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The Role of the Combitube and Laryngeal Tube

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Introduction

First described in 1987[1], the Combitube combines the lumen of an endotracheal tube with an esophageal obturator airway. The dual lumen design facilitates airway management for the skilled or novice operator. Like a conventional endotracheal tube, it can be inserted into the trachea blindly or using direct laryngoscopy. Like an esophageal obturator or LMA, it can also be introduced blindly. If the Combitube resides in the esophagus, the obturator (blue) lumen can be used to ventilate the patient. The number of attempts to successful placement should be minimized since ventilation is possible whether the device is placed in the esophagus or trachea. The structural features of the esophageal-tracheal Combitube (ETC) are detailed in Figure 12.1.

Complications associated with its use and the high cost of this single-use product have precluded the Combitube from elective in-hospital use. Newer airway devices have supplanted its place in the management of difficult airways. Nevertheless, it remains more widely available than most of its alternatives, and training rescuers to use it is substantially easier[2–4].

Indications

The Combitube has been successfully used in multiple settings, including emergent prehospital settings, in-hospital emergencies, in-hospital airway rescue, and elective in-hospital surgery.

The Combitube is endorsed (Class IIa) by the American Heart Association for the support of ventilation and oxygenation during resuscitation and the peri-arrest period. In randomized trials, ventilation via a Combitube compared favorably to an endotracheal tube[5].

The American Society of Anesthesiologists describes the Combitube as a commonly cited technique to manage difficult ventilation[6]. Many case reports describe successful airway rescue in "cannot intubate-cannot ventilate" situations. These situations include not only CPR and resuscitation, but obstetrics, ICU, and airway rescue in the operating room[7,8].

Elective airway management has faded as a realm for the Combitube due to complications ranging from minor (tongue engorgement, sore throat), to severe (subcutaneous emphysema, pyriform sinus rupture), and life threatening (esophageal tear, pneumopericardium)[9–11]. While these complications can be serious, they are preferable to severe hypoxia and its consequences, which is why the Combitube remains available as a rescue device. Keys to minimizing minor and severe trauma include use of a rigid laryngoscope to facilitate Combitube placement and using a smaller device (see Table 12.1)[12].

Placement of the Esophageal Combitube

Placement of the ETC may be divided into two phases: a placement phase during which the device is placed in the airway, and a ventilation phase during which one or both cuffs are inflated; then ventilation is attempted and confirmed. The placement phase may be blind or blind and aided with a laryngoscope. Laryngoscopy may reveal a view of the glottis which permits endotracheal intubation with the ETC.

The ventilation phase consists of cuff inflation(s) and selection of lumens to attempt ventilation. The sequence of cuff and lumen selections is dependent on the clinical scenario. In emergencies, time to ventilation is minimized by fully inflating the pharyngeal and distal cuffs, and testing ventilation via the blue lumen (labeled "1"). Statistically, blind placement typically results in the ETC in the esophageal position, thus ventilation is more probable via the blue lumen. Figure 12.2 reflects the phases of routine ETC placement.

