

EDITORIAL VIEWS

Anesthesiology
77:843-846, 1992

Laryngeal Mask Airway

Indications and Contraindications

The laryngeal mask airway (LMA), originally described by Brain,¹ has achieved great popularity in the United Kingdom, as best exemplified by the fact that 59% of all general anesthetics at the Royal East Sussex Hospital are now administered using the LMA as the airway management technique.² Given the high degree of success in easily obtaining a clinically acceptable airway in anesthetized normal patients, as well as the multiple reports ($n = 27$, see below) demonstrating that proper alignment of the LMA with the larynx facilitates blind and fiberoptic intubation of the trachea, the LMA has been proposed as 1) a routine airway for general anesthesia and 2) as an aid in the management of a difficult airway (*i.e.*, an emergency airway as well as an airway intubator [conduit]). Because the LMA has only recently become widely available in the United States and because serious complications may result from its inappropriate or incorrect use, it is important to understand exactly the indications and the contraindications to its use to maximize benefit and minimize risk.

Use as a Routine Airway

Until now, few studies have compared the advantages and disadvantages of the LMA with other commonly used airway management techniques. This issue of ANESTHESIOLOGY contains a report of a randomized prospective study comparing the quality of the airway with the LMA with that of a standard face mask/oropharyngeal airway system.³ The authors found that problems associated with airway management (difficulties in maintaining an airway and $SpO_2 < 95\%$) were significantly more common in patients in the face mask (control) group than in the LMA

group. Also, because with the LMA the mandible does not need to be supported, the anesthesiologist has otherwise free hands; less fatigue is likely; and remote observation is possible. The authors found, as have others, that stimulation related to insertion of the LMA is approximately the same as that for an oropharyngeal airway.³

As Smith and White also report, the use of the LMA for routine airway management is far from problem-free and that there are several important relative contraindications.³ The most common problem in patients with no obvious anatomic abnormalities is failure to achieve correct placement. It is important to understand that the usual fit of the LMA around the larynx, as assessed using flexible fiberoptic endoscopy,^{4,5} radiologic investigation,⁶ and nuclear magnetic resonance imaging,⁷ is somewhat variable. When the LMA is in its ideal position, the epiglottis and esophagus are outside and the laryngeal opening is totally within the rim of the LMA; this is obtained only 50–60% of the time.^{4–7}

When the epiglottis is within the proximal rim of the LMA, the tip of the epiglottis is downfolded toward the larynx 50–90% of the time, and the lateral aryepiglottic folds are infolded toward the larynx half of the time^{4–7}; these distortions of the epiglottis can partially obstruct both the distal end of the LMA tube as well as the larynx. The distal rim of the LMA is usually wedged in the hypopharynx, but in 10–15% of cases the esophagus may be clearly seen inside the distal rim, and in some cases the distal rim may be directly opposite the glottis. However, these variations in the laryngeal position of the LMA, even though they represent a partial degree of obstruction, do not cause any apparent difficulty with respiration, and in 95–99% of adult^{4,8,9} and pediatric patients^{5,10–13} the airway is ultimately judged to be clinically acceptable (although proper position may have required two insertion attempts).

Accepted for publication July 1, 1992.

Key words: Equipment: endotracheal tube; laryngeal mask; oral pharyngeal airway. Techniques: fiberoptic endoscopy; tracheal intubation. Resuscitation. Ventilation: positive pressure; spontaneous.

One to five percent of placements in anatomically normal patients are wholly inadequate; these result from backfolding of the distal cuff, occlusion of glottis by the distal cuff and by complete backfolding of the epiglottis, and 90–180° rotation of the mask.^{4,5,8–13} Smith and White³ report a 6% incidence of a wholly inadequate airway with the LMA that may have been related, in part, to the fact that the anesthesiologists participating in the study were 2nd- and 3rd-yr residents³; the learning curve associated with positioning the LMA is quite flat, but it is still steeper for an inexperienced person than for an experienced person.

