The Laryngeal Tube: A New Simple Airway Device

Volker Dörges, MD*, Hartmut Ocker, MD*, Volker Wenzel, MD†, and Peter Schmucker, MD*

*Department of Anesthesiology, University Hospital of Lübeck, Lübeck, Germany; and †Department of Anesthesiology and Critical Care Medicine, The Leopold-Franzens-University of Innsbruck, Innsbruck, Austria

The face mask, laryngeal mask, and the Combitube® (Tyco Healthcare/Sheridan, Argyle, NY) are devices commonly used to ventilate the lungs of nonintubated patients (1,2), but some disadvantages may result in inadvertent ventilation-associated complications. For example, the face mask is associated with large dead space ventilation, leakage, and gastric inflation (3). In contrast, the laryngeal mask is an alternative airway adjunct that is simple to use, resulting in both minimal dead space ventilation and gastric inflation (4,5). Nevertheless, a possible limiting feature of the laryngeal mask may be the risk of aspirating gastric contents (6) because fiberoptic studies have found 6%–9% visualization of the esophagus (7,8). Although the Combitube® was developed as an alternative to endotracheal intubation to secure the airway in an emergency setting, its complex structure requires extensive instruction and training to ensure correct placement within an acceptable time (9). The purpose of this study was to assess whether the newly developed Laryngeal Tube (VBM Medizintechnik GmbH, Sulz, Germany), somewhat a single-lumen, shortened Combitube®, can provide sufficient ventilation and adequate oxygenation in patients undergoing routine induction of anesthesia.

Methods

The Laryngeal Tube is a multiple-use, single-lumen, silicon tube with an oropharyngeal and esophageal low pressure cuff and a ventilation outlet between these cuffs (Figure 1). With the patient’s head in the neutral position, the tube is placed into the oropharynx until a distinct resistance is felt; both cuffs are subsequently inflated with a cuff pressure manometer. Inflation of the oropharyngeal cuff closes the oropharynx; the esophageal inlet is closed by inflating the lower cuff. Accordingly, the ventilation outlet of the Laryngeal Tube is placed in front of the vocal cords (Figure 2).

After approval of the institutional review board and written, informed consent, 30 adult ASA physical status I and II patients (age, 26–82 yr; Mallampati 1/2) participated in our study and underwent general anesthesia with usual monitoring for routine surgery. After breathing oxygen for 3 min, the induction of anesthesia was initiated with IV alfentanil (15 μg/kg) and IV propofol (2.5 mg/kg; maintenance, 10–15 mg · kg⁻¹ · h⁻¹ IV). The Laryngeal Tube was always inserted by the same anesthetist. Ventilation (fraction of inspired oxygen: 0.4; fraction of inspired nitrous oxide: 0.6) was controlled with a tidal volume of 7 mL/kg, respiratory rate of 10 breaths/min, and monitored with a cardiorespiratory monitor.

After insertion of the Laryngeal Tube, and after 2, 5, 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. Time of insertion was measured from loss of the eyelash reflex to delivering the first tidal lung volume. Oropharyngeal leak pressure was measured with the head in neutral position at cuff inflation pressures from 60–90 mm Hg (increments, 10 mm Hg). 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 (10). To prevent lung barotrauma, the expiratory valve was opened as soon as peak airway pressure reached 40 mm Hg; occurrence of gastric inflation was assessed with a stethoscope placed on the epigastrium. Placement of the Laryngeal Tube was controlled with fiberoptic endoscopy.

Results

For patients ranging from 155 to 197 cm, size 3 (height < 160 cm; weight < 60 kg), size 4 (160–175 cm; 60–80 kg), and size 5 (>175 cm; >80 kg) Laryngeal Tubes were used. In all cases, the Laryngeal Tube was
inserted successfully on the first attempt (range, 8 to 28 s; median, 21 s). Ventilation and blood gas variables 10 min after the insertion revealed both sufficient ventilation and oxygenation (Figure 3, Table 1); no gastric inflation was noted in any patient. Fiberoptic endoscopy confirmed visualization of the epiglottis and/or the posterior pharyngeal wall, and correct placement of the Laryngeal Tube tip in the esophageal inlet. Mean airway leak pressure ranged from 24 to 40 cm H$_2$O at an oropharyngeal cuff inflation pressure of 60–90 mm Hg (Table 2).

