



# Definitive airway management of patients presenting with a pre-hospital inserted King LT(S)-D<sup>TM</sup> laryngeal tube airway: a historical cohort study

## Gestion finale des voies aériennes de patients ayant un tube laryngé King LT(S)-D<sup>TM</sup> inséré avant l'hospitalisation: une étude de cohorte historique

Arun Subramanian, MD · Annery G. Garcia-Marcinkiewicz, MD · Daniel R. Brown, MD, PhD · Michael J. Brown, MD · Daniel A. Diedrich, MD

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### Abstract

**Purpose** The King LT(S)-D<sup>TM</sup> laryngeal tube (King LT) has gained popularity as a bridge airway for pre-hospital airway management. In this study, we retrospectively reviewed the use of the King LT and its associated airway outcomes at a single Level 1 trauma centre.

**Methods** The data on all adult patients presenting to the Mayo Clinic in Rochester, Minnesota with a King LT in situ from July 1, 2007 to October 10, 2012 were retrospectively evaluated. Data collected and descriptively analyzed included patient demographics, comorbidities, etiology of respiratory failure, airway complications, subsequent

definitive airway management technique, duration of mechanical ventilation, and status at discharge.

**Results** Forty-eight adult patients met inclusion criteria. The most common etiology for respiratory failure requiring an artificial airway was cardiac arrest [28 (58%) patients] or trauma [9 (19%) patients]. Four of the nine trauma patients had facial trauma. Surgical tracheostomy was the definitive airway management technique in 14 (29%) patients. An airway exchange catheter, direct laryngoscopy, and video laryngoscopy were used in 11 (23%), ten (21%), and ten (21%) cases, respectively. Seven (78%) of the trauma patients underwent surgical tracheostomy compared with seven (18%) of the medical patients. Adverse events associated with King LT use occurred in 13 (27%) patients, with upper airway edema (i.e., tongue engorgement and glottic edema) being most common (19%).

**Conclusion** In this study of patients presenting to a hospital with a King LT, the majority of airway exchanges required an advanced airway management technique beyond direct laryngoscopy. Upper airway edema was the most common adverse observation associated with King LT use.

The requirement for written informed consent was waived by the Institutional Review Board. IRB contact information: Mayo Clinic Institutional Review Board, 201 Building 4-60, 200 First Street SW, Rochester, MN 55905, USA; Phone: 507-266-4000.

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A. Subramanian, MD · A. G. Garcia-Marcinkiewicz, MD · D. R. Brown, MD, PhD · M. J. Brown, MD · D. A. Diedrich, MD (✉)

Department of Anesthesiology, Mayo Clinic College of Medicine, 200 First Street SW, Rochester, MN 55905, USA  
e-mail: diedrich.daniel@mayo.edu

### Résumé

**Objectif** Le tube laryngé King LT(S)-D<sup>TM</sup> (King LT) a gagné en popularité comme voie aérienne transitoire pour la gestion préhospitalière des voies aériennes. Dans cette étude, nous avons effectué une analyse rétrospective de l'utilisation du King LT et des critères d'évaluation résultants associés aux voies aériennes dans un seul centre de traumatologie de niveau 1.

