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ORIGINAL ARTICLE

The success rate of nasotracheal intubation using lightwand does not depend on the laryngoscopic view

Yozo Manabe · Mika Seto · Shigeru Iwamoto · Shinji Tominaga · Shogo Taniguchi

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Abstract

Purpose The purpose of this study was to evaluate the usefulness of Trachlight (TL) for nasotracheal intubation and to determine the relationship between the grade of laryngeal view and the subsequent ease of nasotracheal intubation using TL.

Methods Patients requiring nasotracheal intubation were enrolled in this study. Laryngoscopy was performed in all patients under topical anesthesia, with 8% lidocaine spray applied to the supraglottic region and the vocal cords. Glottic visualization during laryngoscopy was assessed using the Cormack and Lehane classification. Patients were allocated to four groups according to this classification. If the TL intubation was unsuccessful after three attempts, intubation was carried out using direct laryngoscopy. Intubation difficulty was assessed by the original 6-point scale and the total intubation time was also recorded.

Results Trachlight intubation was successful in 89.1% of the 110 patients enrolled in the study. There was no observed correlation between the original 6-point scale and glottic visualization. The total intubation time and the ratio of "unsuccessful" cases were not significantly different among the four groups.

Conclusion No relationship was found between the ease of nasotracheal intubation using TL and glottic visualization.

Keywords Nasotracheal intubation · Trachlight · Glottic visualization

Y. Manabe (✉) · S. Iwamoto · S. Tominaga · S. Taniguchi
Department of Systemic Management for Dentistry,
Kagoshima University Medical and Dental Hospital,
8-35-1, Sakuragaoka, Kagoshima 890-8544, Japan
e-mail: yozo3105manabe@yahoo.co.jp

M. Seto
Department of Dentistry and Oral Surgery,
Fukuoka University, Fukuoka, Japan

Introduction

Nasotracheal intubation is often indicated in oral and maxillofacial surgery. An alternative orotracheal intubation technique using a lightwand device, Trachlight (TL; Laerdal Medical, Armonk, NY), has been reported to facilitate tracheal intubation in patients with difficult airways [1]. Studies on the validity of TL use for nasotracheal intubation have also been published [2, 3]. In addition, the incidence of complications related to light-guided intubation is reported to be low because elevation of the epiglottis by the laryngoscope blade is not required [4, 5]. A method for grading intubation difficulty based on the laryngoscopic view has been suggested by Cormack and Lehane [6], with grade 3 or 4 considered to indicate difficulty in tracheal intubation by direct laryngoscopy. Ainsworth and Howells [7] reported no apparent correlation between grade 3 or 4 and orotracheal intubation success rate (100%) using TL. To date, no report has detailed nasotracheal intubation difficulty using TL in relation to the laryngeal view classified by Cormack and Lehane. We hypothesized that the nasotracheal intubation technique using TL would not be associated with the laryngoscopic view.

This study was designed to determine the relationship between laryngeal view grade and subsequent nasotracheal intubation ease by TL.

Patients and methods

This study was approved by the Ethics Committee of Fukuoka Dental College, and written informed consent was obtained from each patient.

Patients [American Society of Anesthetists (ASA) 1 or 2] anesthetized by either one of two anesthesiologists between April 2003 and March 2008 for elective oral and maxillofacial surgery under general anesthesia that required nasotracheal intubation were enrolled in this study. Patients with a history of upper airway surgery were excluded. Participants underwent a preoperative airway assessment by the attending anesthesiologist that included a Mallampati score [8] and a fully opened mouth (interincisor gap measured in millimeters). Demographics such as age, gender, weight, and height were also recorded.

Each patient was routinely monitored during the entire procedure. A rapid-acting anesthetic (propofol 1–1.5 mg/kg, or thiamylal 3–5 mg/kg) was administered intravenously, mask ventilation was ensured, and vecuronium bromide (0.1 mg/kg) was administered. The nasal mucosa of both nostrils was disinfected and probed with absorbent cotton immersed in 10% povidone–iodine with 1:100,000 epinephrine, and the wider patent nostril was chosen for intubation. Lidocaine jelly was then used as a lubricant for the nasopharyngeal airway tubes, which had increasing caliber sizes to dilate the meatus of the selected nasal cavity. Laryngoscopy was performed in all cases using a size 3 Macintosh laryngoscope blade for topical anesthesia on the supraglottic region and the vocal cords by using 8% lidocaine spray. This is standard protocol in our department.

