Managing the Out-of-Hospital Extraglottic Airway Device

Darren Braude, MD, EMT-P*; Michael Steuerwald, MD; Trent Wray, MD; Richard Galgon, MD

*Corresponding Author. E-mail: dbraude@salud.unm.edu, Twitter: @darrenbraude.

0196-0644/$-see front matter

https://doi.org/10.1016/j.annemergmed.2019.03.002

Continuing Medical Education exam for this article is available at http://www.acep.org/ACEPeCME/.

[Ann Emerg Med. 2019;74:416-422.]

Extraglottic devices (commonly referred to as supraglottic airways) are often placed in the out-of-hospital setting either as a primary airway or after a failed attempt at intubation.[1–4] They may be used in any critically ill patient with the need for airway management, including those with cardiac arrest, trauma, medication or drug toxicity, pneumonia, and pulmonary edema. Recent evidence from 2 large, international, randomized controlled trials suggests that extraglottic device placement may be the preferred airway management strategy for out-of-hospital cardiac arrest,[3,4] which likely means that more patients will arrive in emergency departments (EDs) with extraglottic devices in place in the near future.

Because of their unique features and deployment in critically ill patients, rapid, reflexive removal of a functioning extraglottic device without a well-considered plan may lead to aspiration, hypoxemia, loss of the airway, or all three. ED providers must therefore be comfortable assessing and managing patients who arrive in the ED with an extraglottic device placed by emergency medical services (EMS).

WHAT IS AN EXTRAGLOTTIC DEVICE?

Extraglottic devices are invasive airways that are inserted blindly through the oropharynx but do not enter the larynx. They are seated either above (supraglottic) or behind (retroglottic) the glottic opening (Figure 1). Supraglottic devices have one cuff that may or may not be inflatable, whereas retroglottic devices have dual inflatable balloons to seal both the esophagus and the pharynx, with ventilation originating from between the 2 balloons. Retroglottic devices may have 1 or 2 lumina. Examples of common extraglottic devices used in out-of-hospital care are found in Figure 2. The dual-lumen esophageal-tracheal Combitube may be blindly placed in the trachea up to 10% of the time, in which case it can function adequately as an endotracheal tube.[5]

HOW CAN I ASSESS AND TROUBLESHOOT THE FUNCTION OF AN EXTRAGLOTTIC DEVICE?

Upon ED presentation, the first consideration is to assess ventilation with waveform capnography, chest rise, and lung auscultation. Barriers to adequate ventilation may reside within the extraglottic device or the patient. Troubleshooting measures may include reseating the device deeper within the oropharynx, slightly withdrawing the device (more common with the King Laryngeal Tube), or adding or subtracting cuff volume. If time and patient status permit, the use of video laryngoscopy can help determine whether the extraglottic device is appropriately seated and guide subsequent repositioning.[6] Clinical conditions that may impair ventilation despite a well-positioned extraglottic device include tension pneumothorax, severe bronchospasm, and severe gastric distention. Once adequate ventilation is ensured, the focus turns to assessment of oxygenation. Similar to an endotracheal tube, poor oxygenation may respond to increased FiO_2 or positive end-expiratory pressure. Other maneuvers that may improve oxygenation include gastric decompression, change in patient positioning, and optimization of patient hemodynamics.

WHEN SHOULD AN EXTRAGLOTTIC DEVICE BE REMOVED OR EXCHANGED FOR AN ENDOTRACHEAL TUBE?

