The use of the laryngeal mask airway in recovery

The laryngeal mask is being used increasingly both for the management of cardiorespiratory arrest and recovery after surgery. In this article, the author describes the design and development of the mask and looks at its use in recovery departments. A discussion of training issues is also included.

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The laryngeal mask airway (LMA), commonly used in the operating theatre, is increasingly being used by hospitals for the management of cardiorespiratory arrest and in recovery following surgery.

The literature relating to the LMA has correspondingly grown in recent years, helping to define its uses, merits and disadvantages. A survey from 1983-1991 reveals a total of 183 publications on the LMA and over 70 per cent of these were in UK journals (Brimacombe and Shorney 1993). As of August 1996, there are estimated to be nearly 1,000 publications worldwide on the LMA (Personal communication 1996).

As a result of this increased use, recovery staff and ward nurses involved in airway management need to know how to manage patients with an LMA in place (Brain 1993, Brimacombe 1993).

HISTORY
Dr Archie Brain invented the LMA in 1981 at the London Hospital, Whitechapel (Brimacombe 1993). He made plaster casts of the cadaveric human pharynx and modelled his mask on the shape of this structure (O'Meara 1995). The earliest prototype consisted of a flange from a Goldmann dental mask attached to a 10mm diameter plastic tube. After conducting a pilot study, he refined the cuff to improve its fit and incorporated a grid to prevent the epiglottis from becoming trapped.

Ultimately, he produced an airway which could be insertedatraumatically, blindly, and which could provide a seal capable of withstanding 20cm H2O pressure. Eventually, in 1985, his work attracted commercial interest, and the LMA was approved for use in the UK in 1988 (Brain 1983). However, despite its worldwide popularity, the LMA was only released in the US in 1992 (Brimacombe 1992).

DESIGN
The cuff on the LMA is large, elliptical and placed at the very end of the tube. The tip of the mask rests against the upper oesophageal sphincter, the sides facing into the pyriform fossae and the upper border under the tongue (Green 1991). The mask is made of silicone compounds and incorporates a polysulfone connector and a polypropylene valve (Intavent 1993).

The current design is available in six sizes. The appropriate size is determined by the patient's weight and, after insertion, inflated with the appropriate volume of air (Table 1) (O'Meara 1995).

The shaft of the LMA is available with the traditional wide bore lumen or a narrower non-kinking design which is reinforced with a metal spiral. It can withstand repeated autoclaving, however, the manufacturer recommends that each LMA be used no more than 40 times (Intavent 1993). A new prototype LMA is currently being evaluated. The key design features are that it incorporates a second mask to isolate the upper oesophagus and a second dorsal cuff to increase the seal against the glottis (Brain et al 1995).

INSERTION TECHNIQUE
In-depth insertion technique can be found in the instruction manual (Brain 1993). In brief (O'Meara 1995) (Figs. 1-6):
- The mask should be inserted fully deflated and adequately lubricated
- The patient should be anaesthetised and his/her head placed in the 'sniffing the morning air' position
- The cuff should be inserted through the mouth and applied to the hard palate and then advanced into the

Fig. 1.
Box 1. Step by step insertion technique

Fig. 1: Under direct vision, press the mask tip upwards against the inner surface of the patient's upper incisors to flatten it out.

Fig. 2: Using the index finger, keep pressing upwards as you advance the mask into the pharynx to ensure the tip remains flattened and avoids the tongue.

Fig. 3: Keeping the neck flexed and head extended, press the mask into the posterior pharyngeal wall using the index finger. Note that the index finger must be directly in line with the mask aperture.

Fig. 4: Continue pushing with the tip of the index finger guiding the mask downward into position. By withdrawing the other fingers and slight pronation of the forearm, it is usually possible to push the mask fully into position in one fluid movement.

Fig. 5: Now grasp the tube firmly with the other hand and withdraw the index finger from the pharynx. Press gently downward with this other hand to ensure that the mask remains fully inserted. In the event insertion to the correct depth has not been achieved using the index finger, this action will ensure full insertion.

