Anaesthesia Equipment

Use of a lighted stylet for intubation via the laryngeal mask airway

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Purpose: To assess a new technique for intubation via the laryngeal mask airway (LMA) in which a lighted stylet is used to optimise the position of the LMA before intubation.

Methods: In 114 patients, following LMA insertion, the lighted stylet (Trachlight Wand™) with mounted tracheal tube (TT) was advanced 1.5 cm beyond the mask aperture bars and the anterior neck observed for a distinct central point of light at the cricothyroid membrane (CTM). If this was not seen, the LMA was repositioned in the pharynx, depending on the location of the light, by manually advancing, withdrawing or rotating the device, manipulating the head/neck or trying an alternative size. Tracheal intubation was attempted only when transillumination was correct. The TT with lighted stylet was advanced until the supra-sternal notch was transilluminated.

Results: In 89 patients (78%) the CTM was transilluminated without repositioning, in 12 (10%) a single positional adjustment was required, and in 10 (9%) a change of LMA size was required. In three patients (3%) transillumination of the CTM was impossible. In the 97% of patients in whom transillumination was correct, tracheal intubation was successful in all at the first attempt without the need for further repositioning or size change.

Conclusion: The lighted stylet is useful in facilitating intubation via the LMA in anaesthetised adult patients when used as a guide to optimal LMA position.

Objectif : Évaluer une nouvelle technique d'intubation au moyen du masque laryngé (ML) dans lequel un stylet lumineux est utilisé pour maximiser la position du ML avant l'intubation.

Méthodes : Chez 114 patients, après l'insertion du ML, le stylet lumineux (Trachlight Wand®) sur lequel est monté un tube endotrachéal (TE) a été poussé de 1,5 cm au-delà des barres d'ouverture du masque et la partie antérieure du cou a été examinée pour déterminer un point central précis de lumière au niveau de la membrane crico-thyroïdienne (MCT). Si ce point central n'était pas visible, le ML était remplacé dans le pharynx, selon la localisation de la lumière, par poussée manuelle, en retirant ou en tournant l'appareil, en manipulant la tête ou le cou ou en essayant un masque de taille différente. L'intubation endotrachéale était tentée seulement quand la transillumination était jugée adéquate. Le TE avec le stylet lumineux a été introduit jusqu'à ce que le creux de la fourchette sternale soit transilluminé.

Résultats : Chez 89 patients (78 %) la MCT était transilluminée sans remise en place, chez 12 patients (10 %) un seul ajustement a été nécessaire et chez 10 patients (9 %) un changement de taille du ML a été requis. Chez trois patients (3 %) la transillumination de la MCT a été impossible. Parmi les 97 % de patients chez qui la transillumination était adéquate, l'intubation trachéale a été un succès pour tous dès le premier essai sans avoir recours à une remise en place ultérieure ou à un changement de taille du ML.

Conclusion : Le stylet lumineux est utile pour faciliter l'intubation au moyen du ML chez les patients adultes sous anesthésie quand il est employé comme guide de position optimale du ML.

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THE LMA has a role in the management of the difficult airway both as a substitute airway and as an aid to tracheal intubation.¹⁻⁴ Reported success rates for blind and fibre-optic guided passage of a tracheal tube vary between 19-93%⁵⁻⁷ and 96-100%^{5,8,9} respectively depending on technique, experience, the number of attempts taken and the tracheal tube chosen. A variety of aids to blind tracheal intubation through the LMA have been described including the use of a stylet, bougie or tube changer,¹⁰⁻¹² but success rates remain unpredictable at 0 - 85%. Recently, Asai *et al.* reported the unsuccessful use of a lighted stylet with inner metal guide as an aid to blind intubation via the LMA.¹³ In this study, the lighted stylet was used to direct the tracheal tube and confirm tracheal placement. We postulated that the lighted stylet might be more useful if it were also used to optimise the position of the LMA prior to attempted intubation.