There are 2 important considerations for managing an extraglottic device in the ED: first, is the extraglottic device providing adequate ventilation and oxygenation; and second, does exchange to an endotracheal tube need to occur urgently or electively? This decision process is outlined in Figure 3. If ventilation is inadequate and cannot be rapidly corrected, remove the extraglottic device, perform bag-valve-mask ventilation, and prepare for intubation or a surgical airway. Alternatively, consider the insertion of a different size or type of extraglottic device, or immediate performance of a surgical airway with the

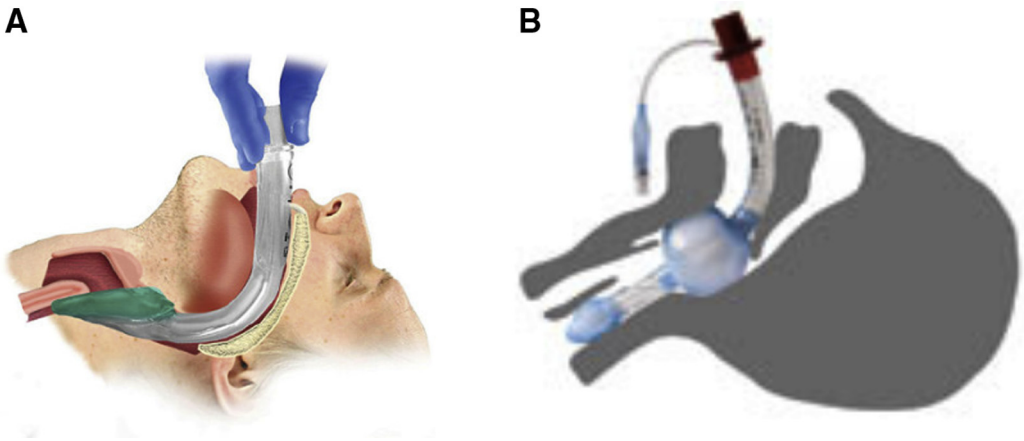


Figure 1. Examples of a supraglottic device (i-gel supraglottic airway device; Intersurgical Ltd., Wokingham, UK), which is situated above the glottis (*A*); and a retroglottic device (King LT-D Ambu USA, Columbia, MD), which situates a balloon behind the glottis in the upper esophagus (*B*).

extraglottic device in place. If ventilation is adequate but oxygenation is not, the cause is more likely related to the patient's underlying condition than the extraglottic device. In that case, anticipate rapid desaturation once the device is removed. Attempt to optimize oxygenation by applying or increasing positive end-expiratory pressure while preparing for urgent exchange to an endotracheal tube.

If both ventilation and oxygenation are adequate, exchange of the extraglottic device can be performed electively or even deferred until competing clinical priorities are addressed. In the University of New Mexico ED, it is common to perform the initial resuscitation and imaging, including computed tomographic scans, with an out-of-hospital extraglottic device in place. If well functioning, the extraglottic device may also be used during cardiopulmonary resuscitation; termination of resuscitation may occur with the extraglottic device in place.

Because extraglottic devices lack a tracheal cuff, some providers may have concerns about the risk of aspiration with their continued use in the ED. However, the risk of pulmonary aspiration is likely limited with the extraglottic device in place.[7,8] Clinically significant air leak and gastric insufflation around an extraglottic device is unlikely at lower peak inspiratory pressures, particularly with devices that allow gastric decompression.[9–11] The prevalence of aspiration is similar whether an extraglottic device or endotracheal tube is placed, suggesting that the aspiration events likely occur before airway insertion.[3,4,7,8,12,13]

Always assess the risk and benefits before performing any extraglottic device exchange. Consider predictors of airway difficulty (Table 1) balanced against the anticipated clinical course. If EMS personnel placed the extraglottic device because of difficulty with intubation, consider a more conservative approach to extraglottic device exchange. Retroglottic devices such as the King Laryngeal Tube and the Combitube, as well as the rigid supraglottic LMA Fastrach, should be removed within 2 to 4 hours to avoid compression of the tongue and other pharyngeal structures.[14–16] Other supraglottic devices may potentially be left in place much longer. Patients with upper airway pathology that may result in airway obstruction, those requiring very high positive end-expiratory pressure, or those requiring high plateau pressures may benefit from earlier exchange to an endotracheal tube. Patients undergoing emergency procedures that involve the oropharynx as a conduit, such as esophagogastroduodenoscopy or transesophageal echocardiography, or those leaving the ED to go to the cardiac catheterization laboratory or interventional radiology suite may similarly benefit from earlier elective extraglottic device exchange (Table 2).