**Méthodes** Les données de tous les patients adultes arrivant avec un King LT en place à la Mayo Clinic de

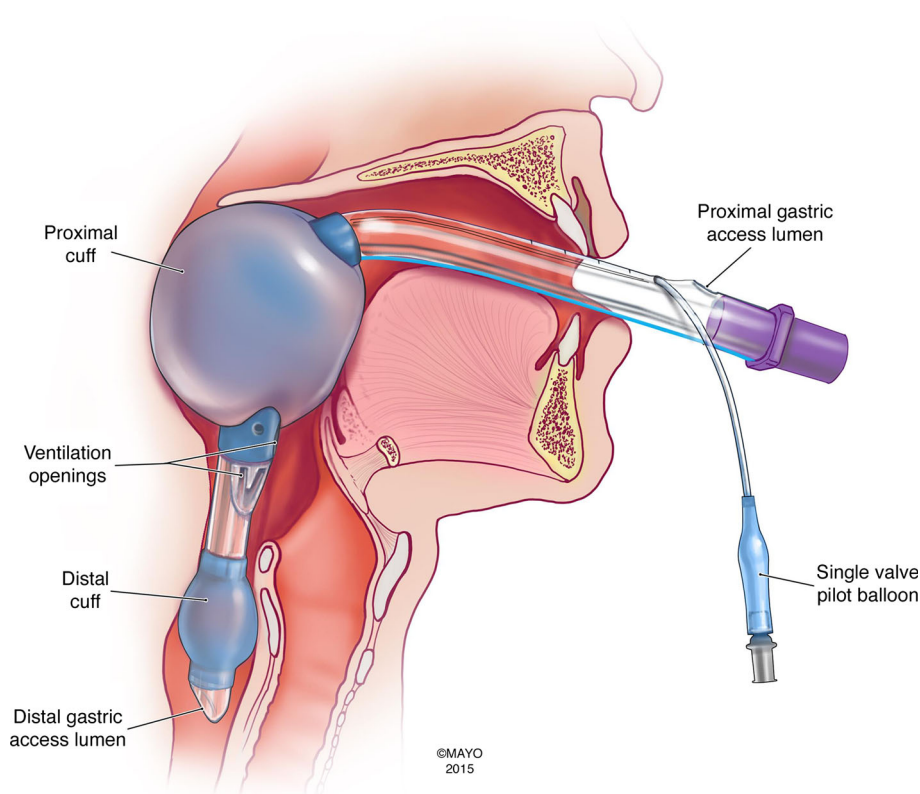
Rochester, Minnesota, entre le 1er juillet 2007 et le 10 octobre 2012 ont été évaluées de façon rétrospective. Les données collectées et analysées de façon descriptive incluaient les données démographiques des patients, les comorbidités, l'étiologie de la défaillance respiratoire, les complications des voies aériennes, la technique finale de gestion subséquente des voies aériennes, la durée de la ventilation mécanique, et l'état du patient au moment du congé.

**Résultats** Quarante-huit patients adultes répondaient aux critères d'inclusion. Les étiologies les plus fréquentes de la défaillance respiratoire nécessitant une voie aérienne artificielle étaient un arrêt cardiaque (28 [58 %] patients) ou un traumatisme (9 [19 %] patients). Quatre des neuf patients traumatisés avaient un traumatisme facial. Une trachéotomie chirurgicale a été la technique finale de gestion de la voie aérienne pour 14 (29 %) patients. Un cathéter d'échange endotrachéal, une laryngoscopie directe et une vidéolaryngoscopie ont été utilisés dans, respectivement, 11 (23 %), dix (21 %) et dix (21 %) cas. Sept (78 %) patients traumatisés ont subi une trachéotomie chirurgicale comparativement à sept (18 %) patients médicaux. Des événements indésirables associés à l'utilisation du King LT sont survenus chez 13 (27 %) patients : l'œdème des voies aériennes hautes (c'est-à-dire, gonflement de la langue et œdème de la glotte) étant le plus fréquent (19 %).

**Conclusion** Au cours de cette étude portant sur des patients arrivant à l'hôpital avec un King LT, la majorité des échanges de voies aériennes a nécessité une technique de gestion avancée des voies aériennes allant au-delà de la laryngoscopie directe. Un œdème de la voie aérienne haute a été l'évènement indésirable le plus souvent observé avec l'utilisation du King LT.

Alternative supraglottic airway devices such as the esophageal tracheal Combitube™ (Mallinckrodt-Covidien; Boulder, CO, USA) permit effective ventilation by creating an airtight seal above the level of the vocal cords. Since their introduction in 1987, emergency medical services (EMS) personnel have used these devices for emergency airway management in out-of-hospital tracheal intubations.<sup>1,2</sup> The King LT(S)-D™ laryngeal tube (King Systems; Noblesville, IN, USA), herein abbreviated as the King LT, is a newer-generation alternative supraglottic device (Fig. 1) that is reported to have advantages over previously available devices.<sup>3</sup> When compared with other airway management devices, the King LT shows comparable insertion times, higher success rates, and improved safety when used by EMS personnel.<sup>4,5</sup> Its use is thus gaining popularity amongst EMS personnel for emergent out-of-hospital airway management.<sup>6</sup>

**Fig. 1** King LT(S)-D™ is the newest disposable laryngeal tube with suction. It consists of an airway tube designed to lie along the length of the tongue extending distally to the proximal esophagus. There are two inflatable balloons above and below the laryngeal inlet creating a seal with ventilation occurring through openings between the cuffs. Used with permission of Mayo Foundation for Medical Education and Research. All rights reserved