The objective of this study was to assess the efficacy of using a lighted stylet to optimise LMA placement prior to blind tracheal intubation.

Methods

One hundred and fourteen consecutive ASA 1-2 patients scheduled for elective surgery requiring tracheal intubation were investigated following hospital ethical committee approval and written informed consent. Patients were excluded from the study if they were under 18 yr, had respiratory tract / pharyngeal pathology, or were at risk of regurgitation. Six experienced LMA users (> 75 uses each) were trained in the study protocol. All investigators had some experience with the lighted stylet (Trachlight Wand™, Laerdal Medical Corporation) before the start of the study (> five uses each).

Premedication was with 0.04 mg·kg⁻¹ midazolam *iv* approximately 30 min before induction of anaesthesia. Standard monitoring was applied. Patients were pre-oxygenated for two minutes and given 2-3 µg·kg⁻¹ fentanyl *iv* followed one min later by 2-4 mg·kg⁻¹ propofol *iv* over 30 sec. The lungs were ventilated with oxygen 100% via a face mask for 30 sec and the LMA was inserted using the standard technique¹⁴ when the lash reflex was lost, the jaw was relaxed and the patient apnoeic. Additional boluses of 0.5 mg·kg⁻¹ propofol *iv* were given as required until an adequate level of anaesthesia was achieved for placement of the LMA. A size #4 LMA was used for small adults (< 60 kg) and a size #5 for large adults (≥ 60 kg). The LMA cuff was inflated with air until an effective seal was formed or up to the maximum recommended volume (30 ml, size #4; 40 ml, size #5). Adequate ventilation was judged by chest wall movement, capnography

(maintain end-tidal CO₂ within normal range: 35-45 mm Hg) and an oropharyngeal leak pressure 10 cm H₂O (determined by listening at the mouth) during manually assisted ventilation. If adequate ventilation was not possible, the LMA was removed and the alternative size inserted. The size #3 was not used in this study. Once adequate ventilation was established, patients were given 0.1 mg·kg⁻¹ vecuronium *iv*. After three minutes, the LMA was disconnected from the anaesthesia breathing system. The patient was prepared for tracheal intubation with the head and neck supported on a standard pillow 8 cm in height (neutral position). A 6.5 mm ID tracheal tube (length, 29.5 cm; external diameter 0.8 cm) was used with the size #4 LMA; a 7.0 mm ID tracheal tube (length, 31.5 cm; external diameter 1.0 cm) was used with the size #5 LMA. The lubricated tracheal tube (TT) (Mallinckrodt, Modena, Italy) was mounted on the Trachlight Wand™. This device comprises a handle with battery, a flexible wand with distal light source and a rigid inner metal guide (Figure 1). The rigid inner metal guide, which provides stiffness when the Trachlight Wand™ is used as a stand-alone intubation aid, was removed to allow the TT greater flexibility during passage into the trachea. Prior to placement, the soft luminous tip of the lighted stylet was positioned 0.5 cm beyond the distal tip of the TT. The lighted stylet with mounted TT was advanced to 1.5 cm beyond the level of the mask aperture bars using the centimetre markers as a depth guide, and the anterior neck observed for signs of light with the room illumination reduced. The detection of a distinct central point of light without a halo at the CTM was

FIGURE 1 The Trachlight Wand™
A = GUIDING HANDLE. B = METAL GUIDE.
C = SOFT LIGHT WAND. D = LIGHT SOURCE

FIGURE 2 The position of the Trachlight Wand™ light source and tracheal tube in relation to the bowl of the laryngeal mask airway

