The intubating laryngeal mask airway: an initial assessment of performance†

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Summary
A new prototype of the laryngeal mask airway (LMA), the intubating laryngeal mask airway (ILMA), was used to facilitate tracheal intubation in 100 fasted patients presenting for elective surgery. Alignment of the ILMA with the larynx was assessed fibreoptically before intubation without the investigator performing the intubation being aware of the view score. Ease of intubation correlated with the view obtained and with the degree of manipulation of the ILMA needed to achieve tracheal intubation. Intubation was successful in 93 patients. Of the seven intubation failures, five occurred in the first 20 patients. Conventional connection to the breathing system and ventilation of the lungs of the patients were possible throughout the intubation procedure. (Br. J. Anaesth. 1997; 79: 710–713).

Key words
Equipment, masks anaesthesia. Intubation tracheal. Intubation tracheal, technique.

The laryngeal mask airway (LMA) represents a major advancement in airway management. In addition, it has been used to facilitate tracheal intubation by a variety of methods. An early prototype of the laryngeal mask airway was used for intubation in a patient known to present with a difficult tracheal intubation. We describe a new prototype, the intubating laryngeal mask airway (ILMA), and a preliminary assessment of its performance in aiding tracheal intubation in fasted surgical patients.

Patients and methods
The ILMA (fig. 1) incorporates a standard LMA cuff in sizes 3, 4 or 5 and a metal airway tube and handle. The latter allows manipulation of the device within the patient’s airway. The airway tube has a wider internal diameter (1.3 vs 0.9 cm) and is shorter 14.5 vs 20 cm) than the standard LMA tube (size 3 or 4). In addition, there is a silicon rubber bite block surrounding the upper part of the stem. The ILMA admits up to a 9.0 mm cuffed tracheal tube.

After obtaining Ethics Committee approval, informed consent was obtained from ASA I and II adult patients presenting on elective surgical lists. Patients were excluded if they had a history of active gastro-oesophageal reflux, severe respiratory disease or inadequate fasting. After i.v. induction of anaesthesia with fentanyl 1 μg kg⁻¹ and a sleep dose of propofol, neuromuscular block was produced with atracurium 0.6 mg kg⁻¹. The lungs were pre-oxygenated and patients were monitored with ECG, capnography, pulse oximetry and a peripheral nerve stimulator. Patients’ lungs were gently ventilated manually by face mask and after ablation of the train-of-four response to peripheral nerve stimulation an ILMA of appropriate size to patient weight was introduced (usually a size 4 for females and size 4 or 5 for males). The ILMA was preloaded with a 7 or 8 mm cuffed tracheal tube (TT) (Portex Ltd, Hythe, Kent, UK) with the cuff of the TT tube inflated within the stem of the ILMA to ensure an airtight seal. Before insertion, the cuff of the ILMA was deflated using a cuff deflating device (Intavent Orthofix Ltd, Maidenhead, Berks, UK) to ensure maximal extraction of air yet retaining a smooth cuff profile; the dorsal surface was lubricated with KY jelly (Johnson and Johnson Ltd, Maidenhead, UK). The ILMA had been inserted by passing the device along the posterior pharyngeal wall, conventional connection of the TT tube to an anaesthetic breathing system and ventilation of the patients’ lungs was attempted (fig. 1). Successful placement/ventilatory ability was judged by chest wall movement and capnography (maintain Pco₂ within normal range) during gentle manually assisted ventilation. Inhalation anaesthesia with nitrous oxide and enflurane in oxygen was introduced at this stage.

Alignment of the ILMA with the larynx was assessed by an independent observer using a fibre-optic intubating laryngoscope, (Olympus LF-2, Keymed Ltd, Keymed House, Southend-on-Sea, UK) which was passed through the diaphragm of the tracheal tube connector (Intersurgical, Wokingham, UK) until the tip was lying just inside the ILMA.


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grill. The view obtained was then graded according to a scoring system (table 1).

