A Missed Diagnosis of Laryngotracheal Injury Secondary to Emergency Intubation: Lessons Learned

V Sha Kri Eh Dam[1,2,*], Sakinah Mohamad[2], Nik Fariza Husna Nik Hassan[3], Mohd Zulfakar Mazlan[4]

ABSTRACT

Iatrogenic laryngotracheal trauma is a potentially fatal complication of endotracheal intubation, especially in an emergency setting. Symptoms are almost always related to speech, breathing, and swallowing. Hoarseness being the commonest symptom, while shortness of breath and stridor always signify more devastating injury. We present a case of iatrogenic subglottic and tracheal stenosis, which was misdiagnosed in the emergency department during the first visit. This case report highlights the importance of salient history and thorough examination with a high index of suspicion in a stridorous case with a recent history of intubation. Early detection and management are vital to avoid a life-threatening event.

KEYWORDS

endotracheal intubation; laryngotracheal trauma; tracheostomy

AUTHOR AFFILIATIONS

[1] Department of Otorhinolaryngology-Head & Neck Surgery, Hospital Tengku Ampuan Rahimah, Jalan Langat, 41200 Klang, Selangor, Malaysia
[2] Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia
[3] Speech Pathology Programme, School of Health Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia
[4] Department of Anaesthesiology and Intensive Care, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia
* Corresponding author: Department of Otorhinolaryngology-Head & Neck Surgery, Hospital Tengku Ampuan Rahimah, Jalan Langat, 41200 Klang, Selangor, Malaysia; e-mail: kridamrong@gmail.com

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INTRODUCTION

Larynx and trachea are vital organs providing important functions for breathing, phonation, and swallowing. The laryngotracheal complex consists of a cartilaginous framework supported by a variety of muscular and ligamentous soft tissue structures (1). Injury to these structures should alert physicians of the potential airway compromise and challenges in the management.

The mechanism of laryngotracheal injury can be classified into external and internal. The former is further classified into blunt and penetrating injuries, while the latter always due iatrogenic and inhalation injuries (2). Intubation probably being the leading cause of iatrogenic injury now due to its widespread use to secure the airway. Larynx being the most common site of the injury secondary to endotracheal intubation, while trachea and oesophageal injuries are more frequently associated with difficult intubation (2).

Endotracheal intubation (ETI) remains the goal standard procedure for airway management (3). However, it can cause complications, some of which are life-threatening, like laryngeal trauma, subglottic stenosis, and tracheal rupture. It is well accepted that post-intubation laryngotracheal injury is related to the duration of intubation. Injury following short term intubation in an elective setting is rare, accounting about 6.3% (4). The percentage was likely to be higher in the emergency setting due to inadequate evaluation of the airway or preparation of the patient and equipment.

Other risk factors for the injury are excessive cuff pressure, inappropriate endotracheal tube (ETT) size, difficult airway patient, use of introducers like stylet or bougie, inadequate muscle relaxant, and inexperience of person performing intubation (3, 5). Besides that, patient-specific factors such as female sex, cigarette smoking, and gastroesophageal reflux disease also have been shown to play a role (6).

Symptoms of intubation related laryngotracheal injury are almost always related to speech, breathing, and swallowing. The patient may present with dysphonia, aphonia, hoarseness, shortness of breath, stridor, sore throat, dysphagia, and odynophagia. Most of the symptoms are usually resolved by 48 hours. Thus, more devasting injury should be suspected if symptoms last more than 72 hours (7).

The most common lesion is vocal cord hematoma, followed by mucosal thickening with oedema, mucosal laceration, laceration of vocalis muscle, arytenoid subluxation, and contact ulcer with or without granuloma formation and vocal cord immobility (6). Vocal cord immobility is the result of either cricoarytenoid joint dislocation, inter-arytenoid scar or recurrent laryngeal nerve palsy. There are reported case of tracheal rupture, however, it is rare (8).

The long-term management is depending on the type of injury and severity, whilst in the short term, patients may benefit from a tracheostomy in severe cases. Here, we report a case of missed diagnosis of subglottic and tracheal stenosis secondary to emergency intubation, how we managed the patient and lessons learnt.

CASE REPORT

A 16-year-old boy presented with progressive worsening of shortness of breath for three days duration. He had a history of intubation after alleged motor vehicle accident six days before the current presentation. At that time, he was brought to the hospital by ambulance with Glasgow Coma Score (GCS) of 7/15 and was intubated at the Emergency Department (ED) with a cuffed ETT size 7.5 mm (inner diameter), anchored at 21 cm for airway protection. However, there was no documentation of any difficulty of intubation as well as the number of attempts of intubation. He was admitted to the Intensive Care Unit (ICU) overnight, extubated on the following day, and transferred to the general surgical ward. Apart from the severe traumatic brain injury (without intracranial bleed), he also sustained a closed fracture of the left distal radius. He was discharged home on day 4 of admission.