**Discussion**

Appropriate positioning of the Laryngeal Tube was proven with fiberoptic endoscopy in all patients. Hence, inflation of the lower cuff closed the esophagus and may have protected the airway of regurgitation, which is a major hazard when ventilating an unprotected airway (11,12). Insertion times for the Laryngeal Tube were comparable to those reported for laryngeal mask airways (13). After the induction of anesthesia, the Laryngeal Tube allowed immediate ventilation of the patient with no prolonged lack of ventilation, as this might cause further oxygen desaturation in difficult conditions such as cardiopulmonary resuscitation without the possibility of preoxygenation. Our data show that sufficient ventilation and oxygenation could be achieved when using the Laryngeal Tube similar to the laryngeal mask or Combitube®. Simple handling of the Laryngeal Tube, and aspiration protection might be a substantial advantage of this airway device in emergency airway management. In contrast, although the Combitube® provides protection from aspiration of gastric contents, correct use of the Combitube® requires extensive regular training (9).

In our experiment, 60-mm Hg cuff pressure was sufficient to ensure a leak airway pressure of $\sim$24 cm H$_2$O, which is similar to the laryngeal mask (14). Even airway pressures of up to $\sim$40 cm H$_2$O would have been possible without gastric inflation. Because most patients can be safely ventilated with peak airway pressures of 20 cm H$_2$O, a safety margin would be incorporated with 70-mm Hg cuff pressure, allowing peak airway pressures up to 30 cm H$_2$O.

Limitations of this preliminary study are lack of evidence for aspiration protection and absence of comparison with the laryngeal mask and Combitube®. Because vomiting facing the blind ending of the Laryngeal Tube may provoke esophageal rupture, modification of the device for free gastric drainage would be desirable. Further, because of breathing oxygen before Laryngeal Tube insertion, our patients were not hypoxic and/or hypercarbic before the intervention. In conclusion, the Laryngeal Tube might be a simple, alternative device to the Combitube® to secure the airway.

**References**


Table 1. Arterial Blood Gas Samples With the Laryngeal Tube

<table>
<thead>
<tr>
<th></th>
<th>Before anesthesia</th>
<th>After 10 min of ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SaO2 (%)</td>
<td>96 ± 1</td>
<td>99 ± 1*</td>
</tr>
<tr>
<td>Pao2 (mm Hg)</td>
<td>82 ± 9</td>
<td>170 ± 58*</td>
</tr>
<tr>
<td>Paco2 (mm Hg)</td>
<td>35 ± 3</td>
<td>38 ± 4‡</td>
</tr>
<tr>
<td>pH</td>
<td>7.42 ± 0.01</td>
<td>7.40 ± 0.04†</td>
</tr>
</tbody>
</table>

Data is given as mean ± so.
Fraction of inspired oxygen = 0.4, respiratory rate = 10 breaths/min, tidal volume = 7 mL/kg.
Laryngeal Tube (VBM Medizintechnik, Sulz, Germany).
*P < 0.001 versus before induction.
†P < 0.05 versus before induction.

Table 2. Oropharyngeal Leak Pressures for the Laryngeal Tube at Different Oropharyngeal Cuff Inflation Pressures

<table>
<thead>
<tr>
<th>Oropharyngeal cuff inflation pressure (mm Hg)</th>
<th>Oropharyngeal leak pressure (cm H2O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>24 ± 4*</td>
</tr>
<tr>
<td>70</td>
<td>31 ± 5†</td>
</tr>
<tr>
<td>80</td>
<td>37 ± 3‡</td>
</tr>
<tr>
<td>90</td>
<td>40 ± 1</td>
</tr>
</tbody>
</table>

Data is given as mean ± so.
Laryngeal Tube (VBM Medizintechnik, Sulz, Germany).
*P < 0.001 versus 70 mm Hg.
†P < 0.001 versus 80 mm Hg.
‡P < 0.001 versus 90 mm Hg.


