

The Laryngeal Tube in Emergency Medicine: A practical approach to its use

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Securing the airway is one of the major aspects for a successful resuscitation.

In the current guidelines of the European Resuscitation Council (ERC) and the American Heart Association (AHA) the importance of the Laryngeal Tube as device to secure the airway during cardiopulmonary resuscitation has been pointed out again.

With the following practical description of the Laryngeal Tube we would like to offer a view for the safe handling of the device, primarily for the benefit of our patients.

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The problem of emergency ventilation

Ventilation of a patient in an emergency situation is a particular challenge for every user, regardless if paramedic or emergency physician, because patients in emergencies have to be considered as non-fasted compared to clinical routine procedures. For emergency patients the presence of gastric content in the stomach always has to be considered. During Bag-Valve-Mask Ventilation this gastric content can lead to regurgitation either immediately or due to additional stomach insufflations. If gastric content reaches the trachea it leads to aspiration pneumonia, which can cause severe problems during and following intensive care treatment. Besides the initial oxygenation, emergency ventilation should therefore always have the aim to protect against aspiration.

A secure management of the airway is only possible with endotracheal intubation. Initial oxygenation is required until intubation material is prepared. Therefore the treatment is usually started with Bag-Valve-Mask ventilation. Besides the problem of correct face mask fitting the applied ventilation pressure is not only passed on to the entry of the trachea but also to the oesophagus. The healthy anesthetized patient in clinical treatment is protected from gastric insufflations due to the oesophageal closing pressure of 20 cmH₂O. During resuscitation however this oesophageal closing pressure can drop to approximately 6-8 cmH₂O (1). Tests on simulators with such a reduced oesophageal closing pressure confirmed that under these circumstances gastric insufflations can hardly be avoided using Bag-Valve-Mask Ventilation. Up to 50 % of the given tidal volumes could reach the stomach (2). Hence, using Bag-Valve-Mask Ventilation the risk of aspiration during resuscitation is significantly increased.

Endotracheal intubation should therefore always be aimed at securing the airway for emergency patients. Endotracheal intubation under particular conditions at the emergency spot has always to be considered as a difficult intubation (non-fasted patient, difficult patient positioning, facial trauma, insufficient light, changing teams). Even for experienced emergency physicians an emergency intubation is not always without problems at the first attempt. To guarantee continuous chest compressions at the same time, they should only be interrupted shortly by possible unsuccessful intubation attempts.

Supraglottic airway devices as a solution?

Due to these facts supraglottic airway devices like the Laryngeal Mask and the Combitube had already been included in the 2000 algorithm for resuscitation as alternative adjuncts for airway management. Since this time ambulances are committed to carry at least one further device for airway management with the ability to use it correctly. However it is known that the Laryngeal Mask does not offer a safe protection against aspiration (3). The Combitube proved to be relatively difficult in its use and can only be used for patients taller than 150 cm (4).

The Laryngeal Tube

The current guidelines of the European Resuscitation Council (ERC) (5) and the American Heart Association (AHA) (6) include the Laryngeal Tube (LT) as additional supraglottic airway device. Many studies on several hundred patients proved that the Laryngeal Tube is a reliable device for airway management (7, 8). It shows that the Laryngeal Tube can be placed easily and quickly (9). With the LT pulmonary tidal volumes can be applied comparable to those of an endotracheal intubation (10). A seal of the oesophagus furthermore reduces the risk of gastric insufflations. This aspiration protection makes the Laryngeal Tube to a superior alternative, especially in respect of primary ventilation, compared to the combination face mask / Guedel Airway (11).

Due to this background the current ERC guidelines newly mention the Laryngeal Tube as replacement for Bag-Mask-Ventilation within the scope of cardiopulmonary resuscitation. The initial use of the LT furthermore offers the advantage of continuous chest compressions immediately after LT placement (5).

On the other hand the concept of sealing the oesophagus through the Laryngeal Tube has been early recognized as a problem during the use for emergency patients. Beside a spontaneous regurgitation of the non-fasted patient, regurgitation can also be caused by an abdominal pressure increase during external chest compressions. In individual cases regurgitation against a blocked oesophagus could lead to an increased pressure which could result in the risk of oesophageal rupture (12).