The shortness of breath was actually noticed at home after being discharged. It was initially tolerable then progressively worsening until he was unable to lie flat and needed to sleep in a sitting position. It was associated with hoarseness, weak voice, odynophagia, noisy breathing and non-productive cough. He visited ED one day after been discharged due to worsening shortness of breath. He was treated as atypical pneumonia and discharged home with antibiotics. Unfortunately, he presented again to ED in less than 24 hours as his symptoms became more severe.

On examination, he was lethargic-looking with the presence of inspiratory stridor, hoarseness, tachypneic with a respiratory rate of 22 breaths/min and subcostal recessions. Besides that, his maximum phonation time was 7 seconds, unable to count one to ten in a single breath but with a good cough quality suggestive of inadequate subglottic pressure but with good glottic closure. His oxygen saturation (SpO_2) and arterial blood gas (ABG) were still within the normal range. However, sequential ABG showed a rising pattern of carbon dioxide (CO_2) level. A referral to Otorhinolaryngology (ORL) team was done and flexible nasopharyngolaryngoscopy (FNPLS) performed at ED revealed some granulation tissues at the subglottic region with a small airway opening seen at the posterior part of the subglottic region. Supraglottic and glottic structures were normal-looking and bilateral vocal cords were mobile symmetrically.

Lateral soft tissue neck X-ray demonstrated soft tissue thickening with narrowing of the airway from C5 to C7 cervical vertebra (Figure 1). Otherwise, chest X-ray showed a relatively clear lung field. Since he was stable, computerized tomography (CT) scan of the neck was done for more details regarding the anatomical obstruction. The CT scan revealed circumferential subglottic soft tissue thickening extending from the level of the lower border of C5 to lower border of C7 cervical vertebrae, causing subglottic and tracheal stenosis (Figure 2). The length of the stenosis was 3 cm, with the narrowest segment width of 4 mm. Lower trachea and bilateral primary bronchi were preserved.

The patient was then subjected to emergency tracheostomy, direct laryngoscopy, and tracheoscopy to secure and then assess the airway. The patient was intubated with

Fig. 1 Lateral soft tissue neck X-ray shows soft tissue thickening with narrowing of airway from level of C5 to C7 cervical vertebra.

Fig. 2 Sagittal view, soft tissue window of contrasted CT scan of neck shows circumferential soft tissue thickening extending from level of lower border of C5 to lower border of C7 cervical vertebra causing subglottic and tracheal stenosis.

cuffed micro-laryngeal tube (MLT) size 4.0 mm (inner diameter), anchored at 22 cm on the third attempt after failed two attempts with larger ETT. Tracheostomy was performed under general anaesthesia and was uneventful. A cuffed tracheostomy tube size 7.5 mm (inner diameter) was inserted between the 3rd and 4th tracheal rings. Through the upper part of the tracheal incision, the stenotic segment was seen just above the 3rd tracheal ring. Direct laryngoscopy showed pinkish-red granulation tissue in the subglottic region. Tracheoscopy revealed the total length of the stenotic segment was about 38 mm, starting from 5 mm below the true vocal cord to 4 mm above tracheostoma. There was presence of immature granulation tissue at the anterior part of the tracheal wall and mucosal tear at the left posterolateral part of the tracheal wall causing false tract (Figure 3). In addition, there was some slough at the posterior commissure. Luminal obstruction by the stenotic segment was measured by about 78% thus, it was Cotton-Myer grade III. He was started on intrave-

