Case Report

Tracheal Injury from Blunt Trauma: Identification and Ventilatory Management in the Emergency Department

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Abstract

Traumatic tracheal tears are rare and usually occur due to blunt traumatic chest injury. It is underreported and may lead to serious outcomes and life-threatening events. Tracheal tears in blunt chest injury are usually associated with other organ injuries, such as pneumothorax, hemothorax, cardiac contusion, large vascular injury and pulmonary contusion. Thus, the association with other injuries makes it difficult to diagnose. In this case report, we describe the challenges in identifying tracheal injuries and managing ventilation in patients with pulmonary contusions resulting from blunt chest trauma in the Emergency Department.

keywords: *tracheal tear, blunt chest injury, ventilation*

INTRODUCTION

Traumatic tracheal injury can become a life-threatening condition if it is not identified early during the initial resuscitation of trauma patients.[1] However, recognizing tracheal injury can be challenging. Patients with tracheobronchial injury usually have concomitant injuries, leading to worse outcomes and greater mortality.[1,2] Additionally, the presence of pulmonary contusion makes identifying and managing tracheal tears even more challenging in these patients.

In a retrospective case series by Rossbach MM et al., tracheobronchial injury was often missed due to multiple associated injuries. They concluded that the difficulties arise from subtle initial findings, the presence of associated injuries, the lack of air leakage unlike in penetrating injuries, and the requirement of bronchoscopy to confirm the diagnosis.[3,4] Traumatic blunt chest injuries also alter respiratory physiology by affecting lung compliance, skin and muscle integrity, and lung mechanics, causing leakage in the respiratory system, and leading to changes in the nervous system and circulatory system.[5] Thus, potential air leakage, pneumothorax, and respiratory distress can occur in patients with tracheal injury.[3] In this case, we reported difficulty in identifying tracheal tear injury associated with lung contusion, which posed a challenge in ventilation management for the team in the emergency department (ED).

CASE

A 20-year-old male, motorcyclist was brought to the ED following a high impact collision with a bus. The trauma team, suspected maxillofacial, traumatic brain and thoracic injuries because oxygen saturation could not be maintained. He suffered epistaxis, bleeding from the oral cavity and an altered mental state.

Upon arrival, his oxygen saturation was 70% on room air (RA) and 80% with a nonrebreather mask 15 l/min and he had a Glasgow Coma Scale (GCS) score of E1V2M5. There was bleeding from both nasal cavities and a gurgling sound from the oral cavity despite regular suction. The patient was intubated for airway protection and ventilatory support. Intubation was successful on the first attempt

However, post-intubation, the saturation rate remained at 80–84% despite an oxygen fraction (FiO_2) of 1.0. There was no tracheal deviation or step deformity in the trachea, no neck fullness, equal chest rise, no wounds or bruises, no crepitus around the neck or chest, no subcutaneous emphysema, and equal air entry. Extended focused assessment sonography in trauma (EFAST) showed unremarkable findings. Thus, a chest tube was not inserted at this

point as it is not indicated for lung contusion, and there was no circulatory compromise in this patient.

The initial ventilation setting was volume-controlled mode, with a tidal volume of 450, FiO_2 set at 1.0, and positive end-expiratory pressure (PEEP) titrated to maintain oxygenation at more than 92-95%. The settings were eventually adjusted by reducing the PEEP until the patient could maintain 92-95% oxygen saturation. The saturation was finally stabilized with a PEEP titrated to 14. In the latter ventilator setting with a PEEP of 14, arterial blood gas (ABG) showed pH: 7.27, PaCO2: 50, PaO2 469, HCO3: 21.3, BE: 3.5. The patient's oxygen saturation was maintained at 95-96% with a minimum PEEP of 10 and FiO2 of 1.0.

The chest radiographs revealed bilateral lung contusions were more pronounced on the right side, with pneumomediastinum, but no rib fracture or hemopneumothorax (Fig. 1). Subsequently, the patient underwent a whole body computed tomography (WBCT) scan. CT revealed emphysema from the cervical region to the thorax region (Fig. 2). Discontinuity in the trachea suggested a possible tracheal tear at the thoracic level T2/T3, coinciding with the tip of the endotracheal tube (ETT) placement in this patient, as depicted in the image (Fig. 3).

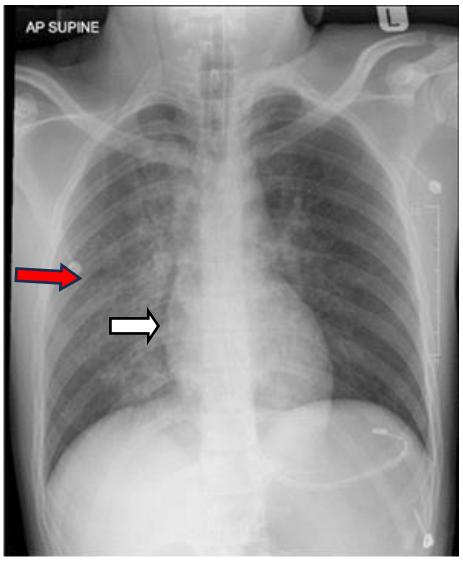

Figure 1: Chest radiograph of the patient showing bilateral lung contusion more on the right side (red arrow) and pneumomediastinum (white arrows).

