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Emergent Reconstruction of Laryngeal Penetrating Neck Injury: A Case Report

ABSTRACT

Objective: This paper aims to describe an unconventional surgical procedure performed in a case of penetrating neck injury involving the larynx.

Methods:

Design: Case Report
Setting: Tertiary Government Hospital
Patient: One

Results: A 38-year-old man sustained a hacking laceration to the anterior neck that extended into the hypopharyngeal area transecting the thyroid cartilage. After pre-emptive tracheostomy, the patient was referred to otorhinolaryngology – head and neck surgery due to the extensive hypopharyngeal injury. Neck exploration performed to control bleeders confirmed a Schaefer-Fuhrman Classification Group 3 penetrating neck injury. Anastomotic reconstruction of the hypopharynx, transected thyroid cartilage and strap muscles was attempted using absorbable sutures with post-operative re-establishment of structural continuity and documentation of full bilateral vocal fold mobility. The patient was about to be discharged home with a tracheotomy and nasogastric tube when he suddenly deteriorated and expired on the eighth post-operative day.

Conclusion: Our technique might be utilized in cases where urgent reconstruction of laryngeal structures is considered despite serious damage to the laryngeal skeleton and may provide a temporary surgical option for similar cases in an emergent setting. However, we cannot recommend it as a routine standard on the basis of one case.

Keywords: *Larynx; penetrating neck injury; vocal cord; reconstruction; neck exploration*

The neck contains many important vital structures that are potentially life threatening when severed, so penetrating neck trauma can cause significant morbidity and mortality.^{1,3} Zone II of the neck is a defined anatomic region extending from the cricoid to the angle of the mandible that has been observed to have the most number of neck injuries.⁴ Its anatomic contents (e.g. major blood vessels) make Zone II injuries challenging to manage and explore with open surgical approaches and prompt diagnosis and timely intervention can be crucial in such cases.⁵ We present one such case.

CASE REPORT

A 38-year-old man was brought to the emergency room with a deep open wound on his anterior neck after being hacked with a “bolo” (jungle machete). The patient was awake with no signs of respiratory distress and minimal bleeding. He was immediately brought to the operating room where pre-emptive tracheostomy was performed by a general surgeon who referred the patient intraoperatively to

otorhinolaryngology – head and neck surgery. Wound exploration revealed an approximately 10 cm long, smooth-edged diagonal laceration over the anterior neck. Its depth extended to the anterior border of the carotid artery on the right severing some fibers of the infrahyoid muscles on the left. (Figure 1) It was approximately at the level of the upper half of the thyroid cartilage, 1 cm from glottic area. (Figure 2A-C) The cut transected the thyroid cartilage and detached the epiglottis from the posterior surface attachment at the petiole. It also reached the hypopharyngeal area up to the anterior border of the prevertebral mucosa above the esophageal inlet in close proximity to the major blood vessels. Ligation of smaller bleeders was performed with no significant carotid or major venous injuries identified.

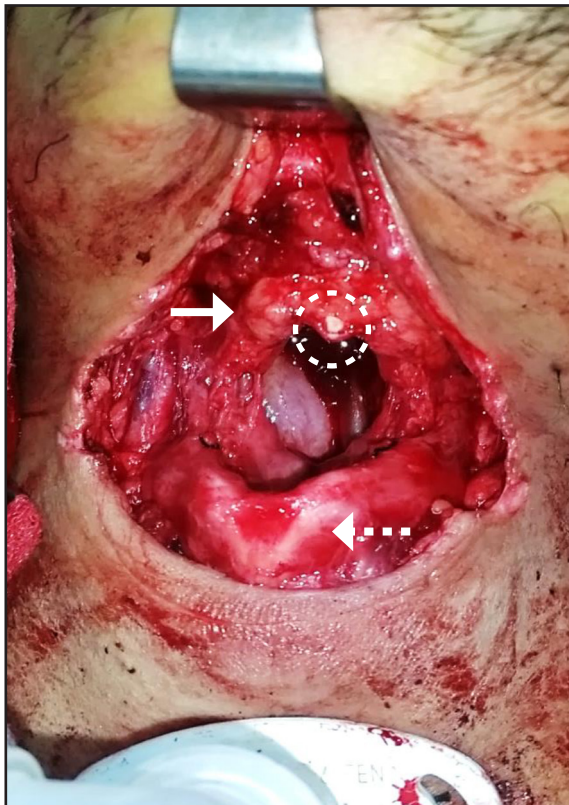


Figure 1. Anterior neck wound exposing the anterior border of the carotid artery (right) and infrahyoid muscles (left). The petiole of the epiglottis also seen in the picture (dashed circle). Note the upper half of the thyroid cartilage (solid arrow) and notch of the thyroid cartilage (dashed arrow).