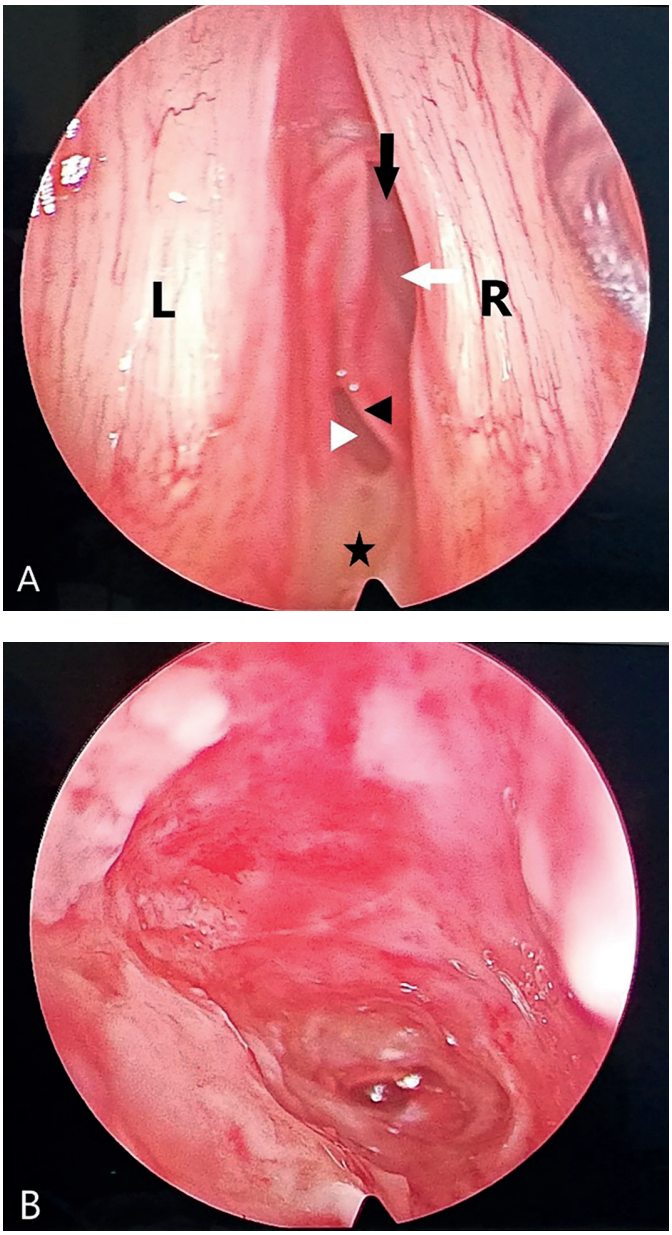

Fig. 3 A. Endoscopic view of the subglottic region shows present of granulation tissue at the anterior part (black arrow) with narrowed subglottic region (white arrow), mucosal tear at the left posterolateral part (black arrow head) causing false tract (white arrow head) and present of slough at the posterior part (star). L: left vocal cord; R: Right vocal cord. B. Endoscopic view of trachea shows narrowed tracheal lumen with present of granulation tissues and slough.

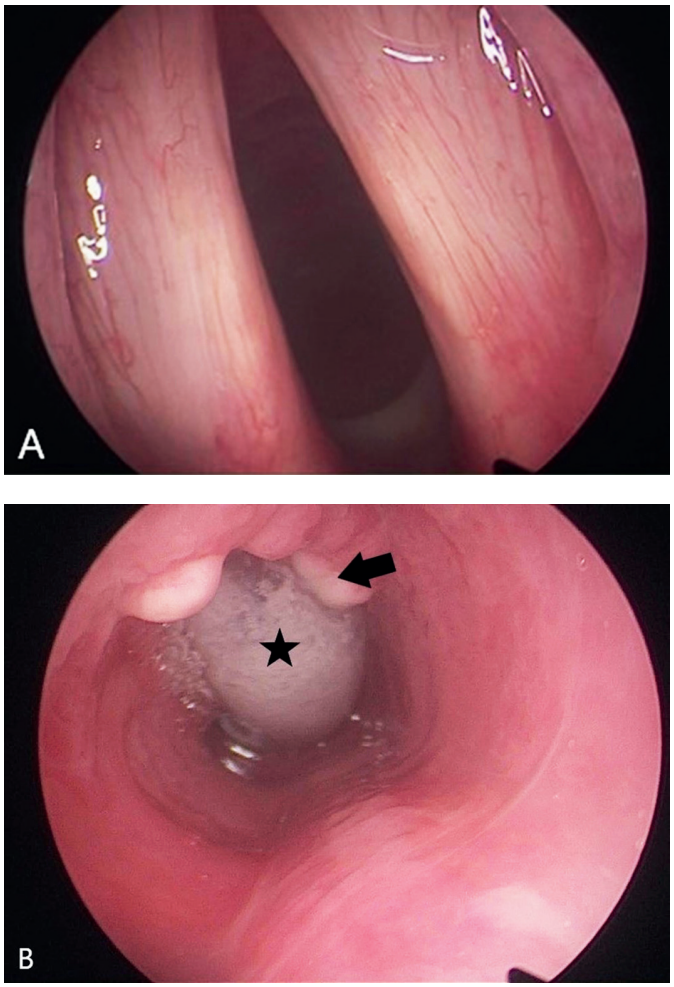

Fig. 4 Endoscopic view of the subglottic (A) and trachea (B) after 2 weeks shows well healed subglottic and tracheal wall with minimal granulation tissue (arrow) at the superior part of tracheostoma and tracheostomy tube (star).

nous (IV) dexamethasone 8 mg three times daily (TDS) for three days to reduce the tissue oedema and inflammation, and IV Augmentin, 1.2 g TDS for five days to cover for infection.

