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Penetrating Neck Trauma Involving Zone I: Surgical Intervention and Outcomes

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Abstract: Penetrating neck injuries (PNI) are injuries that penetrate the platysma and represent a major cause of morbidity and mortality due to the vital structures confined in the neck area. They account for approximately 5–10 % of all trauma cases presenting to the emergency department. Depending on the depth of penetration and anatomy of trachea, the deeper the penetration, the bigger chance that tissues surrounding the trachea to be injured, causing complications including the lungs. We reported a male patient presented with respiratory distress approximately eight hours after sustaining a penetrating neck wound. Initially, he was fully conscious but had difficulty in breathing. Physical examination revealed low oxygen saturation, lagging movement of the right chest wall, dull right lungs percussion, absence of right vesicular breath sound, mild anemia, subcutaneous emphysema, and an anterior neck wound (3x2 cm) with no active bleeding. C-spine control, intubation and chest tube were performed. Chest auscultation identified persistent ronchi in the right lung. Imaging confirmed subcutaneous emphysema (C2-C7), right hemothorax, and tracheal rupture. Surgical intervention included wound explorationand tracheostomy. A vertical rupture involving the anterior tracheal rings (4–6) was identified and managed with a tracheal cannula. No posterior tracheal injury was found. Postoperatively, the patient showed improved airway patency with subsiding emphysema, though right lung expansion remained limited. In conclusion, this case highlights the proximity of vital structures poses challenges in surgical access, underscoring the need for meticulous airway management and postoperative monitoring.
Keywords: pentrating neck trauma; tracheal rupture; subcutaneous emphysema; hemothorax

INTRODUCTION

Penetrating neck injuries (PNI) are injuries that penetrate the platysma and represent a major cause of morbidity and mortality due to the vital structures confined in the neck area. Injuries involving the larynx and trachea are especially dangerous as they pose a risk of airway compromise. These injuries could be intentional or accidental and the mechanisms and severity vary. They account for approximately 5–10 % of all trauma cases presenting to the Emergency department. Mortality rate for PNI in civilian populations range between 3 - 20 % with about 50% due to exsanguinating haemorrhage secondary to vascular injuries.[1,2] The central airway, comprising the larynx and trachea, is crucial for oxygen delivery to the alveoli; therefore, injuries to these structures can rapidly lead to life-threatening asphyxia. Immediate airway stabilization is the primary objective in cases of central airway trauma.[3] Depending on the depth of penetration, the deeper the penetration, the bigger chance that tissue surrounding the trachea to be injured, causing complications to the lungs.[4] Penetrating injuries to the neck have been considered along the lines of anatomical location, with all injuries in Zone II requiring surgical exploration, and those in Zone I and III requiring imaging.[5] Tracheo-innominate artery fistula (TIF) is one the complication that can occur in a lower tracheal rings tracheostomy. Though rare, it might present with sentinel bleeding 24–48 hours before the onset of massive hemorrhage, necessitating high clinical suspicion and prompt intervention.

CASE PRESENTATION

A male patient presented with respiratory distress secondary to a penetrating neck wound sustained approximately eight hours prior to admission. The patient initially was fully conscious (Glasgow Coma Scale 15) but had a difficulty in breathing. Vital signs showed a low blood pressure, tachycardia, low oxygen saturation with lagging movement of the right chest wall, decreased right stem fremitus, dull right lungs percussion, vesicular breath sound on the right lungs. The patient was suspected with penetration trachea injury, hemothorax, and second-grade hypovolemic shock. First aid of c-spine control, intubation, chest tube and fluid resuscitation was performed on him. From the chest tube, 1200 mL of blood flowed out with undulation. On evaluation, his conjungtiva appeared anemic, there was symmetrical chest wall movements with an indwelling right-sided chest tube, draining approximately 100cc of undulating blood and ronchi sound was heard throughout the right side of the lungs. Wound location was on the anterior of the neck, measuring 3x2cm, with no active bleeding but palpable subcutaneous crepitation was heard. There were several cut wounds on the second and third fingers of the left hand, each of 2x0.5 cm in size, but no blood was found (Figure 1).

A **B** **C** **D**

Figure 1. Clinical picture of the case. A, Anterior view of the wound; B, Lateral view of the wound; C, cut wounds on the fingers; D, chest tube inserted

Blood tests showed leukocytosis and mild anemia. X-ray examination revealed subcutaneous emphysema (Figure 2) was found on cervical vertebrae C2-C7. Chest X-ray showed hematothorax of the right lungs before a chest tube was inserted, and after three days, the chest X-ray revealed pleural effusion on the right lung and a chest tube was present (Figure 3).

