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Prehospital Laryngeal Tube Airway Device Placement Resulting in Hypopharyngeal Perforation: A Case Report

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Abstract

A 26-year-old female patient presented in cardiac arrest from presumed opioid overdose. An Ambu King LTS-D laryngeal device was placed by EMS providers for airway management during the resuscitation. There was no documented difficulty with placement and breath sounds and waveform capnography were consistent with appropriate placement. The resuscitation was terminated on scene after extensive resuscitative efforts by the EMS crew. Upon autopsy of the patient, it was discovered that the laryngeal tube device had caused a deep 5cm perforation to the left piriform recess. The laryngeal tube had bent and was pushed into the perforation in the piriform recess; had the patient had regain of spontaneous circulation this could have caused significant morbidity. Laryngeal tube airway devices have shown increased usage in healthcare settings, in particular in the prehospital arena. Studies of these airway devices have shown they have quick insertion times, high success rates, and low complications. Tongue swelling and minor trauma are common complications of laryngeal tube airway devices. The case report describes a rare, yet potentially life-threatening complication of laryngeal tube airway device placement- hypopharyngeal injury. If unrecognized, this injury could lead to serious complications. Providers should be aware of the common and uncommon injuries that are associated with prehospital laryngeal tube airway device placement.

Keywords: Laryngeal Tube, Supraglottic Airway, King Airway, Complication, Prehospital

Prehospital Care

An advanced life support (ALS) emergency medical services (EMS) ambulance was dispatched to a 26-year-old female for a possible drug overdose. The patient was last seen by her family the previous night. Per report from the family, they went to wake her up in the morning and found her face down on the bed and
unconscious. They proceeded to call 911 at that time. Upon arrival to the scene 5 minutes after dispatch, the ambulance crew found a female patient in cardiac arrest undergoing cardiopulmonary resuscitation (CPR) by the first-responding engine crew who was already on scene. Manual CPR was transitioned to a mechanical CPR device when additional personnel and equipment arrived to the scene. An intraosseous (IO) device was used to establish access in the right humerus without complication. Bag-valve mask (BVM) ventilation was initiated. An impedance threshold device was placed as well. The BVM ventilation was transitioned to an Ambu King LTS-D laryngeal tube several minutes into the resuscitation. Visual estimation of the patient’s height was used to select the King LTS-D size. A King LTS-D Size 4 was placed on the first attempt and confirmed with bilateral breath sounds and placement of waveform ETCO2 monitoring. There was no documentation by the paramedic performing the procedure of any difficulty with placement of the King LTS-D device. Throughout the resuscitation the patient remained in asystole on the cardiac monitor. Per American Heart Association (AHA) Advanced Cardiac Life Support (ACLS) guidelines, epinephrine was administered every 3-5 minutes for a total of six (6) doses. The patient never regained spontaneous circulation. Family was present with the EMS crews during the resuscitation and the resuscitation was terminated via standing order. The death met the local criteria for forensic autopsy and the medical examiner’s office was called to respond to the scene.

**Autopsy Findings**

Upon arrival to the medical examiner’s office for forensic autopsy, several findings were made on post-mortem examination as documented in the autopsy report.

It was noted that just distal to the King LTS-D’s proximal oropharyngeal cuff and ventilatory openings and 4cm proximal to the distal esophageal cuff, the King tube was bent at almost 90 degrees and the distal end had caused a deep 5cm perforation to the left piriform (pyriform) recess (sinus). (Figure 1) The bent portion of the King Airway was pushed into the tear in the piriform recess with the tip caught by the mucosa and covering the opening of the tube and holding the bent tube in position in the perforation. (Figure 2,3)
The authors’ postulate that the device likely still functioned effectively given the location of the bend in relation to the ventilation openings which is why breath sounds and ETC02 was confirmatory of successful placement. (Figure 4) However, should the patient have experienced return of spontaneous circulation (ROSC), this injury could have caused significant morbidity and mortality. Additionally, given the device was functioning without evidence of malposition or complication, the recognition of the injury may have been delayed.

