The Laryngeal Mask Airway: A Comparison Between Two Insertion Techniques

Howard G. Wakeling, MBBS, BSc, MRCP, FRCA, Patrick J. Butler, MBBS, FRCA, and Peter J. C. Baxter, FRCA
Anaesthetic Department, North Hampshire Hospital, Basingstoke, England

The purpose of the study was to compare the ease of insertion of the laryngeal mask airway using the standard uninflated approach or with a fully inflated cuff. Two hundred consecutive patients undergoing anesthesia using a laryngeal mask airway were randomized to have the laryngeal mask inserted using either method. Successful insertion was judged primarily by the clinical function of the airway. The number of insertion attempts to achieve a satisfactory airway and whether an alternative technique was required for success were recorded. On removal of the laryngeal mask, a blind observer noted the presence or absence of blood. Just before leaving the recovery room, each patient was asked whether they had a sore throat. Insertion technique made no difference with regard to first attempt success. However, the presence of blood on the removed masks (P < 0.01) and sore throat (P < 0.01) were less frequent in the inflated cuff group. We conclude that the inflated cuff insertion technique is an acceptable alternative to the standard approach and has the advantage of reducing the incidence of minor pharyngeal mucosal trauma, as evidenced by mucosal bleeding and sore throat. Implications: Insertion of the laryngeal mask airway with the cuff fully inflated is equally successful to the standard uninflated approach in experienced hands. The inflated technique was associated with less minor pharyngeal mucosal trauma and, consequently, a lower incidence of postoperative sore throat. This implies that the inflated technique would be acceptable to the general population of laryngeal mask users.

Methods

After approval from the Basingstoke Ethical Committee and North Hampshire Hospital Trust Board, 200 consecutive patients who were undergoing anesthesia using the laryngeal mask airway were randomized into two groups. Randomization was achieved by determining the order of a pair of data collection forms by coin toss. Once randomized forms were divided between the investigators, the masks were inserted according to the coded instruction on the data collection form. Exclusion criteria included patients less than 16 yr of age, preoperative sore throat, and those undergoing oral and nasal surgery.

The majority of patients were premedicated using oral benzodiazepine (temazepam or diazepam) with or without diconal. Anticholinergic drugs were avoided to prevent drying, which may have influenced the ease of insertion. Anesthesia was induced with propofol 2.5 mg/kg and an opiate (morphine, fentanyl, or meperidine) followed by isoflurane, nitrous oxide, and oxygen. No muscle relaxants were used before laryngeal mask insertion. If more than one insertion attempt was required, the patient was kept adequately anesthetized with inhaled agents or additional propofol before further insertion attempts were made.
made. All three authors had used the laryngeal mask since it first became available in the United Kingdom in 1990. All three investigators read the instruction manual (1) again and practiced both methods of insertion before commencing the study to ensure that both techniques were followed accurately to reduce investigator bias. Each investigator had the prior experience of inserting a minimum of 150 laryngeal masks.

After induction of anesthesia in Group A, the laryngeal mask was inserted with the cuff fully deflated using the standard method described by Brain (1). The posterior aspect of the deflated mask was coated with a water-based lubricant. The head was positioned with flexion of the neck and extension of the head (standard endotracheal intubating position) using the nondominant hand. The masks were held like a pen and inserted while pressing up against the palate and posterior pharyngeal wall using the index finger. Once the mask began to descend in the posterior oropharynx, the index finger of the nondominant hand was then used to press on the laryngeal mask tube to continue insertion until resistance was felt when the mask tip reached the triangular base of the oropharynx. The cuff was then inflated until a seal was obtained (15–20 mL for size 3; 25–30 mL for size 4) without any further pressure on the laryngeal mask tube. The maximal cuff volume was never exceeded; if an adequate seal was not obtained with the maximal volume, then the mask was removed and another insertion attempt was made.

In Group B, the laryngeal masks were first prepared by deflating them fully and then inserting 20 mL into size 3 masks and 30 mL into size 4 masks. The masks were then lubricated on the posterior and lateral aspects with the same water-based lubricant as in Group A. The lateral aspect was lubricated in the inflated group as the full masks came into contact with the lateral wall of the oropharynx during insertion. The head was positioned as in Group A, and the mask was inserted into the mouth in the correct orientation (same orientation as Group A). Pressure was then applied to the laryngeal mask tube to insert it. The masks were kept close to the hard palate during insertion to facilitate easy passage around the posterior pharyngeal wall in one smooth movement until resistance was felt as the tip reached the base of the hypopharynx.

Size 3 laryngeal masks were used in the majority of women, whereas size 4 masks were used in most men, which was customary at that time at the North Hampshire Hospital. Insertion of the laryngeal mask followed a strict protocol; up to three attempts were made to insert the mask using the allocated method, and the number of attempts required was recorded. An attempt was defined as one passage of the laryngeal mask into the oropharynx only. If unsuccessful after three attempts, then one attempt was made using the alternative approach. If still unsuccessful, then a different size could be used or the procedure abandoned.

