



Traumatic gunshot wound to the larynx with subsequent aspiration of the bullet

Practice Points

- Both penetrating neck injuries and foreign-body aspiration can present with an array of signs/symptoms including hoarseness, shortness of breath, rapidly expanding neck mass, hemodynamic instability and respiratory distress.
- Initial triage should include an evaluation of the airway, breathing and circulation.
- Unstable patients potentially require intubation/neck exploration.
- For stable patients, direct laryngoscopy to evaluate the airway should be performed when available.
- Stable patients can be further evaluated with imaging technology including chest x-ray, neck CT scan, ultrasonography or angiography.
- Newer paradigms for penetrating neck injuries suggest a selective neck exploration, regardless of the level, depending on the instability of the patient and the concern for large vessel injury.
- Nondisplaced and small laryngeal fractures can be treated conservatively, while large fractures can be plated.
- Injuries involving penetrating neck injuries, laryngeal fracture, foreign-body aspiration or any combination of the three should be treated systematically, following a basic algorithm for optimal care.

David F Smith¹,
Christopher R Kieliszkak²,
Kent Stevens³,
Stacey L Ishman^{*4}
& Wayne M Koch¹

¹Department of Otolaryngology, Head & Neck Surgery, Johns Hopkins School of Medicine, Baltimore, MD 21287, USA

²School of Medicine, New York College of Osteopathic Medicine, Old Westbury, NY 11568, USA

³Department of General Surgery, Division of Trauma Surgery, Johns Hopkins School of Medicine, Baltimore, MD 21287, USA

⁴Department of Pediatric Otolaryngology, Head & Neck Surgery, Cincinnati Children's Hospital, Cincinnati, OH, USA

*Author for correspondence:

Tel: +1 513 803 3823

stacey.ishman@cchmc.org

Penetrating trauma to the neck, laryngeal fracture and foreign-body aspiration are three injuries that, individually, infrequently occur in adults. Reports of penetrating neck injuries and foreign-body aspiration presenting simultaneously, have been described in the literature. The authors present the previously unreported case of a penetrating gunshot wound to the pharynx with resulting laryngeal fracture followed by aspiration of the bullet in an adult patient. In this case, appropriate treatment of the neck injuries must be prioritized along with locating and removing the aspirated foreign body.

Keywords: airway • aspiration • foreign body • laryngeal fracture • neck injury • penetrating • traumatic

Penetrating neck trauma is an injury that potentially presents a host of complicated treatment challenges. Penetrating neck injuries in adults are more common from stab wounds or projectiles [1]. Owing to the close proximity of vital structures, management of penetrating neck injuries can be quite complex [2]. Treatment of penetrating injuries should initially begin

with an evaluation of the airway [3]. Further treatment involves careful consideration of the level of injury, hemodynamic stability of the patient, and the availability of medical equipment. Laryngotracheal trauma is an injury that can result in significant morbidity and mortality [4], and yet it accounts for only one in 30,000 emergency department visits [3]. Similar to the presentation of an adult

with an aspirated foreign body, the signs and symptoms of a laryngeal fracture can be highly variable, ranging from mild hoarseness to airway obstruction. Foreign-body aspiration is far less common in adults than in children. In adults, the clinical presentation of foreign-body aspiration can be milder than is classically seen in children, as most foreign bodies in adults are located distally in the bronchial tree [5].

Individually, penetrating neck injuries, laryngeal fractures and foreign-body aspirations are uncommon injuries, and it is even more unlikely that the three present concurrently in the same patient. Besides the possible airway, nerve or vascular injury, asphyxiation from the foreign body is another real and immediate concern for the team managing care. Penetrating injuries to the neck with aspiration of the foreign body into the bronchial tree have only been presented in the literature twice [6,7]. We present the unusual, and as of yet, unreported case of a gunshot wound to the anterior neck, resulting in laryngeal fracture and aspiration of the bullet into the right bronchus.

