

Case Report

Trans-manubrial approach for the management of tracheal perforation secondary to blunt trauma

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ABSTRACT

Traumatic tracheal injury is uncommon and mostly caused by blunt, penetrating, and iatrogenic injuries. Depending on the mechanism tracheal trauma may also be associated with injury to adjacent structures, including the cervical spine, cerebrovascular vessels, or digestive tract. These patterns are associated with high morbidity and mortality. Maintaining a high index of suspicion for tracheal injury is one of the most crucial factors for reducing mortality through early detection of tracheal trauma. Anterior mediastinal tracheostomy (AMT) is a complex operation typically performed in extensive cervicothoracic malignancy, stoma recurrence, or carcinoma of the cervical esophagus invading into cervical trachea but can be applied to traumatic injuries as well. In the clinical case presented, the patients' prior surgical history and kyphotic anatomy necessitated a trans-manubrial approach for tracheostomy as opposed to the standard open or percutaneous approaches.

Keywords: Neck trauma, Tracheal perforation, Anterior mediastinal tracheostomy, Blunt trauma

INTRODUCTION

Tracheal injuries are relatively rare and often occur as a result of trauma, whether blunt, penetrating, iatrogenic, or due to inhalation-related mechanisms.¹ These injuries may be accompanied by damage to surrounding structures such as the cerebrovascular vessels, esophagus, or cervical spine, all of which contribute to a significant risk of morbidity and mortality. Prompt recognition and a high level of clinical suspicion are essential to reduce complications associated with tracheal trauma.² The clinical manifestations of tracheal trauma can vary depending on the type and severity of the injury. Frequently observed signs include subcutaneous emphysema, pneumomediastinum, and pneumothorax, which may or may not be associated with respiratory compromise. Other symptoms can involve hemoptysis, dyspnea, dysphagia, and chest discomfort. Initial evaluation should prioritize airway stabilization and

address any associated traumatic injuries.³ Treatment approaches range from conservative management to surgical repair, based on the underlying cause, extent of the injury, and presence of other complications.¹ Anterior mediastinal tracheostomy (AMT) is a technically challenging procedure most often indicated in cases involving advanced cervicothoracic malignancies, recurrent stoma issues, or cancers of the cervical esophagus that infiltrate the trachea.^{4,5} However, it may also be appropriate for select traumatic scenarios. In the case discussed, the patient's surgical history and pronounced kyphosis necessitated a trans-manubrial route for tracheostomy, as conventional open or percutaneous techniques were not feasible.

CASE REPORT

This patient is a 99-year-old male with extensive past medical history including hypertension, atrial fibrillation

on Apixaban, mild congestive heart failure, sinus node dysfunction for which he underwent a pacemaker in 2017. As part of his pacemaker work-up in 2017 had a transesophageal echocardiogram complicated with upper esophageal perforation requiring transcervical esophageal repair, tracheostomy and percutaneous endoscopic gastrostomy tube placement. He was successfully decannulated a few months later.

He now presented to the trauma bay after sustaining a mechanical fall. On primary survey his airway was intact and he was noted to have severe kyphosis without point tenderness to the cervical spine. Secondary survey was remarkable for bilateral cervical subcutaneous emphysema, hemoptysis and right shoulder pain. Trauma work-up was remarkable for cricoid cartilage fracture with tracheal perforation (Figure 1), as well as a C5 end-plate fracture. Esophagram was negative for traumatic injury.

In light of worsening subcutaneous emphysema on clinical exam endotracheal intubation was performed for airway protection. Neurosurgery was consulted for the C5 fracture and recommended no further intervention as the patient's cervical spine was anatomically fused from his extensive degenerative disease. The trauma team held extensive discussions with the patient's family, otolaryngology and cardiothoracic surgery. Decision made to proceed with surgical intervention for the tracheal injury.

Initially the patient was taken to the operating room for bronchoscopy and direct laryngoscopy which revealed a perforation near the left subglottic area in the trachea. The esophagus was not able to be traversed due to stenosis but the upper esophagus appeared normal on visualization. Given the complexity of the trachea defect, its location directly behind the manubrium due to the patient's severe kyphosis, the prior inflammation in his neck and tracheostomy after the esophageal perforation, the decision was made to abort the procedure. After further discussions and planning, a trans-manubrial approach for placement of a tracheostomy was elected.

