LMA Uses in Difficult Airway Algorithm

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OBJECTIVES

After the lecture, participants will (1) understand the anatomical and physiological principles of the laryngeal mask airway (LMA), (2) be able to apply the correct LMA insertion technique, and (3) be familiar with the uses of the LMA-Classic and the intubating LMA-Fastrach in patients with difficult-to-manage airways and the clinical applications of the LMA in the American Society of Anesthesiologists Difficult Airway Algorithm.

CASE PRESENTATION

It has been 10 years since the LMA was introduced into clinical practice in the United States. The LMA has been used more than 100 million times worldwide without a single death directly attributed to its use and now has a well-established role in the management of patients with normal and difficult-to-manage airways. This Refresher Course Lecture will focus on the uses of the LMA and the intubating LMA in different clinical pathways of the ASA Difficult Airway Algorithm. Several elective and emergency clinical situations will be presented to illustrate the appropriate techniques for LMA use in patients with difficult-to-manage airways.

Introduction

Depending on experience, difficulty in tracheal intubation is encountered in 1-3 % of anesthetized patients. Failed intubation rate is approximately 0.05-0.2%. “Cannot intubate, cannot ventilate” scenario is fortunately rare (0.01% of patients), but it usually leads to a catastrophic event and accounts for the majority of serious morbidity and mortality related to anesthesia.

The LMA has a role in the management of the difficult airway both as a primary airway and a guide to intubation. Over the past 10 years teh LMA has been used in the management of pediatric and adult patients with a difficult airways, and it has been the subject of several reviews. LMA is one of the three non-surgical techniques currently recommended for use in “cannot intubate, cannot ventilate” scenario, but it is the only one of these three that is used in routine anesthesia. As such, the skill of LMA use can be practiced and maintained daily, and the device can be available immediately for use.

Historical Aspects of the LMA in Airway Management

The potential of LMA for emergency and non-emergency management of patients with difficult airway was appreciated shortly after its invention. In February 1983, an early prototype was used successfully by Dr. Brain in a 114-kg male undergoing laparotomy who could not be intubated.

The first publication describing LMA as a possible solution to airway management in the emergency situation appeared in the Archives of Emergency Medicine in 1984. In 1985 LMA was applied successfully in the management of 5 patients with anticipated difficult intubation. By October 1987, after an excellent record in 21 adult difficult intubations, LMA was used successfully for the first time in a failed pediatric intubation. Fiberoptic investigation conducted by Dr. Brain suggested the possibility of using the LMA as a guide for tracheal intubation. This concept was further developed by the inventor between May and June 1983 by creating a prototype of LMA that was used to blindly intubate three patients with a size 9-mm tracheal tube. In 1989 Allison and McCrory used fiberoptic guidance for tracheal intubations. An awake intubation via the LMA was first reported by McCrirrick and Pracilio in 1991. In 1993 the LMA was incorporated into the Practice Guidelines for Management of the Difficult Airway by the American Society of Anesthesiologists Task Force on the Management of the Difficult

Airway. Relatively little data was available then to fully appreciate LMA′s role in difficult airway situations. By 1996 the literature on and experience with the LMA had substantially increased and Dr. Benumof (who participated in the development of the ASA algorithm) assessed LMA′ s potential in a difficult airway scenario. His recommendations were, that LMA should be considered not only in the originally recommended emergency limb, but also in the additional 4 places of the algorithm: 1) on the awake intubation limb of the algorithm as aid to tracheal intubation; 2) on the non-emergency pathway as a definite airway or 3) as an aid to tracheal intubation in anesthetized patients; 4) as an aid to tracheal intubation after establishing airway on the emergency limb. Essentially, depending on the level of expertise, the LMA can be used in any place of the ASA algorithm. In his review Dr. Benumof concluded, "With multiple uses and multiple places of use, the LMA is an important option within the ASA difficult airway algorithm. More importantly, the clinical record of LMA use in "cannot intubate, cannot ventilate" situations has been excellent, and in patients whose lungs cannot be ventilated because of the supraglottic obstruction and whose trachea cannot be intubated due to unfavorable anatomy (but not periglottic pathology), the LMA should be immediately available and considered as the first treatment of choice."

The Anatomical Evaluation of the Airway with Mallampati grade, and Cormack and Lehane scoring, and the ease of LMA insertion.