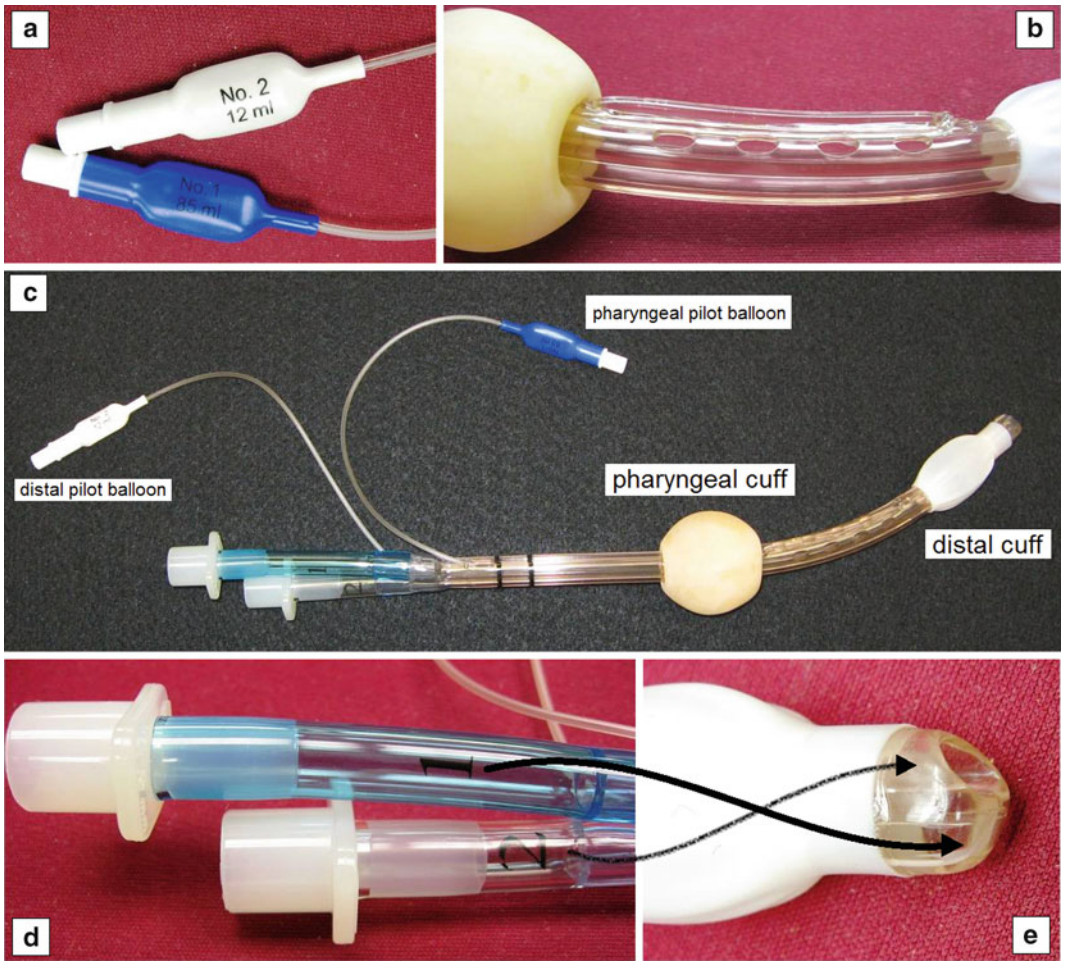

Figure 12.1. Anatomy of a Combitube. (**a**) Each cuff inflates separately. The *blue* (No. 1) pilot balloon connects to the proximal (pharyngeal) cuff. The cuff capacity is 85 mL for the Combitube SA (small adult). The *white* (No. 2) pilot balloon connects to the distal cuff. Cuff capacity is12 mL. (**b**) Eight side ports of the *blue*-topped lumen (labeled "1") open between the proximal (pharyngeal) and distal cuffs. In the likely event of esophageal intubation, ventilation occurs via these holes. Air is forced into the glottis because of the seals of the *yellow* pharyngeal cuff (*blue* pilot balloon) and the *white* esophageal cuff (*white* pilot balloon). (**c**) The Combitube is a double lumen device designed to permit ventilation whether placed in the trachea or esophagus. If tracheally placed, the device seals the trachea via the distal cuff (*white* pilot balloon) and ventilates via the distally opening lumen (labeled "2"). If esophageally placed, the device creates two seals: proximally in the pharynx with the pharyngeal cuff (*blue* pilot balloon) and distally in the esophagus with the distal cuff (*white* pilot balloon). Ventilation occurs via the side ports of the *blue*-topped lumen (labeled "1"). If placed in the esophagus, the *open* lumen can be used to decompress the stomach. (**d**) Blow *blue* first. The *blue* lumen (labeled "1") opens via side ports located between cuffs. This lumen extends to the end of the device where it ends blindly (*solid line*, Box **D**-**E**). Blind placement results in esophageal placement 95 % of the time; thus conventional wisdom advises to ventilate via the blue lumen first to confirm esophageal placement. The clear lumen (labeled "2) also extends to the end of the device but ends in an open orifice (*shaded line*, Box **D**-**E**). (**e**). The end of the device reveals one open orifice (from the clear lumen, labeled "2"), and one "dead-end" orifice (from the *blue* lumen, labeled "1").

Table 12.1. Size selection of ETC.