The patient was measured at 64 inches tall and the King Airway Size 4 was appropriately sized based on the patient’s height.

Additional injuries noted on the autopsy report included a superficial liver laceration, pulmonary and mediastinal hemorrhage, myocardial contusion, blood in the pericardial sac, and hemoperitoneum. These were attributed to the resuscitation.

The official cause of death was ruled to be opioid intoxication.

DISCUSSION

Quick insertion times, high success rates, and low complication rates have led to the rapid integration of supraglottic airway (SGA) devices in the EMS setting. Studies by Wang et. al and Benger et. al. have continued to push the supraglottic airway to the forefront in airway management, in particular for cardiac arrest given these attributes as well as the lack of convincing superiority of tracheal intubation over supraglottic devices. (1,2) Worldwide usage of the laryngeal tube has increased from 0.2 million in 1999 to more than 16 million uses in 2013. (3)

Hypopharyngeal or esophageal injuries from laryngeal tube airways, or any airway device, are of significance given their potential for serious and sometimes lethal complications. Perforation of the pyriform sinus has been described as an iatrogenic source of injury from airway management procedures, transesophageal echocardiography, and nasogastric tube placement among others. (4,5,6) It is a rare, but potentially fatal,
injury that must be recognized. Complications include mediastinal emphysema, hematoma or mediastinitis, pneumothorax, retropharyngeal abscess, and resultant sepsis. Treatment is controversial and ranges from medical therapy to surgical options. (4) Esophageal perforation is a related condition and extremely rare with an estimated 3.1/1,000,000 population per year. (7) Iatrogenic causes are implicated in around 70% of esophageal perforation cases. Iatrogenic etiologies include endoscopic procedures, endotracheal intubation, other airway management device placement, nasogastric tube placement, and transesophageal echocardiography, among others. Patients usually present with pain (80%). Other symptoms include nausea and vomiting, hematemesis, dysphagia, tachypnea, cough and fever. Subcutaneous emphysema and pneumothorax or hemothorax are other signs. Mortality after esophageal perforation is reported at 10-25% with early recognition and even higher if delayed; iatrogenic injuries tend to have lower mortality rates than other causes. Treatment can be nonoperative or operative depending on the specific injury. (8) The follow discussion will focus on injuries associated with placement of laryngeal tube airways.

Laryngeal Tube Airways

The Laryngeal Tube was developed in 1999 and further advanced by King Systems as a disposable device named the LT-D in the United States in 2003. The current iteration is the Ambu King LTS-D (Ambu Inc, Columbia, MD). It was designed as an improvement on the double-lumen esophageal tracheal airway or Combitube (ETC). (9) The straightened, beveled distal tip of the laryngeal tube is designed to reduce the risk of the tube entering the trachea and ensure insertion into the esophagus. A meta-analysis from 2010 by Hubble et al showed a pooled success rate of 96.5% for all patients and clinicians. (10)

Complications associated with the placement of supraglottic airway devices have been reported previously in the literature. A review of the placement of these devices in the perioperative period grouped complications into several categories: aspiration, airway trauma, loss of the airway on insertion, failed insertion, displacement after insertion, loss of airway during maintenance, and extubation-related problems. They further described the sites and types of traumatic injuries to include the pharyngeal mucosa, laryngeal apparatus, uvula, epiglottis, tongue, teeth, and lips. Microscopic trauma is thought to be relatively common with supraglottic airway placement, but to have little downstream consequences. More significant trauma is
often the result of forceful placement or indirectly from compression by the device. Severe trauma leading to life threatening complications to the pharyngeal structures or esophagus are extremely rare however. (11)

An early study from 2004 by Matioc described the “bouncing sign” which was present on 5/75 Laryngeal Tubes that were mispositioned in the glottic/periepiglottic elastic structures. The remaining laryngeal tubes that were correctly placed had a negative “bouncing sign.” The sign describes the bouncing back of the tube when incorrectly placed in the aforementioned elastic structures and indicate that the user should reattempt placement. This study provides evidence that the laryngeal tube can be inadvertently placed in the hypopharyngeal structures, though there is no mention of structural damage in this study. (12)