Although it is customary to exchange any extraglottic device before interfacility transport, in select cases it may be prudent or necessary to transport with the extraglottic device in place. Considerations include the adequacy of extraglottic device function, concerns about subsequent airway management, pulmonary or systemic deterioration (eg, upper airway edema, progressive deterioration in pulmonary function), duration of transport, predicted difficulty of extraglottic device exchange, and preference of the transport team. Ensure that the receiving facility is aware of the extraglottic device use during transport so that they can mobilize appropriate resources before the patient's arrival.

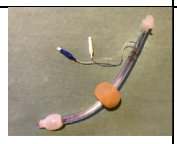
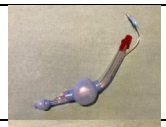
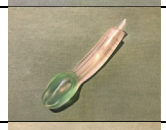
Device	Image	Position/Type	Gastric Decompression?	Allows Endoscopic Intubation?	Pediatric sizes available?
Combitube™		Retroglottic Dual-lumen Dual-balloon	Yes Up to size 14F in Adult Regular size	No	No
King Laryngeal Tube™		Retroglottic Single-lumen Dual-balloon	Yes (LTS-D) Up to size 18Fr	No	Yes
Laryngeal Mask Airway® Unique™ (LMA)		Supraglottic Inflatable cuff	No	Yes	Yes
LMA® Supreme™		Supraglottic Inflatable cuff	Yes Up to size 16 Fr	No	Yes
LMA® Fastrach™		Supraglottic Inflatable cuff	No	Yes	30 kg and up
Ambu® Auragain™		Supraglottic Inflatable cuff	Yes Up to size 16 Fr	Yes	Yes
i-gel™		Supraglottic Non-inflatable cuff	Yes Up to size 14 Fr	Yes	Yes
Cookgas® AirQ™		Supraglottic Inflatable cuff or self-pressurizing	Yes Esophageal blocker device or standard gastric tube	Yes	Yes

Figure 2. Examples of commonly used out-of-hospital extraglottic devices.

HOW SHOULD I OPTIMIZE THE FUNCTION OF AN EXTRAGLOTTIC DEVICE?

The extraglottic device should be secured in place with tape or a commercial tube-securing device. You must use a commercial tube holder designed specifically for the wide diameter of an extraglottic device; a standard endotracheal tube holder may not work. In addition, the i-gel O2 Resus Pack comes with a strap intended to secure only that device. A gastric tube should be placed to decompress the stomach if a gastric decompression port is available on the particular device (Figure 2). This will further reduce the risk of aspiration in the absence of a cuffed endotracheal tube. If a bite block is not already present on the device, one should be placed. The patient may begin receiving ventilator support with conventional lung-protective ventilator settings,[17,18] although a pressure control mode may be preferable to ensure that peak inspiratory pressures remain below approximately 20 cm H_2O to minimize air leak and gastric insufflation.[9–11,17–19] If an air leak occurs, consider changes in ventilator parameters to reduce peak inspiratory pressures. Waveform capnography should be monitored to assess appropriate positioning and ventilation. Patients should receive analgesia and sedation with or without paralysis just as if they were intubated.

HOW DO I EXCHANGE AN EXTRAGLOTTIC DEVICE FOR AN ENDOTRACHEAL TUBE?

