

## Airway 101

### Supraglottic airway devices/ laryngeal masks



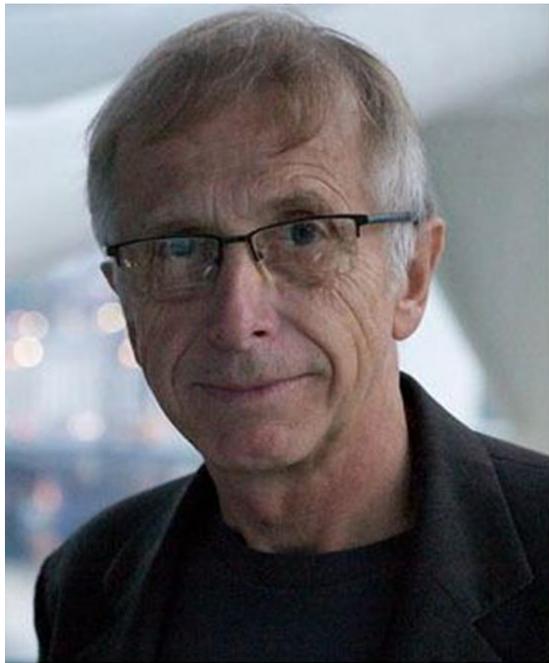
By the perioperativeCPD team

#### History

Even though supraglottic airways are now used in the majority of general anaesthetics, they are a relatively recent addition to the airway trolley. The first successful supraglottic airway device, the Laryngeal Mask Airway (LMA), was introduced commercially in 1988. These airways were unique when first introduced as they sat outside the trachea and provided a hands-free means of achieving a gas-tight airway without intubation or muscle relaxants. Prior to the introduction of the LMA anaesthetists mainly had two options for airway management; face mask or tracheal tube. They are indicated for airway management in fasted patients who do not suffer from significant gastro-oesophageal reflux.

The LMA was developed by Dr Archie Brain, a British anaesthetist. Dr Brain used around 200 prototypes in over 7000 anaesthetics before the current LMA design was finalised. A year after its introduction in 1988, every UK hospital had ordered LMAs.

Dr Brain subsequently designed the Intubating, Reinforced, ProSeal and Supreme LMAs.



*ARCHIE BRAIN*



*The Goldman mask cuff attached to a 10mm plastic tube was the basis of LMA prototypes*

More information about Dr Archie Brain and the development of the LMA can be found here:

[https://en.wikipedia.org/wiki/Laryngeal\\_mask\\_airway](https://en.wikipedia.org/wiki/Laryngeal_mask_airway)

It gained popularity quickly as it had several unique advantages including the ease and speed of placement, the ability to be placed without direct visualisation of the larynx, improved hemodynamic stability, reduced anaesthetic requirements, lack of a need for muscle relaxation, and an avoidance of the risks of trachea intubation (e.g., trauma to the teeth and airway structures, sore throat, coughing on emergence, bronchospasm).

Also in the 'can't intubate, can't ventilate' scenario, the decision to use such devices can be used to gain time until help arrives.

Coincidentally, propofol became widely available around the same time, which was essential for the laryngeal mask to become successful. The reason for this is that propofol works much better than thiopental in suppressing airway reflexes in non-paralyzed patients, allowing insertion without coughing, gagging, and patient movement.

The LMA and its derivatives are now widely accepted and is the airway used in more than 50% of surgical patients in the UK. Their use is also increasing in both pre-hospital care and hospital arrest trolleys due to their ease of insertion, high success rate and minimal interruption time to chest compressions. Unlike the endotracheal tube (ETT) an LMA is not a definitive airway as it only prevents limited protection from gastric aspiration

