

Supra-glottic Airway Devices

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The ability to maintain an airway is one of the core skills and defining role of an anaesthetist. It is needless to say that maintenance of the airway is of paramount importance in anaesthesia

Prior to the introduction of the new generation supraglottic airway devices, maintenance of a patent airway in anaesthetised patients required either tracheal intubation or the continued use of a face mask.

A Supra- glottic airway is any device used above the larynx or glottis that facilitates establishment of a reasonable airway conduit to allow acceptable ventilation in routine anaesthetic practice. These devices allow hands-free maintenance of an open airway, allowing spontaneous or assisted ventilation in the anaesthetised patient.

The introduction of the laryngeal mask heralded an era of hands-free airway maintenance without the need for tracheal intubation. Several other airway devices, that lies outside the trachea and attempt to provide a leak-free airway. These devices are collectively known as supra-glottic airway devices.

Supra-glottic airways generally demonstrate:

1. The ability to be placed without direct visualization of the larynx
2. Increased cardiovascular stability on insertion
3. Increased cardiovascular stability on emergence
4. Minimal rise in intraocular pressure on insertion
- 5 They normally provide little or no protection against aspiration of refluxed gastric contents. They are contraindicated in patients with full stomachs or prone to reflux.

The Laryngeal Mask Airway (LMA) - classic.

Developed by Anaesthesiologist Dr. Archie Brain for commercial use in 1988 after 7 years research, 200 prototypes and 7000 patient studies.

Important issues include:

1. Insertion technique and training
2. Place in Management of Difficult Airway
3. Use for Positive Pressure ventilation
4. Regurgitation and Pulmonary Aspiration
5. Use in Prolonged procedures

B. Indications

1. Alternative to ventilation through face mask and endotracheal tube (ETT)
2. Temporizing/rescue measure in patients with difficult airway
3. Conduit for Fibre optic scope, bougie and small diameter ETT
4. Secure airway in awake subjects (topical anaesthesia and nerve blocks)
5. New developments allow for novel uses described later

Problems and Complications

1. Low pressure seal. Unsafe when using high pressures e.g. above 20cmH₂O, leading to gastric insufflations and oropharyngeal leakage.
2. Full stomach –risk of aspiration (un-fasted , pregnancy, hiatal hernia) however after 200 million patient uses worldwide and meta analysis study show Pulmonary aspiration risk is 2 per 10 000 cases versus 1.7 per 10 000 for ETT.
3. Obesity -low pulmonary chest wall compliance
4. Trauma to pharyngeal mucosa-due to pressure exerted by cuff. Cuff pressure not to exceed 60cm H₂O. This is pressure inside cuff and not external pressure exerted on mucosal surface. Pharyngeal volume and compliance are important hence the choice of the correct size of LMA is crucial. Sizes based on age and weight-approximate cuff volumes advised.
5. Infection risk – Autoclaved in steam but there is a risk of prion disease (Protein –virus like without nucleic acids) especially new variant Creutzfeld- Jakob disease (vCJD).This is a transmissible human spongiform encephalopathy that is fatal.

Single use LMAs made from PVC, chlorinated plastic – contributes to production of carcinogen Dioxin when burnt and is not biodegradable. Route of disposal is landfill sites.

The Proseal Laryngeal Mask

Superior in design when compared to other designs of LMA's which allows easier placement and ability to withstand higher airway pressures.

Have two lumens, one for ventilation and the other for gastric/esophageal lumen which allows access to the oesophagus for direct drainage or passing a gastric tube.

The cuff inflates in a three dimensional manner with the elliptical cuff augmented by a second cuff behind the bowl, known as the rear boot or dorsal cuff. A seal pressure of up to 35 cm H₂O can be achieved. Therefore best suited for laparoscopic surgery amongst the other supraglottic airway devices.

Other designs of LMA's include – Intubating Laryngeal Mask Airway, LMA C Trach. Both designs provide the ability to secure the trachea especially in difficult airway setting. The ability to directly visualize the glottic opening provide additional comfort with C Trach Laryngeal Mask Airway.