CT-scan showed rupture of the trachea and laceration in the lungs (Figure 4). Diagnosis

before intervention was suspected tracheal rupture and right hemothorax on the chest tube area, subcutaneous emphysema on the neck, penetrating trauma on the anterior side of the neck (zone 1) and lacerate wounds on the second and third left fingers. Intervention given was wound exploration and tracheostomy as needed.

Surgical exploration was performed, revealing a penetrating wound extending through the platysma, sternohyoid, and sternothyroid muscles. A vertical rupture of the anterior tracheal rings 4-6 was identified, extending laterally. When the endotracheal tube was taken out, there were no signs of posterior tracheal injury. Tracheal canule was inserted on the wound's location, next a bronchoscopy was performed and no injuries were seen in the posterior trachea (Figure 5).

After intervention, the patient responded to verbal commands. Patient was able to breathe with ease on the canule and emphysema subsided. Ronchi persisted on the right side of the lungs.

Figure 2. X-ray of the colli showed subcutaneous emphysema

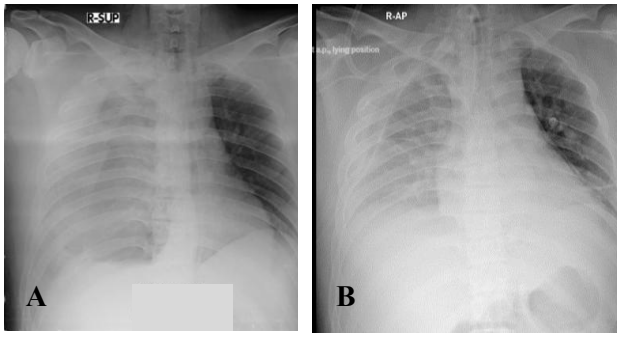

Figure 3. A, X-ray of the thorax showed hemothorax on the right lungs; B, three days after, pleural effusion on the right lungs with chest tube

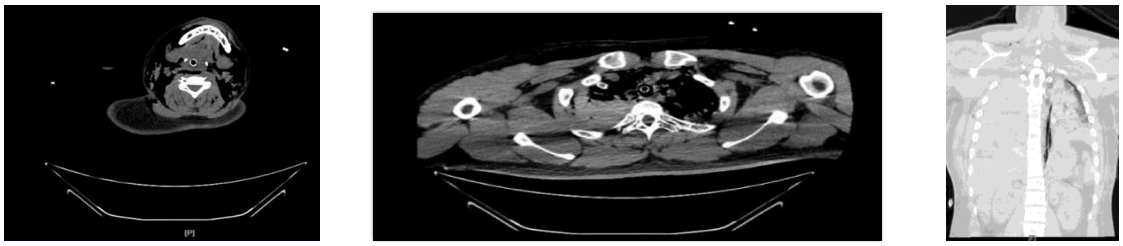

Figure 4. CT-scan of the cervical vertebrae showed rupture of the trachea and laceration on the lung

Figure 5. Bronchoscopic evaluation after surgery

DISCUSSION

Penetrating neck injuries are injuries that penetrate the platysma. Injuries involving the larynx are particularly concerning due to the risk of airway compromise. The initial evaluation of patients with neck trauma should adhere to Advanced Trauma Life Support (ATLS) principles. In this case, it is a non-iatrogenic tracheobronchial injury (TBI). Non-iatrogenic TBI are usually caused by road accidents, crush injuries, burying, stab injuries, gun-shot, hyperextension of the neck, hanging, and strangulation. They could affect neighboring organs such as the osseous structures

of the thorax (ribs, sternum, spine), lungs, diaphragm, spleen, liver, great vessels, heart and brain.[3] Penetrating neck injuries are classified based on anatomical zones, each with distinct management protocols. Zone I is particularly critical due to the presence of vital structures, including the innominate vessels, the origins of the common carotid and subclavian arteries, the vertebral artery, the brachial plexus, the trachea, the esophagus, the apex of the lung, and the thoracic duct. Injuries in this zone are often life-threatening due to the involvement of major vascular structures, the mediastinum, and the cervical and thoracic esophagus. Surgical exposure in Zone I is technically challenging due to the overlying clavicle and the complex bony framework of the thoracic inlet. Patients with Zone I injuries are frequently alert, with a low likelihood of associated spinal cord injury, as neurological deficits are uncommon in these cases.[2] In this case, it is shown to be more of a vascular injury on zone I, so further imaging and surgery is needed. Since up to one-third of patients with zone I injury has no initial symptoms, evaluating the aortic arch, great vessels and esophagus is a must.[5]

If the canule is inserted below the wound, it might cause trachea-innominate artery fistula. Diagnostic modalities such as bronchoscopy, conventional angiography, and CTA can assist in diagnosis, though they have limited sensitivity. Preventative strategies include limiting intubation duration to less than three weeks, employing proper tracheostomy techniques, utilizing blunt and flexible tracheostomy tubes, positioning the tracheostomy between the second and third tracheal rings, and minimizing excessive head and neck movement to reduce the risk of fistula formation.[6,7]