The patient was discharged home after five days of observation in the ward, and the tracheostomy tube was changed to uncuffed tube sized 7.5 mm (inner diameter). He was well and underwent another direct laryngoscopy and tracheoscopy under general anaesthesia about two weeks later. Unexpectedly, it revealed a well-healed subglottic and tracheal wall with just minimal granulation tissue at the superior part of tracheostoma (Figure 4). The tracheostomy tube was then changed to a smaller size, spigotted and subsequently decannulated successfully. He was well and remained asymptomatic even after six months follow-up.

DISCUSSION

Intubation related laryngotracheal injury is common, as high as 73% in patients intubated for more than 24 hours, and larynx is more common than trachea to be injured (5, 9). Short term intubation less than 24 hours and in the elective setting is relatively rare causing laryngotracheal injury (4). The injuries are ranging from mild to severe and life-threatening conditions.

In our case, the patient was able to be extubated in less than 24 hours after intubation. However, the laryngotracheal injury was so extensive which required tracheostomy to secure the airway. By Bernoulli's principle, when a patient is breathing rapidly, the air flows through a severely narrowed airway (in this case, through the stenosed subglottic and upper tracheal regions) causes that restricted area to collapse and later on becomes more oedematous. Therefore, tracheostomy helps to rest that area to heal and to prevent more complications apart from securing the airway. In this case, the tracheostomy was inserted slightly lower than usual (between 2nd and 3rd tracheal rings), distal to the site of stenosis to avoid the area of laryngotracheal injury. We also noticed the presence of immature granulation tissue and mucosal tear with a false track (as shown in Figure 3), which could be the results of traumatic injury during intubation. This injury may happen in an emergency setting where everything needs to be acted fast, especially when dealing with the airway. Study also showed laryngeal injury is more common in emergency intubation (5). Besides that, if a restless patient with GCS 7/15 was not properly relaxed during intubation, this can increase the risk of laryngotracheal injury.

Post-extubation patients may experience a variety of symptoms. Hoarseness is the commonest symptom followed by sore throat and odynophagia (4, 9). A systemic review revealed that hoarseness and vocal cords injury are relatively common following short-term general anaesthesia (10). In the vast majority, this symptom is temporary and lasts on a mean two to three days (11). However, in a case of persistent symptoms with dyspnoea and stridor, a more serious complication should be suspected. Our patient presented with worsening obstructive symptoms and hoarseness for more than three days; however, he was discharged home and treated as pneumonia on the first visit to ED. Although pneumonia is also a common condition in patients of post-intubation and ICU admission, intubation related laryngotracheal injury should always be suspected in this type of patient and presentation.

Pneumonia may share some similar symptoms with intubation related laryngotracheal injury. Thus, further investigation should be carried out. This is including a simple neck and chest X-ray. Only a chest X-ray was performed during the first visit; thus, the diagnosis of laryngotracheal injury was missed. A simple clinical examination such as FNPLS can be performed in the ED setting by a skilled operator, which provides excellent visualization of the supraglottic, glottic, and possible subglottic region. In our case, granulation tissue was seen in the subglottic region, causing narrowing of the airway, otherwise normal supraglottic and glottic structures, and mobility of vocal cords. However, it is to note that, in certain cases such as suspected acute epiglottitis in children, the contact of the tip of the scope with the epiglottis or laryngeal mucosa may cause laryngospasm and upper airway "shut-down".

Besides laryngotracheal stenosis, differential diagnosis of stridor with history of intubation would include edema of the vocal cord or subglottic region, vocal cord granuloma, vocal cord palsy, cricoarytenoid dislocation, webbing

of anterior commissure and tracheomalacia especially in prolonged intubation. Stridor is one of the red flag signs for airway emergency. Stridor is different from stertor. Stridor is defined as high-pitched sound, caused by partial obstruction of the airway due to abnormal apposition of two tissue surfaces in proximity, with resultant in turbulent airflow (12). In contrast, stertor is a low-pitched, mainly inspiratory sound that may be produced by obstructing lesions of the nasopharynx, oropharynx and hypopharynx (13). The quality of the stridor may give clue to site of obstruction as seen in table 1 (12).