I-gel airway

A novel supra glottic airway using a mask made from gel-like thermoplastic elastomer without inflatable cuff. The distal bowl has a sophisticated 3 dimensional structure intended to mirror peri-laryngeal anatomy. Potential advantages include easier insertion, stability after insertion, minimal risk of tissue compression and cheaper manufacturing costs due to simplicity of design.

Inflatable cuffs have the potential to cause tissue distortion, venous compression, nerve injury and absorption of anaesthetic gases. Recent studies on fresh cadavers show that the I-gel conforms well to perilyngeal anatomy and the unique gel performed as expected. Adequacy of position was ascertained by lateral neck X-rays, fibre optic examination and neck dissection.

The simplicity of design, ease of insertion and good laryngeal positioning make the I-gel an attractive choice for the difficult airway scenario.

The laryngeal tube (LT)

Supra glottic re-usable airway made from silicone that consists of an airway tube and two cuffs-proximal and distal. The suction version has an additional lumen for passage of a gastric tube.

The proximal cuff provides a seal in the upper pharynx and the distal cuff seals the oesophageal inlet-both cuffs inflated by a single pilot tube and balloon.

The manufacturer recommends the intra cuff pressure to be 60cmH₂O for adequate functioning. The pressure exerted by the cuff on the oropharyngeal mucosa has been measured with microchip sensors in recent studies and these reveal that the exerted pressure is about 24-

36cmH₂O. The pharyngeal mucosal vasculature is compressed when pressure exceeds 35cmH₂O. When nitrous oxide is used intra cuff pressures may rise to about 120cmH₂O and the exerted pressure to ~ 50cmH₂O compressing if not collapsing the blood vessels.

The laryngeal tube and cLMA compare similarly in clinical trials but the laryngeal tube needs more adjustments to obtain a clear airway. Studies comparing the efficacy of the laryngeal tube with the ProSeal LMA show that even though higher leak pressures were achieved with the LT the ProSeal may be more effective during controlled ventilation under general anaesthesia due to better airway patency and less adjustments needed.

Complications include airway obstruction, malpositioning, mucosal ischemia and tearing of the cuff. Also expansion of the cuff during nitrous anaesthesia is worrying as cuff rupture and high exerted pressures are real possibilities.

A special feature of the LT is that once in place, the trachea can be intubated nasally.

The Cobra Perilaryngeal Airway

So named for its resemblance to the venomous snake *Naja haje* (Egyptian Cobra). It consists of a translucent silicone airway tube with a single inflatable cuff, 15mm standard adapter, a distal end with a smooth posterior surface and soft frond-like anterior grilles that cover the airway orifice.

During a recent trial of the Cobra PLA the study had to be stopped prematurely for two reasons Firstly 2 cases of pulmonary aspiration out of 64 patients and secondly because of concerns about the design when used in controlled ventilation.

Cuffed Oropharyngeal Airway (COPA)

Greenburg and Toung introduced the COPA in 1992. It is a modified Guedel's airway with a cuff at its distal end and a standard 15 mm connector at its proximal end to serve as an adapter for an anaesthesia circuit or an AMBU bag. The COPA is made from PVC for one time use. When inflated, the cuff displaces the base of the tongue and elevates the epiglottis from the posterior pharyngeal wall, providing a clear airway and an airtight seal.

The COPA comes in 4 sizes (8, 9, 10, and 11 cm), reflecting the distance between the distal tip and the proximal flange.

The appropriate size is one larger than a regular oral airway. The cuff volumes are approximately 3-3.5 times the size of the COPA (e.g. size 8, 25 ml, size 9, 30 ml, size 10, 35 ml and size 11, 40 ml).

COPA can be inserted after proper lubrication and gentle flexion of patient's neck either directly or by reverse Guedel's technique (airway placed backward and rotated)

Van Vlymen et al compared the COPA and LMA and found that the COPA has a lower oropharyngeal leak pressure than the LMA (22 cms H₂O vs. 26 cms H₂O) Peak and mean airway pressures and end tidal CO₂, at desired inspiratory (delivered) tidal volumes are similar but expiratory tidal volume is significantly low indicating either air-trapping or gastric insufflation. Moreover, like LMA, it does not protect the airway from gastric regurgitation.

One clear advantage is that nasal intubation can be performed with COPA.

