Using the laryngeal mask airway to manage the difficult airway
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Before 1990, the choice of an airway device essentially was limited to the facemask or the endotracheal tube (ETT). Since then, a number of novel supraglottic airway devices have been developed. The laryngeal mask airway (LMA; The Laryngeal Mask Company Limited, LMA North America, San Diego, CA) was introduced to the United States in 1991 after 3 years of use in the United Kingdom and other countries. Today the LMA has a clearly established role as an airway device in the elective setting when neither the procedure nor the patient require tracheal intubation. Perhaps more importantly, the LMA also has proved extremely useful in managing the difficult airway. Dr. Archie Brain, inventor of the LMA, continues to create additions to and variations of the original LMA. At present, these variations include eight sizes of the original (LMA-Classic), a single-use LMA (LMA-Unique), a reinforced/flexible LMA (LMA-Flexible), an LMA specifically designed for tracheal intubation (LMA-Fastrach), and an LMA with an integral gastric access/venting port (LMA-ProSeal). As of April 2002, there are more than 2140 Medline citations involving the LMA. This article reviews the use of the various LMA devices to manage the difficult upper airway.

Laryngeal mask airway-Classic

The LMA has an important role in the management of the difficult airway. Included in the American Society of Anesthesiologists’ Practice Guideline for the Difficult Airway, it can be used as the primary airway or as a channel for a fiberscope. Successful use of the LMA does not require the same constellation of factors required for direct laryngoscopy and tracheal intubation. Consequently, it can provide an airway in both the “cannot intubate—can ventilate” and the
cannot intubate—cannot ventilate” situations if the problem is supraglottic in nature. The relative ease of learning how to insert and use the LMA has facilitated its use by health care workers other than anesthesiologists and nurse anesthetists. Such individuals include paramedics, neonatologists, emergency room physicians, and critical care nurses.

The trachea can be intubated a number of ways using the original LMA. All such techniques rely on the fact that the aperture of a properly positioned LMA aligns itself anatomically with the glottis (Fig. 1). Passing an ETT blindly through the LMA into the trachea has an unacceptably low degree of success. Difficulties include catching the ETT tip on the aperture bars or the anterior commissure. The latter problem is a result of the natural bend in a standard polyvinyl chloride (PVC) ETT and the angle at which the ETT exits the LMA. A maximum 7.0-mm internal diameter cuffed ETT can be passed through the size 5 and 6 LMAs; a maximum 6.0 can be passed through sizes 3 and 4. An important limitation in using a standard ETT is that it may not project far enough beyond the LMA through the larynx and into the trachea to provide a secure airway. One solution is

Fig. 1. Schematic of a properly positioned LMA.
to use a 6.0 microlaryngeal tube (Mallinckrodt Critical Care, Glens Falls, NY),
which is 5 cm longer than a standard 6.0 and 2.5 cm longer than a standard
7.0 ETT (Fig. 2).

An elegant and safe technique uses the LMA as a channel for a fiberscope.
Those who are familiar with fiberscopic techniques appreciate the critical im-
portance of the channel the fiberscope traverses. When properly positioned, the
LMA orifice is directly opposite the laryngeal inlet. In preparation, a well-
lubricated ETT is placed in the tube portion of the LMA and the cuff is inflated
(Fig. 3). A swivel adapter (Portex No. 625191, Sims Portex, Keene, NH) allows
delivery of oxygen and volatile anesthetic while a flexible fiberscope (eg, 5-mm
outer diameter) is passed through the LMA and into the trachea. The cuff is
deflated, the ETT is advanced into the trachea, and its proper position is confirmed.

At this point, an important limitation becomes apparent. There is no simple
way to remove the LMA without disturbing the ETT. The LMA should be
deflated and left in place until the trachea is extubated. If the LMA must be
removed or the ETT changed because of inadequate diameter or length, an
exchange catheter can be passed through the ETT (within the LMA) into the
trachea, the LMA can be removed, and another ETT can be passed over the stylet.
A catheter with a lumen (Cook airway exchange catheter, No. C-CAE-14.0-83,
Bloomington, IN) is safest because one can ventilate the lungs with a jet ventilator
with just the exchanger in place. Caution always is warranted when using these
catheters and jet ventilation.
Recently, a new airway catheter became available to make this procedure easier. The Aintree Intubation Catheter (Cook, No. C-CAE-19.0-56-AIC) is an exchange catheter with a lumen large enough for a fibroscope. Once an LMA is positioned properly, the Aintree catheter can be passed into the LMA, and a fibroscope can be passed through it (Fig. 4). Under fiberoptic guidance, the catheter is passed through the LMA into the trachea. Then the fibroscope and LMA can be removed, leaving just the catheter in place. An ETT with an inner diameter of 7 mm or larger can be passed over the catheter into the trachea. This step may be difficult because of the short length of the catheter. If necessary, the catheter can be used to jet-ventilate the lungs. With this technique, special ETTs are not needed, and a large ETT can be placed initially.

Laryngeal mask airway-Fastrach

The LMA-Fastrach or intubating LMA (ILMA) is designed to specifically overcome the problems associated with (blind) tracheal intubation through the original LMA. It consists of a rigid, anatomically curved airway tube made of stainless steel with a standard 15-mm connector. The tube is wide enough to accommodate an 8.0 ETT and short enough to ensure passage of the ETT beyond the vocal cords. A rigid handle attached to the tube facilitates one-handed insertion, removal, and most importantly, adjustment of the device’s position so that the aperture directly opposes the larynx.

