The Laryngeal Mask Airway – First Class on Difficult Airways

Jukka Räsänen

Background

Airway management is one of the most essential skills in the practice of anesthesiology and inability to secure the airway is one of the most common reasons for major anesthesia-related complications. By far the most important recent contribution to airway management has been the introduction of the Laryngeal Mask Airway (LMA) into clinical practice.

The LMA was conceived and designed by Dr. Archie Brain in the United Kingdom in 1981, and first used in a human patient the same year. The first publication regarding this device appeared in the British Journal of Anesthesia in 1983, followed by the first clinical series in 1985. Commercial production of LMA's started in 1988 and by 1990, they were available in all hospitals with operating rooms in the United Kingdom. By the time the LMA entered the American Society of Anesthesiologists' difficult airway algorithm (1996), it had been used in over 30 million patients. The LMA has now become an established part of routine airway management, and it is included in the routine and emergency airway management armamentarium of both hospitals and out-of-hospital emergency crews.

Types of Laryngeal Mask Airways

Currently, three types of LMA's are sold commercially: the standard LMA, the flexible LMA (FLMA) and the intubating LMA (ILM). The standard LMA comes in 7 sizes covering a range of patients from premature infant to large adult (Table 1.) The mask is made of silicone and does not contain latex. The flexible LMA has a wire-reinforced flexible tube, which allows it to be secured away from the surgical field during operations involving the head and neck, without compromising airway patency.

The intubating LMA consists of three parts 1) the ILM itself, 2) the tracheal tube, 3) a flexible rod.

Table 1. Characteristics of standard laryngeal mask airways.

LMA size	Patient weight (kg)	Cuff volume maximum (ml)	Largest tracheal tube (ID mm)	Bronchoscope size (mm)
1	< 5	4	3.5	2.7
1.5	5 – 10	7	4.0	3.0
2	10 - 20	10	4.5	3.5
2.5	20 – 30	14	5.0	4.0
3	30 – 50	20	6.0 cuffed	5.0
4	50 – 70	30	6.0 cuffed	5.0
5	> 70	40	7.0 cuffed	7.3

As opposed to a standard LMA the ILM is a rigid metal tube and a metal handle, the aperture bars in the bowl have been left out, and an epiglottic lifting bar has been added. The metal tube is thin-walled to accept a larger tracheal tube and the rigidity of the device allows easier manipulation. The epiglottic lifting bar improves the likelihood of blind intubation through the ILM by moving the epiglottis out of the way as the tube is passed trough. The tracheal tube is wire-reinforced and reusable. The flexible rod is used to keep the tracheal tube in place as the ILM is removed after successful intubation. The ILM is not currently manufactured in pediatric sizes.

Insertion techniques

Preparation of the LMA and the patient is essential for successful placement. Lubrication of the mask should avoid the use of local anesthetics in order to preserve protective reflexes against aspiration. Some lubricants contain chemical compounds that shorten the life of the LMA cuff, and should not be used. Adequate lubrication is extremely important when the intubating LMA is used, because the relatively tight fit of the components and their material make passage of the tube otherwise nearly impossible.

A selection of LMA sizes should be available in addition to the one most likely to fit, because the anatomical features of the larynx cannot always be predicted from a physical examination. Most induction agents can be used to facilitate placement of an LMA, neuromuscular blockade is not necessary and, in fact, considered to impede proper LMA placement by some. The depth of anesthesia adequate for LMA placement is significantly less than that for tracheal intubation.

Several insertion techniques have emerged to complement the original technique described when the LMA was introduced. The standard technique involves a completely deflated LMA, guided into the pharynx with the index finger of the operator at the junction of the tube and the bowl, with the operator at the head of the patient and the LMA aperture faces caudally. A common alternative technique consists of inserting a partially inflated LMA into the pharynx above the epiglottis with the aperture facing cranially; the LMA is then turned 180 degrees before advancing it into its final position. The latter technique is particularly popular in children because it facilitates negotiating the angle between the mouth and pharyngeal axes. Awake insertion of the LMA under local anesthesia and sedation has been described.

The LMA should be secured after insertion in such a way as to prevent rotation and movement cranially. If surgical access allows, a preferred way to connect the LMA to the anesthesia circuit is to direct the circuit connection caudally and bring the circuit limbs down on the side of the patient's neck and head.

Removal of the LMA can be accomplished either during deep anesthesia or after protective reflexes have returned. Opinions and data favoring both approaches have been presented with approximately equal weight and frequency.

The LMA as an elective airway choice for general anesthesia

The advantages and disadvantages of an LMA over a face mask and a tracheal tube during anesthesia are outlined in tables 2 and 3. The lack of protection from aspiration and the inability to obtain high airway pressures follow most of the contraindications.