Case report

A 56-year-old male with no significant past medical history presented to the Johns Hopkins emergency department after experiencing a 22-caliber short gunshot wound to the anterior neck during an altercation. The patient was transported by emergency medical services with a stable airway and stable vital signs. He initially presented with moderate, subjective shortness of breath but no stridor. Upon questioning by the emergency department team, he complained of hoarseness and odynophagia.

During the physical examination by the otolaryngology resident, the patient was awake, alert and oriented. He was able to follow commands, phonate

without stridor and breathe comfortably; however, significant hoarseness was noted. He had a 1-cm open gunshot wound to the anterior neck at the level of the hyoid and pain to palpation over the thyroid cartilage, with the remainder of the physical examination within normal limits. Flexible laryngoscopy was performed, and the patient was found to have a small amount of bleeding from the left aryepiglottic fold. No obvious exit wound could be visualized within the airway or externally. The left true vocal fold was paretic in the lateral position with a small posterior glottic gap, and the right vocal fold had full motion and approximated in the midline.

The chest x-ray (Figure 1) revealed a metallic object consistent with the shape of a spent bullet in the right lower lobe of the lung with no atelectasis or pneumothorax. The CT scan of the neck (Figure 2) revealed a comminuted fracture of the thyroid cartilage with multiple locules of air at this site. The CT scan also confirmed that there was no injury to the C-spine and no bullet fragments in the posterior soft tissue of the neck. On CT angiography, no vascular injury could be identified. Bullet fragments and a hematoma were found at the level of the anterior commisure below the left thyro-epiglottic ligament with medialization of the right vocal cord. No other airway, vascular or cervical spine injury was noted.

The patient was transported to the operating room urgently for direct laryngoscopy and bronchoscopy. After direct laryngoscopy showed a stable and patent airway, intubation was performed without complication. Both flexible and rigid bronchoscopy were utilized for foreign-body removal. During flexible fiberoptic bronchoscopy, the bullet was found to be lodged in the right lower lobe bronchus (Figure 3). After failed attempts with a wire basket and balloons, removal of the bullet was carried out with a rigid bronchoscope. The bullet was successfully removed with optical forceps and an alligator-style grasper. After removal, the mucosa revealed mild erythema and edema, but no penetrating injury was seen. The trauma surgery team performed an esophagogastroduodenoscopy, which was unremarkable. The patient remained stable and showed no other injuries on the radiographic imaging, therefore no surgical exploration of the neck was performed. No attempt was made to plate the comminuted fracture of the thyroid cartilage given the pattern of the fracture. The open neck wound was cleaned, and due to the small size of the contaminated wound, was allowed to heal secondarily with a simple bandage.

The patient remained intubated and was monitored overnight. He was extubated on postoperative day 1 without complication. The patient improved quickly, and a follow-up speech and swallow evaluation on



Figure 1. Chest x-ray of a patient with a foreign-body aspiration. The aspirated bullet is seen in the right lower lobe, but no pneumothorax or atelectasis is identified.