	Distal cuff recommended volume (mL)	Pharyngeal cuff recommended volume (mL)	For use in patients (height recommendation)
37 F SA (small adult)	10–12	85	Under 5 ft
41 F	10–15	100	Over 5 ft

Many reports suggest the 37 F SA ETC is effective in patients up to 6 ft in height[24]

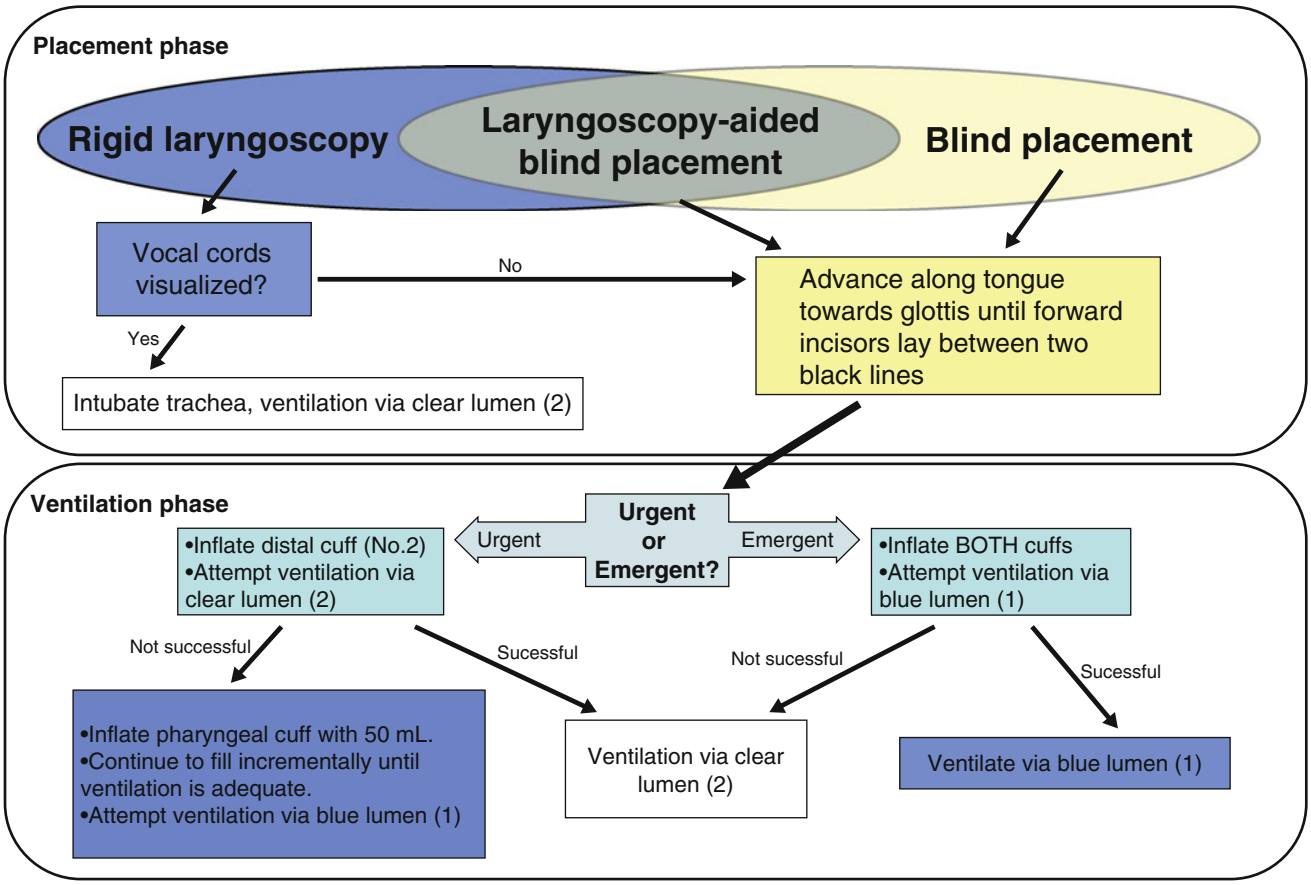

Figure 12.2. For routine ETC use, the placement phase starts with one of three situations: laryngoscope with glottic view, laryngoscope-aided blind, and blind unassisted. The algorithm for the ventilation phase is dependent on the urgency of the clinical scenario. When possible, a minimal inflation technique is preferable to minimize the risk of pharyngeal trauma.

Placement Phase

Placement with Laryngoscope, Vocal Cords Visualized

The ETC may be placed endotracheally akin to a conventional endotracheal tube. The distal cuff should be inflated (labeled white, No. 2), and ventilation should be initiated via the distal lumen (clear, labeled "2"). The pharyngeal cuff need not be inflated.