The most common causes of poor LMA placement are inadequate anesthesia or inadequate relaxation (pharyngeal muscle and/or laryngeal spasm), failure to negotiate the 90° turn from the posterior pharynx to the hypopharynx, and choice of wrong LMA size. In 8–33% of LMA placements, more than one attempt is required, whether it be by residents or seasoned practitioners, or in adult or pediatric patients.^{3,7–14} Correct placement may be more difficult in patients with a small mouth, a large tongue and/or tonsils, and a posteriorly placed larynx (which blocks the advancement of the tip of the LMA into the hypopharynx). Obviously, in view of these placement considerations, the use of the LMA is relatively contraindicated in patients with local pathology in the pharynx and larynx such as tumor, abscess, edema, and/or hematoma.

For two cogent reasons the LMA is also contraindicated in patients who have a risk of regurgitation and/or active vomiting of gastric contents or have blood present in the upper airway. First, the LMA does not provide an airtight seal around the larynx (the usual pop-off pressures are 15–20 cmH₂O). Second, as described above, in 10–15% of patients the esophagus is included within the rim of the LMA and therefore directly exposes the esophagus to positive pressure ventilation; indeed, massive gastric dilation may occur,¹⁵ thereby promoting return of gastric contents.

Because the usual LMA seal pop-off pressure is 15 cmH₂O, the LMA is also relatively contraindicated whenever it is anticipated that positive proximal airway pressures in excess of 25–30 cmH₂O will be required to adequately ventilate the lungs (*i.e.*, in cases of existing or potential development of decreased lung compliance and/or increased airway resistance). Finally, because the LMA may become malpositioned or regurgitation/vomiting may occur at any time, the LMA is relatively contraindicated whenever tracheal intubation cannot be accomplished readily (*e.g.*, when the patient is in the prone position; when the operating table is turned away from anesthetist; or when the potential for difficult intubation is recognized).¹⁶

Use as an Aid in the Management of a Difficult Airway

The LMA has been found to be very helpful in serving as an emergency airway in the patient whose lungs cannot be ventilated using a bag and conventional mask and whose trachea cannot be intubated.^{17–22} Also in this issue of ANESTHESIOLOGY is a letter to the editor describing yet another cannot-ventilate, cannot-intubate situation in which the LMA functioned as an emergency airway.²³ In such a situation, use of the LMA is a reasonable maneuver to try quickly,^{24,25} except when local pathology in the pharynx or larynx (see above) precludes a reasonable chance of even limited gas exchange success. If insertion of the LMA does not effect gas exchange quickly, then transtracheal jet ventilation should be instituted immediately.^{24,26} If the LMA does effect some gas exchange, then some form of stable permanent airway should be obtained as quickly as possible (awake spontaneous ventilation, tracheal intubation [see below], surgical airway) because of the ever-present risk of aspiration²² as well as the need for high levels of positive pressure ventilation.

In addition, the LMA is useful as an airway intubator (conduit) for an intubating tracheal stylet or fiberoptic bronchoscope (FB) (over which an endotracheal tube [ETT] may be passed) in cases in which intubation is difficult but ventilation is possible. There are numerous reports (many as letters to the editor) of use of the LMA as an airway intubator (conduit) for either the blind passage of an ETT (*n* = 1 case report, *n* = 3 series of patients), an intubating stylet (*n* = 5 case reports, *n* = 1 series of patients), or an FB (*n* = 8 case reports, *n* = 9 series of patients). In view of how the LMA usually seats around the larynx, it is obvious that when the LMA has a perfect central position, any of the blind insertions has a good chance of success. It is equally obvious that the greater the degree of noncentral location of the LMA over the larynx, the less the chance of success of blind intubation. In fact, when blind tracheal intubation is attempted through an LMA in a large series of patients thought to have normal anatomy, there is a 26% failure rate on the first attempt and a 10% overall failure rate with an ETT,^{27,28} and there is an 18% overall failure rate with an intubating stylet.²⁹ The use of cricoid pressure decreases the chance of passing an ETT blindly through the LMA into the trachea (but not the chance of passing the LMA itself).^{30,31} Of course, passage of an FB through the LMA has a much higher chance of success and is virtually 100% successful in most series. A 6.0-mm-ID cuffed ETT may be passed over the FB (and through the shaft of the LMA), and if a larger ETT is desired, the LMA and 6.0-mm-ID cuffed ETT may be exchanged for a larger ETT over a jet stylet.²⁴