The LMA should not be used in patients at increased risk for pulmonary aspiration from factors

Table 2. Advantages and disadvantages of the LMA over face mask during anesthesia

Advantages
More effective airway seal
Ventilation is easier and less fatiguing
Ventilation requires less skill/experience
Airway gas monitoring is more accurate
Hypoxemia is less common
Gas waste is reduced
Scavenging is more effective
Remote airway management is possible
Surgical access is improved
Compression of facial structures is avoided
Direct access to the glottis
Disadvantages
Incidence of esophageal reflux may be higher

such as obesity, trauma, pain, gastrointestinal disease, autonomic neuropathy, use of gastroparetic drugs, pregnancy or questionable NPO status. It would also be a poor airway choice for surgical procedures that can lead to regurgitation of gastric contents from positioning, peritoneal traction, or increased intra-abdominal pressure. Patients with low lung compliance or high airway resistance may not be adequately ventilated with an LMA because the glottic seal is usually lost at peak airway pressures above 20 cmH_2O. Therefore, surgical procedures involving the thorax, and significant restrictive or obstructive pulmonary disease may preclude the use of this device. Conditions causing deviations from normal upper airway or oropharyngeal anatomy and a bleeding diathesis may not allow successful insertion or use of an LMA.

Personal notes: In my own practice of anesthesiology in children and adults I consider the conditions outlined above as contraindications but otherwise use the LMA whenever possible in all age groups. I do limit its use to anesthetics that last less than 2 hours and if the duration of the procedure unexpectedly increases, I consider tracheal intubation through the LMA. I do use the LMA for operations in the lateral decubitus position, but not in patients who need to be placed prone or in a steep Trendelenburg position for surgical access. When the surgery involves the head or neck, I use the LMA only if I am assured that the surgeon is comfortable with and respectful of the airway and that emergency entry into the surgical field for airway access will not harm the patient. I do believe that the LMA alters the neck anatomy significantly; this may be a consideration for some surgical procedures involving that area including cannulation of the neck veins.

Table 3. Advantages and disadvantages of the LMA over tracheal intubation during anesthesia

Advantages
Placement is easier
Placement is quicker
Less cardiovascular stimulation during insertion and emergence
Less change in intraocular pressure during insertion
Lower frequency of cough during emergence
Higher oxygen saturation during emergence
Lower incidence of sore throat
Lower incidence of voice abnormalities
Disadvantages
Gastric insufflation more likely
Air leak likely at airway pressure > 15 – 20 cmH_2O
Airway less effectively protected from aspiration

Use of the LMA for securing a difficult airway

Perhaps the greatest contribution of the LMA is its use to allow ventilation and intubation in situations where a tracheal tube cannot be placed with conventional techniques. In the absence of significant oropharyngeal pathology, an LMA can usually be inserted successfully as long as the mouth can be opened to an interdental distance of at least 15 mm in an adult patient. In 1993, LMA was added to the ASA difficult airway algorithm and in 1996 its place in that algorithm was extended to include management of both recognized and unrecognized difficult airway where it appears as a means of providing ventilation and an intubation conduit in both the emergency and non-emergency arms.

The use of the LMA as a primary technique in cases of known difficult airway is controversial. Those who favor awake intubation point to the potential failure of the LMA to provide adequate ventilation, a condition reported to occur with a variable rate of 0.4 – 6 % of insertions. If an LMA is successfully placed, a tracheal tube can be passed through it blindly or with the aid of a fiberoptic bronchoscope. Reported success rate of blind passage of a tracheal tube via a standard LMA vary from 30 to 93 %, the use of an intubating LMA should yield success rates of 80 to 90 %. The success rate of fiberoptic intubation through an LMA is close to 100 %.

Personal notes: I have found the LMA invariably successful in establishing conditions adequate for ventilation in several cases of unanticipated inability to intubate and ventilate an adult patient. Subsequent fiberoptic intubation failed in only one patient because a tracheal tube long enough to reach through a #5 LMA was not available; in this case the anesthetic was delivered using the LMA only. My experience with the intubating LMA in adult patients with normal airways so far has yielded 100

% successful blind passage of tracheal tube on first attempt. However, my technique of choice for an adult suspected difficult airway is still awake fiberoptic intubation.

In pediatric patients with anticipated difficult airway, inhalational induction with spontaneous breathing, insertion of the LMA followed by fiberoptic intubation through it, is my technique of choice. This stems from the difficulty of performing awake fiberoptic bronchoscopy in the pediatric age group and from the lack of rigidity of small bronchoscopes when used alone, without the LMA as a conduit. If the LMA is to be removed after intubation, I use a second, smaller tracheal tube to hold the original tracheal tube in place as the LMA is withdrawn.

Complications

With appropriate selection of patients, proper anesthetic technique, training, and periodic examination of equipment, problems arising from LMA use are rare. Reported problems include aspiration of gastric or pharyngeal contents, stimulation of pharyngolaryngeal reflexes, trauma to pharyngeal structures, compression of neurovascular elements in the neck, and fragmentation or herniation of the LMA itself. To date there no deaths directly attributable to the use of LMA have been reported.

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Jukka Räsänen, Professor
Department of Anesthesiology
Mayo Clinic
200 First Street SW
Rochester, MN 55905
USA