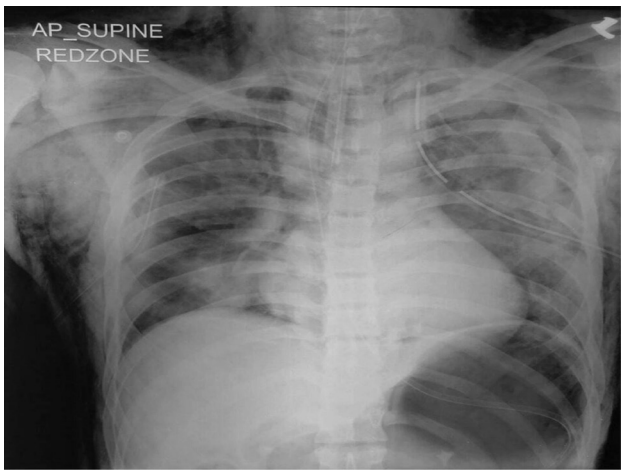

Figure 1: Chest X-ray shows bilateral pneumothorax with bilateral thoracostomy tubes in situ and 3rd to 6th left ribs fracture with massive subcutaneous emphysema

His hemodynamic status improved with the chest tubes insertion, but he required high ventilatory settings, and he struggled with persistent respiratory acidosis. Emergent computed tomography (CT) of the thorax revealed a tracheal injury directly distal to the cuff of the endotracheal tube (ETT) involving the oesophagus, causing extensive subcutaneous emphysema; 1st to 8th left ribs fracture with haemopneumothorax, right-sided pneumothorax, and also pneumomediastinum (Figure 2). CT of the other areas, including the brain, abdomen, and pelvis, did not reveal any evidence of intracranial bleeds, spinal fractures, or solid organ injuries.

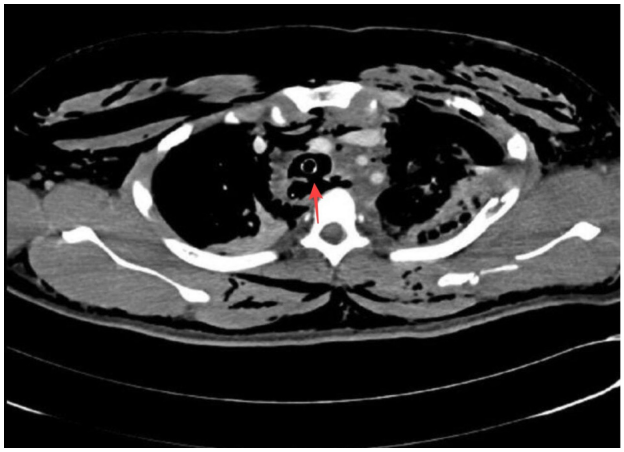

Figure 2: CT scan shows posterior tracheal wall injury (red arrow) involving the left lateral wall of the esophagus causing extensive subcutaneous emphysema, right pneumothorax, left haemopneumothorax, and also pneumomediastinum

Given the location of the injury just distal to the initial ETT placement, his ETT was subsequently advanced past the breached mucosa under bronchoscopic view by the otolaryngology team before surgical intervention. The surgical and otolaryngology teams then proceeded with a combined surgery of a right thoracotomy with oesophagal and tracheal repairs. Intra-operatively, there was a corresponding posterior tracheal tear seen at about 2 cm proximal to the carina with a 4 x 2 cm defect connected to an esophageal membranous defect measuring about 5 cm at the 25 cm oesophagogastroduodenoscope distance from the incisor. The patient was subsequently nursed in the intensive care unit (ICU) with high ventilation settings throughout his stay. Unfortunately, this patient succumbed to his injuries after seven days of hospitalisation due to ventilatory failure.