Strategies for exchange from extraglottic device to endotracheal tube may be categorized as extraluminal (placed around the extraglottic device) or endoluminal (placed through the extraglottic device). Although some case series describe surgical airway as a predominant

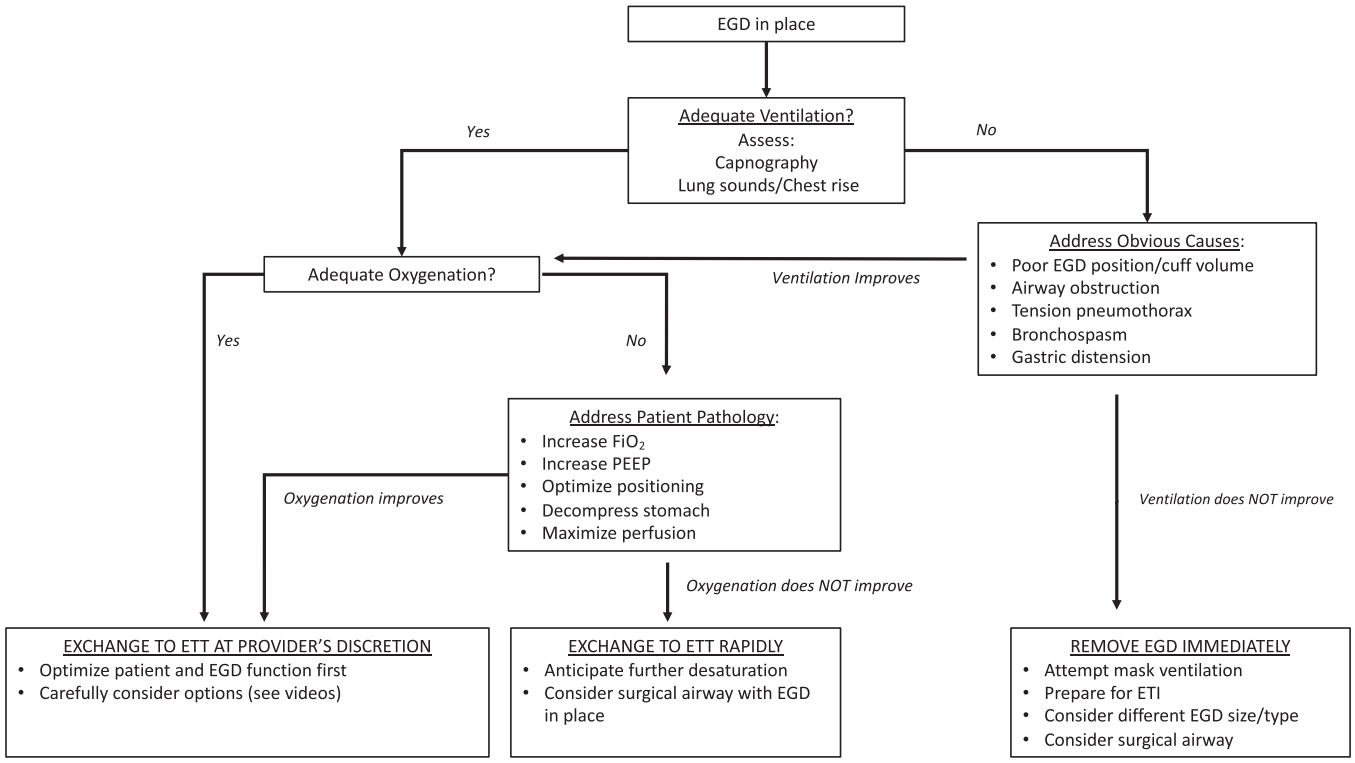


Figure 3. Algorithm summarizing approach to the patient arriving in the ED with an EGD in place. *EGD*, Extraglottic device; *FiO_2*, fraction of inspired Oxygen; *PEEP*, positive end-expiratory pressure; *ETI*, endotracheal intubation.

method for exchanging a King Laryngeal Tube,[20,21] we and other authors have not found this to be necessary.[22,23]

Option 1: Remove Extraglottic Device and Perform Standard Laryngoscopy (Denovo)

This approach may be used with an extraglottic device when a difficult airway is not anticipated, patient physiology is favorable, sufficient equipment for a more secure exchange is not available, or time is limited. If possible, the stomach should be decompressed before extraglottic device removal. If the patient has intact airway reflexes or awareness, consider the use of an induction agent and paralytic prior to intubation. As with all intubations, optimize patient positioning and oxygenation. Leave the extraglottic device in place to provide oxygenation and ventilation until paralysis has been achieved. If intubation proves unexpectedly difficult, consider reinsertion of the same extraglottic device or a different model that is better suited for endoluminal exchange.