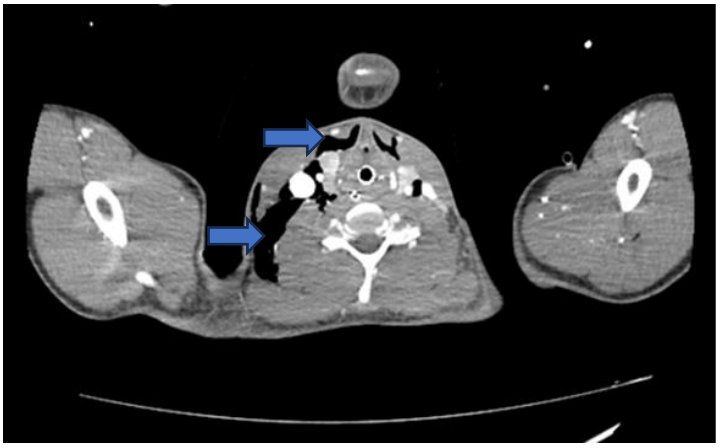

Figure 2: Cervical CT image showing subcutaneous emphysema in the cervical region. More at the right side of the cervical region. Blue arrows indicate emphysema.

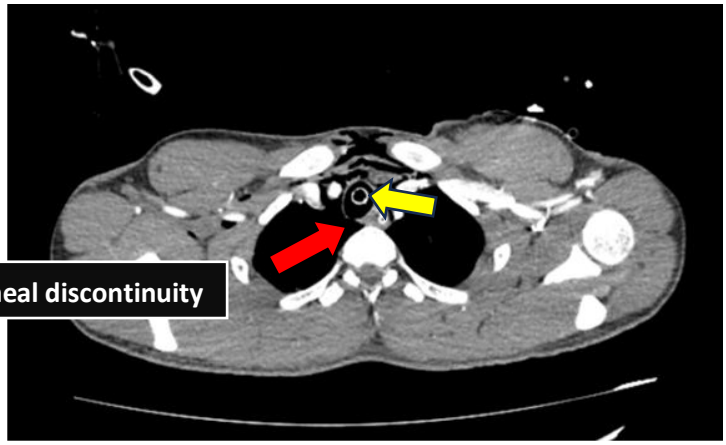

Figure 3: CT thorax at the third rib. The red arrow shows tracheal discontinuity with the ETT lumen in situ. The yellow arrow shows the ETT tip.

The patient was then admitted to the surgical intensive care unit (SICU). Bilateral chest tubes were later inserted in the SICU after the development of bilateral pneumothorax, which is expected to be complication of tracheal injury. A multidisciplinary meeting was held, and conservative management was opted for. No bronchoscopy was performed to confirm the diagnosis, given the small tear shown on the CT Thorax. Finally, the patient was extubated after five days of admission to the SICU, and chest tubes were removed.

DISCUSSION

In the ED, patients with tracheal tears and pulmonary contusions require special attention due to the limited literature on their management. Uncertainty in managing ventilation during initial resuscitation for this injury may compromise the life of the trauma patient.[6] Thoracic tracheal injury can be easily missed, especially in patients with multiple injuries.[1,7,8] Here we discuss initial resuscitation, and airway and ventilation management as suggested by a few literatures for guidance in the future.

(I) Initial resuscitation and intubation.

Identifying tracheal injury can be challenging, especially when the injury is subtle. Tracheobronchial injury is often associated with signs and symptoms such as subcutaneous emphysema, tachypnea or dyspnea, and hemoptysis. In this patient, there were no signs of massive air leakage or air escape from the wound.[3] Thus, a high index of suspicion is needed, especially for patients with blunt trauma.

The CT scan played an important role in diagnosing tracheal tears in this case despite the absence of bronchoscopy. It can visualize the entire airway, including the trachea and bronchial tree, and provide detailed images of the structures around the airway, helping to differentiate tracheobronchial injuries from other chest injuries. CT scans are generally highly sensitive and specific, but their use should be balanced against factors such as clinical presentation and potential radiation exposure.[3]

One should have experience in airway management and tracheal injury management when handling the airway of this patient.[2] In polytrauma patients with suspected tracheal injury, intubation is crucial as respiratory failure can occur due to multiple injuries and the tracheal rupture itself.[9] The patient's condition which is associated with pulmonary contusions, can accelerate airway and respiratory compromise.[2]

The insertion of bilateral chest tubes in this case later in the SICU was indicated to address the development of bilateral pneumothorax. Conservative management was opted for, considering the potential presence of tension pneumothorax resulting from ongoing positive airway ventilation.[4]

(ii) Airway passage leakage in ventilated patients.