Nevertheless, since the airway is not definitively secured by an endotracheal tube (ETT) or tracheostomy tube, the King LT is not conducive to prolonged mechanical ventilation and should be exchanged for an ETT or a surgical airway in order to allow for ongoing in-hospital care. This subsequent airway management presents challenges for the clinician; for instance, potential pharyngeal and lingual edema can occur from venous and lymphatic compression from the oropharyngeal cuff integral with this type of alternative airway.<sup>7,8</sup> In addition, other factors in this patient population may further complicate airway management, including edema from multiple or traumatic intubation attempts,<sup>9</sup> facial trauma,<sup>9</sup> massive fluid resuscitation, and patient-related factors such as obesity.<sup>10</sup>

Because the pre-hospital use of the King LT by EMS personnel is relatively new, anesthesiologists may be unfamiliar with the device and with the effectiveness of available techniques to perform tube exchanges. As anesthesiologists may be called to evaluate and exchange this device for an ETT under urgent or emergent conditions, understanding the complications associated with the use of the device and the techniques for safely performing a device exchange may be life-saving.

The currently available literature is based on case reports and small studies and describes several airway exchange techniques.<sup>7,11</sup> Accordingly, we retrospectively reviewed the use of the King LT at a single Level 1 trauma centre and characterized the demographics of King LT patients, airway-related complications, and in-hospital definitive airway management techniques.

## Methods

Emergency medical services for this region are provided by Mayo Clinic Medical Transport (MCMT). In 2007, MCMT instituted a change in the backup airway device used for emergency out-of-hospital intubation from the Combitube to the King LT. An institution-wide alerting system was established in order to deliver adequate care for the patients presenting to the emergency department (ED) with the then unfamiliar King LT. Emergency Department personnel alerted a respiratory therapist assigned to the ED each time a patient presented with a King LT *in situ*. The ED was the mandatory port of arrival for all patients tracheally intubated in the field by MCMT, and thus, this process captured all patients presenting with the King LT. Per hospital policy, when a patient with a King LT arrived in the ED, the respiratory therapist immediately contacted the in-house anesthesiologist who, in collaboration with the treating ED physician, coordinated subsequent management of the airway, including alerting other specialty teams such as

ear, nose, and throat (ENT) and trauma surgery as necessary. The trauma service was involved with airway management of all trauma patients as well as any emergent (i.e., those requiring a response within minutes) surgical airway management. The data on all patients managed in this fashion were recorded in a database for future internal review. The Mayo Clinic Institutional Review Board approved this study and, due to the minimal risk nature of this study, granted a waiver of informed consent on October 7, 2012.

Data on all patients presenting to the Mayo Clinic ED from July 1, 2007 to October 10, 2012 were evaluated. Exclusion criteria included children (< 18 yr of age), pregnant women, and patients declining consent for the use of their data for research.

During the study period, the MCMT team employed over 70 paramedics and performed 563 tracheal intubations in the field. Each MCMT team was composed of two paramedics, both trained in airway assessment and management. The paramedics followed a structured algorithm developed by the MCMT for airway assessment and management in the field. Fig. 2 shows the portion of the algorithm after the first failed attempt at ETT placement. For patients requiring tracheal intubation, a clinical judgement was first made regarding attempting tracheal intubation via direct laryngoscopy vs proceeding directly to the King LT. If direct laryngoscopy was attempted first, the King LT was used as a backup device.

The primary outcome of interest was the subsequent definitive airway management technique used (i.e., tracheal intubation or tracheostomy) in patients presenting to the hospital with the King LT *in situ*. Methods used to provide a definitive airway included direct and video laryngoscopy, fiberoptic-guided tracheal intubation, catheter-guided airway exchange, or surgical tracheostomy. Laryngoscopic techniques (direct and video laryngoscopy) involved removal of the King LT and insertion of an ETT during laryngoscopy. The catheter-guided airway exchange entailed using a Seldinger technique along with an Arndt airway exchange catheter (Cook Medical, Bloomington, IN, USA) to replace the King LT with an ETT.