Fig. 6: Inflate the mask with the recommended volume of air. Do not over inflate. Do not hold the tube of the LMA while inflating unless the position is obviously unstable (this may occur in elderly edentulous patients with slack tissues). Normally, the mask should rise up slightly out of the hypopharynx as the cuff is inflated, and the mask finds its correct position.

Recent research has indicated that Propofol may be the most suitable induction agent. Brown et al (1991) and Goodwin et al (1992) pointed to the advantage of reduced requirement for anaesthesia in day case surgery.

Table 1. Physical characteristics and recommended patient size for the different sizes of LMA

<table>
<thead>
<tr>
<th>Size</th>
<th>Shaft Internal (cm)</th>
<th>Cuff Volume (ml)</th>
<th>Patient's Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.25</td>
<td>2-5</td>
<td>&lt;6.5</td>
</tr>
<tr>
<td>2</td>
<td>7.0</td>
<td>7-10</td>
<td>6.5-20</td>
</tr>
<tr>
<td>2.5</td>
<td>8.4</td>
<td>14</td>
<td>20-30</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>15-20</td>
<td>30-70</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>25-30</td>
<td>&gt;70</td>
</tr>
</tbody>
</table>

hypothesis in a single downward thrust. A significant 'give' is felt as it advances beyond the epiglottis. This is the end-point of insertion.

■ The cuff should then be inflated with the appropriate volume of air (Table 1). At this stage the airway may be observed to rise from the mouth. This is normal and impeding this movement by holding the shaft before inflation may result in incorrect placement of the mask (Box 1).

USE OF THE LMA IN RECOVERY

Patients can be transferred into the recovery room while still anaesthetised, a factor which can increase the number of patients operated on. The LMA is designed to be left in place until the return of competent, protective reflexes, but may be removed when the patient is still deeply anaesthetised or awake, either in the supine or lateral position. It must not be removed at a half-way stage, or laryngeal spasm, coughing or gagging may result.

If patients are left to recover with the LMA in place, the recommended form of bite block must be used during recovery and the cuff must not be deflated until the moment of removal (Intavent 1996). If the cuff is deflated before the effective return of swallowing and cough reflexes, secretions may enter into the
larynx provoking laryngeal spasm. Alternatively, the LMA may be removed with the cuff still moderately inflated to aid more complete removal of salivary secretions (Intavent 1996).

Brain (1993) recommended that the mask should only be removed when the patient can open his or her mouth on command, and in a properly staffed and equipped area. In children, it is safe to wait for the patient to eject the inflated mask.

Supplementary oxygen As with most patients recovering from anaesthesia, supplementary oxygen should be provided. Oxygen can be administered through the LMA using a Venturi T-piece system, a modified Bain's circuit, a Portex Thermovent T-piece or an open ended T-piece. Barotrauma is a possibility (Asai et al 1994) and care must be taken to ensure that exhalation is not impaired, even though the LMA partly protects against barotrauma because of the low pressure seal with the glottis. Oxygen 100 per cent can be administered easily by connecting the LMA to an anaesthetic breathing system (Brimacombe 1993).

Emergence from anaesthesia Swallowing is a good sign that the patient is emerging from anaesthesia and alerts the nurse to prepare for removal of the LMA. Patients, however, often remove the LMA themselves. After use, the mask should be washed immediately. It should be sterilised in an autoclave at a temperature no higher than 134° centigrade. The cuff must be deflated immediately before the procedure (Asai and Vaughan 1994). Intavent (1993) recommends device performance tests. Failure on any one test indicates the device has passed its useful life and is no longer safe.

DISADVANTAGES

Aspiration Aspiration is a rare, but potentially lethal, problem that sometimes occurs after light anaesthesia, especially if the cuff is deflated before the patient’s swallowing reflexes return (Griffin and Hatcher 1990). The risk of aspiration is widely perceived as the single most limiting feature of the LMA. Wilkinson et al (1990) reported eight cases of regurgitation from a series of 546, two of whom aspirated. No fatalities have been reported from pulmonary aspiration syndrome associated with the LMA (Brimacombe and Shorney 1993).