A few indications can raise suspicion and point to tracheal injury in ventilated patients. Clinically, there may be an asymmetric chest rise if the tear is at the lower trachea or bronchus[5] Air leakage through tracheal discontinuity can cause the prominence of subcutaneous emphysema, prompting immediate consideration of tracheal tears.[9] In cases of an air leak in the airway, tidal volume may not be achieved adequately.[5]

Additionally, airway pressure may increase. Therefore, it is crucial to take immediate action to address any leaks in the airway passage. Ventilator asynchrony and increased respiratory rate may occur to compensate for the low minute ventilation associated with this injury.[5] However, in our patient, the tidal volume and airway pressure were not significantly affected, possibly due to the site and size of the tracheal tear.

(iii) Oxygenation and ventilation.

A protective ventilatory strategy can be used for pulmonary contusion to improve ventilation, correct oxygenation and prevent further lung injury.[1] The pathophysiology of pulmonary contusion differs from that of acute respiratory distress syndrome (ARDS), as it involves acute lung injury with contused lung tissue, bleeding, inflammation and edema.[5] Florent W et al ventilated patients using a protective ventilation protocol for ARDS. This includes a low tidal volume, typically between 4-8 ml/kg of ideal body weight, which helps minimize additional lung damage.[6]

By using a lower tidal volume and avoiding excessive PEEP, intrathoracic pressure is reduced, preventing further air leakage through the tracheal tear and further damage to the contused lung parenchyma while reducing ventilator-induced lung injury. Additionally, using a volume-controlled mode ensures the guaranteed delivery of tidal volume sets and minute ventilation.[5]

The airway pressure release ventilation (APRV) mode can also be used and is suitable for tracheal tears with pulmonary contusion injury, as it is a time-triggered, pressure-limited, and timed cycle ventilation mode.[5] In our patient, we initially used a higher PEEP to maintain the desired oxygenation level and titrated it according to the optimum PEEP without further recruitment manoeuvres

CONCLUSION

Potential traumatic tracheal injury in patients with blunt chest trauma should be detected early during initial resuscitation and promptly managed in the ED to ensure effective ventilatory management and to prevent life-threatening complications. The combination of ventilation strategies in this patient aimed to provide adequate oxygenation and ventilation

while minimizing lung stress and promoting the healing of the tracheal tear.

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REFERENCES

1. Aljehani Y, Aldossary I, AlQatari AA, Alreshaid F, Alsadery HA. Blunt Traumatic Tracheobronchial Injury: a Clinical Pathway. Med Arch. 2022 Dec;76(6):430-437. doi: 10.5455/medarh.2022.76.430-437. PMID: 36937611; PMCID: PMC10019869.

2. Antonescu I, Mani VR, Agarwal S. Traumatic injuries to the trachea and bronchi: a narrative review. Mediastinum 2022;6:22.

3. Rossbach MM, Johnson SB, Gomez MA, Sako EY, Miller OL, Calhoon JH. Management of major tracheobronchial injuries: a 28-year experience. Ann Thorac Surg. 1998 Jan;65(1):182-6. doi: 10.1016/s0003-4975(97)01001-1. PMID: 9456114.

4. Díaz, C., Carvajal, D.F., Morales, E.I. et al. Right main bronchus rupture associated with blunt chest trauma: a case report. Int J Emerg Med 12, 39 (2019). https://doi.org/10.1186/s12245-019-0258-3

5. Lovich-Sapola J, A. Alter J, Harders M. Mechanical Ventilation in the Trauma Patient [Internet]. Mechanical Ventilation. IntechOpen; 2022. Available from: http://dx.doi.org/10.5772/intechopen.101578

6. Welter S, Essaleh W. Management of tracheobronchial injuries. J Thorac Dis 2020;12(10):6143-6151. doi: 10.21037/jtd-2019-as-05

7. Boutros J, Marquette C-H, Ichai C, et al. Multidisciplinary management of tracheobronchial injury. Eur Respir Rev 2022; 31: 210126 [DOI: 10.1183/16000617.0126-2021].

8. Motghare, Abhilasha; Kharge, Nutan; Soitkar, Rohan; Kotak, Nirav; Hemantkumar, Indrani. Post-traumatic Tracheal Rupture: Anaesthetic Management. Airway 4(1):p 51-53, Jan–Apr 2021. | DOI: 10.4103/arwy.arwy_67_20

9. Wallet F, Schoeffler M, Duperret S, Robert MO, Workineh S, Viale JP. Management of low tracheal rupture in patients requiring mechanical ventilation for acute respiratory distress syndrome. Anesthesiology. 2008 Jan;108(1):159-62. doi: 10.1097/01.anes.0000296104.46682.ca. PMID: 18156895.