Without movement of the patient’s head and neck from the “sniffing position”, obtained with one pillow, TT tube advancement (by either A. K. or E. V. A.) was attempted using one or more of the following methods: (a) without movement of the ILMA (neutral), (b) pulling back of the metal handle of the ILMA towards the intubator (extension) or (c) pushing the metal handle of the ILMA away from the intubator (flexion). Manoeuvres (b) and (c) achieve a rotatory movement of the ILMA in the sagittal axis within the patient’s airway and affect alignment of the mask with the larynx. Ease of intubation was assessed by recording the number of attempts required to intubate the patient’s trachea and the final position of the ILMA at the time of TT intubation was noted. Successful intubation was confirmed by capnography during manually assisted ventilation. Failure to intubate was defined as inability to place the TT tube successfully after all three manoeuvres had been attempted. The ILMA was left in situ for the duration of the case with the cuff deflated.

Results

We have used the ILMA in 100 patients (30 male). Mean age was 50.1 (range 22–87) yr and mean weight 68.7 (range 40–107) yr. Anaesthesia was uneventful in all patients. Placement of the ILMA and adequate ventilation were achieved at the first attempt in all patients. The trachea was intubated successfully in 93 patients, 72 at the first attempt. Of the 28 patients requiring more than one attempt at TT intubation, difficulties with tube advancement resulted from two causes: either TT tube passage was obstructed (this occurred in 25 patients of which 21 patients were intubated successfully after manipulation (table 2)), or the tube passed into the oesophagus (this occurred in three cases and was recognized by the absence of chest wall movement and the use of capnography). Of the seven failed intubations, five occurred in the first 20 patients. Of the 93 patients with a view score of 1 or 2, there was a 95% success rate at tracheal intubation. Of the five patients with a view score of 3, there were four successful intubations and one failure. Of the two patients with a view score of 4, there was one successful and one failed intubation (table 3). The first was caused by the ILMA being inserted too far, resulting in oesophageal intubation (with only the oesophagus being visible on fiberoptic examination); tracheal intubation was achieved when the ILMA was withdrawn slightly. In the second, the ILMA tip had folded forwards, obstructing tracheal tube advancement and was an intubation failure. This patient was one of the failures occurring after the first 20 patients (late failure). The other late failure was a patient who had a view score of 2 after ILMA insertion, but attempts with all three manipulations of the ILMA still resulted in oesophageal intubation. Removal of one pillow and a less exaggerated “sniffing position” enabled easy intubation subsequently; however, this patient was classified as an intubation failure as the fiberoptic view score was known to the intubator.

As the fiberoptic view score deteriorated, more attempts were required to achieve intubation. When success was achieved in patients with a view score of 1, 2, 3 or 4, six of 53 (12%), 12 of 35 (34%), two of four (50%) and one of one (100%) patients, respectively, required two or more attempts at intubation.

In achieving tracheal intubation in those patients with a view score of 1, the ILMA was manipulated

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**Figure 1** Intubating laryngeal mask airway showing a TT tube with diaphragm connector (for fiberoptic sight and assessment of laryngeal position) inserted into the metal stem of the ILMA. Inflation of the TT tube cuff within the ILMA stem and connection of the TT tube connector to the breathing system enables ventilation of the lungs.

**Table 1** Fibreoptic view scoring system

<table>
<thead>
<tr>
<th>Fibreoptic view</th>
<th>Score</th>
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<tbody>
<tr>
<td>Full view of cords</td>
<td>1</td>
</tr>
<tr>
<td>Partial view of cords, including arytenoids</td>
<td>2</td>
</tr>
<tr>
<td>Epiglottis only</td>
<td>3</td>
</tr>
<tr>
<td>Other (e.g. LMA cuff, pharynx)</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 2** Attempts at tracheal intubation

<table>
<thead>
<tr>
<th>Attempts at intubation</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (no manipulation)</td>
<td>72 (72%)</td>
</tr>
<tr>
<td>2 or more (manipulation)</td>
<td>21 (21%)</td>
</tr>
<tr>
<td>Failed</td>
<td>7 (7%)</td>
</tr>
</tbody>
</table>

