

Use of the Laryngeal Mask Airway as an Alternative to a Face Mask during Outpatient Arthroscopy

Ian Smith, F.F.A.R.C.S.,* Paul F. White, Ph.D., M.D., F.F.A.R.A.C.S.†

The laryngeal mask airway (LMA) has recently become available in the United States, and several authors have suggested that it is superior to an anesthesia mask. To test this hypothesis, 64 patients undergoing outpatient arthroscopic knee surgery were randomly assigned to have anesthesia maintained *via* either a laryngeal mask airway (LMA) ($n = 31$) or a standard face mask ($n = 33$). Anesthesia was induced with fentanyl $1 \mu\text{g} \cdot \text{kg}^{-1}$ and propofol $2 \text{ mg} \cdot \text{kg}^{-1}$ and maintained with a variable-rate propofol infusion ($50\text{--}180 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}$) and nitrous oxide 67% in oxygen. The LMA was inserted without difficulty by inexperienced anesthesiologists in 90% of the patients. Problems associated with airway management were more common in patients in the face mask (control) group. Episodes of hemoglobin oxygen desaturation ($< 95\%$) occurred in 52% of patients in the face mask group compared to only 13% in the LMA group ($P < 0.05$). Intraoperative airway manipulations were required in 15% of face mask patients (*vs.* 3% of the LMA group), and difficulties in maintaining an airway were reported by 24% of the resident anesthesiologists caring for patients in the face mask group (*vs.* none in the LMA group) ($P < 0.05$). Insertion of the LMA was not associated with any acute changes in hemodynamic values. Intraoperative hemodynamic values and anesthetic requirements did not differ significantly between the two treatment groups. There were no significant differences in the emergence and recovery times or in the incidence of postoperative sore throats between the two groups. In summary, the LMA appears to offer advantages over the face mask during outpatient arthroscopy under general anesthesia. (Key words: Anesthesia, outpatient; arthroscopy. Complications, intraoperative; hemoglobin oxygen desaturation. Complications, postoperative; sore throat. Equipment: face mask; laryngeal mask; oral airway.)

This article is accompanied by an editorial. Please see: Benumof JL: Laryngeal mask airway: Indications and contraindications. ANESTHESIOLOGY 77:843-846, 1992.

* Clinical Research Fellow, Division of Clinical Research, Department of Anesthesiology, Washington University School of Medicine.

† Professor and McDermott Chair in Anesthesiology, Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical Center.

Received from the Division of Clinical Research, Department of Anesthesiology, Washington University School of Medicine, St. Louis, Missouri and the Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, Texas. Accepted for publication June 30, 1992.

Address reprint requests to Dr. White: Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, 5323 Harry Hines Boulevard, Dallas, Texas 75235-9068.

THE LARYNGEAL MASK AIRWAY (LMA) was originally designed by attaching a shortened endotracheal tube to the cuff of a dental face mask.¹ A reusable commercial version was first marketed in the United Kingdom in 1988. The LMA conforms to the shape of the laryngeal inlet and can be positioned without direct visualization, thereby obviating the need for muscle relaxants. The device is held in place over the larynx by inflation of a cuff. Although the LMA is available in Canada, Australia, and most of Europe, it was only recently approved for clinical use in the United States. This airway device can be used in situations in which either endotracheal tubes or face masks would otherwise have been used. While several authors have commented on the advantages of the LMA over a face mask,¹⁻⁵ no objective, randomized, prospective comparison of the two airway devices has been performed in adults. Furthermore, it has not been determined if the use of an LMA increases the anesthetic requirement, postoperative side effects (*e.g.*, sore throat), and recovery times after ambulatory surgery.

Therefore, we designed a randomized, prospective study to evaluate objective differences in airway parameters, anesthetic requirements, recovery events, and side effects between a standard anesthetic face mask and the LMA in outpatients undergoing a single surgical procedure under standardized anesthetic conditions.