## Terminology

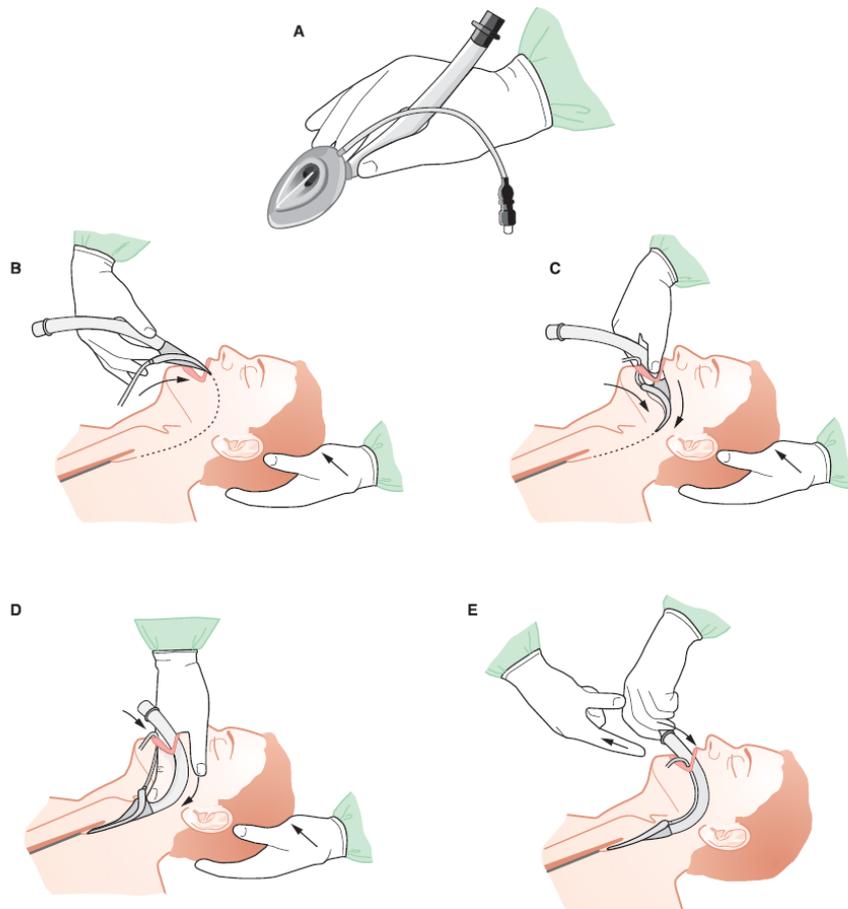
The terminology for these devices can be confusing. The first supraglottic airway device introduced in 1988 was the LMA, now also referred to as the classic LMA or cLMA, or simply LMA.

The term 'LMA' (for 'laryngeal mask airway') is a registered trademark of this original device and all of Dr Brain's subsequent devices. All other 'LMAs' from other companies should be called supraglottic airway devices.

An LMA is a supraglottic airway but not all supraglottic airways are LMAs.

## How they work?

Insertion of an LMA requires the patient's airway reflexes to be absent and is therefore only possible if they are anaesthetised or unconscious.

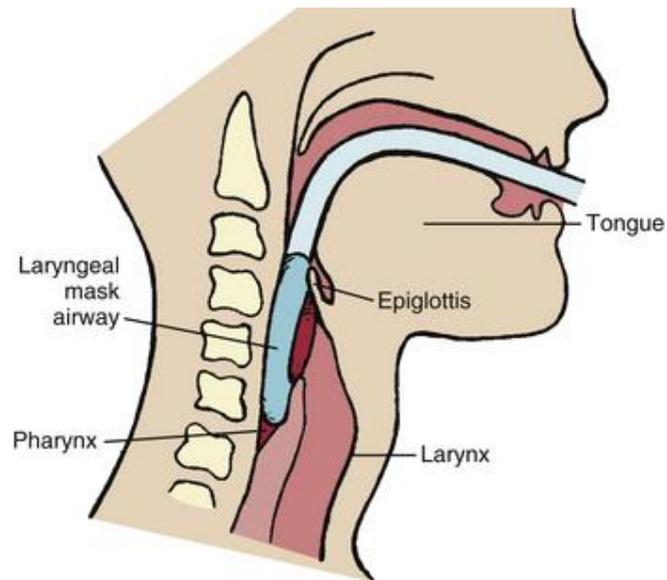


### The classic LMA insertion technique

The original technique for the insertion of an LMA was described by Dr Brain but numerous other ways have also proved successful including many that do not include putting fingers in the non-paralysed patient's mouth. The original technique is described below:

- Prepare the LMA by fully deflating the cuff, apply water-soluble gel to the back of the cuff (ensure none is inside the bowl of the LMA or laryngospasm may occur).
- Hold the LMA like a pen, with the index finger placed anteriorly at the junction of the cuff and tube.
- Push the mask backwards along the hard palate. As the mask moves downwards, the index finger maintains pressure backwards against the posterior pharyngeal wall to avoid collision with the epiglottis.
- Insert the index finger fully into the mouth to complete insertion, stopping when resistance is felt.
- Inflate the cuff without holding the tube or connecting the breathing system.
- When correctly positioned, the LMA will be seen to rise slightly in the mouth.
- It ideally seals to an airway pressure of around 20 cm H<sub>2</sub>O.  
Note: this is the ventilation pressure, the inflation pressure in the cuff should not exceed 60 cm H<sub>2</sub>O
- The 'recommended' volumes of air are the maximum volumes, and if a pressure monitor is not available, it is wise to start with half that volume.