Operative technique: description of anterior mediastinal tracheostomy

The patient was positioned supine with both arms tucked, shoulder roll placed to facilitate exposure (Figure 2). A 10 cm low collar incision performed over the manubrium and clavicular heads and skin flaps were raised cephalad and inferiorly (Figure 3). Circumferential dissection of the clavicles was carried out followed by transection of the clavicular heads with a Gigli saw and excision of the anterior table of the manubrium with an electric oscillating saw (Figure 4). The innominate vein was visualized and protected. The trachea was mobilized, preserving its lateral blood flow and a hook was used to elevate the trachea out of the mediastinum. Five PDS stay sutures were placed around the planned stoma and a

tracheostomy window was created with a 11 scalpel (Figure 5). A 6.0 proximal XLT tracheostomy was inserted, and the stay sutures used to tack the skin flaps down to the tracheostoma (Figure 6). Skin flaps were secured around the tracheostomy stoma site and the incision closed. At the end of the case there was appropriate ventilation with good end-tidal CO₂. His saturation remained >90% for the entire procedure. Bronchoscopy was performed after the procedure to confirm position.

Post-operatively the patient progressed well, his hospital course was complicated with ventilator acquired pneumonia which was treated with 7 days of antibiotics. Patient was able to be weaned off the ventilator and was awake and interactive. He was discharged to rehabilitation on day 14 of hospital stay.

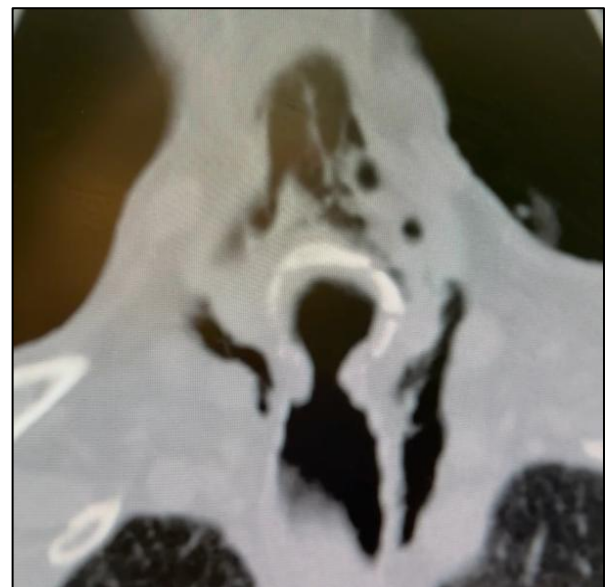


Figure 1: Tracheal perforation on CT cervical spine.



Figure 2: Neck anatomy.

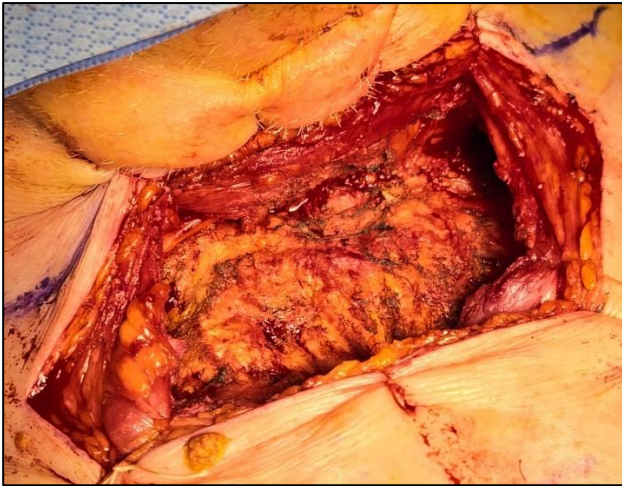


Figure 3: Flap creation and dissection of the sternal manubrium.