Materials and Methods

Sixty-four healthy outpatients scheduled to undergo arthroscopic knee surgery during general anesthesia were randomly assigned to one of two airway management groups according to a single-blind protocol. The patients' airway was managed by an anesthesia trainee (with at least 1 yr of clinical experience) using either a face mask or the LMA, as determined by a computer-generated random number sequence. Patients with anticipated airway difficulties and those at high risk of regurgitation (*e.g.*, history of hiatus hernia, esophageal dysfunction) were excluded from participation in the study. All patients were fasted for at least 3 h before surgery and received no preanesthetic medication.

After insertion of an intravenous cannula and placement of routine intraoperative monitoring devices, patients received a standardized anesthetic induction con-

sisting of intravenous fentanyl $1 \mu\text{g} \cdot \text{kg}^{-1}$ and propofol $2 \text{ mg} \cdot \text{kg}^{-1}$. In the LMA group, a size-3 mask was used for patients weighing less than 60 kg and a size-4 mask for patients $\geq 60 \text{ kg}$. The technique for insertion was based on previously published guidelines.⁶ Before insertion, the cuff was deflated and the posterior surface of the mask was well lubricated. After insertion, the cuff of the mask was filled with 20–30 ml air. When insertion of the LMA was unsuccessful, the patient's head was repositioned and a supplemental dose of propofol, $0.3 \text{ mg} \cdot \text{kg}^{-1}$, was administered before a subsequent attempt was made. If the LMA could not be positioned correctly on the third attempt, it was recorded as a failure, and the airway was managed using a face mask. The LMA was protected from damage by the patient's teeth with a soft gauze bite block. In the face mask (control) group, a Guedel oral airway was used if clinically necessary to maintain a patent airway. Ventilation was manually assisted until a regular breathing pattern was established. Subsequently, all patients were permitted to breathe spontaneously throughout the operation, and no muscle relaxant drugs were administered.

Anesthesia was maintained with a variable-rate propofol infusion, $50\text{--}160 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, and nitrous oxide 67% in oxygen. The propofol infusion was adjusted to maintain a stable respiratory rate, to minimize acute hemodynamic changes, and to avoid purposeful movement. Acute autonomic and somatic responses to surgical stimuli were treated with supplemental bolus doses of intravenous propofol, $0.3 \text{ mg} \cdot \text{kg}^{-1}$. If anesthesia was still inadequate (*i.e.*, purposeful motor activity), supplemental doses of intravenous fentanyl, $25\text{--}50 \mu\text{g}$, were administered. Mean arterial pressure (MAP) and heart rate (HR) were monitored with a noninvasive device (Dinamap®, Critikon, Tampa, FL) before and at 1-min intervals during induction of anesthesia and insertion of the LMA, and subsequently at 1–5 min intervals. End-tidal carbon dioxide (PETCO_2) was continuously monitored, using a sample line attached at the connection between the breathing circuit and the LMA or face mask. Hemoglobin oxygen saturation (SpO_2) was continuously monitored with a pulse oximeter (Ohmeda, Madison, WI), and desaturation was defined as a SpO_2 value of less than 95% persisting for $> 30 \text{ s}$. In the face mask group, patients with repeated (or persistent) SpO_2 values $< 90\%$ after insertion of an oral airway were "rescued" with an LMA device.

At the end of the operation, the propofol infusion and nitrous oxide were simultaneously discontinued. The LMA (or oral airway) was removed when the patient was able to open their his or her mouth on request. The times from the end of anesthesia until awakening (defined as spontaneous eye opening), sitting up in a chair, tolerating oral fluids, ambulating, being judged "fit for discharge", and actual hospital discharge were recorded by a blinded observer. Patients were encouraged to sit up and begin

the mobilization process with crutches (all patients received instruction in their use preoperatively) when they felt able to perform these activities. Patients were considered to be fit for discharge from the Postanesthesia Care Unit (PACU) when they were oriented to time and place, had stable vital signs on sitting up and standing, could void urine, and were able to ambulate (with the use of crutches). Patients were specifically asked about the occurrence of hoarseness and throat soreness before discharge from the PACU. In addition, patients were contacted by telephone on the day after surgery to inquire further about these symptoms as well as to assess their degree of satisfaction with the anesthetic experience.