Option 2: Perform Direct or Video Laryngoscopy With Extraglottic Device in Place (Extraluminal)

This approach is particularly useful with retroglottic devices. The retroglottic tube obstructs the esophagus and limits the potential for inadvertent esophageal intubation. If intubation efforts are unsuccessful, the extraglottic device may be rapidly reinflated to restore its function. When the operator and patient are fully prepared, deflate the appropriate balloon(s), sweep the extraglottic device as far to the left side of the mouth as possible, and perform intubation (Video E1, available online at http://www.annemergmed.com). Direct or video laryngoscopy may be used, often with a bougie; this approach has been reported as highly successful.[22,23] If an adequate view of airway structures is obtained with laryngoscopy, but space within the oropharynx is too limited by the bulk of the extraglottic device to perform the intubation, the extraglottic device may need to be removed to facilitate the procedure.

With the King Laryngeal Tube, the balloons are interconnected and will deflate simultaneously. However, with the Combitube the proximal balloon may be deflated while the distal balloon remains inflated to occlude the esophagus. Because both King Laryngeal Tube balloons are connected, it is also possible to use pressure from the laryngoscope blade to move air from the proximal balloon to the distal balloon such that full deflation is not required for visualization.

Option 3: Endoscopic Exchange (Endoluminal)

Endoscopic exchange is an excellent approach when a supraglottic device or the intubating King Laryngeal Tube

Table 1. Airway risk assessment tools.

Tool	Acronym
Difficult intubation (LEMON)	*L*ook externally *E*valuation "3-3-2" rule *M*allampati score *O*bstruction *N*eck mobility
Difficult bag-valve-mask ventilation (ROMAN)	*R*adiation/restriction *O*besity/obstruction/obstructive sleep apnea *M*ask seal/Mallampati score/male sex *A*ge >55 y *N*o teeth
Difficult surgical airway (SMART)	Surgical history *M*ass *A*ccess/anatomy *R*adiation *T*umor
Difficult extraglottic device use (RODS)	*R*estricted mouth opening *O*bstruction/obesity *D*istorted airway anatomy Stiff lungs/short thyromental distance

(From Brown CA. *The Walls Manual of Emergency Airway Management*. 5th ed. Philadelphia, PA: Wolters Kluwer; 2017. Also from The Difficult Airway Course [available at: http://www.theairwaysite.com]). Used with permission.

is in place, the necessary equipment and expertise are available, the extraglottic device is functioning well, and time permits.[24,25] It is the ideal method if there are indicators of difficult intubation (Table 1). If a compatible extraglottic device (one with a large enough unobstructed lumen for endotracheal tube passage) is well seated, the glottic opening should be positioned directly at the outlet of the device, allowing easy visualization and insertion of an endoscope (or intubating stylet) with subsequent passage of a preloaded endotracheal tube over the endoscope. With the technique described in Video E2 (available online at http://www.annemergmed.com), continuous oxygenation and ventilation may be maintained during the entire exchange.[25]

For extraglottic devices that do not have a large-bore lumen to accommodate an endotracheal tube (such as the LMA Supreme and regular King Laryngeal Tube), an Aintree Intubation Catheter should be used as shown in Video E3 (available online at http://www.annemergmed.com). An Aintree Catheter requires a small-caliber endoscope (ie, less than 4.7 mm outside diameter) for placement.[26] Because oxygenation is limited from the time the extraglottic device is removed until an endotracheal tube is advanced over the Aintree catheter, safe apnea time may be limited.