This issue of ANESTHESIOLOGY also contains a report of two patients who were at increased risk of aspiration of gastric contents and in whom the tracheas were intubated using an FB through an LMA while they were awake.³² The author's anesthetic plan made good sense, for two reasons. First, as the author notes, the relative lack of stimulation in passing an LMA greatly reduces the amount of preparation (topical anesthesia, sedation) that a patient requires.^{29,33-35} Second, once the LMA is in good position, the shaft of the LMA is lined up well with the larynx, and visualization of the laryngeal aperture with an FB is easy (see above). Of course, with the patient awake, "no bridges are burned," and risk remains low even if there is difficulty in inserting the LMA or the FB. The decision to induce general anesthesia in case 2 before insertion of the FB and ETT into the trachea may be criticized because there was no guarantee that movement of the patient's upper airway (gag, vomit, swallow, cough) would not displace the FB away from the laryngeal aperture, and there was no guarantee that the ETT would follow the FB into the trachea (e.g., impact on the right arytenoid/vocal cord).²⁴ For both of these reasons, it might have been more prudent to have intubated the trachea before inducing general anesthesia once the time and effort to hover just proximal to laryngeal aperture with an FB had been taken.

Because the LMA usually works well as an airway intubator (conduit) for an FB, the LMA has been used to facilitate diagnosis using a fiberoptic instrument in patients in whom the airway would be otherwise difficult to control; these include inspection of the larynx and tracheobronchial tree in infants,³⁶ children,³⁷ and adults,³⁵ especially during and after neck surgery that incurs a special risk of injuring the recurrent laryngeal nerve,^{38,39} although the wisdom of this latter use has been debated.⁴⁰ Similarly, the LMA has been proposed as an aid to flexible FB laser ablation of tracheobronchial tree tumors,⁴¹ but this particular application also has been questioned.⁴² The LMA has been used in an infant with tracheal stenosis, but the patient experienced intraoperative respiratory difficulty, and intubation of the trachea may not have been possible.⁴³ The LMA may be uniquely useful in patients with burns of the face (to avoid relaxants and friction to the face) and in patients who need multiple anesthetics over a short period of time (e.g., daily) with the possible need for remote monitoring (radiologic procedures).^{10,44,45} Finally, the LMA has been proposed for patients with an unstable cervical spine because insertion of the LMA does not necessarily require movement of the neck.⁴⁶

In summary, the LMA routinely provides a good airway, but there is a 1-5% incidence of failure and a number of contraindications to its use. The most useful principle

to remember is that the LMA should not be used as a substitute whenever the airway *must* be guaranteed by tracheal intubation. When the LMA is in good position, it can save the life of the patient in whom tracheal intubation and/or ventilation of the lungs is impossible, and it can make cannulation of the trachea either blindly or fiberoptically possible. Nevertheless, it should be understood that many of the contraindications to its routine use also apply to its emergency use (e.g., in the awake unanesthetized patient with a full stomach and upper airway pathology). The LMA can facilitate fiberoptic diagnostic visualization of the upper and lower airway and may be a uniquely useful airway in a few special situations (e.g., in patients with burns of the face and those who require very frequent anesthetics). What is most needed to ascertain further the appropriate applications of the LMA are prospective randomized studies of large series of patients, such as that by Smith and White,³ rather than simply the anecdotal testimony of case reports and letters to the editor that currently constitute a large fraction of the literature on this subject.