The function of the laryngeal masks was determined clinically following strict criteria. We required the ability to easily ventilate the lungs, as assessed by chest movement, without any significant resistance or leak, and no significant resistance to expiration with rapid refilling of the reservoir bag. Capnography was also used. The airway was graded either adequate or inadequate, in which case a further attempt was made after ensuring adequate anesthetic depth. The investigator giving that particular anesthetic made the assessments.

Anesthesia was maintained by spontaneous respiration using a Humphrey ADE circuit (Anaesthetic Breathing System Supplies, Shropshire, UK) using a standard heat-moisture exchanger between the laryngeal mask and the circuit proper to warm and humidify inspired gases. A T-piece Venturi device connected directly to the laryngeal mask provided postoperative oxygen therapy. This delivered 40% inspired oxygen at an oxygen flow of 5 L/min. Once the laryngeal mask was removed, oxygen was delivered via a standard face mask.

At the end of surgery, the patients were taken to the recovery area, where the nurses removed the laryngeal masks after the patients' swallowing reflexes had returned and they could follow commands. The nurses (blind to the method of insertion) then recorded the presence or absence of blood on the laryngeal masks. Any blood at all on the mask or in the secretions on the mask was considered positive. When the patients were ready for discharge, the recovery nurses asked them whether they had a sore throat. Patients who had required airway suction or oropharyngeal airway insertion in between laryngeal mask insertion attempts were excluded from the analysis of blood and sore throat data.

The following data were also recorded for each patient: age, gender, weight, mask size, and duration of anesthesia. Continuous data were analyzed using Student's t-test; frequency data were analyzed using $\chi^2$ with Yates' correction.

**Results**

There was no difference in age, weight, gender, or duration of anesthesia for patients in Groups A and B (Table 1). A satisfactory airway was achieved in 94% of patients in Group A and in 97% ($P > 0.05$) of patients in Group B (Table 2). Six patients in group A, in whom it had not been possible to achieve a good airway with the standard insertion technique, had the mask inserted first time with the cuff inflated. In these patients, the original difficulty related to getting the
masks around the posterior pharyngeal wall. In Group B, there were three patients in whom it had not been possible to insert the laryngeal mask with the cuff inflated. One of them had severe rheumatoid arthritis, and it was not possible to insert the inflated mask due to reduced mouth opening. In the second patient, the laryngeal mask would not pass beyond the tongue with the cuff inflated. In the third patient, a functioning airway was not possible with a size 3 laryngeal mask inserted either with the cuff inflated or deflated; a size 4 mask was then inserted with the cuff inflated, giving a good airway at the first attempt.

Two patients in Group A and one in Group B were excluded from the analysis of blood and sore throat data due to oropharyngeal airway insertion and/or suction. Of the 98 patients in Group A, 15 had some blood on the laryngeal mask after removal (15.3%) compared with 0 patients in Group B ($P < 0.01$). Of the patients in Group A, 21 (21.4%) had sore throats compared with 4 (4.1%) in Group B ($P < 0.01$). The mean ($\pm$ sd) anesthesia duration for patients with sore throats was 46.6 $\pm$ 26.5 min compared with 41.4 $\pm$ 26.7 min in those without ($P > 0.05$).

### Discussion

The laryngeal mask airway has become very popular for anesthesia not requiring endotracheal intubation. In addition to the standard method of insertion, there have been many others described. A recent survey of anesthetic practice in Wales showed that only 30%–34% of anesthesiologists favored the standard approach (4). Indeed, 36%–42% of anesthesiologists indicated that they were unwilling to use the standard method of insertion at all (4). Brimacombe and Berry (5) state that if the standard approach is used correctly, the first-time success rate should be $\approx 98\%$ in less than 20 seconds (5). If the standard approach is as easy and effective as Brimacombe and Berry imply, then one would expect it to be much more popular than Dingley and Asai found (4).

Our results show no difference in insertion rate. First-time insertion rates in series of more than 150 patients using the standard approach vary in the literature from 75% (6,7) to 98% (5). In the present study, the standard approach success rate was 80%, increasing to 94% after three tries. This was similar to results of the 350-patient study by Matta et al. (6) of 75%, increasing to 92% after more than two attempts. With the cuff inflated, our first-time success rate was 89%, increasing to 97% after three attempts. Interestingly, our results were very similar to Matta et al.’s partially inflated success rates of 88% the first time and 97.7% after more than two attempts (6). Brimacombe (8) criticized Matta et al.’s study (6) because the 75% first-time success rate with the standard approach suggested suboptimal technique. Matta ’s reply (9), however, confirmed considerable laryngeal mask experience for all investigators in his study.