Data are expressed as mean values \pm standard deviations (SD). Continuous variables were analyzed using analysis of variance. Changes in continuous variables over time were assessed by paired *t* tests, with Bonferroni's correction for multiple comparisons. Descriptive variables were analyzed using the chi-squared test. A *P*-value of < 0.05 was considered to be statistically significant in all cases.

Results

Thirty-three patients had anesthesia maintained with a face mask, and the LMA was used in the remaining 31 patients. There were no differences between the two study groups in terms of age, weight, height, gender, ASA physical status distribution, length of surgical procedure, or preoperative SpO_2 values (table 1). In addition, there were no significant differences in anesthetic requirements (*e.g.*, averaged maintenance infusion rates, the need for supplemental doses of fentanyl or propofol) between the two airway treatment groups (table 2).

In the LMA group, size-3 masks were used in 6 patients and size-4 masks in the remaining 25. LMA insertion by inexperienced anesthesia trainees was successful on the first attempt in 23 (74%) patients and on the second attempt in 5 (16%). Three attempts were required in 3 pa-

TABLE 1. Demographic Characteristics of the Two Airway Treatment Groups

	Face Mask	Laryngeal Mask
Number (n)	33	31
Age (yr)	36 ± 10	32 ± 15
Weight (kg)	83 ± 22	76 ± 17
Height (cm)	175 ± 13	170 ± 8
Gender (M/F)	19/14	15/16
ASA physical status (1/2)	25/8	24/7
Baseline SpO_2 (%)	98.3 ± 2.3	98.4 ± 3.6
Duration of surgery (min)	35 ± 10	34 ± 16
Duration of anesthesia (min)	51 ± 11	51 ± 17

Mean values \pm SD or numbers (n).

TABLE 2. Anesthetic and Analgesic Requirements of the Two Airway Treatment Groups

	Face Mask	Laryngeal Mask
Preinduction fentanyl (μg)	80 \pm 19	75 \pm 16
Induction propofol (mg)	159 \pm 37	150 \pm 32
Mean propofol infusion rate ($\mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)	89 \pm 18	94 \pm 23
Required fentanyl supplement (n, %)	1, 3	4, 13
Required propofol supplement (n, %)	20, 61	20, 65
Propofol supplements (n)	1.7 \pm 0.8	2.5 \pm 1.8

Mean values \pm SD or numbers (n).

tients. In 2 of these cases, placement was abandoned (table 3), and a face mask with an oral airway was used. These two patients were excluded from the subsequent data analysis. During the maintenance period, one of the LMA patients showed clinical signs of a partially obstructed airway (*i.e.*, inadequate chest movements, small tidal volume, $\text{SpO}_2 < 90\%$), which responded to repositioning of the LMA. No signs of airway obstruction were noted in any other patient in the LMA group.

Oral airways were required in 26 (79%) patients in the control group to maintain a patent airway. Size-70, -80, -90, and -100 airways were used in 1, 5, 13, and 7 patients, respectively. The oral airway had to be repositioned or changed to one of a different size in 5 patients (table 3). In 3 patients, signs of partial obstruction persisted despite attempts at repositioning the oral airway. In addition, minor manipulations of the patient's head and neck position were frequently required to maintain an optimal airway. Furthermore, anesthesia personnel complained of fatigue from supporting the patients' airway in 8 (24%) of the control patients compared to none in the LMA group ($P < 0.05$).