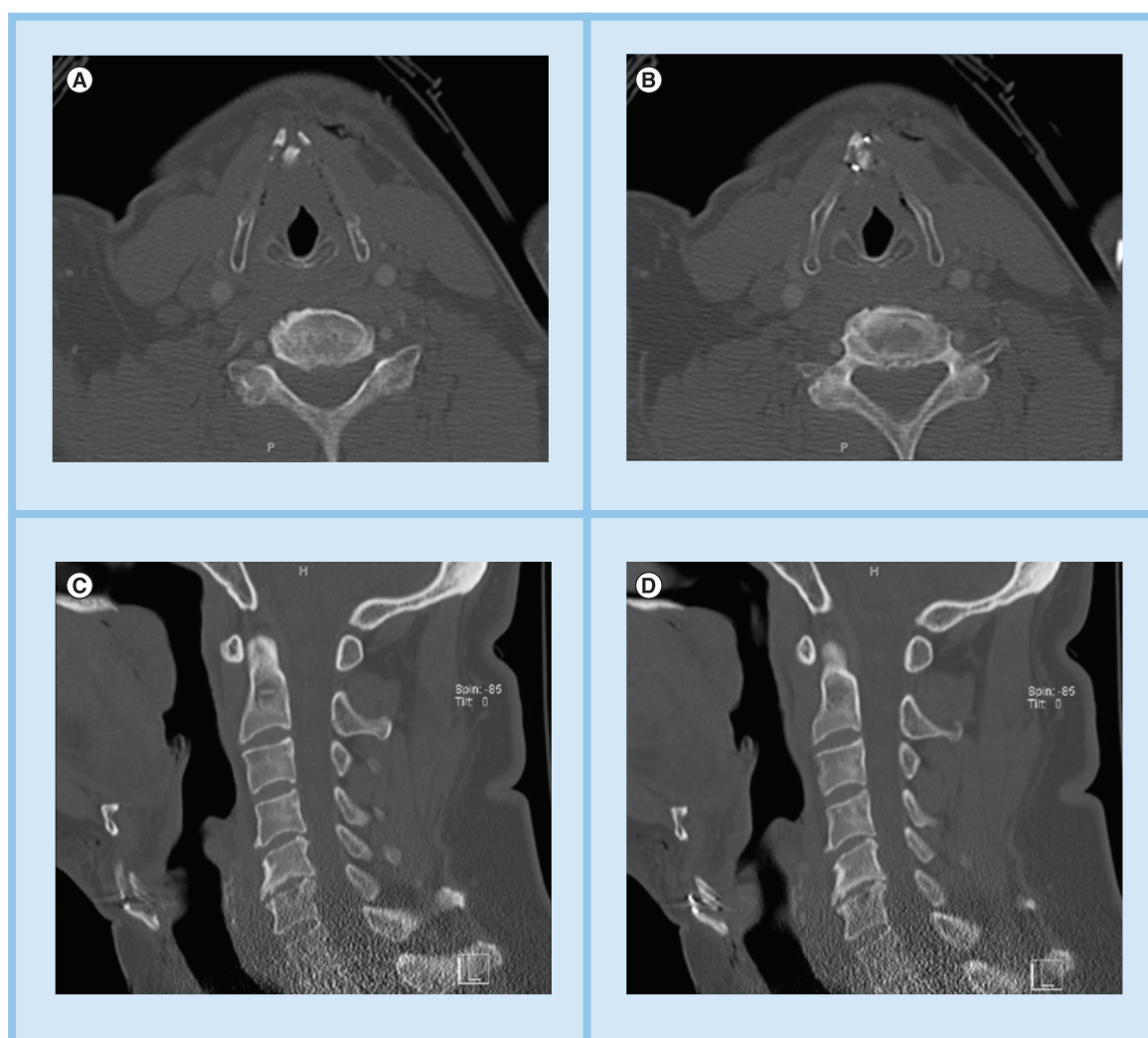


Figure 2. Computed tomography of the neck in a patient with a penetrating neck wound. An axial view of the neck shows (A) a comminuted fracture of the thyroid cartilage and (B) bullet fragments in the soft tissue surrounding the fractured cartilage. (C) A sagittal view of the neck also shows the fractured thyroid cartilage and (D) air in the soft tissue at the entry point around the thyroid cartilage.

postoperative day 2 demonstrated bilateral vocal fold motion. The patient was discharged on the afternoon of postoperative day 3 in good condition, tolerating a soft diet. On follow-up evaluation, flexible laryngoscopy showed full motion bilaterally of the true vocal folds, suggesting the paresis was due to local inflammation around the larynx rather than direct injury to the recurrent laryngeal nerve.