Often if there is a small leak in the LMA after cuff inflation turning the head either left or right will alter the anatomy enough remove the leak.



**A correctly positioned LMA.**

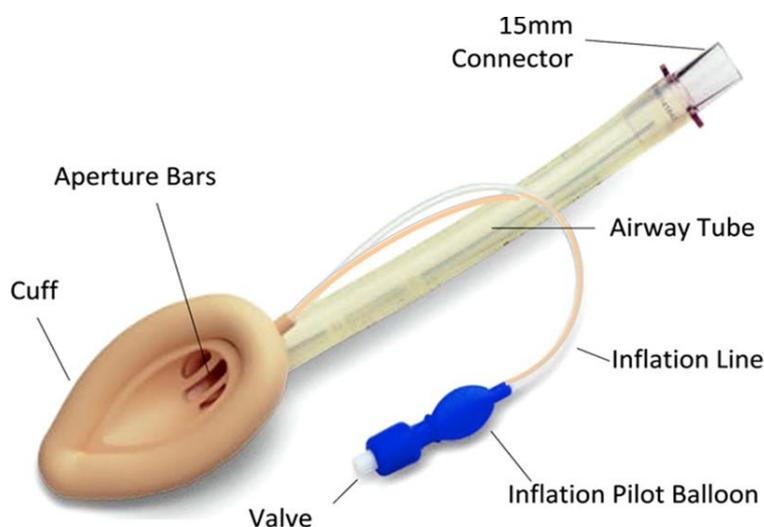
### **Classic Laryngeal Mask (cLMA) Design**

The LMA-Classic (LMA, Classic LMA, LMA-C, cLMA) consists of a curved airway tube which is connected to an elliptical spoon-shaped mask at around a 30° angle.

There are two flexible aperture bars where the tube enters the mask to prevent the tube from being obstructed by the epiglottis. The utility of this feature has been extensively and inconclusively debated and many new designs omit them altogether. An inflatable cuff surrounds the inner rim of the mask. The cuff forms an air-tight seal around the perimeter of the larynx.

An inflation line and self-sealing pilot balloon (MRI safe) are attached to the proximal wider end of the mask. A black line runs longitudinally along the top of the airway tube which can help indicate when the LMA has twisted on insertion. Unlike an ET tube, rotation of an LMA can cause airway obstruction. At the circuit end of the airway tube is a standard 15-mm connector. The LMA is made from silicone and contains no latex.

The original LMA is a reusable device and may be autoclaved up to 40 times although in low-resource countries they have been known to survive over 100 uses. The success of the LMA Classic led to the introduction of many other supraglottic airways, including an increasing number of single-use designs.



**Classic LMA design**

## LMA Sizing

LMAs are available in a range of sizes. These sizes are based on the ideal body weight and are a guide only; a 150kg morbidly obese, but short woman will not take a size 6 LMA.

In many instances it is possible to use a size higher or lower size and achieve a similar result but when there is doubt; the larger size should be chosen for the first attempt.

LMA size	Ideal patient weight (kg)	Patient selection	Max. Inflation volume mls
1	<5	Neonate	Up to 4mls
1 ½	5-10	Infant	Up to 7mls
2	10-20	Infant/child	Up to 10mls
2 ½	20-30	Child	Up to 14mls
3	30-50	Child/Small adult	Up to 20mls
4	50-70	Adult	Up to 30mls
5	70-100	Large Adult	Up to 40mls
6	>100	Adult over 10kg	Up to 50mls

Note: the LMA seals to an airway pressure of around 20 cm H<sub>2</sub>O which is different from the inflation pressure. The airway pressure is the pressure that a patient can be ventilated to without a leak past the cuff.

