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The Intubating Laryngeal Mask Airway Facilitates Tracheal Intubation in the Lateral Position

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Abstract

Although the difficulty of tracheal intubation in the lateral position has not been systematically evaluated, airway loss during surgery in a laterally positioned patient may have hazardous consequences. We explored whether the intubating laryngeal mask airway (ILMA) facilitates tracheal intubation in patients with normal airway anatomy, i.e., Mallampati grade ≤ 3 and thyromental distance ≥ 5 cm, positioned in the lateral position. And we evaluated whether this technique can be used as a rescue when the airway is lost mid-case in laterally positioned patients with respect to success rate and intubation time. Anesthesia was induced with propofol, fentanyl, and vecuronium in 50 patients undergoing spine surgery for lumbar disk herniation (Lateral) and 50 undergoing other surgical procedures (Supine). Patients having disk surgery (Lateral) were positioned on their right or left sides before induction of general anesthesia, and intubation was performed in that position. Patients in control group (Supine) were anesthetized in supine position, and intubation was performed in that position. Intubation was performed blindly via an ILMA in both groups. The time required for intubation and number and types of adjusting maneuvers employed were recorded. Data were compared by Mann-Whitney U, Fisher's exact, chi-square, or unpaired t-tests, as appropriate. Data presented as mean (SD). Demographic and airway measures were similar in the two groups, except for mouth opening which was slightly wider in patients in the lateral position: 5.1 (0.9) *vs*. 4.6 (0.7) cm. The time required for intubation was similar in each group (≈25 s), as was intubation success (96%). We conclude that blind intubation *via* an ILMA offers a frequent success rate and a clinically acceptable intubation time (< one min) even in the lateral position.

Summary—Blind intubation *via* the intubating laryngeal mask airway (ILMA) offers a high success rate and a clinically acceptable intubation time even in patients in the lateral position.

Keywords

Equipment: intubating laryngeal mask airway; Position: lateral: Intubation (Tracheal): technique

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Introduction

Sudden airway loss during surgery when the patient is in the lateral position may become hazardous because tracheal intubation in that position can be difficult (1–3). There are several reports of successful ventilation in patients in the lateral position with the standard laryngeal mask airway (1,2,4), but there are very few reports on the efficacy of the intubating laryngeal mask airway (ILMA, Laryngeal Mask Company, Henley-on-Thames, United Kingdom) for airway management and tracheal intubation in this patient population.

Dimitriou and Voyagis (5) reported successful use of ILMA with a light-guided technique for tracheal intubation of patients in the lateral position. However, the conventional intubating technique through the ILMA is a “blind-on-blind” technique, *i.e.*, both the ILMA and the tracheal tube are inserted without a direct view of the glottis. In the current study, we evaluated the success rate and time required for blind intubation *via* an ILMA in the lateral and supine positions to confirm whether blind intubation via the ILMA can be used as a rescue technique when the airway is lost mid-case in the lateral position.

Methods

With approval of Human Research Committee at Tokyo Women's Medical University and informed consent, we studied 100 ASA physical status I or II patients, aged from 18 to 88 years. Fifty of the patients were undergoing spine surgery for lumbar disk herniation and preferred lying in the lateral decubitus position because pain from nerve root compression was less in that position (Lateral group). The other 50 were patients undergoing various surgical procedures requiring tracheal intubation as part of anesthesia (Supine group). Exclusion criteria included increased risk of pulmonary aspiration, cervical spine pathology, and anticipated airway difficulties, i.e. Mallampati grade IV or thyromental distance of less than 5 cm.

Thirty minutes before induction of anesthesia, patients were given atropine 0.5 mg and midazolam 2 mg intramuscularly. Before induction, patients having spine surgery were positioned in either the right or left lateral decubitus position, per their preference; other patients were positioned supine. In either position, the head was elevated 7 cm by a pillow. Anesthesia was induced with fentanyl 2 $\mu g \cdot kg^{-1}$ followed by a bolus injection of propofol 2 $mg \cdot kg^{-1}$ and maintained with 2% sevoflurane in oxygen until ILMA insertion was attempted. Vecuronium 0.1 $mg \cdot kg^{-1}$ was given for neuromuscular blockade after confirmation of adequate facemask ventilation.