Glottis visualization during laryngoscopy was assessed using the Cormack and Lehane classification [6] by an attending anesthesiologist with at least 3 years of anesthesia experience. This classification involves four grades of glottic visualization. According to this classification, patients were subdivided into four groups: Group 1 (grade 1, most of the glottis is visible); Group 2 (grade 2, only the posterior extremity of the glottis is visible); Group 3 (grade 3, only the epiglottis is visible); Group 4 (grade 4, not even the epiglottis is visible).

Nasal RAE endotracheal tubes (NTT; Mallinckrodt, Glens Falls, NY) were used in this study. Each NTT was cut to the appropriate length so that the tube tip could be adjusted to the light source. The NTT was inserted with the TL after removal of the stylet (TL–NTT) and soaked in warm sterilized normal saline to reduce epistaxis and nasal damage [9]. The TL–NTT was inserted into the nostril and advanced until light was seen in the oropharynx. After further advancing, a blurred light was seen in the submandibular area. The TL–NTT tip was maneuvered anteromedially until a bright spot of light was seen at the cricothyroid membrane; the TL was then withdrawn and the NTT advanced into the trachea. The cuff of the tracheal tube was inflated with air at the peak airway pressure of 25 cmH_2O immediately after intubation to prevent leaks. The location of the NTT tip was confirmed by palpation of the pilot balloon at the level of the suprasternal notch and by capnography. If the intubation was not performed within 60 s or a decrease in arterial oxygen saturation by pulse oximetry <98% was observed, the TL was withdrawn, the opposite nostril and mouth were covered by hand, and ventilation through the NTT was resumed. Three attempts were permitted with ventilation interposed. If the TL intubation was unsuccessful after three attempts, intubation was performed using direct laryngoscopy. One anesthesiologist with 20 years' experience who was blinded to the preoperative assessment and the Cormack and Lehane classification results performed all of the intubations using TL. Intubation difficulty was assessed by the original 6-point scale (Table 1). On the first attempt, the patient's head was placed in a 'sniffing' position; on the second attempt, it was placed in the 'extension' position. The third attempt was made using the tracheal tube cuff inflation technique reported by Elstraete et al. [10]. The number of attempts, the total intubation time, and the TL intubation failures were recorded by another anesthesiologist. The total intubation time was defined as the sum of all intubation attempt durations, but the total time of interposed ventilation was excluded. The duration of each attempt was defined as the time from inserting the TL–NTT into the nostril to the time when the TL was removed from the NTT.

Table 1 Original 6-point scale of nasotracheal intubation difficulty

Score	Description	Classification criterion
1	Very easy	Successfully intubated within 15 s at the first attempt
2	Easy	Successfully intubated between 15 and 30 s at the first attempt
3	Moderate	Successfully intubated more than 30 s at the first attempt
4	Difficult	Successfully intubated at the second attempt
5	Very difficult	Successfully intubated at the third attempt
6	Unsuccessful	Intubation could not be achieved with three attempts of using the lightwand device

Ratios of gender and nostril side between groups were analyzed using the chi-square test. The distribution of Mallampati class and intubation difficulty between groups was analyzed using the Kruskal–Wallis test and Spearman's rank correlation coefficient test. Analysis of variance with Sheffe's post hoc test was performed to compare other data. All statistical analyses were performed using StatView ver. 5.0 (SAS Institute, Cary, NC). Data are presented as number of patients and mean (standard deviation), and $p < 0.05$ was considered to be statistically significant.

Results

A total of 110 patients were enrolled in the study. There were no significant differences among the four groups in terms of height or weight, but the distribution of gender was significantly different ($p = 0.0172$) (Table 2). The Cormack and Lehane classification of the groups correlated well with the Mallampati score ($p = 0.0009$) (Table 3). There were no significant differences in ratios of the nostril side, cuff volume, or tube size. The inter-incisor gap of the Group 4 patients was significantly shorter than that of Group 1 ($p = 0.0043$) and 3 ($p = 0.0096$) patients (Table 4). TL intubation was successful in 98 of the 110 patients (89.1%) and failed in 12 patients (10.9%). Eighty-two patients (74.6%) were intubated on the first attempt, 12 (10.9%) on the second, and four (3.6%) on the third attempt. Twelve patients (10.9%) could not be intubated using this method. Among the four groups, there was no significant difference in the success rate of the first attempt nor in the total intubation time ($p = 0.1758$) (Table 4). There were eight unsuccessful cases in Group 1, one unsuccessful case in both Groups 2 and 3, and two unsuccessful cases in Group 4. No significant differences were found in success rate among the groups (Table 5), and there was no significant correlation between the original 6-point scale and the Mallampati score ($p = 0.2974$) (Table 6).