The most significant clinical finding in our study relates to pharyngeal trauma. The presence of blood on the laryngeal mask on removal was taken as an indication of pharyngeal mucosal trauma. Using this end point, insertion of the laryngeal mask with the cuff inflated significantly reduced pharyngeal mucosal bleeding from 15.3% to 0%. We speculate that this is due to the presentation of a softer leading edge to the posterior pharyngeal wall. Dingley and Whitehead (10) compared the incidence of pharyngeal bleeding using the standard approach with the use of an insertion device. This device had been designed to guide the laryngeal mask around the posterior pharyngeal wall to prevent the mask from touching the mucosa. They found blood on 22% of the laryngeal masks after the standard insertion technique. The insertion device reduced the incidence to only 4%. Brimacombe and Berry (3) found “macroscopic” blood on only 1 of 30 laryngeal masks after the standard insertion method and a similar rate for the partially inflated and fully inflated masks; however, macroscopic was not defined. These rates are considerably lower for the standard technique than those found in this study and in Dingley and Whitehead’s study; however, Brimacombe and Berry’s study (3) had the highest recorded sore throat rate for the standard insertion technique despite the low incidence of blood. The high sore throat rate and low blood incidence in Brimacombe and Berry’s study (3) is difficult to explain.

### Table 1. Distribution of Patient Age, Weight, and Anesthetic Duration in Groups A and B

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (uninflated)</td>
<td>Inflated</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>47 ± 17.1</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>43 ± 25.4</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74 ± 13.9</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>50/50</td>
</tr>
</tbody>
</table>

Data are expressed as mean ± sd.

### Table 2. The Number of Laryngeal Mask Insertion Attempts Required in Groups A and B

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (uninflated)</td>
<td>Inflated</td>
</tr>
<tr>
<td>1 Attempt</td>
<td>80</td>
</tr>
<tr>
<td>2 Attempts</td>
<td>11</td>
</tr>
<tr>
<td>3 Attempts</td>
<td>3</td>
</tr>
<tr>
<td>Other approach successful</td>
<td>6</td>
</tr>
<tr>
<td>Change of size</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
Another indicator of pharyngeal mucosal trauma after use of the laryngeal mask airway is the presence of a sore throat postoperatively. In our study, patients were asked whether they had a sore throat just before they left the recovery area by the recovery nurses, who were blind to the insertion method. Patients were simply asked, "Do you have a sore throat?" and a yes/no response was recorded. Sore throats after laryngeal mask anesthetics tended to be mild and lasted less than 12 hours in a study of 176 patients (11). We chose to collect this data before the patients left recovery because the majority of sore throats would be mild and short lasting (11), and we felt that these data would give a true reflection of sore throat incidence, although our data are restricted to the immediate postoperative period.

Our sore throat rate was 21.4% using the standard approach; this was reduced to 4% by inflating the cuff before insertion (P < 0.01). Our standard approach sore throat rate was lower than that of Dingley and Whitehead (10) (28.5%) and of Brimacombe and Berry (3) (30%). All anesthetics were conducted with the same circuit, heat-moisture exchanger, and postoperative oxygen therapy regimen. We could not control for the systemic narcotic used; however, the patients were undergoing minor surgical procedures in which the overall narcotic use was relatively low. Because patient demographic data and anesthesia duration did not differ between the groups, it is very unlikely that a significant difference in surgical procedures or narcotic use existed between the groups. If our data from the recovery ward were inaccurate, then one would expect that the incidence of sore throat after the standard insertion technique would be different from other similar studies, which it is not.

We did not measure the cuff pressure; therefore, we were unable to control for variations in this. Burgard et al. (12) showed that the cuff pressure of the laryngeal mask increased considerably during the first hour of nitrous oxide anesthesia and related this to a higher incidence of sore throats. However, we suspect that the pressure in the cuffs of the inflated group would have been higher than that of the standard group. This was because the volume of air in the standard group was that required to make a seal, but in the inflated group, the maximal cuff volume was used in all patients. The incidence of sore throat was significantly lower in the group likely to have the highest cuff pressures. If cuff pressures had influenced our results significantly, one would expect an increase in sore throats in patients after inflated laryngeal mask insertion, whereas we found the opposite. This, together with observations on similar anesthetic duration, supports our hypothesis that the difference in sore throat rates relates to the differences in insertion technique and not to differences in cuff pressure and anesthetic duration. We therefore feel that the reduction in sore throats represents the presentation of a softer leading edge to the pharyngeal wall during insertion.

In their study, Brimacombe and Berry (3) used the bronchoscope to look through the laryngeal masks to grade the position within the airway. With the inflated approach, they found more than a 50% incidence of the epiglottis being folded over and were able to visualize its anterior surface through the laryngeal mask. Despite this finding, a satisfactory airway was maintained. This was probably due to airflow through the lateral spaces on either side of the bars (13). Brain (14) states that a deflated posteriorly directed tip on the laryngeal mask is required to avoid collision with the epiglottis and arytenoids and to prevent the entry of the tip into the larynx. Folding of the epiglottis occurs in up to half of the patients using the inflated approach. If this holds true in our patients, the results suggest that this does not compromise the airway and is not associated with an increased incidence of sore throat.

In conclusion, insertion of the laryngeal mask airway with the cuff inflated produced a significant reduction in sore throat and pharyngeal mucosal bleeding. We believe that this is the result of the presentation of a softer leading edge to the posterior pharyngeal wall.

References