Due to this reason the LTS (S=suction) with an additional drain tube has been developed. The drain tube offers the possibility of placing a gastric catheter for suction of gastric content (13). This active and passive pressure relief of the stomach significantly improves aspiration protection. But unlike the combitube accidental stomach insufflations through the second lumen is not possible. Experiences with the first version of the LTS lead to the development of an improved modified version. Besides an optimized positioning the systematic sealing could be improved significantly with the LTS II (14). In particular with the LTS II continuous chest compressions without interruption for ventilation is now possible.

Successful use of the Laryngeal Tube on emergency patients has been reported in several publications (15, 16, 17). These studies have contributed to establish the Laryngeal Tube in many ambulance services as device for airway management. For pre-hospital use of the LT and particularly the LTS II the following applications are possible:

1. For initial emergency ventilation and replacement of Bag-Mask-Ventilation. Endotracheal intubation for a definite airway can be considered as a further step.
2. As alternative device for airway management in case that intubation is not possible.
3. As device for airway management through medical assistance staff or first responders.

Use of the Laryngeal Tube

The Laryngeal Tube is made of silicone and can be used up to 50 times after cleaning and steam sterilization. With the LT-D (D=disposable) the same product from PVC for single use is available as well.

The LTS II includes a second lumen for gastric pressure relief. The LTS II is also available in a disposable version: LTS-D.

The insertion of the different Laryngeal Tube versions is possible without any further adjuncts. It is recommended to open the mouth of the patient by approximately 2 - 3 cm using the “thumb and index finger” technique. Insert the LT in the midline of the mouth along the palate until a slight resistance can be felt. In some cases a slight head extension can facilitate mouth opening and tube placement (photo 1).



Photo 1: Insertion of the LT

After insertion the ventilation holes of the Laryngeal Tube lie in front of the laryngeal inlet (photo 2). The insertion depth can be verified according to the teeth marks at the upper end of the tube. If the correct tube size has been used, the middle black line should be level with the upper teeth of the patient. Repositioning is possible between the upper and lower teeth mark (photo 3).

The special form of the Laryngeal Tube with its slightly S shaped tube ensures the positioning of the distal end into the oesophagus. The distal low-pressure cuff seals the oesophagus. While LT / LT-D totally seal the oesophagus, the LTS II / LTS-D, via the additional drain tube, allow a pressure relief using a gastric catheter. With all versions a proximal low-pressure cuff seals oro- and nasopharynx. Both approximately 1.5 - 2 cm ventilation holes are located between the two cuffs and lie in front of the laryngeal inlet after insertion (photo 2).

For easy handling both cuffs are connected and can be inflated via one inflation line only. The proximal cuff is inflated first to stabilize the tube and to seal oro- and nasopharynx. The distal cuff is then inflated immediately to seal the oesophagus. The proximal cuff is specially designed to avoid cuff extension towards the epiglottis and to ensure optimal ventilation (photo 2).

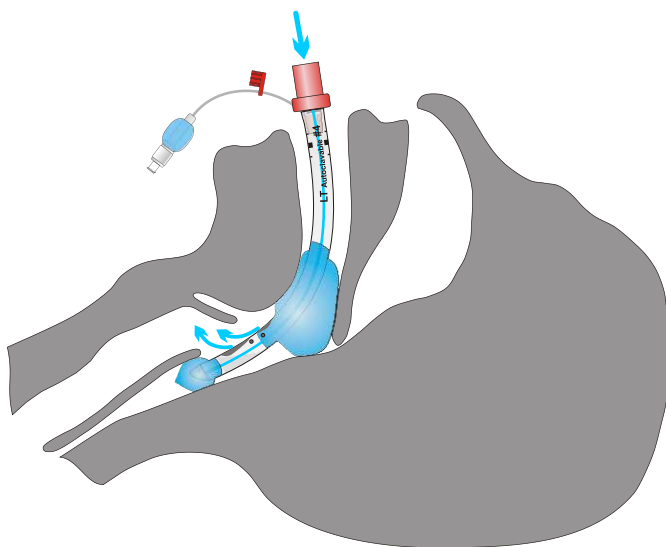


Photo 2: Positioning of the LT



Photo 3: Depth marks for insertion of LT

The different versions of the Laryngeal Tube are available in different sizes. The versions LT, LT-D and LTSII are available in seven different sizes from size 0 for newborns until size 5 for adults taller than 180 cm. The LTS-D is currently available in the sizes 3 - 5. To choose the correct tube size it has to be considered that children are weight selected whereas adolescent patients or patients ≥ 125 cm are height selected (see table). The choice for the respective size corresponds more or less to the choice criteria of the Laryngeal Mask.