**Table 3** Attempts at intubation, classified by fiberoptic view score

<table>
<thead>
<tr>
<th>View score</th>
<th>Attempts at intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>2 or more</td>
<td>6</td>
</tr>
<tr>
<td>Failed</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note: The percentages in the table for 1, 2, 3, and 4 are not provided in the original text. The table assumes the given numbers reflect the percentages.*
in approximately equal degree between the manoeuvres (a)–(c) (intubation was successful in 16 patients in the neutral position, in 18 patients after extension and in 19 patients after flexion manoeuvres of the ILMA). As the alignment of the larynx with the ILMA deteriorated (i.e. view scores 2–4), the final position of the ILMA was predominantly flexion (26 patients), rather than neutral (seven patients) or extension (seven patients) (table 4).

Discussion

We have made a preliminary assessment of the performance of a new prototype of the laryngeal mask airway, the ILMA. After insertion of the ILMA in anaesthetized patients, alignment of the ILMA with the larynx was assessed fibrescopically by an independent observer before the attempted passage of a TT tube. A scoring system for the fibroptic view obtained was based on the direct laryngoscopy grading of Cormack and Lehane and differs from that described by Brimacombe and Berry. It separates view of the larynx from function of the laryngeal mask and is familiar to anaesthetists. Tracheal intubation in 93 of 100 patients was successful. The majority of patients (93) had a view score of 1 or 2 and the trachea was intubated with a success rate of 95%. Of the seven failed intubations, five occurred in the first 20 patients (four with a view score of 1 or 2), demonstrating the presence of a learning curve in acquiring expertise in the use of this prototype of the ILMA. In the five patients with a view score of 3 (only epiglottis visible), four successfully underwent intubation. The degree of device manipulation required to achieve tracheal intubation was related inversely to the view score or alignment with the larynx.

The laryngeal mask airway has been used to facilitate tracheal intubation by a variety of methods. It has been recommended as a conduit for fibroptic intubation for training purposes and for the management of some patients with difficult airways. The salient feature is the possibility of maintaining an airway and oxygenation of the patient throughout the intubation procedure. However, the standard LMA only admits up to a 6.0 mm cuffed tracheal tube. In addition, the cuff of such a tube will not reliably come to lie in the trachea below the vocal cords because of the length of the stem of the LMA. Attempts to overcome these problems have involved cutting and altering the standard laryngeal mask airway. The design of the ILMA with its shorter and wider airway tube attempts to overcome these problems and admit up to a 9.0 mm cuffed TT tube.

In this study patients were paralysed (only after it was confirmed that manual ventilation using a face mask was possible), however if neuromuscular blocking agents were not used it may be that in those patients requiring more than one attempt at TT intubation this degree of airway manipulation could provoke laryngeal spasm. In a case of difficult intubation where neuromuscular blocking agents are usually avoided there are two options with this device. First, the ILMA may be inserted and intubation achieved with the patient awake using topical anaesthesia (personal communication L. Loh, Oxford and D. R. Uncles, Worthing). Second, the ILMA may be inserted after induction of anaesthesia and adequate ventilation of the patient’s lungs confirmed before administration of a neuromuscular blocker.

The ILMA as an intubating aid may be criticized for being a “blind-on-blind” technique (i.e. both the ILMA and TT tube are inserted without direct sight of the larynx). However, other blind techniques for intubation have been described and blind intubation through the standard LMA has been demonstrated successfully. Moreover, fibrescopy may be performed either before or during the intubation attempt if the equipment is available. With the ILMA, manipulation of the rigid tube and handle is transmitted directly to the inflatable cuff, altering its position within the patient’s airway, unlike the standard LMA or more particularly the reinforced LMA. We believe that this manipulation enabling alignment of the ILMA with the laryngeal inlet to facilitate tracheal intubation while being able to ventilate the patient’s lungs throughout the procedure may represent a valuable advance over current intubation aids.

References