The ILMA is available in three sizes (3, 4, 5) that correspond to the cuff size of the original LMA. The remainder of the device is identical for all three sizes, and
all accommodate an 8.0 ETT. Many find insertion of the ILMA easier than the original LMA because the rigid tube follows the anatomic curve of the palate and posterior pharyngeal wall and one’s index finger does not have to enter the mouth. Once positioned correctly, the ILMA can be connected to a circuit and used as an airway device; however, the safety of keeping such a rigid object in the mouth for a long period must be considered.

To achieve the highest degree of success in intubating the trachea blindly through the ILMA, it is recommended strongly that the special, supplied ETT be used (Euromedical ILM Endotracheal Tube, Euromedical, Malaysia). This silicone tube is soft tipped, straight, wire reinforced, and cuffed. When compared with a standard PVC ETT, it exits the ILMA at an angle that facilitates passage through the glottis (Figs. 5 and 6). Three ETT sizes (internal diameter) are available (7.0, 7.5, 8.0), and each fits through each of the three ILMA sizes. Each ILMA comes with one of these special tubes. Because the special ETT is reusable, its cuff is a low-volume, high-pressure design in contrast to the high-volume, low-pressure cuff in a PVC tube. Careful attention must be paid to cuff inflation pressures, particularly when nitrous oxide is used. A relatively larger-size ETT should be used because the low-volume, high-pressure cuff does not have the bulk to span the trachea’s diameter. For men, ILMA sizes 4 and 5 are best for ventilation and blind intubation. For women, sizes 3 and 4 are best for ventilation, but all three can be used for intubation. Once the correct-sized ILMA is positioned properly and the patient is well oxygenated, the special ETT is lubricated and inserted into the ILMA tube. Rotating and moving the ETT in and out helps distribute the lubricant. The single horizontal indicates the depth at which the ETT enters the

Fig. 4. The Aintree catheter, fiberscope, and LMA.
mask aperture. The ILMA handle is grasped and elevated (not levered) just like a laryngoscope. This maneuver straightens the angle between the ILMA and the glottis. The ETT tube is passed gently beyond this horizontal line.

With experience, one can “feel” when the specialized ETT is passing into the trachea. If resistance is felt immediately, the selected ILMA is too large. If resistance is felt 2 cm beyond the transverse line, the epiglottis may be downfolded. Resistance felt at 3 cm may indicate that the selected ILMA is too small. If resistance is felt at 4 to 5 cm, the selected ILMA may be too large. The Instruction Manual and LMA Web site (http://www.lmana.com) [1] provide more detailed guidance. A novel approach is to use a light wand inside the special ETT. The glottic area will “light up” when the ETT is passed successfully into the trachea. A fiberscope also can be used, but it must be passed through an ETT that projects beyond the aperture. In contrast to the easily displaced aperture bars of the original LMA, the ILMA has a single flap, the epiglottic elevating bar. A fiberscope can be damaged if pushed through the epiglottic elevating bar unprotected.

To remove the ILMA once the trachea is intubated, one should remove the 15-mm ETT connector while the ETT cuff remains inflated. This connector should be kept connected to the circuit to avoid its loss. One then can ease the ILMA out by gently swinging the handle to follow the curvature of the rigid shaft. One should swing the ILMA out of the pharynx and mouth while applying
counter-pressure to the ETT. To hold the ETT tube in place, the included stabilizing rod (20 cm) is opposed to its proximal end, which effectively increases the length of the ETT and permits sliding of the ILMA out of the mouth. The ETT tube should be grasped in the pharynx as soon as the ILMA clears. The pilot balloon and inflation line will thread through the ILMA because of its attachment to the proximal end of the ETT. One now can reconnect the 15-mm fitting. If the decision is made to replace this ETT, a tube exchanger can be used in the manner described earlier.

**Laryngeal mask airway-ProSeal**

This unique device represents a substantial change in LMA design. Two issues of concern have bedeviled the LMA. Although rarely an actual problem, some practitioners refuse to use the LMA because of their concern for gastric distention with positive pressure ventilation. To address this issue, the ProSeal has an integral gastric access/venting port and tube. When properly positioned, the distal orifice of this tube lies in the upper esophagus. Sealed off from the glottis, the esophagus and stomach can be vented to air or a 14-F sump tube can be passed and gastric contents evacuated. Mask design is also unique. The bowl is open, and the inflatable portion extends around the back. When inflated, the mask is pushed anteriorly and the glottis becomes enveloped in the bowl, in contrast to
the original design, in which the LMA and glottis opposed each other and the aperture bars prevented the glottis from herniating into the bowl. A better airway seal usually results at a given cuff pressure versus the original LMA. In the elective situation, the ProSeal may expand LMA use to those patients with treated or asymptomatic reflux or hiatal hernia. In addition, the ability to use positive pressure ventilation will be facilitated. In the emergency situation, the ProSeal may prove particularly useful when positive pressure ventilation is necessary and gastric distention or regurgitation is a major concern (eg, failure to intubate in obstetrics). Note that the ProSeal is not useful as a channel for a fiberscope. The ProSeal is discussed in detail by Drs. Brimacombe and Keller elsewhere in this issue.

Reference