Data from both prospective and retrospective studies shows that the ease of LMA insertion does not correlate with Mallampati grade or Cormack and Lehane scoring. It appears that the position of the larynx has little bearing on the LMA insertion. It has been also suggested that the presence of an anterior larynx may make the LMA insertion easier.

The LMA Use in Predicted Difficult Airway

The American Task Force on the Difficult Airway currently recommends awake intubation as the preferred option in the known or strongly suspected difficult airway. Reasons for avoiding LMA usage are that the LMA may not always succeed and face mask ventilation in the event of failure is not guaranteed. The initially reported 6% failure rate for the LMA insertion probably reflects inexperience and misuse of the device, since Verghese at al (experience users) had a failure rate of only 0.4% in 2359 patients, and when the trial was extended to over 11000 patients the results were similar. When the LMA is used in the anticipated difficult airway, the options are to insert the LMA either under general anesthesia or with the patient awake and the airway topicalized. The LMA may then be used as a definitive airway (short procedures when the anesthesiologist remains at patient′s head) or as an aid to the tracheal intubation. Maintaining spontaneous ventilation seems a prudent management when general anesthesia is used. A Sevoflurane inhalation induction in either adult or pediatric patients appears to be both a reasonable and attractive choice.

LMA Use in Unpredicted Difficult Airway

The success of the LMA in rescuing patients from an unanticipated difficult airway situation depends on the nature of the airway problem and on the following factors: familiarity and expertise of the operator with the device in routine clinical practice, adherence to basic principles of failed intubation drills, and prior experience with intubation through the LMA. Although the LMA offers no protection against regurgitation, in an emergency situation, regurgitation may be less likely if hypoxemia is reversed by establishing a patent airway with LMA in a timely fashion. Hypoxic damage due to persistent attempts to intubate a patient with compromised airway and low oxygen saturation is the major problem in failed

airway scenario, and by far a major cause of injury, rather then acid aspiration. The anatomical interaction between cricoid pressure and the LMA has been addressed by Dr. Benumof in his review of the LMA in ASA difficult airway algorithm. For correct LMA placement it is important that the leading edge of the mask is inserted into the hypopharynx behind the arytenoids and the cricoid cartilage. Insertion of the LMA and subsequent tracheal intubation through the LMA may be more difficult or unsuccessful with cricoid pressure in place. It would seem reasonable, however to initially attempt the insertion with cricoid pressure applied if the oxygen saturation is adequate (>95%). If oxygen saturation is low (<95%) or if failure occurs during the initial insertion, cricoid pressure should be transiently released. It is worthwhile mentioning that a successful insertion of the LMA in general and particularly in this scenario is possible only when the mask is completely deflated to form a smooth, thin leading edge.

Examples of Clinical Airway Problems Managed with the LMA
Acromegaly
Ankylosing spondylitis
Rheumatoid arthritis
Facial burns
Failed airway in obstetric patients
Failed rigid bronchoscopy
Fractured jaw
Temporomandibular joint disease
Limited mouth opening (but not less than 10mm)
Micrognathia
Neck contracture/Fixed immobile cervical spine
Ossification of the posterior longitudinal ligament
Cervical spinal tumor
Treacher Collins
Pierre Robin
Unstable neck

Tracheal Intubation with the Use of LMA

Tracheal intubation through the LMA can be achieved either blindly or with the fiberoptic guidance. The advantage of blind technique is that it does not require availability or skill with the fiberoptic scope. The disadvantages include low success rate, airway trauma and time involved in trying to secure the airway. Reported success rates for blind intubation through the LMA vary between 30 and 93% depending on the number of attempts, experience, technique, type of endotracheal tube, and the application of cricoid pressure. The best experience reported by Heath showed that blind passage of a size 6mm cuffed tube was successful in 90% of anesthetized paralyzed patients (with multiple attempts and movement of the head and neck). The cricoid pressure reduced the success rate to 56 % in that series. As concluded by another study, the type of endotracheal tube and the maneuvering of the head and neck played a significant role in succeeding with blind tracheal intubations via LMA. Dr. Brain (LMA inventor) recommends a two stage maneuver for blind intubation through the LMA: first, head extension to maximize the chance of the tip of the endotracheal tube entering the vestibule; secondly, when resistance is felt as the tube tip contacts the anterior wall of the larynx (approximately 3cm) head and neck flexion to align the axes of endotracheal tube and the trachea. This allows better negotiating the S- shaped pathway from the pharynx to the larynx with minimal risk of any trauma.