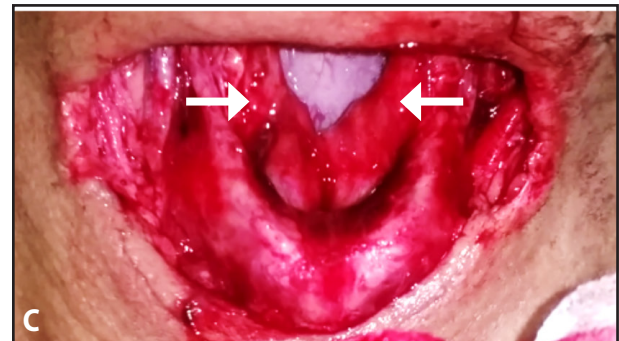
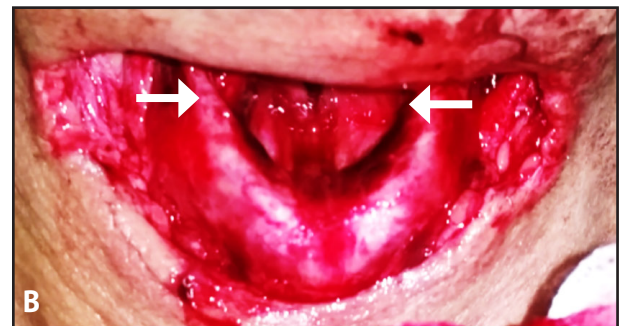
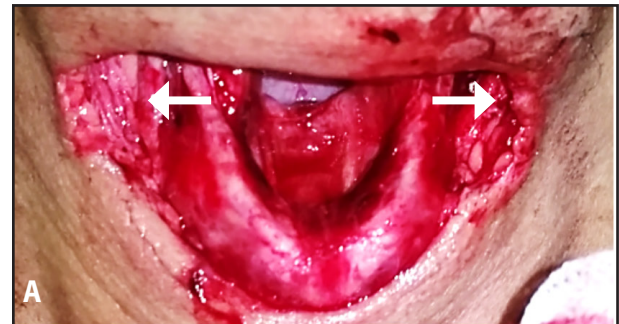


Figure 2. A horizontal cut along the thyroid cartilage exposing the vocal cords. Noted intact and fully mobile vocal cords. The white arrows show the position of the vocal cords **A.** Fully abducted; **B.** Intermediate position; and **C.** Fully adducted.



Figure 3. Intraoperative photo after reconstruction of the thyroid cartilage using absorbable sutures via simple interrupted suturing. Note the thyroid cartilage (solid arrow).

Reconstruction of the severed structures involved simple closure of the hypopharyngeal area using vicryl 4.0 RB-1 simple interrupted sutures, anastomosis of the divided thyroid cartilage using vicryl 4.0 RB-1 simple interrupted sutures, and repair of damaged strap muscles using vicryl 3.0 RB-1 sutures. (Figure 3) A schematic diagram of the surgical procedure is presented in Figures 4A-C. The tracheostomy tube was maintained post-operatively and a nasogastric tube was inserted. No intraoperative problems or immediate post-operative complications were encountered. Standard post-operative wound and tracheostomy care were performed.

One day after surgery, flexible laryngoscopy to evaluate the status of the vocal cords was deferred because the patient exhibited behavioral changes. He was irritated and combative with episodes of flat affect. A toxicology five-panel drug test revealed no evidence of prohibited substance use. A psychiatry referral was suggested but not made by the main service.

On the 5th post-operative day, laryngoscopy revealed a patent airway with fully mobile vocal cords but noticeable swelling and edema of the arytenoids and mucoid secretions. (Figure 6) The patient was maintained on nasogastric tube feeding and anti-inflammatory steroid medications were given.