The Arndt exchange catheter is a 14 Fr catheter that comes packaged with a Teflon-coated extra-stiff wire guide and ventilation and oxygenation adaptors. The exchange first involves advancing a flexible bronchoscope through the ventilation port of the King LT. Next, an exchange wire is inserted through the bronchoscope's working channel and into the patient's airway. The bronchoscope is then removed. An exchange catheter is threaded over the wire guide and advanced through the King LT into the distal trachea. The guidewire is then removed. The cuff of the King LT is deflated, and the King LT is removed leaving the catheter in place. An ETT is then placed over the

**Fig. 2** Mayo Clinic Medical Transport Airway Management Algorithm (after the first failed attempt). Used with permission of Mayo Foundation for Medical Education and Research. All rights reserved

### Following a 1st unsuccessful attempt at oral endotracheal (ET) intubation: <sup>1</sup>

1. Re-oxygenate the patient. If bag-valve-mask ventilation (or other positive-pressure ventilation) is required, use cricoid pressure.
2. If unable to ventilate adequately, attempt to open and clear the airway and try bag valve mask ventilation again.
  - If oxygenation/ventilation attempts via BVM continue to fail, place a King LTS-D (See guideline K.2 King LTS-D Airway).
  - If the King airway is contraindicated or cannot be placed, consider a neck access airway (See guideline K.6 Neck Access Airway).
3. If the patient is successfully ventilated and oxygenated, allow a 2nd ET intubation attempt only after addressing and evaluating the following:
  - Positioning of the patient's airway and clearing of the visual field.
  - If sedation or a paralytic was used, was the dose effective? Is RSI indicated?
  - Are adjustments needed for the tube or laryngoscope blade size?
4. For advanced-level providers, use of the gum bougie stylet is mandatory for all intubation attempts. <sup>2</sup>

### Following a 2nd unsuccessful attempt at oral ET intubation:

1. Re-oxygenate. If bag valve mask ventilation is required, use cricoid pressure.
2. Determine if any of the following were visualized during the ETI attempt: epiglottis, arytenoids, vocal cords, or glottic opening.
3. If the answer is "Yes" to #2 above:
  - Allow a 3rd attempt by a different intubator, if available.
  - For advanced-level providers, use of the gum bougie stylet is mandatory for all intubation attempts. <sup>2</sup>
4. If the answer is "No" to #2 above:
  - Attempt to place a King LTS-D if not contraindicated.
  - Continue the best option of BVM ventilation with oropharyngeal or nasopharyngeal airway, King airway, or neck access airway.

### Following a 3rd unsuccessful attempt at oral ET intubation:

1. Do not allow any additional attempts at oral ETI.
2. Attempt to re-oxygenate. If unable to keep the airway open or provide adequate ventilation using positive pressure and mask, move to the best option below that is indicated, effective and the least invasive:
  - King LTS-D airway
  - Neck access airway
3. Advanced-level providers should contact Medical Control, who may order sedation with **midazolam (Versed)** and paralysis with **vecuronium (Norcuron)**, if needed, to control patient movement and maintain the established airway. <sup>2</sup>

catheter, the catheter is removed, and the appropriate ETT position is confirmed with bronchoscopy.

Either a trauma or ENT surgeon performed all surgical tracheostomies in the operating room. The location where a definitive airway was established (ED, operating room, intensive care unit) and the medical specialty of the airway management provider were recorded. The airway management technique chosen was based on clinical judgement of the treating physicians. The time to airway exchange was defined as the time from ED arrival to the point of definitive airway securement.

Secondary outcomes of interest were complications associated with use of the King LT. A list of potential complications was compiled based on a literature search

and clinical experience and included: upper airway edema (tongue engorgement and glottic edema),<sup>7</sup> subcutaneous emphysema,<sup>12</sup> pulmonary aspiration,<sup>13</sup> and esophageal trauma. Each was recorded as present or absent based on the review of the medical record. Upper airway edema was determined from clinical descriptions provided in the EMS records, airway documents, and medical and procedural records. Subcutaneous emphysema was determined from review of the physician and nursing documentation and from chest radiographs, when available. Pulmonary aspiration was defined as the reported visualization of gastric contents on the vocal cords or within the tracheobronchial tree (if bronchoscopy was performed) or a new infiltrate on chest radiograph (if chest imaging was



performed) within 48 hr of tracheal intubation. Two of the study investigators (A.G.M. and D.A.D.) independently reviewed each record and coded the complications.