In 2008, Kikuchi et. al. described malposition of the Laryngeal Tube Suction II device into the tracheal inlet in 5 out of 50 patients (10%) assessed post-device placement with fluoroscopy. In 4 out of the 5 patients, ventilation was still possible. (13) More recent analysis of this data suggests the laryngeal tubes may have been placed in the piriform sinus; the lack of 3D-imaging in the original study may have made this seem like tracheal inlet placement. (14) This demonstrates the phenomenon we described in our case report, sans the perforation.

An analysis by Schalk et al. also sought to elucidate complications associated with laryngeal tube placement in the prehospital setting. Of the 189 patients recorded in the study, the most common complication was significant tongue swelling (38.6%). They reported stomach distension and soft tissue injury to the oral cavity. Placement in the piriform sinus, as in our reported case, was found in a single device placement in this study on CT scan at the hospital. (14)

A retrospective review of patients arriving to an emergency department from 2007-2012 with a King LTS-D Airway in place, which per protocol was used as a backup airway device, found complications in 27% of patients (13/48). The documented complications associated with the King LTS-D were tongue engorgement (7, 15%), glottic edema (2, 4%), subcutaneous emphysema (2, 4%), pulmonary aspiration (1, 2%), and
esophageal trauma (1, 2%). There is no further description on the type of esophageal trauma in the study.

(15)

A retrospective review by Roth et al. from 2014 found four injuries in 395 patients who had a laryngeal tube (LT-D) placed for airway management by EMTs in out-of-hospital cardiac arrest. There is no further definition of what the injuries were, however, the determination of injury was made by inspection and noted by the emergency physician who took over care. It is unclear what assessment the physician used to look for injuries, but if only visual, it would have been difficult to identify a hypopharyngeal or esophageal injury. (16)

A recent study by Myers et. al. evaluated complications from King LTS-D placement in the prehospital setting. The retrospective chart review of 65 patients found that there were 10 total complications from King LTS-D airway placement; 5 were anatomical complications, 4 were device complications, and 1 was human error. The anatomical complications were limited to epiglottitis and severe mouth/facial trauma. (17)

In the PART Trial, only one adverse event related to oropharyngeal or hypopharyngeal structures was reported in the laryngeal tube study arm (1/460; 0.2%) in the first 24 hours; there was no statistical difference between the laryngeal tube and the endotracheal tube regarding this type of complication. (2)

**Conclusion**

Tongue swelling and minor trauma are likely common complications from laryngeal tube airway placement. The authors’ of this paper could find no reports of confirmed hypopharyngeal perforation directly caused by prehospital misplacement of an Ambu King LTS-D airway with continued function of the device to oxygenate and ventilate in the literature. Misplacement into the piriform sinus has been shown in prior studies, but soft tissue injury resulting in perforation of a hypopharyngeal structure hasn't been previously documented. As such, this paper may demonstrate the first documented case of hypopharyngeal injury from the placement of a King LTS-D laryngeal tube in the prehospital setting. Practitioners of airway management devices should be aware of both the common and rare, yet potentially life-threatening, complications of laryngeal tube airway device placement to include hypopharyngeal or esophageal injury. Providers should insert the devices
cautiously and avoid excessive force. Continuing care providers should be cognizant of evaluating patients for iatrogenic injuries that may be related to airway device usage, even if functioning appropriately.

Bibliography

Figure 1: Autopsy photo demonstrating the 5cm perforation to the left piriform recess

Figure 2: Autopsy photo showing the bent King LTS-D pushed into the perforation in the piriform recess
Figure 3: Autopsy photo showing the bent King LTS-D in relationship to the perforation of the piriform recess.

Figure 4: Photo of the bend in the King LTS-D distal to the proximal oropharyngeal cuff and ventilatory openings and proximal to the distal esophageal cuff.