On the 8th post-operative day, the patient remained stable and was counselled to maintain nasogastric and tracheostomy tube for two weeks. He was preparing to be discharged home when he suddenly had changes in sensorium and became hypotensive and bradycardic. Resuscitation was initiated but the patient expired. The cause of death remains unknown because the relatives did not consent to an autopsy.

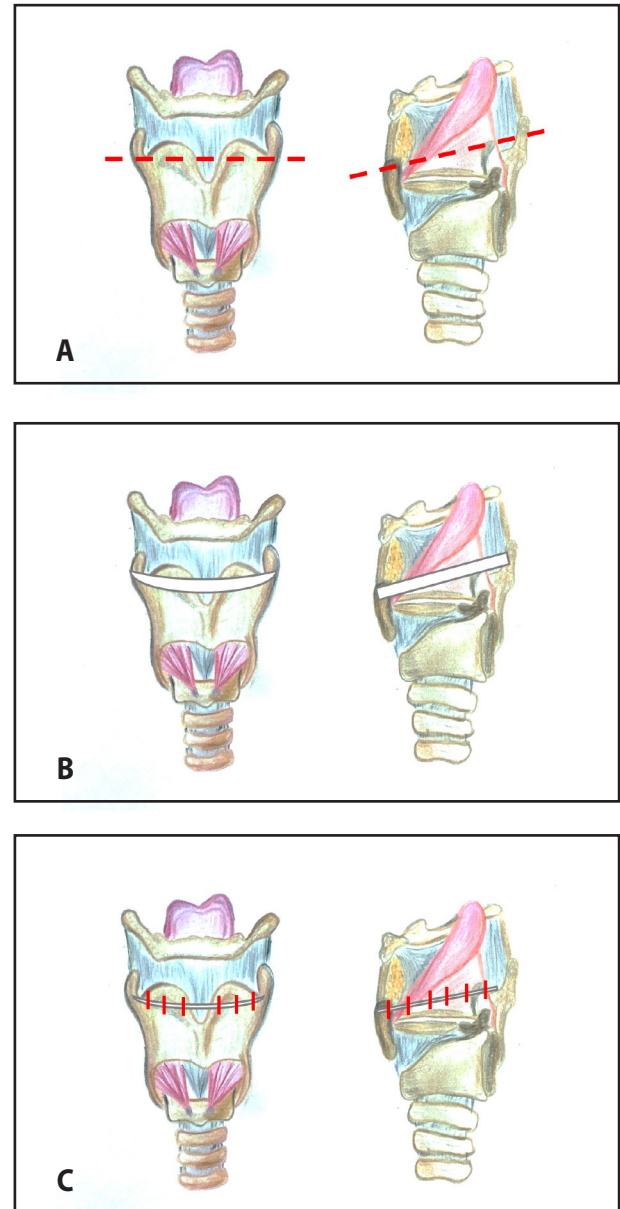


Figure 4. A diagram of the surgical technique. **A.** Approximation of the line of injury (dashed line); **B.** Approximation of the cut at the level of the upper half of the thyroid cartilage, 1 cm above the glottic area (solid vertical line); **C.** Closure of the hypopharyngeal area and anastomosis of the divided thyroid cartilage via simple interrupted suturing (interrupted lines). Illustrations by Ruthlyn S. Pecolera MD.

DISCUSSION

In this case, we were presented with an anterior neck injury through a hacking wound that extended into the hypopharyngeal area, transecting the thyroid cartilage. Considering the extent of the patient's injury, it was important to have a well-planned management from



Figure 5. Postoperative endoscopy revealed a patent airway with mobile vocal cords and noticeable swelling and edema of the arytenoids.