The inflation pressure is a measurement of the air inside the LMA cuff which can be up to 60 cm H<sub>2</sub>O. This is a lot more pressure than is put inside an ETt cuff which should be under 30 cm H<sub>2</sub>O for adults.

## Removal

The LMA should not be removed during emergence until the patient is able to open their mouth to command. Removal earlier than this, e.g. once the patient starts to swallow, is associated with an increase in complications. While the cuff is traditionally deflated prior to removal, it can be removed with the cuff inflated. This technique reduces the risk of secretions on the vocal cords and subsequent laryngospasm, but it is more difficult and is not recommended if patients have loose or damaged teeth.

## Disadvantages of the LMA Classic

- There is a risk of aspiration if regurgitation occurs
- It seals to a relatively low airway pressure of around 20 cm H<sub>2</sub>O.
- It has no integrated bite block so it may be bitten flat during emergence.
- Its position is less stable in edentulous (no teeth) patients.
- The aperture bars may impede fiberoptic intubation through the LMA.
- Twisting of the LMA may lead to airway obstruction.
- Down-folding of the epiglottis may cause airway obstruction although this can often be rectified by withdrawing the still inflated LMA 3-4 cm and reinserting it.

## First-generation SADs

There are now many single use versions of this first LMA made by various manufacturers, most from cheaper PVC rather than silicone. Along with the classic LMA these are now grouped under the term first generation supraglottic airways. This group also includes devices such as the flexi-LMA and the laryngeal tube (LT).

They may or may not protect against aspiration in the event of regurgitation, but have no specific design features that lessen this risk.



Various single-use 1<sup>st</sup> generation supraglottic airways

## Comparison of LMAs and ET tubes

	LMA/ supraglottic airways	Endotracheal tube
<b>Required skills</b>	Lower, esp. in pre-hospital situations	Higher advanced skill, must be performed regularly to maintain skills
<b>Anaesthesia requirements for insertion</b>	Lower, anaesthesia and some gag reflex suppression needed	Higher, muscle relaxants or high dose opiates
<b>Risk of airway trauma</b>	Lower	Higher in the less experienced
<b>Intermittent positive pressure ventilation</b>	Limits to airway pressures, too high risks gastric insufflation	No limit to airway pressure
<b>Risk of aspiration</b>	Higher, only partial protection. Slightly less in 2 <sup>nd</sup> generation SADs	Lower, protects the lower airway
<b>Equipment needed</b>	Lower, no extra equipment required	Higher, needs laryngoscope
<b>Haemodynamic changes with insertion and removal</b>	Lower	Higher, more stimulating

## Flexible/reinforced LMAs

The LMA Flexible and similar designs differ from other supraglottic airways due to the wire-reinforced flexible airway tube, which helps positioning away from the surgical field whilst maintaining a good seal. This is useful in dental, ENT, ophthalmic and head and neck surgery.

Disadvantages this design include that insertion may prove more difficult than the non-flexible designs. Also the coil reinforcement may remain deformed if bitten hard by the waking patient, thus causing an airway obstruction and requiring immediate removal.

The reinforced laryngeal masks have smaller internal diameters and longer lengths than the standard versions, causing an increase in flow resistance.



## Second-generation SADs

SADs that have been designed for additional safety and have design features specifically to reduce the risk of aspiration. This category includes:

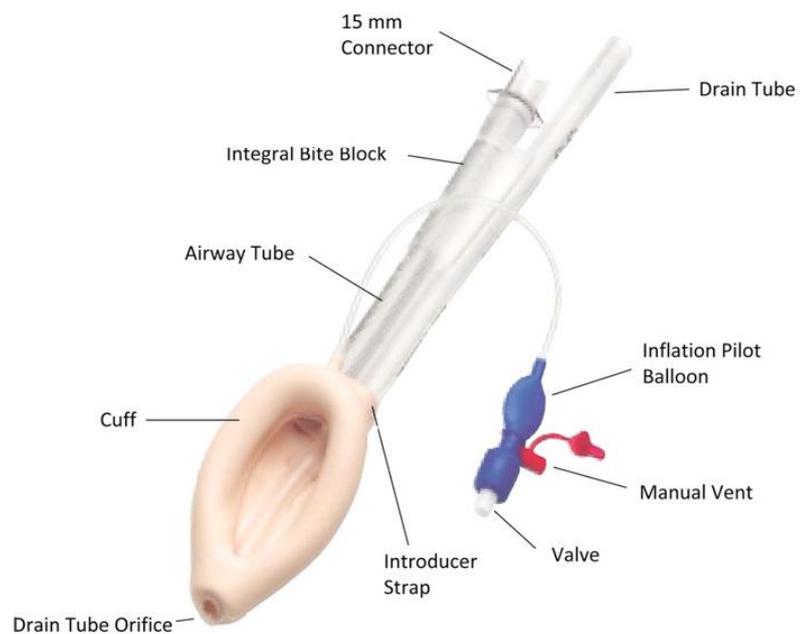
- Proseal LMA
- i-gel
- Supreme LMA (SLMA)