Another approach that has been described involves advancing a disposable Ambu aScope through the lumen until tracheal placement is visually confirmed and then cutting the wand—with subsequent loss of visualization—so that it can be used as a bougie or airway exchange catheter.[27] In our experience, the Ambu aScope wand is neither a good bougie nor a good airway exchange catheter, so we do not generally recommend this approach.

Option 4: Blind Exchange Through Extraglottic Device (Endoluminal)

Blind endotracheal tube introduction is most safe and reliable through the LMA Fastrach, with success rates greater than 90% by using techniques reviewed elsewhere.[28] Blind intubation has also been reported for the

Table 2. Situations in which intubation may be partially desirable over a well-functioning extraglottic device.

Situation	Rationale
Upper airway pathology (inhalation injury, direct trauma, infection)	Progressive upper airway edema below level of device may make delayed intubation difficult and may eventually make ventilation through the EGD impossible.
Poor lung compliance	High required inspiratory pressures may cause a leak, and appropriate mean airway pressures for alveolar recruitment may not be maintained.
Need for very high peak inspiratory pressures or alternative ventilator modes such as airway pressure release ventilation or PRVC	High mean airway pressure may cause a leak, causing gastric insufflation and increasing aspiration risk. In the case of PRVC, a leak may cause inappropriate tidal volumes to be maintained.
Invasive esophageal procedure planned (eg, endoscopy, TEE)	New EGDs may exist to facilitate endoscopy and TEE, but these are not yet standard for emergency situations.
Patient leaving ED for an extended period (eg, to endoscopy suite, cardiac catheterization laboratory) or undergoing prolonged interfacility transfer	Intubation may be more difficult in these situations if it becomes urgently indicated.

PRVC, pressure-regulated volume control; *TEE*, transesophageal echocardiography.

Cookgas air-Q and the i-gel, with lower success rates.[29–32] It may be reasonable to make a single attempt at blind intubation with these extraglottic devices, but it is very important to confirm the tube placement with capnography and not persist if failure ensues. An alternative approach is to pass a bougie through the device and into the trachea. However, airway perforation has been reported,[33] likely because the usual forgiving flexibility of the bougie is lost when it is effectively "anchored" within the lumen of the extraglottic device, a few centimeters from the airway. The manufacturer of the King Laryngeal Tube no longer recommends blind exchange over a bougie. The cautious, experienced provider may consider a single attempt at bougie passage, but the attempt should be aborted if any resistance is encountered.

Option 5: Surgical Airway (Extraluminal)

Performance of a surgical airway may be reasonable when intubation is expected to be extremely difficult and the time, equipment, or expertise for another method of exchange is not available. Placement of the surgical airway may proceed with continued ventilation through the extraglottic device, even if it is suboptimal, as delivery of any oxygen may be vital in these critical situations. We have occasionally used this technique and have found it to be effective.

REMOVAL OF THE EXTRAGLOTTIC DEVICE AFTER ENDOTRACHEAL INTUBATION

After successful endoluminal intubation, removal of the extraglottic device over the endotracheal tube (Video E4, available online at http://www.annemergmed.com) may be difficult and result in inadvertent endotracheal tube dislodgment. Only experienced personnel should attempt this. It may be necessary to leave the extraglottic device in place while ventilating through the endotracheal tube. If it is left in place, we recommend fully deflating any extraglottic device cuffs to minimize pressure against hypopharyngeal soft tissue.

In conclusion, management of an extraglottic device is a critical skill for emergency physicians. Most extraglottic devices provide adequate oxygenation and ventilation, with or without simple troubleshooting, and may be left in place while competing priorities are addressed. Exchange of an extraglottic device to an endotracheal tube should be performed in a systematic, planned manner.

Supervising editor: Henry E. Wang, MD, MS. Specific detailed information about possible conflict of interest for individual editors is available at https://www.annemergmed.com/editors.

