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Open Reduction and Fixation in Acute Laryngeal Trauma Under Endoscopic Guidance

ABSTRACT

Acute laryngeal trauma is a great challenge for the otolaryngologist. Early recognition, accurate evaluation and proper treatment may be crucial to immediate survival and long-term function.

Objective: To describe an endoscopically-guided open reduction and adaptation plate fixation of an acute laryngeal fracture secondary to vehicular accident.

Methods:

- a. **Study Design:** Surgical Innovation/ Case Report
- b. **Setting:** Tertiary Hospital in Metro Manila

Results: Post-operative follow-up showed good vocal fold function and arytenoid position, with no food regurgitation, signs of aspiration or penetration on fiberoptic endoscopic evaluation of swallowing

Conclusion: Endoscopic guidance allows higher magnification minimizing iatrogenic mucosal damage during manipulation.

Keywords: *laryngeal trauma, endoscopic technique, rigid fixation, fracture*

EXTERNAL laryngeal trauma is a relatively uncommon injury estimated at approximately 1 in every 30,000 emergency room visits¹. However, laryngeal injury can result in serious airway problems and impaired voice production if not diagnosed and managed properly, and the consequences of mistreatment are severe.

Historically, the surgical repair of laryngeal fractures involved simple wire fixation of fragments with autologous cartilage grafts for large defects. Internal stents were used to preserve the proper three-dimensional shape of the airway when extraluminal repair could not ensure immediate restoration of a stable laryngeal framework. Although these techniques suffice to align fracture fragments, they do not always restore the functional architecture of the larynx².

With improved image resolution and quality of stroboscopy, videolaryngoscopy became a routine part of the examination of individuals with voice disorders³. However, its use was mainly for pre-operative assessment and post-operative follow-up. A MEDLINE search engine using MeSH Database with the keywords larynx, trauma, and fracture failed to find descriptions of endoscopic-guided management of laryngeal trauma. We describe the management of a case of laryngeal trauma under endoscopic guidance.

CASE REPORT

A 29-year-old male fell from a moving motorcycle, hitting the anterior part of his neck on a concrete curb. A tracheotomy was performed at a nearby hospital due to subsequent loss of voice and difficulty of breathing and he was transferred to the St. Luke's Medical Center Emergency

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Room where a skin abrasion (Fig. 1) and subcutaneous emphysema were noted over the anterior neck.

A neck CT scan (Figs. 2 & 3) showed diffuse subcutaneous/soft tissue emphysema involving the parapharyngeal, carotid, retropharyngeal, submandibular, supraclavicular and posterior cervical spaces, and soft tissue fullness in the region of the larynx. The cricoid cartilage was splayed laterally with a possible posterior fracture. The arytenoid cartilages were slightly asymmetrical and the proximal trachea was slightly narrowed.

Flexible endoscopy showed diffuse laryngeal edema, cricoarytenoid subluxation, right, and anterior commissure prolapse. (Figs. 4 & 5)

Under general anesthesia, the patient was positioned supine with neck slightly extended.

A Transnasal Flexible Laryngoscope was positioned to visualize the vocal folds and provide continuous videocam monitoring throughout the procedure (Figs. 6 & 7).

After preparing and draping, a 6-cm horizontal skin incision at the midinferior margin of the thyroid cartilage was carried through the subcutaneous tissue and platysma. Subplatysmal flaps were elevated to the level of the hyoid bone superiorly and caudal edge of the cricoid cartilage inferiorly. The strap muscles were reflected laterally exposing the thyroid cartilage with healing fractures on both thyroid laminae (Fig. 8) causing collapse of the laryngeal framework.

Further evaluation showed complete bilateral fractures of the anterolateral cricoid cartilage displacing it posteriorly (Figs. 9 & 10). No mucosal injury was noted. These were approximated using Nylon 3/0 (Figs. 11 & 12).

The thyroid cartilage laminae fracture was reduced using a four-hole "six-box type" microtitanium plate with a 4mm self-drilling, self-tapping screw plating system (Fig. 13). Obviating the need for drill holes produced a tight screw-tissue interface in the thyroid cartilage. There also being a midline fracture, the plate was bent across the fracture line to conform to the pre-trauma thyroid cartilage curvature under endoscopic guidance.

The closed-circuit monitoring system allowed us to maintain the position and size of the glottis and thyroid cartilage throughout stabilization. Closure in layers over suction drain and an external dressing completed the procedure.

Post-operative follow-up at 2 weeks showed good vocal fold function and arytenoid position, with no food regurgitation, signs of aspiration or penetration on fiberoptic endoscopic evaluation of swallowing (Figs. 14 & 15).