Discussion

Cases of penetrating neck injuries with retained bullet fragments in the airway are incredibly rare. In fact, only two previous cases of a foreign-body aspiration into the bronchial tree after a penetrating neck injury have been described [6,7]. O'Connor *et al.* presented the first published case of a bullet aspiration after a gunshot wound to the trachea [6]. In this case, the foreign

body was removed successfully using flexible laryngoscopy [6]. Andrews *et al.* described aspiration of a spent bullet following a gunshot wound to the neck, but this bullet was expectorated, allowing the team to avoid flexible or rigid bronchoscopy [7]. Here, we present the case of an adult male who had a bullet aspiration following a gunshot wound to the neck with a laryngeal fracture. Interestingly, the thyroid cartilage decelerated the spent bullet enough to allow aspiration after it entered the lumen of the larynx.

This case report highlights the complications of managing complex neck injuries. When a patient presents with a traumatic injury to the neck as well as aspiration of a foreign body, the approach to treatment can be quite complex. More importantly, there is no clear description regarding the appropriate management of such an injury. The goals of management in

these cases should involve prompt assessment of the patient's condition, including an evaluation of respiratory sufficiency and hemodynamic stability. If the injuries pose imminent danger from a respiratory standpoint, then stabilization of the airway should clearly be the first step. If intubation is required but not possible, then an emergency tracheostomy should not be delayed [8]. Should the patient require emergent intubation or have signs of hemodynamic instability, then flexible versus rigid bronchoscopy in order to remove the aspirated foreign body is required, with surgical exploration of the neck. For patients with penetrating injuries to the neck, some still advocate for mandatory surgical exploration in zone II injuries, especially in situations where serial examinations are not feasible [9]. However, based on the availability of modern sensitive imaging technology, some have advocated for a 'no zone' paradigm shift [10]. With this evolving theory, stable patients can be evaluated through CT scans, ultrasound and angiography, alleviating the need for surgical exploration in patients that lack airway or vascular injury [10].

If the patient is stable, then a more thorough physical examination, including flexible laryngoscopy, should be performed followed by radiographic evaluations. Available radiographic techniques that should be performed include chest x-ray and CT scan of the neck with CT angiography and/or ultrasonography. The patient can then be taken to the operating room for endoscopy and removal of the foreign body. Should the patient have other reasons for surgical treatment, such as plating of fractured cartilage or signs of progressing hematoma, then a selective surgical exploration of the neck can be performed at the same time as the endoscopic bronchoscopy.

Laryngeal fractures potentially complicate management of the penetrating neck injury and foreign-body removal. Management of patients with laryngeal fractures can be quite variable. In a recent retrospective chart analysis, half of the patients that presented with laryngotracheal fracture were treated nonsurgically [4]. For patients with nondisplaced, small fractures, conservative management consisted of steroids, a soft diet and repeat laryngoscopy to confirm airway patency [4]. For patients