Data were also collected on patient demographics, pre-existing medical conditions, reason for initial tracheal intubation, previous tracheal intubation attempts prior to the King LT placement, duration of mechanical ventilation, requirement for eventual surgical tracheostomy, hospital length of stay, and survival to discharge. Severity of illness scores (Acute Physiology and Chronic Health Evaluation [APACHE] III<sup>14</sup> at 24 hr and American Society of Anesthesiologists physical status) were recorded in patients presenting to the intensive care unit and for anesthesia, respectively. Mortality, defined as in-hospital death, was recorded for all patients arriving in the ED with a King LT as well as for all patients arriving in the ED with any artificial airway in place.

Categorical data were summarized as counts and percentages and continuous data as mean [standard deviation (SD)] or median (interquartile range [IQR]) as indicated. Summary data were presented in tabular form. Mortality data between the King LT patients and all other tracheally intubated patients arriving in the ED were compared using a Chi square test. The APACHE scores for these two groups were compared using the Wilcoxon rank-sum test. The association between the trauma and tracheostomy placement was tested using a Chi square test. All statistical analyses were performed using JMP® 9.0.1 statistical software (SAS Inc.; Cary, NC, USA).

## Results

Fifty-two patients presented with a King LT in place. Four patients died soon after arrival and before any definitive airway could be attempted due to complications of their illness, and they were excluded from further study. Patient characteristics are shown in Table 1. Twenty-seven (57%) of the remaining 48 patients were male, mean (SD) age was 60 (19) yr, and mean (SD) body mass index was 32.0 (9.8) kg·m<sup>-2</sup>. The three most common comorbid medical conditions in this population were coronary artery disease 14 (29%), chronic kidney disease ten (21%), and diabetes mellitus ten (21%) (Table 1).

Cardiac arrest [28 (58%) patients] or trauma [9 (19%) patients] were the most common reasons for respiratory failure requiring intubation. Four (44%) of the nine trauma patients had major facial trauma. The King LT was used after the first failed tracheal intubation attempt in 33 (69%) patients. Other attempts at securing the airway prior to King LT insertion included more than one attempt at direct laryngoscopy in 12 (25%) cases and attempts by more than one provider in three (6%) cases.

The King LT was successfully placed on the first attempt in all patients.

Surgical tracheostomy was chosen as the definitive airway management technique in 14 (29%) patients. The Arndt exchange catheter, direct laryngoscopy, and video laryngoscopy were used in 11 (22%), ten (21%), and ten (21%) cases, respectively. Flexible bronchoscopic intubation was used as the definitive airway management technique in only three (6%) cases. The number of each definitive airway technique by etiology of respiratory failure and the time to definitive airway management for each technique is shown in Table 2. A non-surgical airway management was the most commonly used technique in the cardiac arrest patients (Table 2). In contrast, the vast majority [7 (78%)] of trauma patients underwent surgical tracheostomy for definitive airway management. An anesthesiologist secured the airway in 24 (50%) patients, followed by a trauma surgeon [14 (29%)], ED physician [8 (17%)], and critical care physician [2 (4%)]. There were no failed airway exchanges or unplanned emergency surgical airways.

Presenting to the ED with a King LT was associated with increased mortality. A total of 538 patients arrived in the ED with an artificial airway in place and were admitted to the hospital. Of these, 490 (91%) patients had an ETT and 48 (9%) had a King LT airway. Eighteen (38%) of the 48 patients in the King LT group survived to hospital discharge compared with 378 (78%) of 490 patients in the ETT group (odds ratio of mortality if presenting with a King LT airway, 4.44; 95% confidence interval, 2.36 to 8.36;  $P < 0.001$ ). Similarly, the mean (SD) APACHE scores for patients with a King LT were significantly higher than for those with an ETT [96 (36) vs 73 (1), respectively;  $P < 0.001$ ]. Trauma patients were more likely to undergo surgical tracheostomy than medical patients [7 of 9 (78%) vs 7 of 39 (18%), respectively;  $P < 0.001$ ]. Adverse events following King LT use occurred in 13 (27%) patients. Upper airway edema due to tongue engorgement was the most common complication (Table 3). In-hospital course and critical care requirements are presented in Table 1. Median [IQR] duration of mechanical ventilation was 1.2 [0.5-6.8] days; intensive care unit length of stay was 3.8 [1.7-11.5] days, and hospital length of stay was 12.7 [6.3-21.0] days. In the 30 (63%) patients who did not survive to discharge, median [IQR] duration of mechanical ventilation was 1.0 [0.4-2.1] days and time to death was 1.8 [0.4-3.3] days.