Tab. 1 Different quality of stridor pointing towards different sites of obstruction.

Quality of stridor	Site(s) of obstruction
Inspiratory	Supraglottic region (epiglottis, aryepiglottic folds and false cords) Glottic region
Expiratory	Trachea region and below
Biphasic (combination of inspiratory and expiratory stridor)	Glottic Subglottic region

CT scan of the neck is usually not required before tracheostomy, as securing the airway is more urgent. However, since the patient was stable and a long segment of airway narrowing was seen in lateral neck X-ray, the CT scan neck was performed. CT scan provides a better anatomical description of the injury and helps in surgical planning. CT scan gives details of the approximate length of stenotic segment, narrowest diameter of tracheal lumen, distance of upper end of stenotic segment with the true cords, whether it is single or multisegmented stenosis and level of lower end of stenotic segment. It is important in preventing performing tracheostomy through the injury site, which may result in intractable bleeding.

Not all of our patients are as fortunate as in this case whereby a near-complete resolution is achieved within 2 weeks with conservative management post-tracheostomy. The patient was subsequently treated with IV dexamethasone for three days and IV antibiotics for five days post-tracheostomy. This may suggest that if the problem is actually detected earlier post-extubation and treated conservatively with steroids and antibiotics, the patient may not require tracheostomy but this is not true for all patients. Systemic corticosteroid, antibiotic, and closed observation probably would be sufficient (14). The potential benefit of steroids is still open to debate and presumably based on its anti-inflammatory actions (15). The antibiotic was started in our case in view of the presence of the slough at the posterior commissure which suggest infection. Some studies suggested that additional anti-inflammatory property that presence in certain antibiotic may has a beneficial effect on laryngotracheal stenosis (16, 17). In contrast, if the diagnosis is further delayed, the patient may lose his airway. This situation is very challenging in management, which the patient may present with cardiorespiratory distress, and tracheostomy may need to be performed under local anaesthesia at the ED itself. This undoubtedly results in higher mortality and morbidity.

This complication of laryngotracheal stenosis is preventable. First of all, recognition of patients with risk of difficult airway is very crucial. About 10% of patients were found to be difficult for intubation (18). Physician can anticipate difficult intubation in patients with class 3 on upper lip bite test, shorter hyo-mental distance of <3.0–5.5 cm, retrognathia, obese and modified Mallampati score ≥ 3 (18). The mentioned risk factors were not found in our case. Senior physician and/or anaesthetic team should be alerted immediately when facing difficult intubation. Careful intubation taking into accounts of the appropriate ETT size, using low pressure cuffs and avoiding unnecessary trauma, especially in emergency settings, is fundamental in preventing laryngotracheal injury. Other strategies for intubation of difficult airways include awake intubation, video-assisted laryngoscopy, fiberoptic-guided intubation, using stylets (with/without light) or tube changers, and supraglottic airway ventilation for example laryngeal mask airway (LMA) (19). Judicious care should be carried out through the whole intubation period. It is recommended to use soft pressure–high volume ETT and regular checking of cuff pressure to maintain the cuff pressure around 25 cm H_2O (5). Apart from that, managing team should optimize patient and try aiming for early extubation as prolonged intubation is one of the risk factors for laryngotracheal stenosis.

CONCLUSION

Intubation related laryngotracheal injuries are ranging from mild to potential life-threatening. Stridorous patient with history of emergency intubation although duration is short should always give a high index of suspicion for subglottic and tracheal stenosis. Junior doctors should be able to recognize and detect this clinical entity early, and manage accordingly. Despite extensive subglottic/tracheal stenosis, this case was still manageable with a tracheostomy followed by conservative treatments.

LEARNING POINTS

- Physician should have a high index of suspicion for subglottic and/or tracheal stenosis in a case of stridorous patient with a history of emergency intubation.
- Simple imaging such as neck X-ray together with chest X-ray helps in establishing the diagnosis of subglottic/tracheal stenosis as well as ruling out other pathologies.
- Junior doctors should be able to recognize patients with difficult intubation, alert their seniors and urgently refer to anesthetic team when facing a difficult intubation.
- The severity of injury during intubation is a more significant factor than the duration of intubation in this case.
- Some cases of subglottic/tracheal stenosis may be successfully managed with a tracheostomy followed by conservative treatments with systemic corticosteroid and antibiotic, based on their anti-inflammatory property (15–17).

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