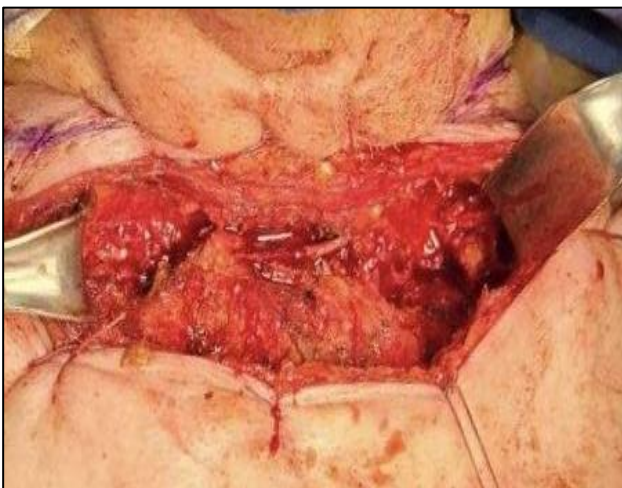


Figure 4: Resection of the clavicular heads and anterior table of the manubrium.

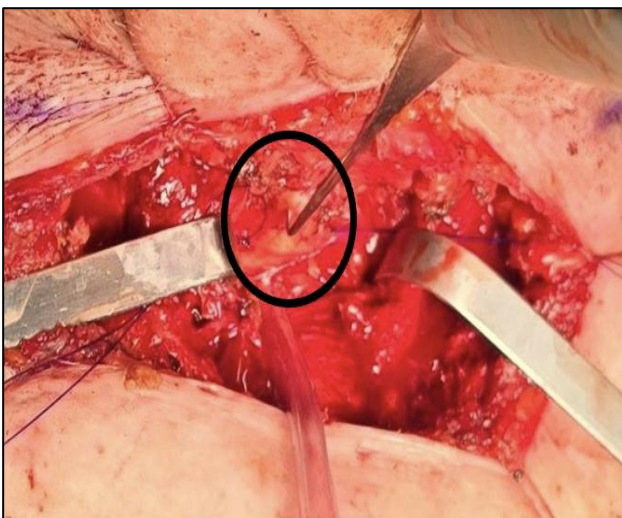


Figure 5: Visualization of the trachea in the upper mediastinum, trachea is encircled in black.



Figure 6: Tracheostomy placement.

DISCUSSION

AMT is a complex procedure, primarily indicated for the management of malignancies, tracheomalacia, tracheal stenosis, and complicated tracheobronchial injuries, as illustrated in this case.²⁻⁹ In the setting of lower neck and upper thoracic cancers, AMT allows for resection of tumors that are otherwise inoperable, as well as superior control of the great vessels and improved survival.^{5,6} AMT is less commonly used for nonmalignant conditions but has shown utility in pediatric cases involving congenital deformities.

AMT is reserved for injuries in the distal trachea, up to 2 cm from the carina, which cannot be accessed with the standard open or percutaneous approach.^{1,2} In our case, the patient had severe kyphosis with his trachea located in the upper mediastinum as well as a prior inflammatory process and tracheostomy, therefore standard open or percutaneous approach was not an option. AMT was deemed to be the only viable alternative.

Outcomes of AMT are highly variable depending on the indication and can be difficult to assess due to the overall rarity of the procedure. In oncologic cases, the survival time is low due to comorbidities related to the cancer diagnosis, while pediatric cases are more favorable, likely due to the patients' young ages and health status prior to surgery.^{5,8} In the setting of tracheobronchial injury, the rates of postoperative complications and overall mortality after AMT are not documented.⁸ Our patient tolerated the procedure and recovery remarkably well considering his advanced age and multiple comorbidities, which potentially indicates favorable outcomes for other patients suffering from complicated tracheobronchial injury.

CONCLUSION

Tracheal injuries are very challenging to manage, especially when present in patients with variant anatomy. In the case presented, we discussed a geriatric patient with severe kyphosis who sustained a mechanical fall and subsequent tracheal fracture. AMT is an invaluable technique, particularly under certain circumstances, as it allows appropriate exposure of the trachea within the mediastinum. It is important to consider that this technique should be performed by a experienced surgeon within the field, in order to minimize morbidity.

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Ethical approval: Not required

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