## Discussion

This novel study of a large cohort describes the definitive in-hospital airway management and reported airway

**Table 1** Demographic and descriptive data on the King LT Cohort ( $n = 48$ )

Demographics	
Age (yr), mean (SD)	60 (18.7)
Male sex, $n$ (%)	27 (57.4)
Body mass index ( $\text{kg}\cdot\text{m}^{-2}$ ), mean (SD)	32.0 (9.8)
Reason for tracheal intubation, $n$ (%)	
Cardiac arrest	28 (58.3%)
Trauma	9 (18.6%)
Respiratory arrest	5 (10.4%)
Neurologic	6 (12.5%)
Severity of illness at presentation, $n$ (%)	
American Society of Anesthesiologists physical status score	
I	0 (0%)
II	0 (0%)
III	1 (2%)
IV	21 (44%)
V	26 (54%)
APACHE III	98.4 (35.5)
Survival, hospital course, and critical care requirements	
Survival to hospital discharge, $n$ (%)	
Duration of mechanical ventilation in survivors, median [IQR] days	1.2 [0.5-6.8]
ICU length of stay in survivors, median [IQR] days	3.8 [1.7-11.5]
Hospital length of stay in survivors, median [IQR] days	12.7 [6.3-21.0]
Death during hospitalization, $n$ (%)	
Duration of mechanical ventilation in non-survivors, median [IQR] days	1.0 [0.4-2.1]
Time to death in non-survivors, median [IQR] days	1.8 [0.4-3.3]
Comorbidities, $n$ (%)	
Coronary artery disease	14 (29%)
Congestive heart failure	4 (8%)
Atrial or ventricular arrhythmia	3 (6%)
Cerebrovascular accident	4 (8%)
Chronic obstructive pulmonary disease	2 (4%)
Asthma	2 (4%)
Gastroesophageal reflux disease	3 (6%)
Chronic kidney disease	10 (21%)
Diabetes mellitus	10 (21%)

ICU = intensive care unit;  
IQR = interquartile range

complications of patients following King LT placement. While the King LT is a successful means by which to manage the airway in the pre-hospital setting, our findings suggest the need for a structured approach to definitive airway management as complications of converting a King LT to a definitive airway are common.

When compared with the Combitube, the King LT requires fewer steps for placement and confirmation, which may translate into more rapid and higher success rates, even by inexperienced providers.<sup>6</sup> In our cohort, the King LT was successfully placed on the first attempt 100% of the time. This success rate is consistent with the published literature<sup>15,16</sup> and supports the use of this device as a first-

line device or an appropriate backup in the pre-hospital setting.

When inflated to pressures as suggested by the manufacturer (i.e., 60 cm H<sub>2</sub>O), the proximal oropharyngeal cuff of the King LT will displace the surrounding soft tissues, including the tongue; however, overinflation of the cuff can occur with resultant exaggerated anatomical distortion and indirect vascular compression. These processes can result in pharyngeal, glottic, and lingual edema.<sup>7,17,18</sup> This upper airway edema has been reported with use of the Combitube,<sup>17</sup> King LT,<sup>19</sup> and the original laryngeal mask supraglottic airway<sup>20,21</sup> and complicates the subsequent exchange of this device for

**Table 2** Definitive airway technique

	All causes <i>n</i> (%)	Time to airway exchange, min median [IQR]	By etiology (%)			
			Trauma	Cardiac arrest	Respiratory arrest	Neurologic
Tracheostomy	14 (29%)	115 [78-163]	7	2	3	2
Direct laryngoscopy	10 (21%)	17 [3-89]	0	8	1	1
Videolaryngoscopy	10 (21%)	63.5 [6-171]	0	7	1	2
Fibreoptic intubation	3 (6%)	2,232 [1-2,744]	0	2	0	1
Arndt	11 (22%)	79 [47-102]	2	9	0	0
Total (%)			9 (18.75)	28 (58.33)	5 (10.42)	6 (12.5)

IQR = interquartile range

**Table 3** Complications associated with the King Laryngeal Tube

Complication	<i>n</i> (%)
Tongue engorgement	7 (15%)
Glottic edema	2 (4%)
Subcutaneous emphysema	2 (4%)
Pulmonary aspiration	1 (2%)
Esophageal trauma	1 (2%)
Total	13 (27%)

a more definitive airway. In our cohort, 19% of patients displayed clinically significant upper airway edema requiring the use of advanced airway management techniques beyond simple direct laryngoscopy for subsequent management. It should be recognized, however, that there are other potential reasons for airway edema in these patients, including primary airway injury, repeated attempts at laryngoscopy, fluid resuscitation, etc.