Discussion

TBI usually occurs in a constellation of symptoms such as acute respiratory distress, pneumothorax, pneumomediastinum, and subcutaneous emphysema. Subcutaneous emphysema is one of the most common presentations in patients with TBI. Therefore, its presence should always alert the treating physicians to the possibility of TBI and prompt them for early confirmatory studies to reach the definitive diagnosis (7). A study of patients with TBI reported that they presented to the hospital with deep cervical emphysema and pneumomediastinum on CXR in 60% of the cases (4). The pathophysiology of subcutaneous emphysema in TBI occurs when the air leakage from the mediastinum spreads into cervical viscera and other tissue planes. Although most of the subcutaneous emphysema and pneumomediastinum may not be life-threatening, massive subcutaneous emphysema can pose a threat to life if it affects the deeper tissues of the thoracic outlet or a large portion of the chest and abdominal wall. Thoracic outlet compression will lead to external airway obstruction and also impede venous return to the heart resulting in hypotension and hypoperfusion of the vital organs. External airway obstruction leads to high airway pressures during ventilation, whilst massive accumulation of subcutaneous air results in chest wall rigidity that restricts lung expansion, leading to persistent difficult ventilation and severe respiratory acidosis secondary to poor gaseous exchange (8). Surgical treatment such as subcutaneous drainage and infraclavicular incisions may be needed if massive subcutaneous emphysema resulted in life-threatening complications. The underlying injuries should be identified and treated promptly (9). In our case, this patient developed massive subcutaneous emphysema and bilateral pneumothorax with cardiovascular compromise, post chest trauma. Bilateral thoracostomy tube insertions were adequate to improve his hemodynamic status but he still required a high ventilation setting. He was then sent for emergent CT imaging after stabilization in the ED to identify the underlying tracheo-oesophageal injuries at the level of T3 vertebra.

In trauma resuscitation, airway management has always been the priority, and any presence of TBI should be rapidly identified so that the initial airway management protects and stabilises the airway without further aggravating the primary injuries. A delay in the diagnosis is reported as one of the most important factors affecting the outcome in TBI. Inadequate airway management in TBI may result in prolonged hypoxia leading to ischemia, irreversible cell death, and organ failure if not quickly reversed by establishing airway control (10). TBI patients should be intubated promptly if there are signs of distress preferably using a flexible bronchoscope. The sole advantage of using flexible bronchoscopy during intubation is that it allows the treating physician to visualize the breached mucosa and ensure that the endotracheal tube (ETT) is placed well beyond the injury site or into the unaffected main bronchus for single lung ventilation. This is because continuous positive pressure ventilation applied above the level of injury may cause worsening pneumothorax, pneumomediastinum, and subcutaneous emphysema.

As for our patient, he was immediately intubated using the Karl Storz C-Mac Video Laryngoscope, as a flexible bronchoscope was not available in our ED. However, the flexible bronchoscopy should be done as soon as possible once the equipment and expertise become available, without any delay, to prevent further air leaks that will continuously expand the pneumomediastinum and subcutaneous emphysema, which will then further impede the ventilation process, causing persistent ventilatory failure. The treating physicians may also prevent further secondary injuries by choosing the most appropriate ETT size, emphasising gentle ETT insertion using appropriate tools and avoiding over-distending the ETT cuff (11). Early identification of TBI is therefore important because it will prompt the treating physicians to plan their resuscitation process and definitive management accordingly. The distal trachea, carina, and proximal main stem of the bronchus are the common sites for blunt TBI and these injuries tend to be very challenging to manage. Its management requires close cooperation between anesthesiologists and surgeons. At present, there are no existing specific guidelines for the surgical management of TBI (12). The decision for surgical or conservative management is largely based on previous case studies, the location, and also the extent of the injuries as well as the patient's underlying co-morbidities. In patients requiring prolonged ventilation, a tracheostomy may be needed to continue ventilatory support but it may only be considered after the tracheobronchial restoration(4,12,13).

Conclusion

TBI is a rare but critical type of injury to detect during the primary survey as the condition usually results in tremendously high in-hospital morbidity and mortality. Rapid identification, proper initial airway management followed by definitive treatment are crucial in managing these patients. Inappropriate initial management may potentially worsen the primary insults and leads to secondary injuries or complications that may reduce the chances of a successful recovery, even after the definitive treatment is instituted.

Acknowledgement

None.

Competing interests

The authors declare no conflict of interest.

Ethical Clearance

Written informed consent was obtained from the patient for his/her anonymized information to be published.

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