Blind Placement, with Laryngoscope, Blind Placement, without Laryngoscope

In this situation, the laryngoscope serves to mobilize the tongue, but the glottis is not visualized. The ETC is placed blindly until the patient's teeth rest between the two black lines (Figure 12.1, Box C). The ETC is inserted along the tongue in the direction of the glottis. If a laryngoscope is not available, the mandible and tongue are grasped and lifted and extended. Once the forward incisors rest between the black lines, one can proceed to the ventilation phase.

The head may remain in neutral position. Care should be taken to avoid contact with the posterior pharyngeal wall. The modified Lipp maneuver (described below) may decrease posterior pharyngeal trauma[13]. Esophageal placement is more likely.

Modified Lipp Maneuver

This maneuver consists of a concerted bend of the ETC in the area between the pharyngeal and distal cuffs. The induced curve should help avoid trauma along the posterior pharynx. The modified Lipp maneuver is shown in Figure 12.3.

Ventilation Phase

Emergent

In emergent situations the priority is minimal time to ventilation and oxygen delivery. Both cuffs are inflated to recommended volumes. The circuit should be attached initially to the blue lumen, labeled "1." Ventilation should be confirmed via conventional techniques. If ventilation is not possible via the blue lumen, the circuit should be attached to the clear lumen, labeled "2," and ventilation should be confirmed via conventional techniques.

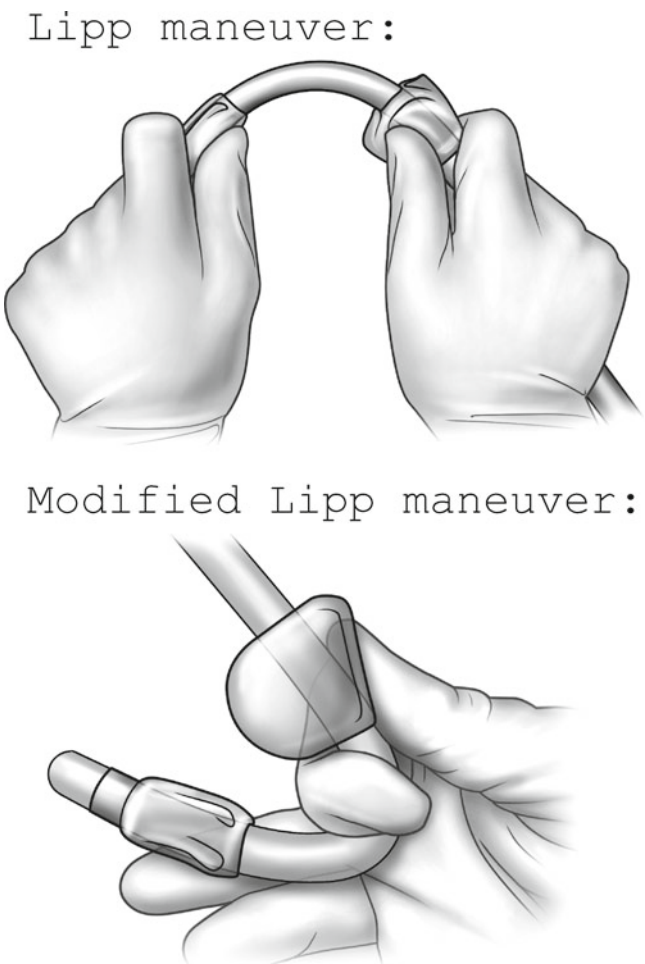

Figure 12.3. Figure of modified Lipp maneuver.

Non-emergent

If the clinical scenario allows for time, pharyngeal complications may be avoided using a minimal inflation technique. In this sequence, the pharyngeal cuff is inflated to less than the manufacturer's recommended volume. A volume of 50 mL is frequently clinically effective[14]. Lumen selection may start with the clear lumen (labeled "2"), but should quickly progress to the blue lumen if necessary. Ventilation should continue with the least amount of volume in the pharyngeal cuff to ensure adequate tidal volumes.

Lateral Placement to Avoid Tongue Engorgement

Tongue engorgement may be lessened by placement of the device lateral to the tongue. In this technique, the tongue is displaced with the same hand that opens the mouth. The device is placed at the opposite corner of the mouth, and eventually lies at the angle of the mouth as its final position.