JONATHAN L. BENUMOF, M.D.

Professor of Anesthesia

University of California, San Diego Medical Center

Department of Anesthesiology

Mail Code 8812

225 Dickinson Street

San Diego, California 92103

REFERENCES

1. Brain AIJ: The laryngeal mask: A new concept in airway management. *Br J Anaesth* 55:801-805, 1983
2. Leach AB, Alexander CA: The laryngeal mask: An overview. *Eur J Anaesthesiol Suppl* 4:19-31, 1991
3. Smith I, White PF: Use of the laryngeal mask airway as an alternative to a face mask during outpatient arthroscopy. *ANESTHESIOLOGY* 77:850-855, 1992
4. Füllekrug B, Pothmann W: The laryngeal mask: Fiberoptic detection of positioning and measurement of gas leakage (abstract). *Anesth Analg* 74:S101, 1992
5. Rowbottom SJ, Simpson DL, Grubb D: The laryngeal mask airway in children: A fiberoptic assessment of positioning. *Anaesthesia* 46:489-491, 1991
6. Nandi PR, Nunn JF, Charlesworth CH, Taylor SJ: Radiological study of the laryngeal mask. *Eur J Anaesthesiol Suppl* 4:33-39, 1991
7. Denman W, Goudsouzian NG, Shorten G: The position of the laryngeal mask airway as determined by magnetic resonance imaging (abstract). *ANESTHESIOLOGY* 75:1045, 1991
8. Sarma VJ: The use of a laryngeal mask airway in spontaneous breathing patients. *Acta Anaesthesiol Scand* 34:669-672, 1990
9. Maltby JR, Loken RG, Watson NC: The laryngeal mask airway: Clinical appraisal in 250 patients. *Can J Anaesth* 37:509-513, 1990
10. Grebenik CR, Ferguson C, White A: The laryngeal mask airway in pediatric radiotherapy. *ANESTHESIOLOGY* 72:474-477, 1990