Blind passage of a tube exchanger or a bougie into the trachea is also possible, followed by removal of the LMA and intubation with an endotracheal tube over the guiding device. Fiberoptically guided intubations

via the LMA have predictably higher success rates over 90- 100% at a single attempt; intubation is usually achieved with minimal risk of trauma and esophageal intubation. In addition, time spend to intubate patient′s trachea via LMA with the aid of fiberoptic scope is much shorter. Optimal LMA placement (skill that can be mastered and maintained only by very frequent use of the device) will significantly increase the chances of success. LMA when placed correctly will provide an excellent view of the vocal cords. Continuous ventilation can be maintained while trying to achieve the intubation. This increases the safety and allows more time for fiberoptically guided intubation. Potentially, even in hands of an infrequent fiberoptic scope user, the elective or emergent intubation may have much higher success rate. Despite it′s usefulness and an excellent track record the regular LMA was not intended by Dr. Brain to be used as a guide for tracheal intubations. Therefore there are several technical features to consider when using the LMA as an aid to intubation. The internal diameter (I.D.) of the LMA tube will accommodate a relatively small cuffed endotracheal tube (the largest endotracheal tube that can be inserted through size 5 LMA is 6.5 mm I.D. cuffed tube), which is usually sufficient to ventilate most of patients. If a larger bore endotracheal tube is needed; a tube changer or bougie can be used to guide a larger endotracheal tube. This technique requires extubation with a smaller tube and thus carries the risk of losing the airway. There is also a potential for aspiration while trying to exchange endotracheal tubes. Another technical aspect, important to consider while using the LMA as a guide for tracheal intubations, is the length limitation of regular endotracheal tubes in patients with long necks. In those patients, the cuff of the endotracheal tube may be either above or at the level of the vocal cords even after the endotracheal tube is inserted to it′s full length into the LMA′s shaft. To eliminate these shortcomings it is useful to keep readily available longer microlaryngeal tubes.

The Intubating LMA-FastrachTM

To take a full advantage of LMA′s potential as a guide for tracheal intubations and to overcome the technical difficulties associated with the regular LMA in these applications Dr. Brain has recently introduced a new Intubating Laryngeal Mask (under the commercial name Intubating LMA-FastrachTM). The intubating LMA-FastrachTM is designed and intended to facilitate either blind or fiberoptically guided tracheal intubations. To point out a few differences, the two bars at the aperture of the regular LMA have been replaced by a single, movable epiglottic elevating bar (EEB) that allows a smooth and unobstructed passage of the endotracheal tube as it emerges from the metal shaft of the LMA-Fastrach. The metal shaft of the LMA-Fastrach allows the insertion of up to 8.5-mm I.D. endotracheal tube. In addition, the shaft is shorter in length, thus eliminating the need for longer endotracheal tubes in patients with long necks. Recently, the effectiveness of the LMA-Fastrach in patients with different types of difficult-to-manage airways was assessed in a large study of 254 patients. The LMA-Fastrach was used in 257 procedures performed in 254 patients with difficult airways, including patients with Cormack-Lehane grade 4 views; patients with immobilized cervical spines; patients with airways distorted by tumors, surgery, or radiation therapy; and patients wearing stereotactic frames. Insertion of the LMA-Fastrach was accomplished in three attempts or fewer in all patients. The overall success rates for blind or fiberoptically guided intubations through the LMA-Fastrach were 96.5% and 100.0%, respectively. This represents the largest analysis to date examining the use of the LMA-Fastrach in patients with difficult-to-manage airways and demonstrates that that the LMA-Fastrach may be particularly valuable tool for emergency or elective airway management of patients in whom other techniques have failed and in the treatment of patients with immobilized cervical spines.

Summary

Good familiarity and expertise with the LMA should be obtained before using it in the management of the difficult airway. A full range of equipment and personnel should be also available. Most authors advocate the widespread availability of the LMA on the difficult airway carts. Of some concern is the fact that only 87% of US trainees have practical experience with the LMA as a potential device for a difficult airway management. In addition, the training seems to be very fragmented and a variety of incorrect techniques for LMA insertion are being currently practiced. In view of the recommendations made by the American Society of Anesthesiologists Task Force of the Management of the Difficult Airway and more recently by Dr. Benumof, it is essential that all trainees gain practical experience with the LMA.

Suggested Readings

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