In the both groups, the ILMA was inserted using the one-handed rotational technique with the investigator’s right hand while the head remained in a neutral position (6). A size 3 ILMA was used for short adults (<160 cm), a size 4 ILMA was used for normal adults (160–170 cm), and a size 5 for tall adults (>170 cm). The cuff was inflated with air (size 3: 20 ml, size 4: 30 ml, size 5: 40 ml) and the breathing circuit was connected to the ILMA. Ventilation via the ILMA was graded as adequate (rectangular capnographic wave form was obtained with no air leak at airway pressure of 20 cm H_2O), possible (capnographic wave form was obtained with air leak at airway pressure below 20 cm H_2O) and impossible (no capnographic trace detected). If ventilation via the ILMA was impossible, one attempt at reinsertion of the same size ILMA was allowed.

Immediately after confirmation of ventilation, a silicone tracheal tube (Euromedical Industries, Kedah, Malaysia) was inserted in the ILMA and intubation was attempted by gently advancing the tube beyond the epiglottic elevator bar. A tracheal tube with an 8.0-mm inner diameter was used for men whereas a 7.0-mm tube was used for women. If resistance was felt, the attempt was deemed a failure and one of the following adjusting maneuvers was applied before each additional intubation attempt: 1) changing the ILMA size, 2) withdrawing the ILMA by no more than 6 cm with the cuff inflated followed by reinsertion (up-down maneuver), 3) adjusting the position of the ILMA until optimal seal was obtained (optimization maneuver), or 4) pulling the handle of the ILMA back towards the intubator (extension maneuver). If no resistance was felt after the tube was advanced 7 cm beyond the epiglottic elevator bar, the cuff was inflated and the circuit was connected to confirm correct ventilation through the tube with capnography. If esophageal intubation was detected, an adjusting maneuver was performed before another intubation was attempted. All tracheal tubes and the ILMA were lubricated with 8% lidocaine jelly before use.

The ILMA was removed after successful tracheal intubation using a stabilizing rod. Tracheal intubation was considered a failure if it could not be accomplished within 3 minutes or all adjusting maneuvers had failed. The patients with unsuccessful intubation had their tracheas intubated with a Macintosh laryngoscope in the supine position: these data were excluded from the analysis of intubation time and total intubation time.

Morphometric data, Mallampati score, mouth opening (the distance between the incisors), thyromental distance, and sternomental distance (with head extended in upright position) were measured preoperatively.

Overall intubation success rate, number of intubation attempts, types of adjusting maneuvers, ILMA insertion time (defined as the time from removal of the face-mask to the time of reappearance of capnographic trace through the ILMA with positive pressure ventilation or to the time the second ILMA insertion attempt was completed in case of ILMA ventilation failure), intubation time (defined as the time from removal of the breathing circuit from ILMA to the time of reappearance of capnographic trace through the tracheal tube with no cuff leak with positive pressure ventilation), total intubation time (ILMA insertion time plus intubation time), frequency of esophageal intubation, mucosal trauma (blood detected on the ILMA), lip or dental injury, and hypoxia ($SpO_2 < 95\%$) were recorded by an unblinded observer. A right-handed anesthesiologist (RK) did all ILMA insertion and intubation procedures: he had positioned more than 100 ILMAs in patients in the supine position and more than 20 in patients in the lateral position when the study started.

Assuming the overall intubation success rate in the supine group would be 95% (7), we decided that a 20% difference in overall intubation success rate between the groups would be clinically important. Therefore, an n of 49 patients in each group would be necessary to detect such a difference with an $\alpha = 0.05$ and $\beta = 0.2$.

Unpaired scored data were examined and compared by Mann-Whitney U-tests. Incidence of intubation complications, number of ILMA insertion attempts, and overall intubation success rate were tested by Fisher’s exact or chi-square tests as appropriate. Other descriptive data were compared using unpaired t-tests.

