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Comparison of two different shapes of stylets for intubation with the McGrath MAC® video laryngoscope: a randomized controlled trial

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Abstract

Objective: This study was performed to compare two different shapes of stylets, 60° and J-shaped stylets, for intubation using the McGrath MAC® video laryngoscope (MVL).

Methods: Two hundred twenty-two patients undergoing surgery under general anesthesia were randomly allocated to Group J (n = 111) or Group 60° (n = 111) and intubated using the MVL with the stylet bent into the allocated shape. The time to intubation (TTI) and other intubating profiles were compared between the groups. Multivariate regression analysis was used to determine the relationship between factors related to difficult intubation and TTI.

Results: The TTI was not different between the two groups. There were also no differences in the intubating profiles between the two groups. In both groups, the TTI was longer with a modified Mallampati score (mMS) of ≥3 and percentage of glottic opening (POGO) score of <50. In Group J, the TTI was longer with a body mass index (BMI) of ≥30 kg/m^2.

Conclusion: The TTI during tracheal intubation with the MVL was not different between the two groups. The TTI was longer with an mMS of ≥3 and POGO score of <50. In Group J, the TTI was longer with a BMI of ≥30 kg/m^2.

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Keywords

Laryngoscopy, video laryngoscope, stylet, intubation, angulation, curvature

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Introduction

A video laryngoscope is an intubating device that incorporates video techniques into a laryngoscope to improve the airway visualization.[1] Among the various types of video laryngoscopes, the McGrath MAC® video laryngoscope (Aircraft Medical, Edinburgh, UK) (MVL) has become popular because it is lightweight and can be prepared quickly and hygienically by changing its disposable blade.[2,3] Its efficacy in both normal and difficult airways has well been described in previous studies.[4,5] However, an improved laryngeal view does not always guarantee successful intubation. Because the oral–pharyngeal–laryngeal axes are not straightly aligned, it is not always easy to manipulate the endotracheal tube as shown on the screen.[1,5,6] Therefore, the manufacturer recommends routine use of stylets to facilitate handling of the endotracheal tube when intubating with the MVL.[4,7]

Proper stylet use is important to prevent stylet-related airway complications.[8,9] Several studies have been performed to investigate how the angulations and shapes of stylets should be optimized for each type of video laryngoscope.[7,10,11] However, few such studies have involved the MVL. In one study, the investigators compared two different tip angulations and showed that bending the stylet 60° was preferable to 90° when intubating using the MVL.[7] However, because the blade the of the MVL is inserted through the midline without shifting the tongue to the left,[3,12] shaping the stylet similar to the blade rather than simply bending it at the tip might be more optimal to overcome the non-straight oral–pharyngeal axis.[10,11]

Therefore, we hypothesized that adding an extra curvature at the proximal part forming the J-shape, similar to the curvature of the MVL blade, might compensate for the non-aligned axes and facilitate passage of the endotracheal tube. The present study was performed to compare two different shapes of stylets, a 60° stylet and a J-shaped stylet, during intubation with the MVL.

Materials and methods

Study participants

This multicenter, prospective, randomized controlled trial was approved by two institutional ethics committees (Kangbuk Samsung Hospital Institutional Review Board, Seoul, Republic of Korea (Approval number: KBSMC 2018-01-033) and Hanyang University Hospital Institutional Review Board, Seoul, Republic of Korea (Approval number: HYUH 2018-01-016)) and registered at ClinicalTrials.gov (NCT03524547). The present study was conducted in two hospitals in Seoul, Korea (Kangbuk Samsung Hospital and Hanyang University Hospital). After screening for eligibility, written informed consent was obtained from all participants. We included patients aged 19 to 65 years with an American Society of Anesthesiologists class of I to III who required tracheal intubation for general anesthesia during elective surgery. The exclusion criteria were a previous diagnosis of difficult intubation, pregnancy, and severe obesity (defined by a body mass index (BMI) of $\geq$40 kg/m^2).