Reflux Wilkinson et al (1990) have reported cases of vomiting at the end of the procedure with vomitus being noted in the anaesthetic breathing system. This supports Koehli’s (1991) concern that the mask preferentially directs vomitus into the trachea. Constant vigilance is therefore needed (Wilkinson et al 1990).

Other potential complications These include coughing, excessive salivation, retching, vomiting, biting, breath holding, recurrent swallowing and oropharyngeal trauma, post-operative hoarseness, dry mouth, dysphagia and sore throat. Post-operative sore throat is usually mild and has been reported to occur in 4-12 per cent of cases (Alexander and Leach 1989). Asai et al (1995) have shown that cricoid pressure without support of the neck (single-handed method) impedes correct placement and ventilation via the LMA if sufficient force is applied. However, Gabbot and Sasada (1995) stated: ‘The evidence as to whether application of cricoid pressure impedes correct placement of LMA is conflicting.’

CONTRAINDICATIONS

The LMA should not be used in non-fasting patients unless the airway cannot be safely secured by other means. Patients with a hiatus hernia are more likely to regurgitate gastric contents under anaesthesia and should also be excluded. Gross or morbid obesity is associated with hiatus hernia and such patients should be excluded unless intubation may be difficult and appropriate antacid therapy has been given pre-operatively.

Patients over 14 weeks pregnant, patients with multiple or massive injury, acute abdominal or thoracic injury, those on opiate medication, those with autonomic neuropathy or any abdominal condition associated with delayed gastric emptying should also be excluded (Brain 1993).
When the patient is in the prone position or where access to the patient's airway is restricted, some anaesthetists consider there is an increased chance of the mask becoming dislodged (Benumof 1992). However, there have been reports where it has been used in this position, particularly during radiotherapy (Ngan Kee 1992). It would seem advisable not to use the LMA when there is doubt about re-securing the airway if the mask becomes dislodged.

PROFESSIONAL TRAINING
Several studies have looked at training nursing staff in the use of the LMA. In a multicentre trial at three hospitals (Stone et al 1994), 130 nurses were trained in the use of LMA as a method of airway management during resuscitation and 164 cases of cardiac arrest were studied. The LMA was inserted at the first attempt in 71 per cent of cases and at the second attempt in 26 per cent of cases. The conclusion was that the LMA offers advantages over other methods of airway and ventilation management, such as bag valve mask or mouth-to-mouth methods currently used by ward nurses.

Davies et al (1990) compared intubation with the LMA in paramedics and concluded that the LMA was inserted more rapidly and insertion was easier to learn. However, it was emphasised that the endotracheal tube should remain the first choice in the emergency situation. Alexander et al (1993) tested ten volunteers after formal training with the LMA, Guedel airway and face mask and found successful ventilation was twice as likely with the LMA compared with the Guedel airway bag and mask.

A comparison of the facemask and LMA was also carried out by Martin et al (1993). The nurses in the study were all intensive therapy staff, 28 of whom had previous experience of face mask use at cardiac arrests and had received in service resuscitation training in the preceding six months. The study showed that the nurses achieved greater tidal volumes with LMA than with face mask ventilation (p<0.01).

Training for nurses is given on mannikins, although instructors are expected to be able to perform the technique on patients. Adaptors are available where necessary for simulated anatomy models. The UK Resuscitation Council is currently liaising with Intavent Ltd on incorporating its training material into the Intavent manual (Colgate Medical, in press), and schools have been set up in eight centres throughout the UK to provide specialist LMA training where required (Personal communication 1996).

CONCLUSION
The LMA represents an exciting innovation in airway management. Many of its applications have already been explored, but these findings need to be consolidated to allow a more precise delineation of the mask's uses (Brimacombe et al 1993). For example, the LMA can be used for airway management by nurses during cardiopulmonary resuscitation and in specific areas such as recovery and intensive care. Sound knowledge of this device, which can be taught in a short time, is therefore important for all healthcare workers involved in airway management.

REFERENCES