11. Mason DG, Bingham RM: The laryngeal mask airway in children. *Anaesthesia* 45:760-765, 1990
12. Jonston DF, Wrigley SR, Robb PJ, Jones HE: The laryngeal mask airway in paediatric anaesthesia. *Anaesthesia* 45:924-927, 1990
13. Ravalia A, Fawcett W, Radford P: The brain laryngeal mask airway in pediatric anaesthesia (abstract). *Anesth Analg* 72:S220, 1991
14. Chow BFM, Lewis M, Jones SEF: Laryngeal mask airway in children: Insertion technique (letter). *Anaesthesia* 46:590-591, 1991
15. Wittman PH, Wittman FW: Laryngeal mask and gastric dilation (letter). *Anaesthesia* 46:1083, 1991
16. Fisher JA, Ananthanarayan C, Edelist G: Role of the laryngeal mask in airway management. *Canad J Anaesth* 39:1-3, 1992
17. Brain AJ: Three cases of difficult intubation overcome by the laryngeal mask airway. *Anaesthesia* 40:353-355, 1985
18. Brain AJ: The laryngeal mask airway: A possible new solution to airway problems in the emergency situation. *Arch Emer Med* 1:229-232, 1984
19. Calder I, Ordman AJ, Jackowski A, Crockard HA: The Brain laryngeal mask airway: An alternative to emergency tracheal intubation (case report). *Anaesthesia* 45:137-139, 1990
20. McClune S, Regan M, Moore J: Laryngeal mask airway for cesarean section (letter). *Anaesthesia* 45:227-228, 1990
21. Denny NM, Desilva KD, Webber PA: Laryngeal mask airway for emergency tracheostomy in a neonate (letter). *Anaesthesia* 45:895, 1990
22. DeMello WF, Kocan M: The laryngeal mask in failed intubation (case report). *Anaesthesia* 45:689-690, 1990
23. Riley RH, Swan HD: Value of the laryngeal mask airway during thoracotomy (letter). *ANESTHESIOLOGY* 77:1051, 1992
24. Benumof JL: Management of the difficult airway: With special emphasis on the awake tracheal intubation. *ANESTHESIOLOGY* 75:1087-1110, 1991
25. The confidential enquiry into maternal deaths in the United Kingdom 1985-1987. London, HMSO, 1991
26. Benumof JL: The importance of transtracheal jet ventilation in the management of the difficult airway. *ANESTHESIOLOGY* 71:769-778, 1989
27. Heath ML: Endotracheal intubation through the laryngeal mask: Helpful when laryngoscopy is difficult or dangerous. *Eur J Anaesthesiol Suppl* 4:41-45, 1991
28. Heath ML, Allagain J: The Brain laryngeal mask airway as an aid to intubation. *Br J Anaesth* 64:382-383, 1990
29. Allison A, McCrory J: Tracheal placement of a gum elastic bougie using the laryngeal mask airway (letter). *Anaesthesia* 45:419, 1990
30. Heath ML, Allagain J: Intubation through the laryngeal mask: A technique for unexpected difficult intubation. *Anaesthesia* 46:545-548, 1991
31. Brimacombe J: Cricoid pressure and the laryngeal mask airway (letter). *Anaesthesia* 46:986-987, 1991
32. Asai T: Use of the laryngeal mask for tracheal intubation in patients at increased risk of aspiration of gastric contents (case report). *ANESTHESIOLOGY* 77:1029-1030, 1992
33. McCirrick A, Pracilio JA: Awake intubation: A new technique. (case report). *Anaesthesia* 46:661-663, 1991
34. Carey MJ, Smith J, Cooney CM: Laryngeal mask to aid tracheal intubation (letter). *Anaesthesia* 46:1083, 1991
35. Brimacombe J: The laryngeal mask airway and flexible bronchoscopy (letter). *Thorax* 46:740, 1991
36. Maekawa N, Mikawa K, Tanaka O, Goto R, Obara H: The laryngeal mask may be a useful device for fiberoptic airway endoscopy in pediatric anesthesia (letter). *ANESTHESIOLOGY* 75:169-170, 1991
37. Walker RWM, Murrell D: Yet another use for the laryngeal mask airway. *Anaesthesia* 46:591, 1991
38. Tanigawa K, Inoue Y, Iwata S: Protection of recurrent laryngeal nerve during neck surgery: A new combination of neutracer, laryngeal mask airway, and fiberoptic bronchoscope (letter). *ANESTHESIOLOGY* 74:966-967, 1991
39. Akhtar TM: Laryngeal mask airways and visualization of vocal cords during thyroid surgery (letter). *Can J Anaesth* 38:140, 1991
40. Charters P, Cave-Bigley D, Roysam CS: Should a laryngeal mask be routinely used in patients undergoing thyroid surgery? (letter). *ANESTHESIOLOGY* 75:918-919, 1991
41. Slinger P, Robinson R, Shennib H: The laryngeal mask for laser resection of a carinal obstruction (case report). *J Cardiothorac Vasc Anesth*, in press
42. Benumof JL: The rigid bronchoscope: Gold standard technique for laser resection of a carinal obstruction (commentary). *J Cardiothorac Vasc Anesth*, in press
43. Asai T, Fujise K, Uchida M: Use of the laryngeal mask in a child with tracheal stenosis. *ANESTHESIOLOGY* 75:903-904, 1991
44. Waite K, Filshie J: The use of a laryngeal mask airway for CT radiotherapy planning and daily radiotherapy (letter). *Anaesthesia* 45:894, 1990
45. Taylor DH, Child CSB: The laryngeal mask for radiotherapy in children (letter). *Anaesthesia* 45:690, 1990
46. Logan A StC: Use of the laryngeal mask in a patient with an unstable fracture of the cervical spine (letter). *Anaesthesia* 46:987, 1991