Spontaneous ventilation resumed 7 ± 4 min after induction of anesthesia in the control group and 8 ± 5 min in the LMA group. Between the time of insertion of the LMA (approximately 5 min after the induction of anesthesia) and skin incision, 17 (52%) of the face mask group

had a decrease in SpO_2 to $< 95\%$, compared to only 4 (13%) in the LMA group ($P = 0.001$). Hemoglobin oxygen saturation $< 90\%$ was recorded in 8 patients in the face mask group and only 1 patient in the LMA group ($P = 0.02$). In four of the face mask group, an LMA was inserted because of repetitive episodes of desaturation after insertion of an oral airway. In each of these cases, SpO_2 remained greater than 95% for the remainder of the operation. However, these four patients were eliminated from the subsequent data analysis. Desaturation did not occur in either of the two LMA patients in whom insertion of the device was unsuccessful. Transient episodes of $\text{SpO}_2 < 95\%$ were less frequent after skin incision, occurring in 10 patients in the face mask group and in 5 in the LMA group ($P = 0.18$).

After induction of anesthesia, MAP and HR decreased in both groups of patients (fig. 1). Although MAP increased toward baseline values after skin incision, HR remained below awake levels for the duration of the procedure. MAP tended to be lower in LMA patients than in those in the face mask group; however, this difference reached statistical significance at only a few discrete time points. More importantly, there was no evidence of a clin-

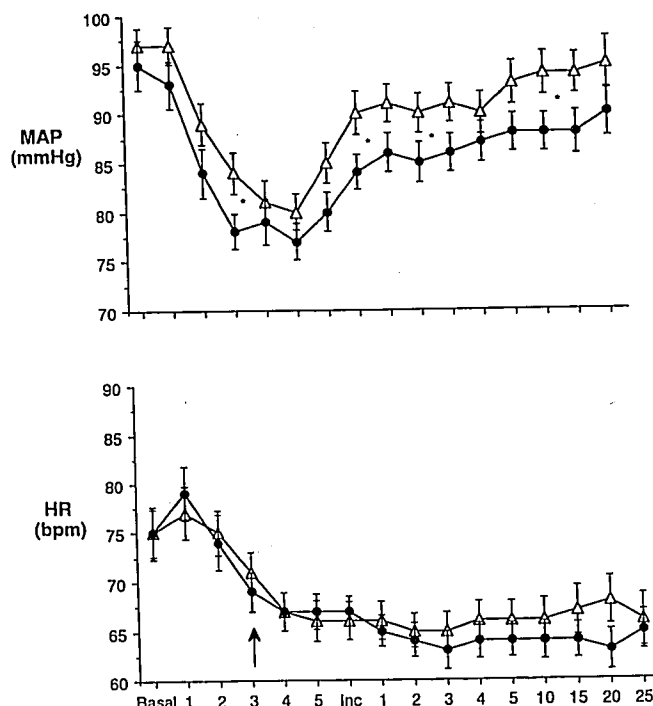


FIG. 1. Changes in mean arterial pressure (MAP; top) and heart rate (HR; bottom) from preoperative baseline values (basal), at 1–5 min after induction of anesthesia, at skin incision (inc) and at the specified times after skin incision. The arrow marks the time of insertion of the laryngeal mask airway. Open triangles = face mask (control); solid circles = the laryngeal mask airway. Values are means \pm SEM. * $P < .05$, from face mask group.

TABLE 3. Airway Problems in the Two Treatment Groups during the Operation

	Face Mask	Laryngeal Mask
Difficult airway insertion	0	3 (10)*
Desaturation ($\text{SpO}_2 < 95\%$)	17 (52)	4 (13)*
Repositioning of airway required	5 (15)	1 (3)
Fatigue from maintaining airway	8 (24)	0*
Persistent (partial) airway obstruction	3 (9)	0
Abandonment of technique	4 (12)†	2 (6)‡

Numbers and percentages (in parentheses).

* Significantly different from face mask group, $P < .05$.

† Secondary to persistent desaturation.

‡ Secondary to failed laryngeal mask airway insertion.

ically significant increase in MAP (or HR) associated with insertion of the LMA. During the maintenance period, HR values were similar in the two airway treatment groups.

Mean PET_{CO_2} concentrations were significantly lower in patients in the face mask group (38 ± 6 mmHg) than in the LMA group (44 ± 5 mmHg, $P < 0.01$). In addition, the range of PET_{CO_2} values was higher in the face mask group (31–46) than in the LMA group (40–49) because lower values were recorded in the face mask group. Mean respiratory rate did not differ between the two groups during the maintenance period (22 ± 5 vs. 23 ± 6 breaths/min in the face mask and LMA groups, respectively).