Statistical analysis was performed using StatView version 5.0 (SAS Institute Inc. Cary, NC, USA) and Sample Power 2.0 (SPSS, Chicago, IL, USA) on a Compaq Armada V300 computer running on the Japanese version of Microsoft Windows 98 platform. Values are expressed as means (SDs) unless otherwise stated. $P < 0.05$ was considered statistically significant.

Results

Twenty-five patients had their tracheas intubated in each lateral decubitus position. No significant differences were found between the right lateral and the left lateral position patients with respect to morphometric or airway assessment data, ILMA insertion time, ILMA ventilation success rate within two insertion attempts (two failures of ventilation in the left lateral position and one failure in the right lateral position), intubation time, or overall

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intubation success rate (one failure of intubation in each lateral position). The right and left lateral positions were virtually identical with respect to difficulty and success rate of blind insertion of ILMA and intubation via the ILMA. We therefore combined results from patients in the left and right lateral positions into a single group that we compared with the patients who were positioned in the supine position.

There were no significant differences between the lateral and supine groups in demographic and airway assessment data except that as a group, mouth opening was wider in the lateral patients (5.1 [0.9] cm) than in the supine patients (4.6 [0.7] cm, $P < 0.01$; Table 1).

The overall intubation success rate was 96% in both the lateral position and supine position groups, i.e. in two patients in both groups, intubation via the ILMA could not be accomplished within allowed three minutes. Other variables related to ILMA insertion and intubation, such as total intubation time, number of ILMA insertion and intubation attempts, and the number and type of adjusting maneuvers, were also similar in the two groups (Table 2). In the right lateral patient with failure, number of intubation attempts was five with up-down maneuver (two times) and optimization maneuver (two times) applied. In the left lateral position with failure, number of intubation attempts was five with up-down maneuver (one time), optimization maneuver (two times), and ILMA size change (one time) applied. One of supine patients with failure had four intubation attempts with optimization maneuver (two times), and ILMA size change (one time) applied. The other patient had three intubation attempts with optimization maneuver (one time), and ILMA size change (one time) applied. All patients with failure were turned supine, then secured the airway with direct laryngoscopy using size 3 Macintosh laryngoscope. All four patients' laryngeal views were Cormack and Lehane grade 1 and no reason of failure was observed.

The incidence of intubation complications including mucosal trauma, dental and lip injury, and esophageal intubation were similar in the two groups (Table 3). There was no hypoxemia (defined as SpO_2 of less than 95%) in either group as measured by pulse oximetry.

Discussion

We evaluated intubation through an ILMA with a blind-on-blind technique in laterally positioned patients. Ventilation was established via the ILMA in 47 of our 50 lateral position patients (94%). The success rate of ventilation via the ILMA in the lateral position was similar to that of the standard laryngeal mask airway (LMA) (4). Our 96% success rate of blind intubation in the lateral position did not differ from that of our supine control patients and was similar to reported rates for supine patients (7).

In supine patients, intubation via the ILMA with a light wand-guided technique provides a success rate similar to the blind method (6,8,); however, the time to intubation was shorter, fewer ILMA adjustment maneuvers were required, and the incidence of esophageal intubation less. In a randomized, crossover study, Dimitriou and Voyagis (9) used a flexible illuminated catheter to aid intubation via the ILMA. The success rate for blind intubation of 90% was significantly lower than the 100% success rate for light-guided intubation. They also reported 100% intubation success rate using a light-guided technique for patients in the lateral position, although they only investigated the right lateral position and did not report the types of adjusting maneuvers and frequency of esophageal intubation (10). Joo et al. (11), in a report comparing intubation via the ILMA with awake fiberoptic intubation in patients with predicted difficult airways, used fiberoptic guidance as a rescue in the ILMA arm of the study to successfully intubate all patients for whom the first blind intubation attempt failed. Use of fiberoptic guidance as a rescue was also described in a group of 80 pediatric patients of more than 25 kg body weight (12). Twenty-seven of 80 children required fiberoptic guidance after an initial failed blind intubation attempt. This approach had a success rate of 96 % and the authors concluded that fiberoptic guidance improves success rate. Our success rate may thus have been improved if we had used a light-guided technique or a fiberoptic technique for intubation via the ILMA. And those methods would be rescues for failed blind intubation via the ILMA in the lateral position. However, our success rate was remarkably good, considering that our technique was blind, rapid, and technically easy. Our incidence of esophageal intubation in the lateral position did not differ significantly from that in the supine control patients and was similar to that reported by Dimitriou and Voyagis (13) — although our studies differed in size selection, race of patients studied, and sequence of adjusting maneuvers.