Randomization and group allocation

The day before surgery, one investigator randomly allocated the patients into Group 60° or Group J in a 1:1 proportion. In Group 60°, the stylet was bent 60° at 6.5 cm above the endotracheal tube tip. In Group J, the stylet was angled using the blade of the MVL as a template. The stylet shape was then confirmed by comparison with the standardized sample stylet template. The representative shapes of both stylets are shown in Figure 1. Prior to the beginning of the study, the randomization sequence was generated by a computer-generated plan with a random permuted block algorithm using an internet-based response system (http://www.randomization.com).

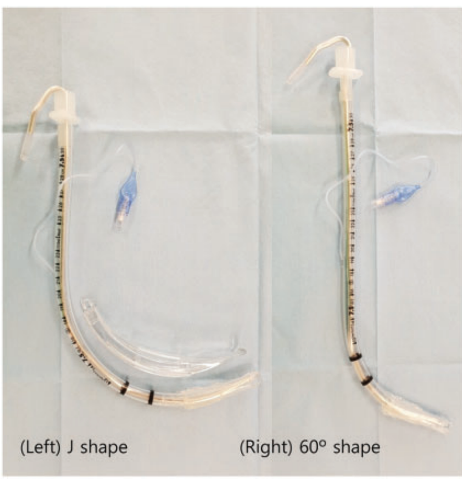

Figure 1. Stylet configurations used in the study. Left: J-shaped stylet. Right: 60° angled stylet.

Anesthetic technique

One hour before surgery, all patients were premedicated with intramuscular glycopyrrolate (0.005 mg/kg). After entering the operating room, a noninvasive blood pressure measurement device, electrocardiograph, and pulse oximetry device were applied and monitoring was started. The depth of anesthesia was monitored *via* state entropy with the Entropy EasyFit Sensor (GE Healthcare, Helsinki, Finland), and muscle relaxation was monitored at the adductor pollicis muscle by a train-of-four count with a neuromuscular monitoring device (M-NMT MechanoSensor; GE Healthcare). The patients lay in the supine position, and the head was oriented in the sniffing position by placing a donut gel pillow under it. Preoxygenation was performed with 100% oxygen for 3 minutes to achieve an oxygen saturation of 100%. Anesthetic induction was conducted with intravenous administration of propofol (1.5–2.0 mg/kg) and remifentanil (1 mcg/kg). After loss of consciousness, rocuronium (0.8 mg/kg) was intravenously administered and the patients were ventilated with 100% oxygen and sevoflurane at 5% to 8% vol. The train-of-four count was monitored every 15 s. The MVL was prepared with anti-fog solution dropped in front of the lens. When the train-of-four count reached zero, tracheal intubation was conducted with the MVL. The anesthesia assistant held the MVL and handed it to the laryngoscopist at the time of intubation, and the laryngoscopist then immediately performed tracheal intubation. Intubation was performed by one of two anesthesiologists who had more than 10 years of clinical experience and had performed more than 20 cases of successful intubation using the MVL. After lubricating the stylet (KoMAC stylet; KoMAC Co., Ltd., Seoul, Korea), the anesthesiologist inserted it into the endotracheal tube (Shiley™; Covidien, Mansfield, MA, USA) (7.0-mm inner diameter for women and 7.5-mm inner diameter for men). The stylet was bent to the shape designated by the group allocation. After successful intubation, the study was ended and anesthesia was performed according to the routine procedures.