There were no significant differences between the two groups in the time from the end of anesthesia until awakening, as measured by spontaneous eye opening (5 ± 2 vs. 6 ± 3 min in the face mask and LMA groups, respectively). The LMA was removed 6 ± 3 min after the end of anesthesia. Oral airways (if used) were removed at about the same time (5 ± 2 min). Similarly, there were no differences between the two groups in the times to achieve recovery milestones or in PACU discharge times (153 ± 38 vs. 151 ± 33 min in the face mask and LMA groups, respectively). Postoperative analgesic requirements were also similar in the two groups.

Six patients in the LMA group reported a sore throat in the PACU. All of these patients had received the size-4 mask, inserted with one attempt in five cases and two attempts in the sixth. All but one patient still had a sore throat 24 h postoperatively. No patient in the LMA group complained of hoarseness. The two patients in whom LMA insertion was unsuccessful did not have postoperative sore throats. Two patients in the face mask group (with oral airways) had postoperative sore throats, and one additional patient complained of hoarseness without a sore throat. All these patients had persistent symptoms at the time of the 24-h follow-up telephone call. Overall patient satisfaction was high in both airway groups. Of the 58 patients who could be contacted at 24 h, all but two (both in the face mask group) were willing to undergo an identical anesthetic in the future.

Discussion

Compared to a face mask with an oral airway, the LMA provided for a more trouble-free airway. The basic LMA insertion technique was easily learned by the previously inexperienced anesthesia trainees after minimal instruction, confirming the findings of other workers.^{2-5,7} In patients in whom more than one attempt at insertion was required, repositioning of the patient's head and "deepening" the level of anesthesia usually resulted in successful placement on the second attempt. Many of the anatomic factors that render tracheal intubation difficult (or im-

possible) do not impede LMA placement.⁸⁻¹¹ However, other anatomic problems may interfere with LMA placement.¹² Because of its alleged ability to produce more profound relaxation of the pharyngeal muscles, propofol is suggested as the intravenous induction agent of choice when insertion of an LMA is planned.¹³

Once the LMA had been properly positioned, airway difficulties were rare. Complete or partial airway obstruction can result from downfolding of the epiglottis.² In addition, displacement of the aryepiglottic folds,¹⁴ kinking of the LMA tube,¹⁵ and rotation of the LMA away from the laryngeal opening also may compromise airway patency. With the correct insertion technique, most of these problems can be avoided.¹⁶ In situations in which airway obstruction is diagnosed, the LMA should be removed completely and reinserted. This approach was successful in our single case of airway obstruction. In contrast, airway problems were much more common when a face mask was used for maintenance of anesthesia.

The anesthesiologist managing the airway with a face mask (with or without an oral airway) frequently complained of fatigue of the hand and arm muscles as a result of the effort required to maintain a patent airway. In these patients, this fatigue factor was eliminated by the use of the LMA. More importantly, the anesthesiologist's hands were available to perform other tasks (e.g., drug administration, record-keeping). Although various types of harnesses and straps have been described for holding a face mask in place,^{17,18} these devices do not always provide a clear airway, and they require frequent adjustments and may cause damage to facial nerves.^{19,20}

The most common problem associated with the face mask in this study was the high incidence of hemoglobin oxygen desaturation, which was not observed in the LMA group. A higher incidence of desaturation has also been reported in pediatric patients anesthetized using a face mask compared to the LMA.²¹ In our study, desaturation was most frequent in the immediate postinduction period before the surgical incision. After induction of anesthesia, a brief period of apnea was common in both airway treatment groups. The presence of the LMA did not shorten the duration of this period (which was similar in both groups). However, assisted ventilation during the period of apnea was more effective with the LMA than with the face mask, thereby decreasing the degree of desaturation. If the LMA had not been available to "rescue" the four face mask patients with persistent low SpO_2 values (after insertion of an oral airway), relatively urgent tracheal intubation would have been required. Later in the procedure, when an effective ventilatory pattern had become established, desaturation was infrequent in both groups.