We expected that the ease of insertion of the ILMA and ventilation might differ in patients positioned in the left and right lateral positions because the right-handed investigator used his right hand to insert the ILMA irrespective of the patient's position. We found, however, that the ease of ILMA insertion and the success rate of intubation were similar in the two positions. We were thus able to combine the data from the two lateral positions for comparison to the supine patient data.

A limitation of our protocol is that patients having spine surgery were allowed to select the right or left lateral position based on comfort rather than being randomized to one side or the other. However, a comparable number selected each side, and it seems unlikely that side selection based on back pain symptoms would confound measurements of the duration and ease of intubation. Baskett and colleagues (14) reported that there was a learning curve with the ILMA over the first 20 uses. The investigator who inserted the airways in our study had placed ILMAs in more than 20 patients in the lateral position prior to the study. It nonetheless remains possible that success rates would be even greater for a highly experienced clinician.

In conclusion, blind intubation via the ILMA is a simple and rapid method of intubating patients with normal airway anatomy, (i.e., Mallampati grade of 3 or less and thyromental distance equal to or longer than 5 cm) in the lateral position that has a high success rate.

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Table 1

Morphometric and Airway Assessment Data.

	Lateral position (n=50)	Supine position (n=50)
Age; years	54 (18)	54 (17)
Sex; M/F	28/22	21/29
Height; cm	161 (10)	160 (9)
Weight; kg	59 (10)	58 (10)
Mallampati score; 1/2/3/4	28/19/3/0	33/15/2/0
Mouth opening; cm	5.1 (0.9)[†]	4.6 (0.7)
Thyromental distance; cm	7.7 (1.0)	7.4 (1.0)
Sternomental distance; cm	16.2 (2.0)	15.4 (2.1)

[†]P<0.05 vs Supine position. Data presented as means (SDs) or numbers of patients.

Table 2

Intubating Laryngeal Mask Airway (ILMA) Insertion and Intubation Data.

	Lateral position (n=50)	Supine position (n=50)
ILMA insertion time; seconds	24(10)	22(6)
Intubation time; seconds	22 (23)	28 (30)
Total intubation time; seconds	44 (24)	50 (30)
ILMA insertion attempts		
1	47 (94)	47 (94)
2	3(6)	3(6)
Grade of ILMA ventilation		
Adequate	43 (86)	46 (92)
Possible	4(8)	4(8)
Impossible	3(6)	0 (0)
Intubation attempts		
1	41(82)	36 (72)
2	3(6)	8 (16)
3	3(6)	3(6)
4	1(2)	3(6)
5	2(4)	0 (0)
Overall intubation success	48 (96)	48 (96)
Adjusting maneuvers*		
None	41 (82)	36 (72)
ILMA size change	3(6)	6(12)
Up-down	7(12)	5(8)
Optimization	10 (16)	10 (16)
Extension	0 (0)	2(4)

*Some patients required more than more than one adjusting maneuver. Data presented as mean (SD) or number of patients (%).

Table 3

The Incidence of Intubation Complications.

	Lateral position (n=50)	Supine position (n=50)
Mucosal trauma	11 (22)	18 (36)
Dental injury	0 (0)	0 (0)
Lip injury	2(4)	0 (0)
Hypoxia (SpO2) < 95%	0 (0)	0 (0)
Oesophageal intubation	4(8)	7(14)

Data presented as number of patients (%).