Fig. 1



Fig. 2

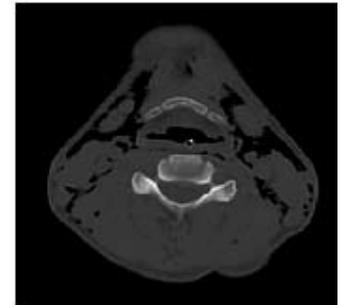


Fig. 3



Fig. 4

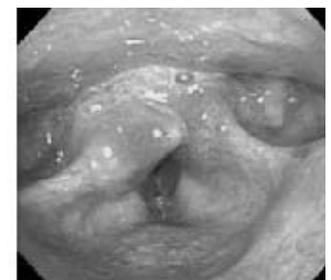


Fig. 5



Fig. 6



Fig. 7



Fig. 8. Healing fractures on both sides of thyroid cartilage



Fig. 14

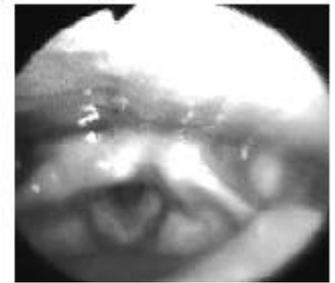


Fig. 15

DISCUSSION

Rarely seen in ENT emergency practice, external laryngeal trauma may be caused by vehicular accidents, accidental strangulation, assault, and falls⁴.

Laryngeal injuries may be classified as suggested by Fuhrman⁵ (table below).

Laryngotracheal Injury Classification

CLASS	DESCRIPTION OF INJURY
I	Minor endolaryngeal trauma without detectable fracture
II	Edema, hematoma, minor mucosal disruption without exposed cartilage, nondisplaced fractures noted on computer tomographic scan
III	Massive edema, mucosal tears, exposed cartilage, cord immobility
IV	A class III injury with more than two fracture lines or massive trauma to laryngeal mucosa
V	Complete laryngotracheal separation

Fuhrman, G.M., et al, J. Trauma, 1990

Laryngeal injuries may be treated medically or surgically depending on initial laryngoscopic and CT scan findings. Class I injuries (where the injury will likely resolve without surgical intervention and the airway is stable) can be safely managed with a minimum of 24 hours of close observation, head elevation, voice rest and humidification of inspired air. Antibiotics and anti-reflux agents are recommended when laryngeal mucosa is disrupted and systemic steroids are often given to reduce laryngeal edema in Class II injuries¹. Nasogastric tube feedings should be considered in the presence of significant mucosal lacerations. Serial flexible laryngeal examinations should be performed to evaluate the airway and healing prior to discharge¹.

The timing of surgery is an important determinant of final outcome in preserving voice quality and airway patency. Indications for surgery range from establishing an airway to open reduction and internal fixation of laryngoskeletal fractures. Surgical exploration is warranted in the presence of large mucosal lacerations, exposed cartilage, multiple or displaced cartilaginous fractures, vocal fold immobility, fractured

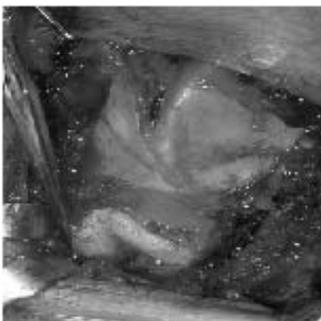


Fig. 9



Fig. 10



Fig. 11

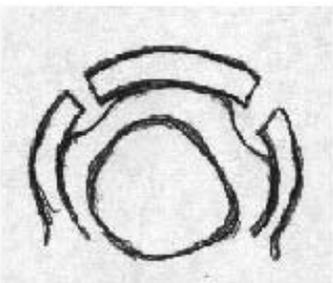
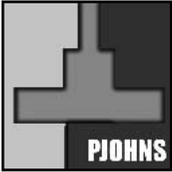


Fig. 12



Fig. 13



cricoid, disruption of the cricoarytenoid joint, and lacerations involving the free margin of the vocal fold or anterior commissure (Class III-V injuries)¹.

Fractures of the cartilages are reduced and can be stabilized using a variety of materials, including stainless steel wires, nonabsorbable suture, and miniplates⁶. If the fracture is comminuted, small fragments of cartilage with no intact perichondrium have to be removed to prevent chondritis¹. As in this case, steel wires or sutures are not used for median or paramedian fractures of the thyroid cartilage because the 2-point fixation only results in flattening of the thyroid cartilage with subsequent airway problems and voice disorders. Applying the principles of

adaptation fixation (previously validated in craniomaxillofacial surgery) to laryngeal fractures, the use of miniplates optimizes surgical repair and regeneration of normal laryngeal cartilage². Adaptation miniplates have the advantage of immediate stability of the larynx (less need for endolaryngeal stenting), ability to bridge large gaps (comminuted fractures), easier restoration of the preinjury geometry of the laryngeal framework¹ and possible shorter hospital stay. Endoscopic-guidance allows higher magnification minimizing iatrogenic mucosal damage during manipulation. Disadvantages include additional costs for the patient and the need for the surgeon's expertise and familiarity with the plating system being used.

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