taken as evidence that the LMA cuff was correctly placed around the laryngeal inlet for tracheal intubation (Figure 2). If correct transillumination of the CTM was not seen, the LMA was repositioned in the pharynx (without removing air from the cuff) depending on the location of the light. The repositioning sequence comprised: 1) a 1 cm inward or outward movement of the LMA if the transillumination was above or below the CTM respectively; 2) centralisation of the LMA cuff by manipulating it from the front of the neck if the transillumination was lateral to the midline; 3) a change in head and neck position (neck extension and/or head flexion) if the first two positional changes failed to produce correct transillumination. If repositioning failed, an alternative size was used and new positional adjustments utilised if required. Intubation was not attempted unless the CTM was correctly transilluminated. Tracheal intubation was then attempted by advancing the TT with lighted stylet until the supra-sternal notch was transilluminated. If any resistance was encountered during the intubation attempt further repositioning or size changes were permitted. Once the TT was *in situ*, it was reconnected to the anaesthesia breathing system and correct placement confirmed by observation of chest wall movement and a normal end-tidal CO₂ trace. A smaller tracheal tube was then wedged into its proximal end to provide sufficient length for the LMA to be removed without disturbing the TT.¹⁵

The following data were recorded by a trained independent observer: age, weight, height, sex, Mallampati score (without phonation), thyromental distance

(maximal head extension), intercal distance, LMA size used, number of attempts at LMA insertion, ventilatory capability of LMA, number and type of repositioning manipulations or size changes required for successful transillumination, number and type of repositioning manipulations or size changes required for successful intubation. The time taken between initial disconnection of the LMA from the anaesthesia breathing system to final successful tracheal intubation was also documented. Finally, any airway complications and episodes of oxygen desaturation < 95% were noted up to the point where the LMA was removed and the TT secured.

Results

Demographic data are presented in Table. The mean (range) number of cases conducted by each investigator was 19 (14–20). The size #4 was initially selected in 74 patients and the size #5 in 40 patients. In 89/114 patients (78%) the cricothyroid membrane was transilluminated without repositioning, in 12 (10%) a single positional adjustment was required (8/12, 1 cm inward; 2/12, 1 cm outward; 2/12, centralisation) and in 10/114 (9%) a change of size was required. In all patients requiring a size change, the size #4 was replaced by a size #5 and no new positional adjustments were made. Manipulation of the head/neck was not successful in providing correct transillumination if repositioning the LMA failed. Following correct transillumination of the CTM, tracheal intubation was successful in 111 (100%) at the first attempt without the need for further repositioning or size change. In three (3%) transillumination of the CTM was impossible despite repositioning, head or neck manipulation and a size change. Tracheal intubation via the LMA was not attempted in these patients. In all three patients the trachea was easily intubated following direct laryngoscopy and all were noted to be Cormack and Lehane grade I. Oesophageal intubation did not occur in any patient. The mean (SD, range) time taken to successful intubation from initial disconnection of the anaesthetic breathing system was 57 (6, 45–65) sec without posi-

TABLE Demographic data. Mean (SD, range)

Age; yr	60 (13, 28–84)
Weight; kg	67 (8, 42–84)
Height; cm	162 (6, 148–174)
Male: female (n)	46:68
Thyromental distance; cm	6.3 (5.6–7.4)
Intercal distance; cm	4.2 (3.4–6.0)
Mallampati score 1/2/3 (n)	46/63/5

tional adjustments, 67 (5, 56-74) sec with positional adjustments and 100 (8, 90-115) sec if an alternative size was used. There were no airway complications or hypoxic episodes during LMA insertion and intubation.

Discussion

Mechanical factors important for successful blind intubation via the LMA are accurate alignment of the cuff with the glottic inlet and a favourable angle of approach between the axes of the anteriorly advancing TT and the posteriorly sloping trachea. If the LMA is positioned too low (size too small), or too high (size too big or inadequate insertion), or malrotated (Guedel insertion technique¹⁶) the tube will progress into the oesophagus, anterior or lateral pharyngeal structures. The greater the angle between the axes of the TT and trachea, the greater the chance that the TT will impact against the anterior structures. To overcome this, a two stage manoeuvre is usually recommended: first, head extension to maximize the chance of the TT tip entering the laryngeal vestibule; secondly, if resistance is felt as the TT tip contacts the anterior wall of the larynx, head and neck flexion to align the axes of the TT and the trachea.¹⁷ Good lubrication, gentleness and use of a tube with a soft rounded bevel should further reduce this risk.