Outcome assessments

The day before surgery, airway assessments were performed, including measurement of the thyromental distance, modified Mallampati score (mMS), inter-incisor distance, neck mobility, and upper incisor dentation status. The thyromental distance was measured from the mental protuberance to the thyroid cartilage with the patient's neck extended backward. The mMS was graded from 1 to 4 and used to predict difficult intubation based on the visibility of intraoral structures while the patient widely opened his or her mouth and protruded the tongue.[13] The inter-incisor distance was measured as the distance between the upper and lower incisors while the patient widely opened his or her mouth. The degree of neck extension was categorized as follows: normal extension, reduced extension, and fixed flexion. The upper incisor dentation status was categorized as follows: absent, normal, or prominent. The airway difficulty score (ADS) was also calculated. The ADS consists of five criteria (thyromental distance, modified Mallampati score, mouth opening, neck mobility, and upper incisors status), each of which is scored from 1 to 3. The sum of these scores predicts the difficulty of intubation and ranges from 5 (low risk of difficult intubation) to 15 (high risk of difficult intubation). An ADS of $\geq$8 is associated with difficult intubation.[14]

The primary outcome of this study was the time to intubation (TTI). The TTI was calculated from the time point at which the tip of the blade passed the incisors to the appearance of the first end-tidal carbon dioxide wave. The TTI was assessed by assistant investigators. After obtaining an optimal view from the MVL monitor, the modified Cormack–Lehane (C-L) grade, percentage of glottic opening (POGO) score, and vocal cord status were recorded. The modified C-L grade ranges from I to IV: grade I, visualization of entire vocal cords; grade IIa, partial view of the glottis; grade IIB, visualization of only the arytenoids or posterior vocal cords; grade III, visualization of only the epiglottis; and grade IV, no visualization of either the epiglottis or larynx. The POGO score defines the proportion of visible parts of the total vocal cord length (from the anterior commissure to the arytenoid notch) as 100%. For example, if the vocal cord is not visible at all, it is expressed as 0% (POGO score of 0), and if the entire vocal cord is visible, it is expressed as 100% (POGO score of 100).[15] The vocal cord status (whether it was abducted or adducted at the time of laryngoscopy) was also recorded. When the laryngeal view was poor, the airway was facilitated with external manipulation such as the application of external laryngeal pressure, additional lifting force, or chin lift. The type of external manipulation used was recorded. After successful intubation, the difficulty of intubation was self-reported by the investigators performing the endotracheal intubation and graded on a 3-point scale: 1, easy; 2, moderate; and 3, difficult. If the TTI was >60 s or the oxygen saturation dropped to <95%, the intubation was stopped and the patient was ventilated with 100% oxygen via a mask. Intubation was attempted up to three times; further attempts were performed with different tools based on the anesthesiologists' preferences and were excluded from analysis. In cases of multiple attempts, the number of attempts was recorded and the TTI was defined by summing the times of all intubation attempts. After successful intubation, oropharyngeal bleeding was assessed by checking for the presence of blood at the blade tip. The intubation difficulty score (IDS) was calculated based on the patients' records. The IDS is used to assess the degree of intubation difficulty and is calculated by the sum of the following seven parameters: number of attempts >1, number of operators >1, number of alternative techniques >1, C-L grade minus 1, operator perception of lifting force required, laryngeal pressure applied, and vocal cord mobility. For each parameter, the ideal situation (such as no difficulty) was scored as 0. The IDS is interpreted as follows: 0, easy; >0 to <5, slight difficulty; >5, moderate to major difficulty; and ∞, impossible.[16]

Statistical analysis

The primary outcome of the present study was the TTI. The sample size was calculated based on a previous study[7]: the TTI (mean ± standard deviation) was 29.3 ± 6.4 s for the 60° stylet and 32.5 ± 9.4 s for the 90° stylet, 101 patients in each group were needed for 80% power, and the type I error was set at 0.05. Predicting a dropout rate of 10%, 222 patients (111 in each group) were deemed sufficient to detect significant differences between groups.