Author affiliations: From the Department of Emergency Medicine (Braude, Wray), Division of Adult Critical Care (Wray), and Department of Anesthesiology (Braude), University of New Mexico Health Sciences Center, Albuquerque, NM; and the Department of Emergency Medicine (Steuerwald) and Department of Anesthesiology (Galgon), University of Wisconsin, Madison, WI.

Authorship: All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding and support: By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist.

REFERENCES

1. Hubble MW, Wilfong DA, Brown LH, et al. A meta-analysis of prehospital airway control techniques part II: alternative airway devices and cricothyrotomy success rates. *Prehosp Emerg Care*. 2010;14:515-530.
2. McMullan J, Gerecht R, Bonomo J, et al. Airway management and out-of-hospital cardiac arrest outcome in the CARES registry. *Resuscitation*. 2014;85:617-622.
3. Benger JR, Kirby K, Black S, et al. Effect of a strategy of a supraglottic airway device vs tracheal intubation during out-of-hospital cardiac arrest on functional outcome: the AIRWAYS-2 randomized clinical trial. *JAMA*. 2018;320:779-791.
4. Wang HE, Schmicker RH, Daya MR, et al. Effect of a strategy of initial laryngeal tube insertion vs endotracheal intubation on 72-hour survival in adults with out-of-hospital cardiac arrest: a randomized clinical trial. *JAMA*. 2018;320:769-778.
5. Rabitsch W, Schellongowski P, Staudinger T, et al. Comparison of a conventional tracheal airway with the Combitube in an urban emergency medical services system run by physicians. *Resuscitation*. 2003;57:27-32.
6. Van Zundert A, Kumar C, Van Zundert T. Malpositioning of supraglottic airway devices: preventive and corrective strategies. *Br J Anaesth*. 2016;116:579-582.
7. Steuerwald MT, Robinson BR, Hanseman DJ, et al. Prehospital airway technique does not influence incidence of ventilator-associated pneumonia in trauma patients. *J Trauma Acute Care Surg*. 2016;80:283-288.
8. Steuerwald MT, Braude DA, Petersen TR, et al. Preliminary report: comparing aspiration rates between prehospital patients managed with extraglottic airway devices and endotracheal intubation. *Air Med J*. 2018;37:240-243.
9. Uppal V, Fletcher G, Kinsella J. Comparison of the igel with the cuffed tracheal tube during pressure-controlled ventilation. *Br J Anaesth*. 2009;102:264-268.
10. Kim YB, Chang YJ, Jung WS, et al. Application of PEEP using the i-gel during volume-controlled ventilation in anesthetized, paralyzed patients. *J Anesth*. 2013;27:827-831.
11. Weller N, Latorre F, Eberle B, et al. Respiratory mechanics, gastric insufflation pressure, and air leakage of the laryngeal mask airway. *Anesth Analg*. 1997;84:1025-1028.