The lower PET_{CO_2} values in the face mask (vs. LMA) group probably reflects the greater difficulty in obtaining accurate measurements. The greater range of PET_{CO_2}

values in the face mask group was probably a result of room air entrainment from intermittent leaks around the face mask. These leaks can also contribute to decreased effectiveness in assisting ventilation when using the face mask. In addition, previous studies have suggested that trace anesthetic gas concentrations were greater in the vicinity of a face mask than in that of an LMA.²²

No significant hemodynamic effects were observed in association with insertion of the LMA. The LMA is located in the pharynx, which is well-adapted to the presence of foreign objects. In addition, laryngoscopy is not required for its insertion. Using continuous, noninvasive measurement of blood pressure, a small, transient increase in blood pressure has been observed after insertion of the LMA.²³ However, a similar increase was also recorded when a Guedel oral airway was inserted. In contrast, the LMA produces significantly less hemodynamic disturbance than that caused by tracheal intubation.^{24,25} During the maintenance period, there appeared to be little difference in hemodynamic variables between the LMA and face mask groups.

The LMA was also well tolerated during emergence from anesthesia. The LMA can be left in position without provoking coughing until the patient is awake enough to open his or her mouth on request. The presence of the LMA did not alter anesthetic requirements, resulting in similar emergence and recovery times in both study groups. Postoperative sore throats were observed in a similar number of patients in the LMA group and in the oral airway group. This observation is in agreement with the findings of other workers,²⁶ who also reported a significantly higher incidence of sore throat associated with tracheal intubation. In our study, only the larger LMA device (size 4) appeared to produce postoperative sore throats. Soreness was probably caused by contact between the posterior pharyngeal wall and the LMA (or oral airway). The similar incidence of upper airway discomfort in both groups postoperatively would imply that the pressure from the LMA cuff was not the major cause. The use of an oral airway in conjunction with a face mask could also increase the risk of damage to the patient's teeth. Although a bite block is recommended to protect the LMA,²⁷ a tight roll of gauze is effective and avoids damage to the teeth.²⁸

The LMAs used during this study were identical to those commercially available in Canada, Australia, and Western Europe. These reusable LMA devices were heat-sterilized (by autoclaving), which provided reliable decontamination but was inconvenient. Furthermore, the repeated autoclaving weakened the devices. During the course of this study, rupture of the cuff occurred in one mask, and rupture of the pilot balloon in another. The inflation valve also failed in one LMA; however, replacement valves are available from the manufacturer. None

of these mechanical problems occurred while the LMA was being used during anesthesia. At the present time, the LMAs (sizes 3–4) cost approximately \$120–\$190. Many of the difficulties associated with the currently available LMA device could be eliminated and the cost reduced if it was manufactured as a disposable item.

In summary, the LMA was successfully used in 94% of the outpatients in which it was inserted during arthroscopic surgery under general anesthesia. Compared to a face mask, the LMA produced a superior airway with a decreased incidence of episodic hemoglobin oxygen desaturation; reduced the need for airway manipulations; and decreased hand and arm fatigue in the anesthesiologist. The use of the LMA was not associated with adverse effects on hemodynamic stability, anesthetic requirements, or emergence and recovery parameters, or with an increased incidence of postoperative sore throats. The LMA appears to be a highly acceptable alternative to a face mask during outpatient anesthesia.

The authors thank Dr. A. I. J. Brain for supplying the laryngeal masks used in this study. They also thank research nurse Katherine Martin, R.N., for her assistance in the postoperative evaluation of these patients.