Data are presented as mean ± standard deviation or median (interquartile range) for continuous variables or as number (percentage) as appropriate. The independent *t*-test or Mann–Whitney U test was used for continuous variables. The chi-square test or Fisher's exact test was used for categorical variables. Multivariate regression analysis was conducted to determine the relationship between the factors associated with difficult intubation and the TTI. As covariates, factors associated with difficult intubation were adjusted using the following parameters: obesity (BMI of ≥30 kg/m^2),[17] mMS of ≥3,[18] thyromental distance of ≤6.5 cm,[19] reduced neck extension, and POGO score of <50.[20] A *P*-value of <0.05 was considered statistically significant. Statistical analyses were performed with IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Two hundred twenty-eight patients were assessed for eligibility from May 2018 to July 2018. After excluding 6 patients (4 who did not meet the inclusion criteria and 2 who declined participation), 222 patients consented to participate in the present study. Among the 111 patients in each group, 1 patient in Group J and 1 patient in Group 60° were withdrawn from the study because of unavailable staff, and 1 patient in Group J was withdrawn because the operation was canceled. Therefore, 109 patients in Group J and 110 patients in Group 60° were included in the analyses (Figure 2).

Table 1 shows the demographic data and baseline airway profiles of the study population. There were no significant differences in the demographic data between the two groups. There were also no significant differences in the airway assessment profiles, including an mMS of ≥3, thyromental distance of ≤6.5 cm, reduced neck extension, upper incisor status, and ADS of ≥8, between the two groups.

The intubation profiles were compared between the two groups. There were no differences in the incidence of a modified C-L glottic grade of ≥2b or POGO score of <50 between the two groups. The TTI was also not significantly different between Group J (25.2 ± 6.8 s) and Group 60° (25.0 ± 5.6 s). The IDS and difficulty of intubation reported by the laryngoscopist were comparable in both groups. There were no differences in the use of external manipulation, multiple attempts to intubate, or bleeding between the two groups (Table 2). A

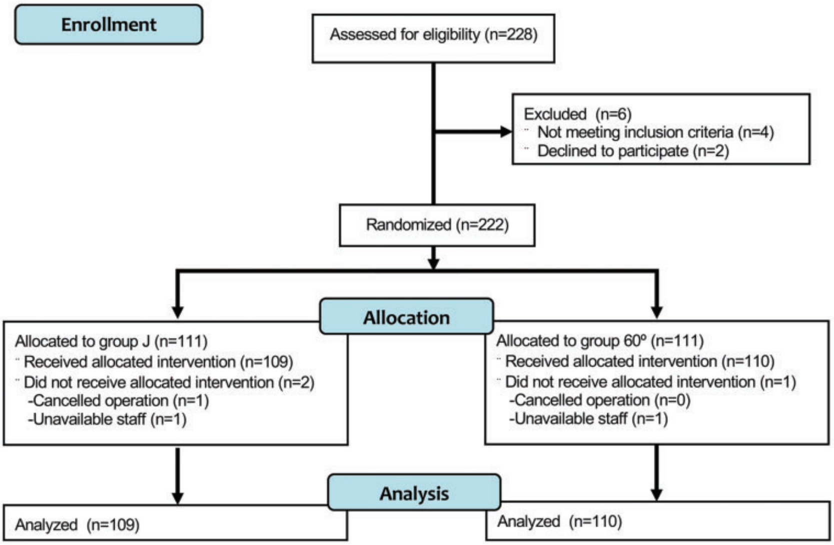

Figure 2. Flow diagram of the study.

Table 1. Demographic data and baseline airway profiles of the study population.

	Group J (n = 109)	Group 60° (n = 110)	*P* value
Age, years	45 ± 14	47 ± 11	0.200
Sex, female	60 (55.0)	58 (52.7)	0.731
Height, cm	164.4 ± 8.9	164.3 ± 8.4	0.890
Weight, kg	67.0 ± 11.4	64.4 ± 12.9	0.107
BMI, kg/m^2	24.8 ± 3.5	23.8 ± 3.5	0.058
BMI of ≥30 kg/m^2	8 (7.3)	5 (4.5)	0.408
ASA class	1 (1–2)	1 (1–2)	0.978
Airway assessment profiles			
Modified Mallampati score of ≥3	21 (19.3)	20 (18.2)	0.837
Thyromental distance of ≤6.5 cm	9 (8.3)	15 (13.6)	0.203
Inter-incisor distance of ≤3 cm	0 (0.0)	0 (0.0)	N/A
Reduced neck extension	15 (13.9)	16 (14.5)	0.868
Upper incisors, absent/normal/prominent	2/103/4 (1.8/94.5/3.7)	1/105/4 (0.9/95.5/3.6)	0.840
Airway difficulty score of ≥8	37 (33.9)	39 (35.5)	0.814

Data are presented as mean ± standard deviation, median (interquartile range), or n (%).
BMI, body mass index; ASA, American Society of Anesthesiologists; N/A, not available.