Discussion

In this study, TL intubation was successful, with an average time of 31.8 s. Our results also show that there was no correlation between the Cormack and Lehane classification and the time required for intubation using the TL. In other words, nasotracheal intubation using TL was not influenced by anatomic variability in this population.

Nasotracheal intubation using a lightguide has been reported since 1959 [11]; however, no report has focused on nasotracheal intubation difficulty using TL in relation to the laryngeal view classified by Cormack and Lehane. It has been accepted that intubation using direct laryngoscopy is difficult in patients with Cormack and Lehane

Table 2 Patient demographics

Variables	Cormack and Lehane classification			
	Group 1	Group 2	Group 3	Group 4
No. of patients	75	12	16	7
Gender (male/female)	22/53*	6/6	7/9	6/1
Age (years)	32.0 ± 13.7	41.8 ± 15.2	42.3 ± 14.9	31.1 ± 21.1
Height (cm)	160.6 ± 7.5	160.0 ± 7.1	162.0 ± 7.1	167.2 ± 10.9
Weight (kg)	55.5 ± 9.6	54.4 ± 11.2	58.1 ± 9.7	58.2 ± 10.9

Data are presented as the mean ± standard deviation (SD)

Cormack and Lehane classification: Group 1 (grade 1, most of the glottis is visible); Group 2 (grade 2, only the posterior extremity of the glottis is visible); Group 3 (grade 3, only the epiglottis is visible); Group 4 (grade 4, not even the epiglottis is visible)

* $p < 0.05$ vs. Group 4

Table 3 Relation between Mallampati score and Cormack and Lehane grade

Mallampati score classification		Cormack and Lehane classification			
Score class	Number of patients	Group 1 ($n = 75$)	Group 2 ($n = 12$)	Group 3 ($n = 16$)	Group 4 ($n = 7$)
1	56	47	4	5	0
2	35	18	8	7	2
3	9	6	0	1	2
4	10	4	0	3	3

Table 4 Result of measurements

Measurement results	Cormack and Lehane classification			
	Group 1 ($n = 75$)	Group 2 ($n = 12$)	Group 3 ($n = 16$)	Group 4 ($n = 7$)
Interincisor gap (mm)	37.3 ± 8.1	35.4 ± 6.2	38.1 ± 11.5	24.6 ± 9.4*, **
Tube size (cm)	7.2 ± 0.3	7.4 ± 0.4	7.3 ± 0.4	7.5 ± 0.3
Nostril side (right/left)	51/24	11/1	10/6	5/2
Cuff volume (ml)	3.9 ± 1.2	4.3 ± 1.6	3.8 ± 0.7	4.6 ± 1.1
Total time to intubate (s)	30.7 ± 35.5	23.0 ± 26.9	35.5 ± 32.3	50.0 ± 45.3
Percentage of patients intubated at the first attempt	74.7	83.3	75.0	57.1
Percentage of patients intubated at the second attempt	10.7	8.3	18.8	0
Percentage of patients intubated at the third attempt	4.0	0	0	14.3
Percentage of patients classified as "unsuccessful"	10.7	8.3	6.3	28.5

Data are presented as mean ± SD, otherwise as a percentage

* $p < 0.05$ vs. Group 3, ** $p < 0.01$ versus Group 1

Table 5 Relation between original 6-point scale and Cormack and Lehane grade

Original 6-point scale			Cormack and Lehane classification			
Score	Description	Number of patients	Group 1 ($n = 75$)	Group 2 ($n = 12$)	Group 3 ($n = 6$)	Group 4 ($n = 7$)
1	Very easy	41	30	6	5	0
2	Easy	22	15	3	3	1
3	Moderate	19	11	1	4	3
4	Difficult	12	8	1	3	0
5	Very difficult	4	3	0	0	1
6	Unsuccessful	12	8	1	1	2