12. Virkkunen I, Ryynanen S, Kujala S, et al. Incidence of regurgitation and pulmonary aspiration of gastric contents in survivors from out-of-hospital cardiac arrest. *Acta Anaesthesiol Scand*. 2007;51:202-205.
13. Radu RR, Kaserer A, Seifert B, et al. Prevalence and in-hospital outcome of aspiration in out-of-hospital intubated trauma patients. *Eur J Emerg Med*. 2018;25:362-367.
14. Gaither JB, Matheson J, Eberhardt A, et al. Tongue engorgement associated with prolonged use of the King-LT laryngeal tube device. *Ann Emerg Med*. 2010;55:367-369.
15. Braude D, Southard A, Bajema T, et al. Rapid sequence airway using the LMA-Supreme as a primary airway for 9 hours in a multi-system trauma patient. *Resuscitation*. 2010;81:576-578.
16. Gerstein NS, Braude D, Harding JS, et al. A case of lingual ischemia and edema from prolonged insertion of a Fastrach laryngeal mask airway. *West J Emerg Med*. 2011;12:124-127.
17. Joly N, Poulin LP, Tanoubi I, et al. Randomized prospective trial comparing two supraglottic airway devices: igel™ and LMA-Supreme™ in paralyzed patients. *Can J Anaesth*. 2014;61:794-800.
18. Devitt JH, Wenstone R, Noel AG, et al. The laryngeal mask airway and positive pressure ventilation. *Anesthesiology*. 1994;80:550-555.
19. Mishra SK, Nawaz M, Satyapraksh MV, et al. Influence of head and neck position on oropharyngeal leak pressure and cuff position with the Proseal Laryngeal Mask Airway and the I-Gel: a randomized clinical trial. *Anesthesiol Res Pract*. 2015;2015:705869.
20. Subramanian A, Garcia-Marcinkiewicz AG, Brown DR, et al. Definitive airway management of patients presenting with a pre-hospital inserted King LT(S)-D™ laryngeal tube airway: a historical cohort study. *Can J Anaesth*. 2016;63:275-282.
21. Hernandez MC, Aho JM, Zielinski MD, et al. Definitive airway management after pre-hospital supraglottic airway insertion: outcomes and a management algorithm for trauma patients. *Am J Emerg Med*. 2018;36:114-119.
22. Dodd K, Driver B, Reardon R. Trauma patients presenting with a King Laryngeal Tube™ in place can safely be intubated in the emergency department. *Am J Emerg Med*. 2018;36:503-504.
23. Dodd KW, Klein LR, Kornas RL, et al. Definitive airway management in emergency department patients with a King Laryngeal Tube™ in place: a simple and safe approach. *Can J Anaesth*. 2016;63:638-639.
24. Moore A, Gregoire-Bertrand F, Massicotte N, et al. I-gel versus LMA-Fastrach supraglottic airway for flexible bronchoscope-guided tracheal intubation using a Parker (GlideRite) endotracheal tube: a randomized controlled trial. *Anesth Analg*. 2015;121:430-436.
25. Landsdalen HE, Berge M, Kristensen F, et al. Continuous ventilation during intubation through a supraglottic airway device guided by fiberoptic bronchoscopy: an observational assessment. *Acta Anaesthesiol Scand*. 2017;61:23-30.
26. van Zundert T, Wong D, van Zundert A. The LMA-Supreme™ as an intubation conduit in patients with known difficult airways: a prospective evaluation study. *Acta Anaesthesiol Scand*. 2013;57:77-81.
27. Chatterjee D, Reid C, Lewis A. A potential technique for flexible scope-assisted intubation using an Ambu aScope 2™ inserted via supraglottic airway device. *Anaesth Intensive Care*. 2012;40:724.
28. Gerstein NS, Braude DA, Hung O, et al. The Fastrach™ Intubating Laryngeal Mask Airway®: an overview and update. *Can J Anaesth*. 2010;57:588-601.
29. Halwagi AE, Massicotte N, Lallo A, et al. Tracheal intubation through the i-gel™ supraglottic airway versus the LMA Fastrach™: a randomized controlled trial. *Anesth Analg*. 2012;114:152-156.
30. Michalek P, Donaldson W, Graham C, et al. A comparison of the i-gel supraglottic airway as a conduit for tracheal intubation with the intubating laryngeal mask airway: a manikin study. *Resuscitation*. 2010;81:74-77.
31. Theiler L, Kleine-Brueggeney M, Urwyler N, et al. Randomized clinical trial of the i-gel™ and Magill tracheal tube or single-use ILMA™ and ILMA™ tracheal tube for blind intubation in anaesthetized patients with a predicted difficult airway. *Br J Anaesth*. 2011;107:243-250.
32. Karim YM, Swanson DE. Comparison of blind tracheal intubation through the intubating laryngeal mask airway (LMA Fastrach™) and the Air-Q™. *Anaesthesia*. 2011;66:185-190.
33. Lutes M, Worman DJ. An unanticipated complication of a novel approach to airway management. *J Emerg Med*. 2010;38:222-224.