Kaplan–Meier plot was constructed to show the percentage of successful intubation over time. The plot showed no difference between the two groups (Figure 3).

Among all patients (n = 219), the TTI was significantly longer with an mMS of ≥3 ($P < 0.001$) and POGO score of <50 ($P = 0.001$). In Group J, the TTI was

Table 2. Intubation profiles of the study population.

	Group J (n = 109)	Group 60° (n = 110)	*P* value
Modified C-L glottic grade of ≥2b	17 (15.6)	15 (13.6)	0.681
POGO score of <50	19 (17.4)	19 (17.3)	0.975
TTI, s	25.2 ± 6.8	25.0 ± 5.6	0.771
Intubation difficulty score	1.0 (0.0–1.0)	1.0 (0.0–1.0)	0.911
Difficulty of intubation			
Easy	89 (81.7)	97 (88.2)	0.141
Moderate	14 (12.8)	12 (10.9)	
Difficult	6 (5.5)	1 (0.9)	
External manipulation			0.715
External laryngeal pressure	8 (7.3)	6 (5.5)	
Additional lifting force	3 (2.8)	1 (0.9)	
Others	1 (0.9)	1 (0.9)	
Not used	97 (89.0)	102 (92.7)	
Multiple attempts to intubate	1 (0.9)	0 (0.0)	0.498
Bleeding	1 (0.9)	0 (0.0)	0.498

Data are presented as mean ± standard deviation, median (interquartile range), or n (%).
TTI, time to intubation; C-L, Cormack–Lehane; POGO, percentage of glottic opening.

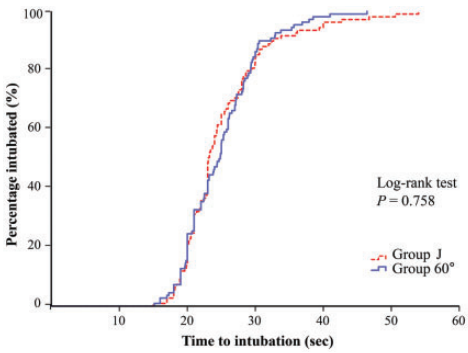

Figure 3. Kaplan–Meier analysis of time to intubation between Group J and Group 60°. The log-rank test showed no significant difference between the groups.

significantly longer with a BMI of ≥30 kg/m^2 ($P < 0.025$), mMS of ≥3 ($P < 0.025$), and POGO score of <50 ($P < 0.037$). In Group 60°, the TTI was significantly longer with an mMS of ≥3 ($P < 0.001$) and POGO score of <50 ($P < 0.001$). The association of the TTI with a BMI of ≥30 kg/m^2 was significantly different between Group J and Group 60° (interaction $P = 0.009$). In Group J, the TTI was significantly longer with a BMI of ≥30 kg/m^2. In Group 60°, however, the TTI was shorter with a BMI of ≥30 kg/m^2, although without statistical significance (Table 3).

Discussion

In this multicenter, prospective, randomized controlled trial, we compared the intubation conditions of the MVL using different shapes of stylets; namely, the J-shaped stylet and the 60° angled stylet. We hypothesized that adding extra curvature to the stylet to create a J shape might facilitate tracheal intubation with the MVL by overcoming the oral–pharyngeal–laryngeal curvature. However, contrary to our expectations, the intubation conditions (including the TTI, IDS, difficulty of intubation, use of external manipulation, and number of intubation attempts) were not different between the two groups. The TTI was significantly longer with an mMS of ≥3 and POGO score of <50 in both groups. However, it took a longer time to perform intubation with a J-shaped stylet in obese

Table 3. Multivariate regression model for TTI.