Table 6 Relation between original 6-point scale and Mallampati score

Original 6-point scale			Mallampati score			
Score	Description	Number of patients	Class 1 ($n = 56$)	Class 2 ($n = 35$)	Class 3 ($n = 9$)	Class 4 ($n = 10$)
1	Very easy	41	24	12	3	2
2	Easy	22	13	6	0	3
3	Moderate	19	9	7	1	2
4	Difficult	12	5	4	3	0
5	Very difficult	4	2	0	1	1
6	Unsuccessful	12	3	6	1	2

classification grades 3 and 4. Ainsworth and Howells [7] reported that the difficulty of oral intubation with TL has no relation to the grade of laryngoscopic view according to the Cormack and Lehane classification. We also found no relation between nasotracheal intubation difficulty using TL and the Cormack and Lehane classification in our patient cohort. We suggest that the reason for this lack of relation is due to the Cormack and Lehane classification being an assessment of the relative difficulty for direct laryngoscopic intubation, while the principal determinant of good visualization of the glottis during direct laryngoscopy is the alignment of the visual axis of the operator with the glottic axis or laryngeal axis [6]; it is therefore not necessary to align these axes for either orotracheal and nasotracheal intubation using TL. Actually, orotracheal intubation using TL has been reported to be the first choice for cervical spine disorders [12] because it does not require neck extension or a sniffing position. In contrast, nasotracheal intubation using TL requires neck mobility similar to blind nasal intubation. Although, it is impossible to detect the tube tip at the three-dimensional position in blind nasal intubation, only the position of the tube tip in the sagittal plane cannot be directed by using TL. Hung et al. [5] found that the Mallampati classification correlated with

Table 7 Relation between original 6-point scale and difficulty of intubation with direct laryngoscopy

Original 6-point scale			Difficulty of intubation with direct laryngoscopy	
Score	Description	No. of patients	Combined group 'easy' ($n = 87$)	Combined group 'difficult' ($n = 23$)
1	Very easy	41	36	5
2	Easy	22	18	4
3	Moderate	19	12	7
4	Difficult	12	9	3
5	Very difficult	4	3	1
6	Unsuccessful	12	9	3

intubation time by the laryngoscope was used, but it did not correlate with intubation time using the TL. Similarly, we also found no relation between TL nasotracheal intubation difficulty and Mallampati classification.

The success rate of TL nasotracheal intubation in our study was 89%. One of the reasons for this low success rate is that cases in which the patients could not be intubated in three attempts were classified as 'unsuccessful' on the basis of the report by Fox et al. [13], which shows that the average number of attempts required for blind nasotracheal intubation by an experienced anesthesiologist is 3.1 times. However, we have had cases in which TL nasotracheal intubation was successful after four or more attempts in the clinical setting. Cases in which intubations were successful after a greater number of attempts may have been included as 'unsuccessful' cases in our study.

There are two causes of unsuccessful nasotracheal intubation by TL: when the tube is inserted into the esophagus, and when the tube is lodged in the tissue surrounding the epiglottis and cannot be advanced into the trachea. In the former case, it is often possible to insert the tube by extending the neck to raise the tube tip. We raised the tube tip by using the tracheal tube cuff inflation technique [10] and had good results. The tracheal tube cuff was inflated with 10 ml of air in the oropharynx and then advanced gently until slight resistance was felt, which indicated that the inflated cuff had made contact with the vocal cords. The cuff was then deflated and the tube advanced into the trachea. This technique is reported to increase the success rate of blind nasotracheal intubation.

The advantage of intubation using a lightwand is that the precise position of an endotracheal tube tip can be determined by checking the light at the sternal notch [14].

Our study has several limitations. First, all intubations were performed by one operator; therefore, the results may be biased toward the expertise of that operator. However, patients were unintentionally sampled so that the Cormack and Lehane grades could be equally dispersed through the study period, and this operator had a great deal of experience in nasotracheal intubation using TL from the beginning of this study. Second, there is also the possibility of errors in judgment in the Cormack and Lehane classification. Nevertheless, all anesthesiologists had >3 years of anesthesia experience; therefore, we believe that the difference in skill is negligible. Third, nasotracheal intubation using TL sometimes requires head extension to raise the tip of the tube toward the glottis; therefore, it is difficult to use this method in patients with cervical spine disorders. Fourth, as this study poses a potential for type II error, a necessity for test with larger sample size cannot be ruled out.

However, there were very few patients with Cormack and Lehane grade 4, and it is difficult to assemble a sufficient number of such patients. We consequently combined Groups 1 and 2 to make a group of easy tracheal intubation under direct laryngoscopy (Group 'easy') and combined Groups 3 and 4 to make a group of difficult tracheal intubation under direct laryngoscopy (Group 'difficult') and attempted compare these two combined groups in terms of difficulty of nasotracheal intubation using TL. There was no significant difference in background between the groups and there was no significant correlation between the original 6-point scale and the difficulty of intubation with direct laryngoscopy ($p = 0.1178$) (Table 7).

In conclusion, there was no relation between the ease of nasotracheal intubation using TL and glottic visualization.

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