Nine groups have investigated the success rates of blind intubation via the LMA either directly with the TT,⁵⁻⁷ or after passage of other intratracheal devices such as the gum elastic bougie,^{10,11,18} tube changer^{12,20} or lighted stylet.¹³ Heath found that blind intubation was successful in 90% of anaesthetised paralysed patients, but that cricoid pressure reduced the success rate to 56%.⁶ Lim *et al.* investigated the influence of the type of tracheal tube and head/neck positioning and found that after a maximum of three attempts, success rates were 30-93% with the Portex tube performing the best.⁷ The first attempt was performed in the Magill position and was successful in 52% of patients; the second attempt using extension at the atlanto-occipital joint was successful in a further 35%; the third attempt used varying degrees of neck flexion over the trunk and extension at the atlanto-occipital joint. Langenstein compared blind intubation via the LMA in patients with abnormal and normal airways and showed that the success rates were similarly low in both (22 *vs* 19%).⁵ Successful blind passage of a gum elastic bougie (GEB) has been reported with success rates of 0-88%.^{10,11,18} Allison and McCrory suggested that success rates were higher if the curved GEB tip was pointed anteriorly and then rotating it by 180 when it entered the trachea.¹⁰ Dean *et al.* suggested

that advancing the tip of the GEB through the mid-line shaft prior to LMA placement increased the success rate.¹⁸ Although successful use has been reported for tube changers,^{21,22} two small trials have demonstrated low success rates of 0¹² and 30%,²⁰ the latter with previously good fiberoptic view of the cords. Some tube changers are thicker and stiffer than the normal bougie making them more likely to follow a posterior path and enter the oesophagus.²⁰ Wafai *et al.* have shown that success rates increase from 0 to 85% within 3 attempts if the tube changer tip is curved anteriorly.¹²

Asai *et al.* abandoned a 40 patient trial comparing blind intubation with and without the Trachlight Wand™ after 12 cases.¹³ In this study, the Trachlight Wand™ with the inner metal guide was used to guide the TT into position rather than to optimise the position of the LMA. In patients in whom the lighted stylet was used, it was easy to intubate via the LMA in only one of six patients. In another patient, tracheal intubation succeeded at the second attempt after flexing the patient's neck. In the remaining four patients it was impossible to intubate the trachea. Without the use of the lighted stylet, tracheal intubation through the LMA succeeded in one of six patients at the first attempt and in another patient at the second attempt. It was suggested that the low success rate was due to a lack of control of the curve of the lighted stylet because of the restrictions imposed by the LMA tube, or that the lighted stylet was too short to reach the end of the TT (35 cm). The authors concluded that the success rate of blind intubation must be very low, particularly when the position of the patient's head and neck is not manipulated. We consider that the inner metal guide might have contributed to the high failure rate by reducing the flexibility of the TT.

Our data suggest that transillumination of the CTM with a lighted stylet is a useful indicator that the LMA and the glottic inlet are accurately aligned for intubation. If this technique is followed, manipulation of the patient's head and neck may not be needed for successful intubation and this may have implications for patients with cervical spine pathology. Interestingly, we found that head and neck movement did not change the position of the transilluminated light. This may reflect the positional stability of the LMA cuff during head/neck movement. Our data also suggest a first time success rate of 78% for totally blind intubation since adjustment of the LMA position or a size change was only required in 22%.

We suggest that the LMA/Trachlight technique is practised on manikins and elective anaesthetised patients before being utilised for airway rescue, the

elective difficult airway or in the awake patient. This technique offers advantages over other blind techniques through the LMA and may be a suitable alternative to fiberoptic guided intubation through the LMA when equipment is unavailable. The main disadvantage of the technique is that ventilation is not possible during intubation attempts. The performance of the technique in patients with difficult airways is yet to be evaluated.

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