In elective surgeries using this lateral placement technique, tongue engorgement was decreased in incidence and duration. Device effectiveness appears unaffected by lateral placement, as cuff leaks did not occur[15].

Minimal Leakage Technique to Avoid Tongue Engorgement

The minimal leakage technique has been recommended to decrease compression of lingual veins and thus tongue engorgement[16]. The technique is described for the oropharyngeal cuff of the Combitube SA which is rated for 85 mL.

The proximal (blue) cuff is inflated with 50 mL of air, then inflated in 10 ml increments until the air leak is extinguished. Air leaks are identified by auscultation at the neck or comparison of exhaled tidal volumes. Typical cuff volumes ranged from 40 to 85 mL[17].

Complications Associated with Combitube Use

Ninth and Twelfth Cranial Nerve Dysfunction

Zamora et al. report a patient who awoke with sore throat, dysphagia, tongue deviation, and posterior tongue numbness following Combitube placement for a Caesarean section. Symptoms resolved completely after 3 months[18].

Esophageal Perforation

Esophageal perforation has been reported in many arenas including the operating room[19] and out-of-hospital rescue. Presenting symptoms include subcutaneous emphysema, pneumomediastinum, and pneumopericardium. The key to improved outcome is early diagnosis and treatment.

The mechanism of injury appears more than mechanical, as esophageal tears occur beyond the end of the device[20].

Pyriform Sinus Perforation

Pyriform sinus perforation following Combitube placement was reported in a case of angioedema and respiratory arrest. The patient presented with massive subcutaneous emphysema, pneumomedistinum, and pneumopericardium[21].

Endotracheal Intubation After Combitube Placement

There might be occasions when a Combitube is used for emergency rescue, but an ETT is required for prolonged ventilation of the patient. The technique using the flexible bronchoscope to facilitate the conversion from Combitube ventilation to endotracheal intubation with a standard ETT is shown in Figure 12.4.