Advanced airway techniques other than direct laryngoscopy were deemed necessary by the treating physician in 38 (79%) patients. These techniques included video laryngoscopy, flexible bronchoscopy, the use of an Arndt airway exchange catheter, and surgical tracheostomy. The choice of technique was influenced by patient factors (i.e., patient size, physical examination), previous attempts at securing the airway in the field, the comfort level of the specialty team managing the airway, and the etiology of respiratory failure.

The majority of the trauma patients (7 of 9 [78%]) underwent surgical tracheostomy in the operating room. This incidence is higher when compared with other trauma populations.<sup>22</sup> We surmise that this was due to the observed upper airway edema, perceived airway difficulty from facial injuries (4 of the 9 patients), and failed attempts at direct laryngoscopy. Familiarity of the trauma surgeons in the conduct of surgical tracheostomies may also have contributed. In any case, these findings advise careful airway evaluation, including consideration of surgical

tracheostomy, when managing trauma patients presenting with King LTs.

Thirty-two (82%) of 39 non-trauma patients underwent successful airway exchange without tracheostomy. Techniques included video laryngoscopy or the use of an Arndt airway exchange catheter for exchange to an ETT. This finding suggests that, in non-trauma patients, King LTs can be safely exchanged without the need for a surgical tracheostomy.

A surgical tracheostomy as the primary method for securing the airway for all patients with a King LT has been advocated in the literature based on a small six-patient series.<sup>19</sup> Data from our much larger series argues against this strategy for non-trauma patients. A further argument against routine tracheostomy is that the majority of patients presenting with a King LT either died (30 [62%] patients) within two days of hospital admission due to complications associated with their illness or tracheal extubation was performed within seven days, i.e., before a tracheostomy is often considered for weaning from the ventilator.

For other similar airway devices, such as the Combitube and the laryngeal mask supraglottic airway, the reported range of pulmonary aspiration is 4-12%.<sup>13</sup> While the design of the King LT, specifically the distal esophageal cuff, isolates the stomach more effectively than the laryngeal mask supraglottic airway,<sup>23</sup> pulmonary aspiration of gastric contents is still possible. In our cohort, the incidence of pulmonary aspiration was 2%. Because the aspiration event could have occurred before King LT placement or after intubation, we cannot attribute this incidence solely to use of the King LT device.

A major limitation of this study is the biased patient population. Our patient cohort was skewed towards trauma and comprised mostly of patients with high severity of illness. This greater severity of illness may have contributed to the rate of surgical tracheostomy. Furthermore, because of the relatively high prevalence of

obesity in the referral base, the incidence of difficult airways is potentially higher. Nevertheless, the conclusion that critically ill patients presenting with a King LT *in situ* require an advanced airway management technique beyond direct laryngoscopy appears valid and generalizable.

The second potential limitation is the lack of standardization of the airway exchange strategy. The technique chosen for exchanging the King LT was dictated by the clinician at the bedside. Nevertheless, the aim of this study is only to highlight the finding that patients presenting to the ED with a King LT present a real airway challenge and undue reliance on direct laryngoscopy is potentially dangerous. In our series, the majority of patients needed careful planning for airway exchange. The airway exchange technique that is eventually chosen should be an individualized decision. In fact, we show that all the different airway exchange strategies, by different specialties, were associated with low complication rates.

The third limitation of our study is its retrospective nature. Determining reasons for the various airway management techniques and characterizing complications were limited by the data available in the medical record. To account for this limitation, all available medical records were thoroughly scrutinized by at least two investigators. Any subsequent studies that provided information pertinent to the study, such as bronchoscopy, surgery, and radiology reports, were also incorporated. Lastly, as this is a single-centre study, not all specific management practices may be generalizable.

In conclusion, it is essential that anesthesiologists become familiar with the techniques, complications, and patient populations associated with use of the King LT. An advanced airway management technique beyond direct or video laryngoscopy is typically necessary to exchange the device for an endotracheal tube. Trauma patients presenting with this airway device in place may be at higher risk of airway exchange failure and the need for tracheostomy.

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**Conflicts of interest** None declared.

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