Nasal airways

Nasal (nasopharyngeal) airway establishes a conduit from the nose to just behind the base of the tongue. It is better tolerated than an oral airway in a person with intact gag reflexes. Contraindications to its use include hemorrhagic disorders or basilar skull fractures. There is no evidence that nasal airways cause significant bacteremia. A nasal airway resembles a shortened tracheal tube with a flange or movable disk at the outside end to prevent it from passing into the nares. Various types of nasal airways are available in the market. The simplest one is common nasal airway made up of either PVC or latex material in which distal end is beveled tip while proximal end is shaped like the bell of a trumpet (commonly called "nasal trumpets"), limiting total

insertion of the airway and loss of the device in the nasopharynx or having a movable disk to fix the airway at desired length, and more simpler have a safety pin piercing to proximal end to prevent its migration into the nasal cavity.

Another variety called Linder nasopharyngeal airway, which has flattened proximal flange, straight cut distal end, and a balloon tipped catheter. Other varieties are Cuffed nasopharyngeal, and Binasal airway.

Binasal airway consists of two nasal airways joined together by a connection that has an adaptor for attachment to the breathing system. Apart from providing the hinder less airway movement with good tolerance than oral airway,

its other uses in supporting the airway are

- (i) working as a stent in obstructed airway,
- (ii) where effective oropharyngeal toileting is needed especially during maxillary and dental surgery
- (iii) to serve as conduit to pass and guide the FOB, ETT or nasogastric tube
- (iv) to dilate the nasal passage in preparation of nasotracheal tube insertion
- (v) even working as a treatment for hiccups. Before inserting the nasopharyngeal airway, proper preparation is mandatory to avoid serious complication of bleeding, damage to turbinated and/or septum. Proper lubrication, use of phenylephrine and/or lignocaine can be applied well before use of the device.

Streamlined pharynx airway liner (SLIPA)

The SLIPA is another new single use supraglottic device and provides an inexpensive alternative to the Laryngeal Mask Airway. It is so named because it shaped like a slipper with “toe, bridge and heel”. No cuff is necessary for the device to seal in the pharynx because its shape is similar to that of pressurized pharynx. The dimensions of the airway need to match those of the patient, and therefore a large range of sizes will be required if this airway is to become reliable. This disadvantage is likely to be compensated for other potential advantages relating to cost of production (no cuff mechanism required) and advantages relating to its hollow structure. During its insertion, assistant should lift the jaw forward to negotiate the ‘toe’ of the chamber past the bend in the pharynx at the base of the tongue. “Bridge” fits into the piriform fossa sealing the upward outlet at the base of the tongue. The “heel” anchors the SLIPA into position by sliding into the nasopharyngeal opening and soft palate.

Combitube

The Oesophageal Tracheal Combitube is designed to allow blind placement in either the oesophagus or the trachea.

It consists of two lumens with two cuffs. An open ended distal lumen with a low volume cuff is designed to make a seal in either the trachea or the oesophagus. The second lumen is sealed at its distal end but has a series of fenestrations that lie between the distal cuff and the much larger proximal cuff that is designed to occlude the oropharynx.

It is available in two sizes:

41 Fr standard adults, and 37 Fr for small adults.

It is supplied with two syringes: a 10 ml syringe for the distal cuff and an 85 ml syringe for the proximal cuff.

Suggested inflation volumes are:

37Fr Distal Cuff 5-12 ml, Oropharynx cuff 40-85 ml

41Fr Distal Cuff 5-15 ml, Oropharynx cuff 40-100 ml

On blind insertion it will tend to enter the oesophagus where, after inflating both cuffs, the patient

can be ventilated using the fenestrated second lumen.

If placed blindly or under direct vision by use of a laryngoscope in the trachea, the distal lumen can be used as a conventional tracheal tube. It is mainly intended for use in emergency airway management.

An oesophageal detection device, CO₂ detector or capnography are needed to help identify its placement, and the correct lumen to use for ventilation.

Complications:

1. Sore throat, dysphagia
2. Upper airway haematoma / haemorrhage
3. Oesophageal laceration
4. Oesophageal perforation
5. Vocal cord injury
6. Tracheal laceration

Combitube is associated with greater cardiovascular instability upon insertion.