Size	Patient	Patient size	Color code
0	Newborn	< 5kg	transparent
1	Baby	5 - 12kg	white
2	Child	12 - 25kg	green
2.5	Child / Adult	125 - 150cm	orange
3	Adult	< 155cm	yellow
4	Adult	155 - 180cm	red
5	Adult	> 180cm	purple

Tab.: Available sizes of the Laryngeal Tubes

The 15 mm standard connector of the Laryngeal Tube is color coded according to the different sizes. The same color code is printed on the included syringe (20 ml syringe for sizes 0 and 1; 60 ml syringe for sizes 2 and 2.5; 100 ml syringe for sizes 3 - 5). The approximate cuff inflation volumes are between 10 ml for the LT size 0 and 90 ml for the LT size 5. These inflation volumes are indicated on the syringe in the same color according to the respective tube connectors. This facilitates the correct use of the product especially in emergency situations. Cuff inflation for the Laryngeal Tube can also be made via a cuff pressure gauge (photo 4). A cuff pressure of 60 cmH₂O should be applied.



Photo 4: Cuff inflation via a cuff pressure gauge

The main new feature of the LTS II and the disposable LTS-D is the additional drain tube at the posterior side of the tube, which allows the insertion of a gastric- or suction catheter (LTS II max. 16 Ch, LTS-D max. 18 Ch). Especially for non-fasted emergency patients this allows the relief of intra-gastric pressure (photo 5a, 5b).

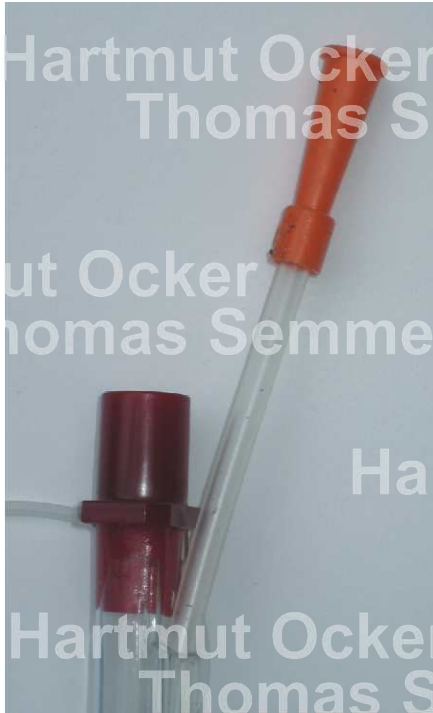


Photo 5a, 5b: Insertion of a gastric- or suction catheter via the additional drain tube of the LTS-D

Tips for the use of the Laryngeal Tube

Due to the production process little rest air can remain in the cuffs of the Laryngeal Tube especially after a long period of stocking. To avoid difficult insertion or damage to the cuffs this rest air should be completely evacuated with the syringe.

Prior to insertion of the Laryngeal Tube the mouth and pharynx of the patient should be inspected. Should the tongue be folded back caused by a loss of muscle tension, it is necessary that the tongue is brought back into its correct position prior to insertion of the Laryngeal Tube. This can be done e.g. via the Esmarch' maneuver or via stabilization over the index finger. Otherwise there is the risk that the tongue hinders the correct positioning of the Laryngeal Tube in the lower pharynx.

During ventilation with the Laryngeal Tube a reduction of the tidal volume to avoid high ventilation pressures is not necessary. Hence, with the Laryngeal Tube an immediate application of an adequate tidal volume is possible. Assuming an initial oxygen deficit the patient may profit from this.

The use of a bacterial filter is possible without causing problems with the Laryngeal Tube. To avoid tension to the tube the additional use of a catheter mount tubing is recommended. This significantly reduces the risk of an accidental dislodgement of the Laryngeal Tube. The slight increase of the dead space can be compensated by adjusting the tidal volume.

Due to the stabilization of both cuffs an immediate fixation of the Laryngeal Tube is not necessary. However the use of the included biteblock with fixation possibility is useful to avoid accidental dislodgement of the tube.