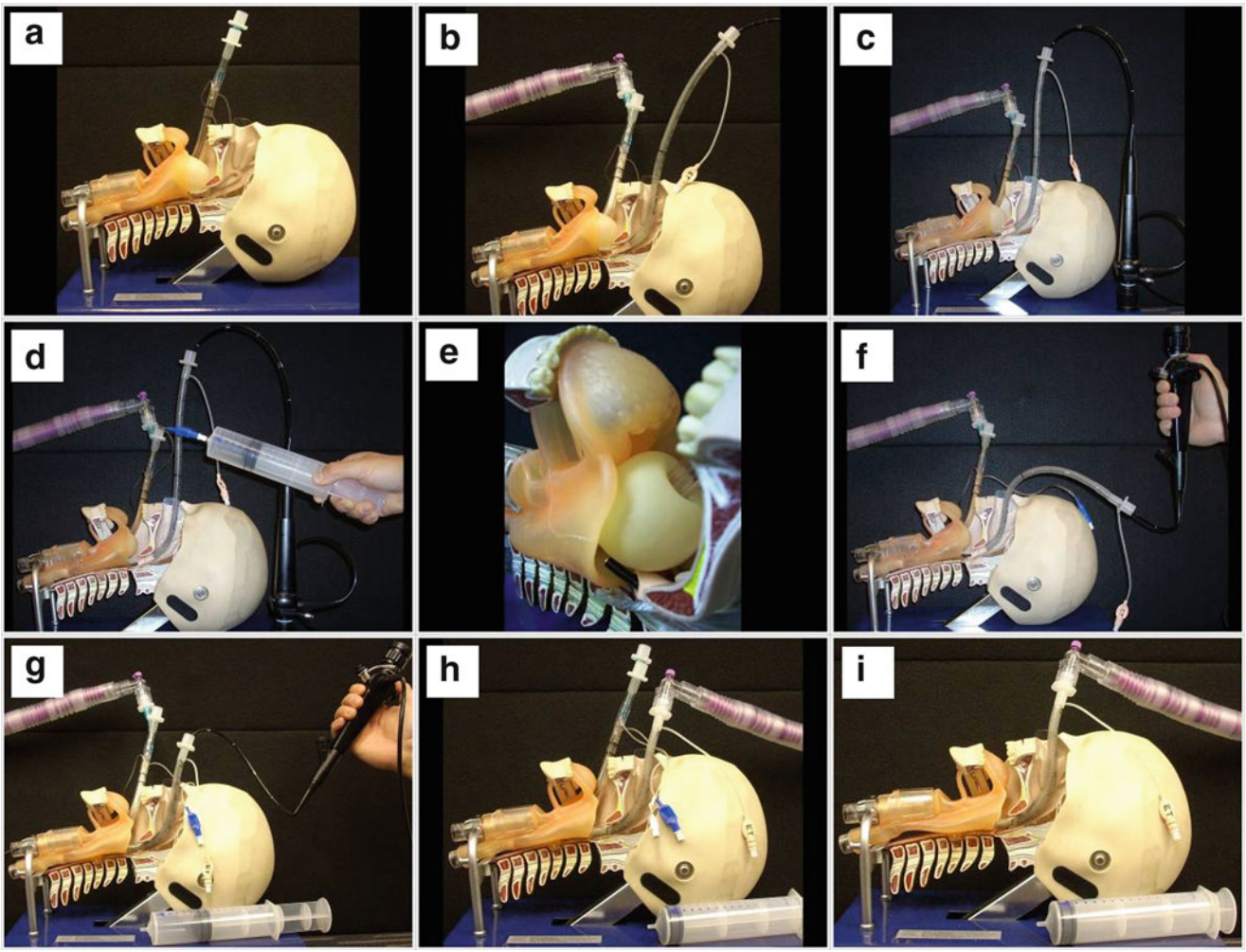

Figure 12.4. Conversion of Combitube to endotracheal tube facilitated by use of a flexible bronchoscope. (**a**) Combitube placed in the esophageal position. While ventilation continues via the blue lumen (labeled "1"), the stomach may be decompressed via gentle suction to the clear lumen (labeled "2"). (**b**). Reinforced endotracheal tube placed nasally while mechanical ventilation continues. (**c**) Flexible bronchoscope is introduced through the endotracheal tube, visualizing the pharyngeal cuff of the Combitube. (**d**) The pharyngeal cuff is partially or completely deflated to allow the bronchoscope to pass through to the glottis. (**e**) The endotracheal tube may be advanced alongside the cuff of the Combitube. This will allow for reinflation of the pharyngeal cuff, and thus positive pressure ventilation can continue during bronchoscopy. (**f**) The bronchoscope is guided into the trachea. (**g**) The pharyngeal cuff of the Combitube is sufficiently deflated to permit advancement of the endotracheal tube into the trachea. (**h**) Endotracheal placement of the endotracheal tube is confirmed, ventilation continues via the endotracheal tube. (**i**) The distal (esophageal) cuff of the Combitube is deflated, and the Combitube is removed.

Next Generation Devices

EasyTube

In many respects, the EasyTube represents the next generation ETC. Structural similarities include dual lumens, dual cuffs, and two inflation ports. Modifications include a larger ventilation port distal to the pharyngeal cuff that accommodates a flexible bronchoscope. Below the distal cuff, the EasyTube is smaller than the ETC as it contains a single lumen. The ETC contains two lumens, of which one ends in a dead end[22].

King LT, LT-D, LTS-D

The King LT (laryngeal tube) series of airways are smaller, simplified versions of the ETC. Similarities to the ETC include dual cuffs and ventilation ports between the cuffs. The two cuffs are connected, thus it is possible to inflate both via a single inflation point. The original King LT is a single lumen device which ends at the distal cuff. The LTS has a second lumen which extends to the tip of the device. It is designed for suction of the esophagus. The proximal opening of the suction lumen does not allow for connection to a breathing circuit. The advantage in these devices is their simplicity. One inflation port and one ventilation lumen dispense with the need for inflation or ventilation algorithms. One disadvantage is the inability to ventilate the patient if the device should happen to reside in the trachea. The "D" signifies the disposable version of the device[23].

Conclusion

Because of its unrivaled ease of placement, the Combitube remains an important and potentially life-saving tool in the hands of both first responders and in-hospital care providers. Unfortunately, the large size and relative stiffness of the Combitube has led to a range of potentially severe complications and so other devices are generally preferred where possible.