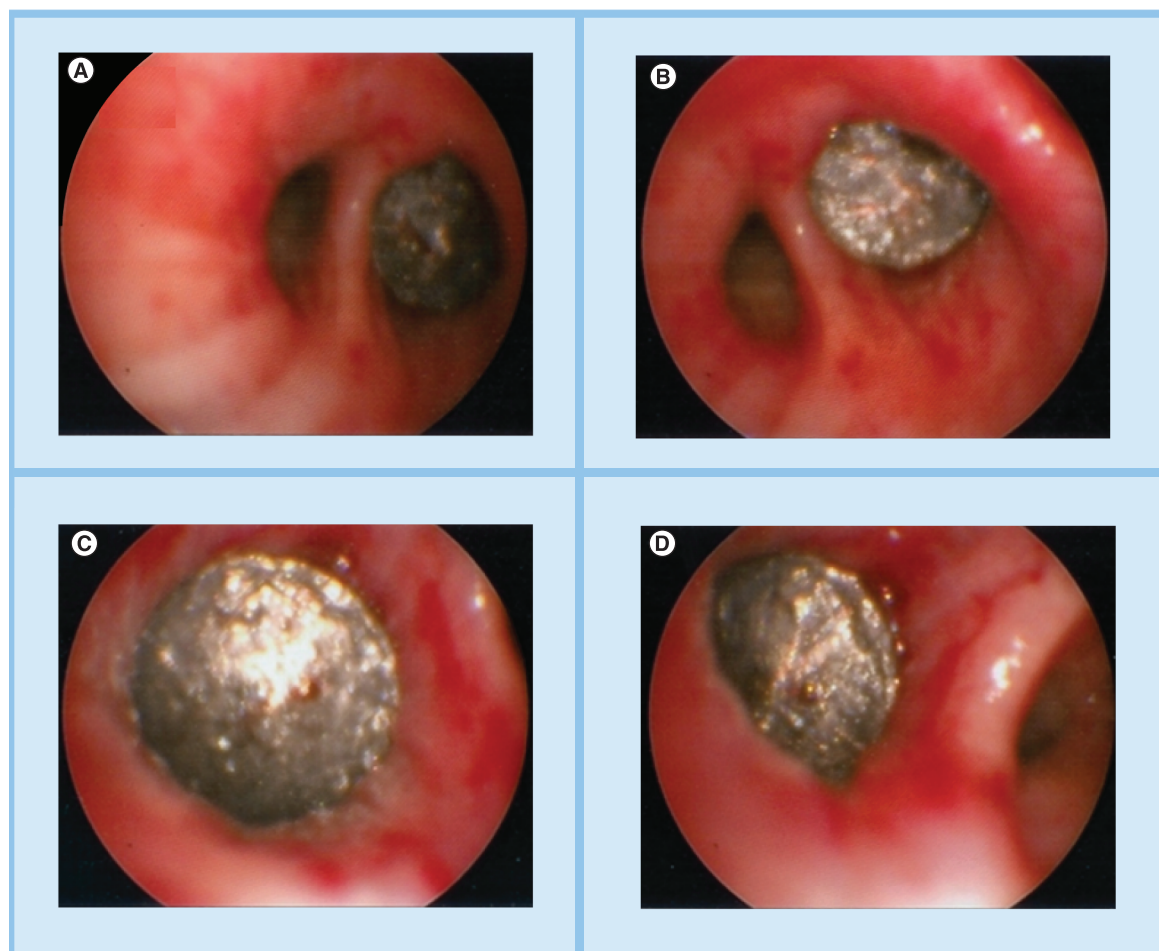


Figure 3. Bronchoscopy shows the aspirated bullet in the right lower lobe bronchus and mild erythema of the mucosa surrounding the bullet (A–D).

with comminuted or large fractures, open reduction and internal fixation with stabilization was performed, and approximately half of the patients in this study required a tracheostomy [4]. Treatment for these injuries should clearly be individualized, based on presenting signs and symptoms and findings during the initial workup. In this patient, the nondisplaced nature of the fracture, as well as the stability of the airway, led the team to pursue conservative management, without the need for plating.

In conclusion, we report the rare case of a traumatic gunshot wound to the neck followed by aspiration of the bullet into the right lower lobe of the lung. Individually, penetrating injuries to the neck, laryngeal fracture, and foreign-body aspirations can be difficult to manage appropriately. When a penetrating neck injury occurs concurrently with a laryngeal fracture and foreign-body aspiration, it is best to have a systematic approach to treatment in order to avoid disastrous outcomes. In many instances, management should be multifaceted, utilizing physical examination and radiographic findings, followed by endoscopic bronchoscopy and selective neck exploration where indicated. It is our goal that an organized, systematic algorithm will aid in optimal patient care. Given the shifting paradigms involving

the treatment of penetrating neck injuries and laryngeal fractures, this algorithm will likely evolve in the near future.

Informed consent disclosure

The authors state that they have obtained verbal and written informed consent from the patient for the inclusion of their medical and treatment history within this case report.

Disclaimer

Per the Johns Hopkins Office of Human Subjects Research, this case report was reviewed by the representative for the Institutional Review Board and deemed not to be human subjects research.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

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