## Proseal LMA

This is a reusable LMA designed by Archie Brain to overcome problems encountered with the LMA Classic. The inflatable cuff has been extended onto the reverse of the device in order to improve the seal, particularly around the oesophagus.

A gastric drain tube which opens at the tip has been added along with an integrated bite block. The drain tube is designed to channel gastric fluid away or permit the passage of an orogastric tube. It also reduces the likelihood of inflation of the stomach during prolonged ventilation. It was the first of the second generation supraglottic airways.

The LMA Proseal has a removable metal introducer which can be used to aid insertion although this can sometimes hinder rather than help and it requires a deeper level of anaesthesia. Seals to around 30cm H<sub>2</sub>O, 50% higher than the classic LMA.

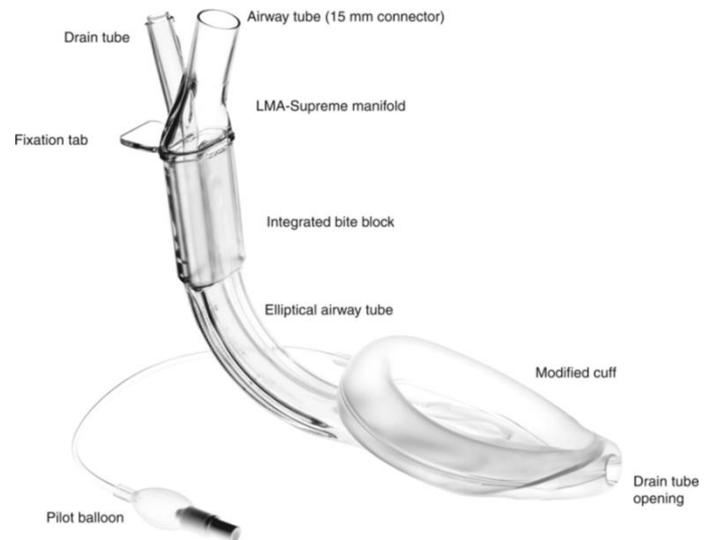


## LMA Supreme

The LMA Supreme is a single-use 2<sup>nd</sup> gen. device similar, but not identical, to the LMA Proseal.

It is pre-curved to facilitate insertion; so no introducer is required. There is also an improved cuff design that produces higher airway leak pressures. It also has an integrated bite block and a gastric drain tube.

The LMA Supreme seals at approx. 25cm H<sub>2</sub>O, less than the LMA Proseal.

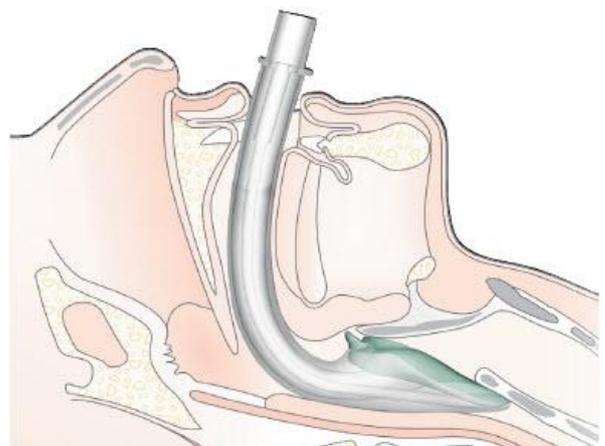


## I-gel

The i-gel is a single use-2<sup>nd</sup> generation device which has a soft, anatomically shaped, noninflatable cuff made of an elastomer gel. The gel further moulds to the airway shape when it warms to body temperature. Its wider oval design results improved stability in edentulous (no teeth) patients, acts as an integral bite block and prevents rotation. It comes in both paediatric and adult sizes.