References

1. Frass M, Frenzer R, Zdrahal F, et al. The esophageal tracheal combitube preliminary results with a new airway for CPR. Ann Emerg Med. 1987;16:768–72.
2. Rumball CJ, MacDonald D. The PTL, combitube, laryngeal mask, and oral airway: a randomized prehospital comparative study of ventilatory device effectiveness and cost effectiveness in 470 cases of cardiorespiratory arrest. Prehosp Emerg Care. 1997;1:1–10.
3. Tanigawa K, Shigematsu A. Choice of airway devices for 12,020 cases of nontraumatic cardiac arrest in Japan. Prehosp Emerg Care. 1998;2:96–100.
4. Russi Christopher S, Lonny M, Hartley MJ. A Comparison of the King-LT to endotracheal intubation and combitube in a simulated difficult airway. Prehosp Emerg Care. 2008;12(1):35–41.
5. American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Part 7.1: Adjuncts for Airway Control and Ventilation Circulation, Dec 2005; 112: IV-51 - IV-57.
6. http://www.asahq.org/For-Members/Practice-Management/Practice-Parameters.aspx#airway. Practice Guidelines for Management of the Difficult Airway. Anesthesiology 2003; 98:1269–77.
7. Zamora JE, Saha TK. Combitube rescue for Cesarean delivery followed by ninth and twelfth cranial nerve dysfunction. Can J Anaesth. 2008;55(11):779–84.
8. Frass M, Frenzer R, Mayer G, Popovic R, Leithner C. Mechanical ventilation with the esophageal tracheal combitube (ETC) in the intensive care unit. Emerg Med J. 1987;4:219–25.

9. Richards C. Piriform sinus perforation during esophageal-tracheal combitube placement. J Emerg Med. 1998;16(1):37–9.
10. Gaitini Luis A, Vaida Sonia J, Somri M, et al. The combitube in elective surgery: a report of 200 cases. Anesthesiology. 2001;94:79–82.
11. Vézina D, Lessard MR, Bussières J, Topping C, Trépanier CA. Complications associated with the use of the esophageal-tracheal combitube. Can J Anaesth. 1998;45(1):76–80.
12. Mercer MH, Gabbott DA. The influence of neck position on ventilation using the combitube airway. Anaesthesia. 1998;53:146–50.
13. Urtubia RM, Frass M, Staudinger T, Krafft P. Modification of the Lipp maneuver for blind insertion of the Esophageal-Tracheal Combitube. Can J Anaesth. 2005;52(2):216–7.
14. Gaitini LA, et al. Minimal inflation volume for combitube oropharyngeal balloon. J Med Ar. 2010;8(3):27–32.
15. Ahmed SM, Rizvi KA, Khan RM, Zafar MU, Nadeem A. Less tongue engorgement with lateral placement of the Esophageal Tracheal Combitube. Acta Anaesthesiol Scand. 2008;52(6):834–7. Epub 2008 May 19.
16. Rabitisch W, Kolster WJ, Burgmann H, et al. Recommendation of the minimal volume technique to avoid tongue engorgement with prolonged use of the Esophageal-Tracheal Combitube. Ann Emerg Med. 2005;45(5):565–6. author reply.
17. Urtubia RM, Aguila CM, Cumsille MA. Combitube®: a study for proper use. Anesth Analg. 2000;90:958–62.
18. Zamora JE, Saha TK. Combitube rescue for Cesarean delivery followed by ninth and twelfth cranial nerve dysfunction. Can J Anaesth. 2008;55(11):779–84.
19. Bagheri SC, Stockmaster N, Delgado G, Kademani D, Carter TG, Ramzy A, et al. Esophageal rupture with the use of the Combitube: report of a case and review of the literature. J Oral Maxillofac Surg. 2008;66(5):1041–4.
20. Klein H, Williamson M, Sue-Ling HM, et al. Esophageal rupture associated with the use of the Combitube™. Anesth Analg. 1997;85:937–9.
21. Richards C. Piriform sinus perforation during esophageal-tracheal combitube placement. J Emerg Med. 1998;16(1):37–9.
22. Gaitini LA, Yanovsky B, Somri M, Tome R, Mora PC, Frass M, et al. Prospective randomized comparison of the easytube and the esophageal-tracheal Combitube airway devices during general anesthesia with mechanical ventilation. J Clin Anesth. 2011;23(6):475–81.
23. http://www.kingsystems.com/medical-devices-supplies-products/airway-management/supraglottic-airways/
24. Roland W, Shawn D, Bernhard P. Is the Combitube® a useful emergency airway device for anesthesiologists? Anesth Analg. 1999;88(1):233.