Zone 1 injury showed several different unexpected complications which initially appear less severe. The most common primary injury site was the neck but the complications manifested elsewhere (lungs, pleural cavities or vasculature). Several cases showed complication of bilateral pneumothoraces which suggested an indirect mechanism and pseudoaneurysm of the thyrocervical trunk which caused recurrent hemothorax. If the penetrating injury partially tears the trachea, larynx or bronchi, air could leak into the deep cervical spaces which travels to the mediastinum and spread to the pleural cavity. It could spread to only one pleural cavity but might spread to both pleural cavities, causing bilateral pneumothoraces. Imaging, CT scan, as the gold standard could show pneumomediastinum. Macklin effect, which could be seen in blunt chest trauma, high-speed deceleration or co-exist with tracheobronchial tear, is a process where a sudden increase in intra-alveolar pressure leading to alveolar rupture, allowing air to dissect along the bronchovascular sheath towards the mediastinum, resulting in pneumomediastinum. Hemothorax itself resulted from an injury to the blood vessels. With the Macklin effect, the blood from the injured blood vessel may slowly move to the pleural space. Delayed bleeding from the pseudoaneurysm may cause a recurrent hemothorax, which highlights that some complications may appear hours or days after the injury.[8-11]

CONCLUSION

This case presented a patient with respiratory distress caused by penetrating neck injury complicated by tracheal rupture, right-sided hemothorax and subcutaneous emphysema. Surgical intervention involved wound exploration and tracheostomy as necessary. Despite these residual findings, the overall clinical course demonstrated stabilization, and ongoing respiratory management, drainage monitoring, and pulmonary care remained crucial in the recovery phase. Zone 1 injury showed several different unexpected complications which initially appear less severe.

Conflict of Interest

The authors confirm no conflict of interest in this study.

REFERENCES

1. Sharma SB, Amata AO. Penetrating neck injuries involving the larynx: a report of three cases. Trauma Emerg Care. 2016;1(2):138-47. Doi: https://doi.org/10.15761/TEC.1000110
2. Alao T, Waseem M. Neck Trauma. [Updated 2023 Jul 3]. In: StatPearls [Internet]. Treasure Island (FL):

StatPearls Publishing; 2025 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470422/
3. Welter S, Essaleh W. Management of tracheobronchial injuries. J Thorac Dis. 2020;12(10):6143–51. Doi: https://doi.org/10.21037/jtd-2019-as-05
4. Kolleri JJ, Al-warqi A, Mohamed RI, Khaliq A, Mirza S. Extensive surgical emphysema following stab injury to the neck. Cureus. 2021;13(12):e20126. Doi: https://doi.org/10.7759/cureus.20126
5. Royal Children's Hospital Melbourne. Blunt and penetrating neck trauma. In: Trauma Service Manual. Available from: https://www.rch.org.au/trauma-service/manual/Blunt_and_penetrating_neck_trauma/
6. Balci AE, Eren N, Eren S, Ulku R. Surgical treatment of post-traumatic tracheobronchial injuries: 14-year experience. Eur J Cardiothorac Surg. 2022;22(6):984-9. Doi: https://doi.org/10.1016/S1010-7940(02)00591-2
7. Ravi C. McKnight CL. Chest Tube. [Updated 2022 Oct 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan. Available from:https://www.ncbi.nlm.nih.gov/books/NBK459199/
8. Farsi D, Nouri GH, Mofidi M, Hafezimoghadam. Unusual bilateral pneumothoraces due to zone I neck stab wound. BMJ Case Rep 2012;2012(1):bcr2012006538. Doi: https://doi.org/19.1136/bcr-2012-006538
9. Elkbuli A, Shaikh S, Ehrhardt JD, McKenney M, Boneva D. Superficial stab wound to zone I of the neck resulting in thyrocervical trunk pseudoaneurysm presented as recurrent hemothorax and successfully managed by coil embolization. Am J Case Rep. 2020;21(l):e920196-1-e920196-7. Doi: https://doi.org/10.12659/AJCR.920196
10. Katsuri S, Muthirevula A, Gadennavar AS, Lingaraju VC. Bilateral pneumothoraces secondary to an insolated midline zone 1 cervical stab injury. Indian J Thorac Cardiovasc Surg. 2021;37(3):338-40. Doi: https://doi.org/10.1007/s12055-020-01094-w
11. Hsu C, Silverstone L, Ismail M. Macklin effect. Radiopaedia. 2026. Available from: http://radiopaedia.org/articles/macklin-effect. Doi: https://doi.org/10.53347/rID-20665