A Comparison of the Laryngeal Tube with the Laryngeal Mask Airway During Routine Surgical Procedures

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The laryngeal mask airway (LMA; Laryngeal Mask Company, Henley-on-Thames, UK) is an established airway device, whereas the laryngeal tube (LT) is relatively new and therefore not as well investigated. Therefore, the purpose of the present prospective, randomized, controlled trial was to compare the LT with the LMA in routine clinical practice. In 50 patients undergoing general anesthesia for minor routine surgery, standardized anesthesia was induced and maintained with alfentanil and propofol. Patients were randomized to controlled ventilation (fraction of inspired oxygen $= 0.4$; fraction of inspired nitrous oxide $= 0.6$; tidal volume $= 7$ mL/kg; respiratory rate $= 10$ breaths/min) with the LT ($n = 25$) or the LMA ($n = 25$). Oxygen saturation was recorded before the induction of anesthesia and after the administration of oxygen. After 2 and 10 min of ventilation with the LT or LMA, oxygen saturation, end-expiratory carbon dioxide, expiratory tidal volume, and peak airway pressure were recorded.

Capillary blood gas samples were taken before the induction of anesthesia and after 10 min of ventilation. Time of insertion and airway leak pressure of each device were measured. The time of insertion was comparable with both devices (LT versus LMA, median 21 s versus 19 s; $P$ not significant). Blood gas samples and ventilation variables revealed sufficient ventilation and oxygenation with either device ($P$ not significant). Peak airway pressure (LT, $17 \pm 3$ cm H$_2$O; LMA, $15 \pm 3$ cm H$_2$O) and airway leak pressure (LT, $36 \pm 3$ cm H$_2$O; LMA, $22 \pm 3$ cm H$_2$O) were significantly ($P < 0.05$) higher when using the LT compared with the LMA. In conclusion, using the LT and LMA resulted in comparable ventilation and oxygenation variables in this model of ASA physical status I and II patients undergoing routine surgical procedures. The newly developed LT may be a simple alternative device to secure the airway.


The laryngeal mask airway (LMA; Laryngeal Mask Company, Henley-on-Thames, UK) has been well established for more than a decade and is often used when endotracheal intubation is not necessarily required (1). Nevertheless, simple handling of the LMA is limited by the potential risk of aspiration (2) because fiberoptic studies have found ~6%–9% visualization of the esophagus via the LMA (3,4). The newly developed laryngeal tube (LT), somewhat a single-lumen, shortened Combitube, was designed to prevent the risk of regurgitation by blocking the esophagus. Although we have previously shown that the LT is safe and efficient (5), it is unknown how this airway device scores in comparison with the LMA. Accordingly, the purpose of the present study was to assess both the LT and LMA in patients undergoing routine surgical procedures. Our hypothesis was that there would be no difference between groups in regards to the primary study end-points: number of ventilation failures, time of insertion, expiratory tidal volume, oxygen saturation, end-tidal carbon dioxide, blood gas variables, peak airway pressure, and airway leak pressure.

Materials and Methods

The LT (VBM, Sulz, Germany) is a multi-usable, single-lumen, transparent silicon tube with an oropharyngeal and an esophageal low-pressure silicon cuff and with a ventilation outlet between these cuffs. Although the LT seems to provide ventilation similar to the LMA, it does follow a different strategy in sealing...
the tracheal inlet. With the patient’s head in the neutral position, the tube is placed into the oropharynx until a distinct resistance is felt. Using the cuff pressure manometer, both cuffs of the modified LT are simultaneously inflated through a single port up to a pressure of 80 mm Hg. The oropharyngeal cuff is inflated first, followed by the esophageal cuff because of different resistance characteristics of the connected tubing. The inflated oropharyngeal cuff closes the oropharynx while the esophagus is closed by the lower cuneiform cuff. Accordingly, the ventilation outlet of the LT is placed in front of the vocal cords (Fig. 1).

After approval of our IRB and written informed consent was obtained, 50 adult ASA physical status I and II patients (age range, 17–77 yr) undergoing general anesthesia for minor routine surgical procedures volunteered to participate. After breathing oxygen for 3 min, anesthesia was induced with alfentanil (15 µg/kg) and propofol (2.5 mg/kg); anesthesia was subsequently maintained with propofol (~6 mg · kg⁻¹ · h⁻¹). Patients were randomly allocated to controlled ventilation with either the LT (n = 25) or the LMA (n = 25); the same anesthesiologist always inserted each device. Mechanical ventilation (fraction of inspired oxygen = 0.4; fraction of inspired nitrous oxide = 0.6) was performed with a tidal volume of 7 mL/kg, a respiratory rate of 10 breaths/min (Julian, Draeger, Lübeck, Germany), and monitored with a cardiorespiratory monitor (AS 3, Datex-Ohmeda, Helsinki, Finland).