Although the easy handling of the Laryngeal Tube has been proven many times, proper instruction and regular training are necessary. Only this can guarantee the correct use of the Laryngeal Tube in emergency situations. According to the experience of the authors repeated training on an airway trainer under supervision should be necessary at least every three months. To verify the use of the Laryngeal Tube in practical use a proposal of a protocol for quality management is attached.



Required material:

a: Laryngeal Tube, syringe and biteblock.



b: Water-soluble lubricating jelly, practically packed in a single use package.



After removing the Laryngeal Tube from the sterile pouch the tube has to be lubricated sufficiently prior to insertion. Alternatively water can be used for lubrication.



Via only one inflation line evacuate both cuffs completely with the syringe.



Open the mouth app. 3 cm using the thumb and index finger technique. The head can remain in a neutral position.



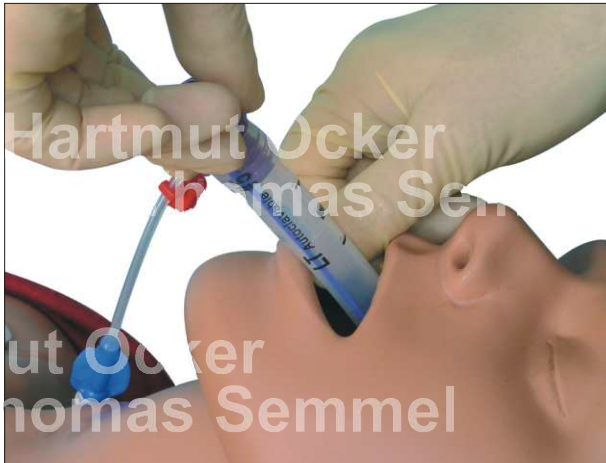
Hold the Laryngeal Tube like a pen in the area of the teeth marks (three black marks).



The tongue can be fallen back due to an elapsed tonicity. Prior to Laryngeal Tube placement the tongue is brought back to its original position using the index finger.



Insert the Laryngeal Tube centrally along the hard palate into the hypopharynx. Stabilization via the index finger avoids obstruction of the posterior pharyngeal area



Advance the Laryngeal Tube until a slight resistance can be felt. The center black line should now be level with the upper front teeth.



Inflate the cuffs of the Laryngeal Tube with the syringe, considering the respective color code, which is indicated on the syringe.



Connect the resuscitation bag to the 15 mm standard connector. If the patient cannot be ventilated adequately, the Laryngeal Tube can be repositioned between the upper and lower teeth mark. Experience has indicated that initially placing the tube deeper, inflating the cuffs and withdrawing until ventilation is optimized results in the best depth of insertion because tissue is retracted away from the laryngeal inlet.



Check the position of the Laryngeal Tube via auscultation and etCO₂ measuring. In emergency situations a visual control of chest movements might be sufficient.



Biteblock in situ (lateral view).



Biteblock in situ (view from top).



Correctly positioned and fixed
Laryngeal Tube.



Ventilation via a catheter mount tubing.



Laryngeal Tube with attached bacterial filter.



Ventilation via catheter mount tubing using a bacterial filter.



Cardiopulmonary resuscitation with the Laryngeal Tube.



Chest compression as well as ventilation can be easily made by one person.

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Protocol for quality management with the use of the Laryngeal Tube

Operation number: _____

Patient data:

Age: _____ Size (app. in cm): _____

☐ male ☐ female

☐ probably primary respiratory arrest

☐ probably primary circulatory arrest

Application data:

☐ LT ☐ LT-D ☐ LTSII ☐ LTS-D

Laryngeal Tube size:

Used by:

☐ Emergency physician ☐ Paramedic ☐ Family doctor / others

Suction catheter: ☐ yes ☐ no

Application reason:

☐ Initial ventilation (as alternative to mask ventilation)

☐ After successful mask ventilation

☐ After failed mask ventilation

☐ After failed intubation

Application problems:

(Several answers possible)

☐ Difficult placement ☐ Second attempt necessary

☐ Ventilation possible with leak ☐ Ventilation impossible

Further procedure:

Endotracheal intubation by:

☐ Emergency physician ☐ Paramedic

☐ Patient transport to hospital with Laryngeal Tube in situ

Remarks:



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