References

1. Brain AIJ, McGhee TD, McAteer EJ, Thomas A, Abu-Saad MAW, Bushman JA: The laryngeal mask airway: Development and preliminary trials of a new type of airway. *Anaesthesia* 40:356–361, 1985
2. Brodrick PM, Webster NR, Nunn JF: The laryngeal mask airway: A study of 100 patients during spontaneous breathing. *Anaesthesia* 44:238–241, 1989
3. Maltby JR, Loken RG, Watson NC: The laryngeal mask airway: Clinical appraisal in 250 patients. *Can J Anaesth* 37:509–513, 1990
4. Coyne BJ: The use of the laryngeal mask airway in day case and short stay surgery. *Ir J Med Sci* 159:185–186, 1990
5. Sarma VJ: The use of a laryngeal mask airway in spontaneously breathing patients. *Acta Anaesthesiol Scand* 34:669–672, 1990
6. Brain AIJ: Laryngeal mask and trauma to uvula: A reply (letter). *Anaesthesia* 44:1014–1015, 1989
7. Davies PRF, Tighe SQM, Greenslade GL, Evans GH: Laryngeal mask airway and tracheal tube insertion by unskilled personnel. *Lancet* 336:977–979, 1990
8. Chadd GD, Ackers JW, Bailey PM: Difficult intubation aided by the laryngeal mask airway (letter). *Anaesthesia* 44:1015, 1989
9. Brain AIJ: Three cases of difficult intubation overcome by the laryngeal mask airway. *Anaesthesia* 40:353–355, 1985
10. Calder I, Ordman AJ, Jackowski A, Crockard HA: The Brain laryngeal mask airway: An alternative to emergency tracheal intubation. *Anaesthesia* 45:137–139, 1990
11. Beveridge ME: Laryngeal mask anaesthesia for repair of cleft palate. *Anaesthesia* 44:656–657, 1989
12. Van Heerden PV, Kirrage D: Large tonsils and the laryngeal mask airway (letter). *Anaesthesia* 44:703, 1989
13. Brain AIJ: Further developments of the laryngeal mask (letter). *Anaesthesia* 44:530, 1989

14. Payne J, Edwards J: The use of the fiberoptic laryngoscope to confirm the position of the laryngeal mask (letter). *Anaesthesia* 44:865, 1989
15. Goldberg PL, Evans PF, Filshie J: Kinking of the laryngeal mask airway in two children (letter). *Anaesthesia* 45:487-488, 1990
16. Brain AIJ: Studies on the laryngeal mask: First, learn the art (letter). *Anaesthesia* 46:417-418, 1991
17. Lee E: A simple chin-support device during face mask anesthesia (letter). *Anesth Analg* 71:713, 1990
18. Elton RJ: Alternative chin-support device during face mask anesthesia (letter). *Anesth Analg* 73:235, 1991
19. Glauber DT: Facial paralysis after general anesthesia. *ANESTHESIOLOGY* 65:516-517, 1986
20. Munn KA, Williams RT, Shafto CM: Transient unilateral blindness following general anaesthesia. *Can Anaesth Soc J* 25:433-435, 1978
21. Johnston DF, Wrigley SR, Robb PJ, Jones HE: The laryngeal mask airway in paediatric anaesthesia. *Anaesthesia* 45:924-927, 1990
22. Sarma VJ, Leman J: Laryngeal mask and anaesthetic waste gas concentrations (letter). *Anaesthesia* 45:791-792, 1990
23. Hickey S, Cameron AE, Asbury AL: Cardiovascular response to insertion of Brain's laryngeal mask. *Anaesthesia* 45:629-633, 1990
24. Braude N, Clements EAF, Hodges UM, Andrews BP: The pressor response and laryngeal mask insertion. *Anaesthesia* 44:551-554, 1989
25. Watcha MF, White PF, Tyschen L, Stevens JL: Comparative effects of laryngeal mask airway and endotracheal tube insertion on intraocular pressure in children. *Anesth Analg*, 75:355-360, 1992
26. Alexander CA, Leach AB: Incidence of sore throats with the laryngeal mask (letter). *Anaesthesia* 44:791, 1989
27. Marks LF: Protection of the laryngeal mask airway (letter). *Anaesthesia* 45:259, 1990
28. Brain AIJ: The laryngeal mask in patients with chronic respiratory disease (letter). *Anaesthesia* 44:790-791, 1989