It has separate ventilation and gastric channels. The patient end of the integrated gastric channel is positioned in the upper oesophagus. It seals to around 25 cmH<sub>2</sub>O, similar to the proseal LMA and can be used as a conduit for fiberoptic intubation.

It has become popular in both pre-hospital care and in-hospital resuscitation due to its ease of insertion and high success rate. It is faster and safer for those inexperienced in tracheal intubation.



I-gel 2<sup>nd</sup> generation supraglottic airway

## Intubating LMA (Fastrach)

The intubating LMA is specialised LMA designed to help difficult endotracheal intubation either blindly or in conjunction with a fibroscope while minimising the requirements for head and neck manipulation. It allows ventilation between intubation attempts. There are both single-use and re-useable versions.

It is rigid and anatomically curved, with a lumen wide enough to accept a reinforced size 8.0 ETT, and short enough to ensure passage of the endotracheal tube cuff beyond the vocal cords. It comes with a tube pusher and a flexi-tube which has a removable connector and a soft tip.

An intubating LMA takes skill and experience to use successfully.

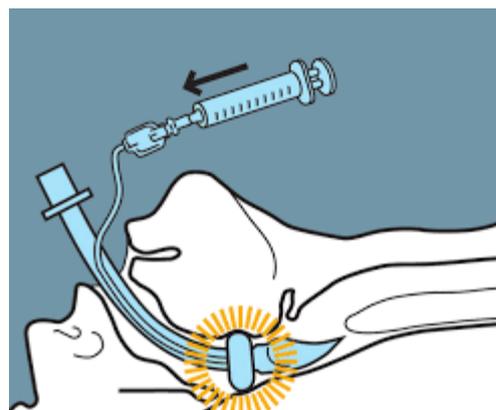


A reusable Intubating LMA and a single-use Fastrach

## Other supraglottic airways

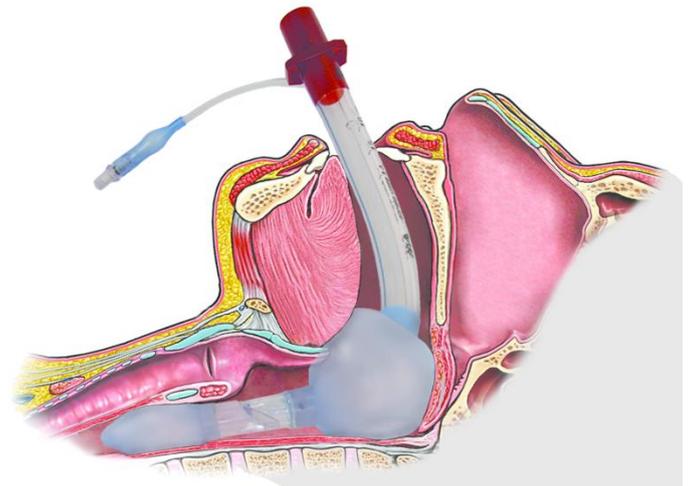
### CobraPLA

The CobraPLA was designed as an alternative to a laryngeal mask and is supplied in eight sizes designed for use in patients ranging from neonate to adult >140 kg. The 'cobra head' borders the laryngeal inlet holding the epiglottis out of the airway, but the device seals using a cuff in the hypopharynx. Insertion time and success are similar to the LMA Classic although there may be an increased risk of pulmonary aspiration. Again it has largely been replaced by the i-gel.



## Laryngeal tube

The laryngeal tube (also known as the King LT) is an airway management device designed as an alternative to laryngeal mask airways, and tracheal intubation. This device can be inserted blindly into the hypopharynx just above the oesophagus to create an airway during anaesthesia and resuscitation so as to enable mechanical ventilation of the lungs. Compared to LMAs the LT is more likely to lead to airway obstruction, and less likely to lie over the larynx.



## Oesophageal/tracheal tubes (Combitubes)

The combitube is designed primarily for the pre-hospital and emergency setting. This device has two lumens and two cuffs and is made for blind insertion. It usually enters the oesophagus where the distal cuff is inflated. The proximal cuff then acts as a pharyngeal seal, and ventilation takes place through the side holes between the cuffs. If the device enters the trachea, the other lumen is used as a normal tracheal tube. Ventilation is possible with either tracheal or oesophageal intubation. It can be inserted blindly, quickly and with a relatively low level of skill although it has quite a relatively high rate of airway obstruction.



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