assessment to treatment to attain maximum recovery.⁵ The structural complexity of the neck makes it one of the anatomically complicated parts of the human body that can sustain multiorgan injuries from extra-laryngeal or penetrating traumas.⁶ This patient's neck injury was classified using the 5-group Schaefer-Fuhrman classification.⁷ First developed in 1982 by Schaefer *et al.*, and later amended by Fuhrman *et al.* in 1990 to describe the four groups and add the 5th group, the Schaefer-Fuhrman classification is the most widely used classification of laryngeal trauma severity.⁷ Group I covers all minor laryngeal edema or lacerations without any detectable fractures. Group II covers all demonstrable severe edema, hematomas minor mucosa discontinuity without any cartilage exposed, or absence of displaced fractures. Group III involves massive edema, extensive mucosal lacerations, exposed cartilages and or displaced fractures; any presence of vocal cord immobility. Group IV includes cases with destabilized laryngeal framework, noticeable disruption of the anterior commissure, presence of more than 1 unstable displaced fracture, and/or presence of severe mucosal injuries. Those with complete laryngotracheal separation fall under Group V.³⁻⁷ Our patient had massive edema of the anterior neck area and large mucosal lacerations exposing the thyroid cartilage without displaced fractures or vocal cord immobility making him fall under Group III.

In the United States, approximately 1 in 137,000 cases of laryngeal trauma are attributed to external causes⁸ To the best of our knowledge, there are no local studies or statistics on blunt and penetrating neck

injuries. Examination and initial management of laryngeal trauma should be part of primary and secondary surveys according to Advanced Trauma Life Support guidelines.⁹ Airway support and securing viable blood supply should be the immediate concern. There are numerous algorithms recommended for the management of laryngeal injuries depending on its severity.^{5,7,10} Management ranges from medical treatment (e.g. antibiotics, steroids, and anti-reflux agents) for mild cases to surgical treatments including endoscopy, stent and plate application for more severe injuries.^{6,7,11} Disparity of management can be observed within each class hence the management must be modified.¹² In addition, none of the existing classifications describes the prognosis although recommended management is indicated per grouping described by Schaefer and Fuhrman.^{3,5,6}

There is disagreement over the optimal timing of repair for severe cases requiring surgical intervention.^{3,5,13} Jewett *et al.* in 1999 proposed the time for initiation of laryngeal repair is within 12 hours post injury and should not be delayed after 24 hours.^{5,8} Thevasagayam and Pracy in 2005 recommended varied timing for initiation of treatment depending on severity according to Schaefer-Fuhrman Classification: 24 to 48 hours observation for group I; open exploration within 24 hours for groups 3, 4 and 5.⁷ Even deferral of intervention may result in granulation tissue proliferation and more problematically, laryngeal stenosis.^{5,8} On the other hand, Liao *et al.* in their 2014 study involving 48 patients with external laryngeal trauma, found that the long term outcome of laryngeal function was related to initial injury status and not affected by surgical timing.⁶ Furthermore, they reported that definitive surgical treatment can be delayed until the patient is ready for the procedure.⁶

The main indications for open laryngeal repair are displaced, unstable laryngeal fracture, cricotracheal separation, detachment of anterior commissure or extensive mucosal disruption as suggested based on the Schaefer-Fuhrman classification.⁵⁻⁷ Endoscopy should be performed for further evaluation of other endolaryngeal injuries, mucosal loss should be addressed if noticed and further cartilage repair and stent application should also be considered.^{5,7,11}

On the other hand, based on the Laryngeal Trauma Management Protocol,¹⁴ cases that belong to the Group 3 classification should undergo open reduction and internal fixation of fractures with or without endoscopic repair. The need for endolaryngeal stenting in the presence of massive mucosal injury is also recommended¹¹ but controversies attributed to their usage concerns the type of material to be used as stent and its duration of use¹¹ as well as its association with granulation tissue formation and mucosal ischemia.⁷ The problem arises if the resources needed (e.g. stents) are not readily available.

In this case, the immediate technique performed entailed hypopharyngeal repair by simple interrupted suturing using absorbable sutures. The technique was relatively easy to perform with fairly good post-repair laryngeal function. Although the vocal cords were edematous post-operatively, they were fully mobile and could fully coaptate.

In conclusion, our technique might be utilized in cases where urgent reconstruction of laryngeal structures is considered despite serious damage to the laryngeal skeleton, and may provide a temporary surgical option for similar cases in an emergent setting. The following conditions should be noted: the wound was ≤ 10 centimeters long and had smooth edges; there was no involvement of major blood vessels; and the upper half of the thyroid cartilage was transected without involvement of the glottic area. However, even with these conditions, we cannot recommend our technique as a routine standard on the basis of one case.

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