After 2 and 10 min of ventilation, end-tidal carbon dioxide, expiratory tidal volume, and peak airway pressure were recorded. Additionally, two capillary blood gas samples were taken during room-air breathing before the induction of anesthesia and after 10 min of ventilation using the respective airway device. Time of insertion of the device was measured from loss of the eyelash reflex until delivery of the first tidal lung volume.

With the LT inflated up to a cuff pressure of 80 mm Hg, and the cuff of the LMA inflated with the recommended volume of 30 mL (size 4) and 40 mL (size 5), the oropharyngeal leak pressure was measured with the head in the neutral position. The expiratory valve of the circle system was closed at a fixed gas flow of 3 L/min, and the airway pressure at which the aneroid manometer reached equilibrium was noted (6). To prevent lung barotrauma, the expiratory valve was opened as soon as peak airway pressure reached 40 cm H₂O. Stomach inflation was not assessed because this is technically very difficult and does not reveal data that are sensitive and specific enough to distinguish exact levels of stomach inflation.

The Mann-Whitney U-test was used for comparison between the two airway devices. The Wilcoxon test was used to determine differences in patient characteristics, blood gas variables, and respiratory variables; a P value of <0.05 was considered significant.

Results
Fifty patients ranging from 158 to 193 cm in height participated in our study. The size four LT or LMA was used in patients <175 cm and the size five in all patients >175 cm, respectively. No differences in age, weight, or height were detected between groups. In all cases, both airway devices were inserted successfully on the first attempt (time of insertion for LT versus LMA; median, 21 s versus 19 s; P = not significant). Blood gas samples and ventilation variables were comparable between groups and revealed both sufficient ventilation and oxygenation with either device (Table 1). Peak airway pressure (P < 0.05) and airway leak pressure (P < 0.001) were significantly higher throughout the experiment when using the LT compared with the LMA (Table 2).

Discussion
Because of the technical design of the LMA, the esophageal inlet may not be sealed at all times. Although pulmonary aspiration is very rare when using the LMA (incidence, ~2 in 10,000 cases), it may impair patient safety (7). In contrast, fiberoptic endoscopy studies have confirmed that the tip of the LT is placed in the esophageal inlet. Accordingly, inflating the esophageal cuff of
patients may be ventilated with a peak airway pressure of ~24 cm H\(_2\)O (5), a 60-mm H\(_{\text{g}}\) cuff pressure of the LT was sufficient to ensure an airway leak pressure of ~24 cm H\(_2\)O (5), which is similar to our data and that from other investigators using the LMA (6). Following the manufacturer’s recommendations, the cuff pressure of 80 mm H\(_{\text{g}}\), as used in the present study, resulted in an airway leak pressure of ~36 cm H\(_2\)O. Because most patients may be ventilated with a peak airway pressure <23 cm H\(_2\)O when using the LT, cuff pressure might be slightly reduced to minimize mucosal irritation or hypoperfusion. Although a cuff pressure of 80 mm H\(_{\text{g}}\) might be appropriate to maintain a safety margin for positive pressure ventilation when using the LT, this recommended cuff pressure may be potentially dangerous, particularly in the elderly. A reduced cuff pressure of ~60–70 cm H\(_2\)O may provide an adequate seal, resulting in an airway leak pressure between ~24 and ~31 cm H\(_2\)O, as previously described (5). A further increase in cuff pressure when nitrous oxide is administered may be avoided when a cuff pressure manometer is used.

As a limitation, we are unable to exclude lack of evidence for aspiration protection by the LT. Also, a different experiment will be required to prove that better seal reduces gastric distension or protects against regurgitation. Furthermore, because vomiting facing the blind ending of the LT may provoke esophageal rupture, modifications of the device for free gastric drainage would be desirable. Additionally, in our small study, we found only little differences in ventilatory variables between the LT and LMA, which may not be replicated in obese patients or those with potentially difficult airways.

In conclusion, use of the LT and LMA resulted in comparable ventilation and oxygenation variables in this model of ASA physical status I and II patients undergoing routine surgical procedures. The newly developed LT may be a simple alternative device to secure the airway. Further studies in a larger number of patients are required to determine whether the LT may be an alternative airway device for emergency airway management as well, such as the LMA (10).

**References**


