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Original Contribution

Fiberoptic assessment of the Laryngeal Mask Airway (Laryseal) position after one hour of positive pressure ventilation: an observational study

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Abstract

Study Objectives: To determine, by fiberoptic endoscope, malpositioning of the Laryngeal Mask Airway (LMA) and other extraglottic devices.

Design: Prospective study.

Setting: University-affiliated medical center.

Patients: 60 adult, ASA physical status 1 and 2 patients, aged 20 - 60 years, scheduled to undergo ophthalmic procedures with general anesthesia during controlled ventilation via LMA (Laryseal).

Measurements: Adequacy of ventilation was determined by the absence of audible leak and appropriate capnograph trace. Fiberoptic assessment and imaging of LMA position were done after proper insertion of the LMA and after one hour of positive pressure ventilation (PPV). Assessment included position of the epiglottis, glottis, and cuff.

Main Results: The epiglottis was visible in 50 patients (83.3%). Vocal cords were visible in 58 patients at the time of insertion, and in 52 patients after one hour of PPV ($P = 0.047$). The arytenoids were herniating through the mask aperture after one hour of PPV ($P = 0.0132$). The cuff position was less optimal after one hour of controlled ventilation ($P = 0.032$).

Conclusion: LMA position may change spontaneously with time during PPV, especially when the LMA position is not optimum at the time of insertion. The LMA should be adequately inserted with all possible measures in cases with general anesthesia and PPV. Fiberoptic assessment of LMA position intraoperatively may be advantageous.

1. Introduction

Since the introduction of the Laryngeal Mask Airway (LMA), its use has expanded enormously. The LMA is now used routinely to maintain anesthesia in the vast majority of surgical procedures [1].

The mask has a flattened, pear-shaped, inflatable cuff with an open front. After proper insertion, the opening should overlay the glottis with its proximal end opposite the base of the tongue and the distal part just in front of the upper esophageal sphincter forming a seal [2]. A fiberoptic bronchoscope inserted through the LMA should

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have a clear direct view of the vocal cords if it is in place [3].

The LMA may be used for either spontaneous ventilation or positive pressure ventilation (PPV) when it is correctly inserted in front of the glottis. A fiberoptic endoscope can be used to determine the accurate position of an extraglottic device relative to the surrounding anatomical structures [4]. An improperly placed LMA may not always be detected clinically [5]; thus its position may be checked via a fiberoptic bronchoscope [6]. Inaccurate positioning of an LMA may increase the incidence of gastric inflation, reflux of gastric contents, and tracheal aspiration, especially if the patient is undergoing controlled ventilation [7]. Few previous studies have assessed the position of the LMA after a certain period of mechanical ventilation; most of these studies discussed the effect of nitrous oxide on cuff volume.

The aim of this study was to assess the anatomical position of the LMA relative to the glottic and extraglottic structures after one hour of PPV compared with its position at the time of insertion.

2. Materials and methods

The study protocol was reviewed and approved by the Ethics Committee of the Alexandria Main University Hospitals. Written, informed consent was obtained from all patients participating in the study. This observational study was carried out in 60 adult, ASA physical status 1 and 2 patients, aged 20 to 60 years, who were scheduled for ophthalmic surgery during general anesthesia with PPV via LMA. Patients were excluded from the study if they had a respiratory disease, a body mass index > 30 kg/m^2, or if their interincisor distance was < 2.5 cm. Patients were also excluded if they were liable to aspirate, if they were undergoing an emergency procedure, or if any manipulation of head and neck position was required.

All patients were routinely monitored. Premedication was done using intravenous midazolam 0.03 - 0.05 mg/kg 5 minutes prior to induction. Anesthesia was induced while patients were placed in the supine position, with the patient's head and neck in the sniffing position, using a small pillow 10 cm under the occiput. Induction of anesthesia was done using fentanyl 1 μg/kg, propofol 2 - 3 mg/kg, and atracurium 0.5 mg/kg. All patients were manually ventilated via facemask until full action of the muscle relaxant. The Laryseal (Flexicare Med. Ltd, Mid Glamorgan, UK) was chosen because it has no epiglottic bars and thus provides a clear view of the laryngeal structures, allowing better assessment via the flexible fibreoptic bronchoscope. The LMA was inserted while the cuff was fully deflated using the standard method described by Brain[1] by a single anesthesiologist who had used the LMA > 200 times. The manufacturer's recommendations were used for size selection, device fixation, and its reuse limit (< 40 times). Once the LMA was in place, the intracuff pressure was set at 60 cm H_2O using a handheld pressure gauge (Endotest; Rüsch, Kernen, Germany). Anesthesia was maintained using isoflurane 1% - 1.5% in oxygen 100%, and increments of atracurium were given according to the train-of-four ratio using ulnar nerve approach via a nerve stimulator.

Ventilation was achieved with a tidal volume of 6 - 8 mL/kg and a respiratory rate of 10 to 12 breaths/min with an inspiratory:expiratory ratio of 1-2. Maximum airway pressure was set not to exceed 20 cmH_2O. Adequacy of ventilation was determined by the absence of an audible leak during ventilation and by appropriate capnograph trace and end-tidal CO_2 ($ETCO_2$). Complete or partial airway obstruction was defined as loss of the capnograph trace or desaturation to < 95%. Cases were excluded if any intraoperative ventilatory event occurred that required manipulation of the airway or the device.

3. Materials and methods

Fiberoptic assessment of the LMA position was done by flexible fiberoptic endoscope (Olympus BF type P30; Olympus Optical Co., Ltd, Tokyo, Japan); high-resolution images were taken through a digital camera attached to the eye piece. All fiberoptic assessments were performed while the tip of the bronchoscope was one cm above the terminal end of the ventilation port of the LMA. Photos and assessments were taken at two times:

- After proper insertion of the LMA. This was determined by applying an airway inflation pressure of 20 cm H_2O. The larynx was auscultated for the absence of audible leak and both lungs were auscultated for adequate bilateral air entry.
- After one hour of PPV (surgeries less than one hr were excluded).

The following parameters were measured and compared in a photographic image taken by the practitioner:

- Position of the epiglottis regarding visibility and herniation through the mask aperture;
- Position of the glottis regarding visibility of the vocal cords and the arytenoids being visible or herniating;

Table 1 Demographic data of the 60 study patients

Age range, yrs (means ± SD)	22 - 58 (42.6 ± 9.85)
Gender (M/F)	39/21 (65%/35%)
ASA physical status (1/2)	41/19 (68.3±31.7)

[1] Brain AIJ. The Intavent Laryngeal Mask Instruction Manual. 2d edn. Henley-on-Thames (UK): Intavent International SA; 1992.