Variable	Total (n = 219)	Group J (n = 109)	Group 60° (n = 110)	Interaction *P* value
(constant)	23.5 (22.5–24.5)	23 (21.5–24.5)	23.9 (22.7–25.2)	
BMI of ≥30 kg/m^2	2.1 (−1.1–5.3)	5.3 (0.7–9.8)*	−2.4 (−7.0–2.1)	0.009†
Modified Mallampati score of ≥3	4.3 (2.3–6.3)*	3.6 (0.5–6.8)*	4.7 (2.3–7.2)*	
Thyromental distance of ≤6.5 cm	−1 (−3.4–1.5)	2.7 (−1.7–7.0)	−2.8 (−5.6–0.0)	
Reduced neck extension	0.2 (−2.1–2.6)	1.9 (−1.9–5.8)	−0.8 (−3.5–1.9)	
POGO score of <50	4.4 (2.3–6.5)*	3.6 (0.2–7.1)*	4.6 (2.1–7.1)*	

Data are presented as β (95% confidence interval).
TTI, time to intubation; BMI, body mass index; C-L, Cormack–Lehane; POGO, percentage of glottic opening.
*$P < 0.05$ by multivariate regression analysis.
†Interaction *P* value for BMI of ≥30 kg/m^2 and group by multivariate regression analysis.

patients (BMI of ≥30 kg/m^2), while the 60° angled stylet facilitated intubation in these patients. Neither a shorter thyromental distance nor reduced neck extension affected the TTI with either of the two stylet shapes.

When performing intubation using a video laryngoscope such as the GlideScope® (Verathon, Bothell, WA, USA) or MVL, it is often challenging to insert the endotracheal tube through the vocal cords irrespective of an excellent glottic view.[1,7,11,12] This occurs because the oral–pharyngeal–laryngeal axes are not straightly aligned during intubation with these video laryngoscopes. Moreover, the blade is introduced over the tongue by a midline approach when intubating with the MVL.[3,12] Because the tongue is not pushed to the left side and the right part of the tongue is protruded, it is not easy to manipulate the endotracheal tube, which enters from the right side of the tongue.[12] Therefore, to overcome this geometrical mismatch, the manufacturers recommend the routine application of stylets when intubating with the MVL.[1]

Several studies have been performed to investigate the optimal stylet shapes for video laryngoscopes. The results suggested that different stylet angulations and shapes might be used according to the type of video laryngoscope because of differences in the design of each videolaryngoscope.[7,11,21,22] When using the GlideScope® video laryngoscope, a 90° angled stylet facilitated faster and easier intubation than did a 60° angled stylet.[11,23] When using the C-MAC D-Blade® video laryngoscope (Karl Storz GmbH, Tuttlingen, Germany), a stylet with a blade shape or hockey stick shape allowed better performance in intubation.[22] To the best of our knowledge, however, few studies have involved the MVL. One study showed that the TTI was shorter with the 60° than 90° stylet, which was a result opposite that of the GlideScope®.[7] This discrepancy is thought to be caused by the different blade shape, which is more angulated in the GlideScope® than in the MVL.[7] However, the study involved a smaller number of patients (n = 140) than did our study. Furthermore, the study did not include enough patients with possibly difficult airways. For example, no patients in the study population had a modified C-L glottic grade of ≥2b. Our study involved a higher number of participants (n = 219) than the previous study, and 32 (14.6%) patients had a modified C-L glottic grade of ≥2b. However, neither the TTI nor difficulty of intubation was different between the two groups. This result might be explained as follows. After the laryngeal view was obtained, tracheal intubation was performed by the two-stage process of delivery of the tube to the vocal cord and advancement of the tube into the trachea.[7] It was easier to introduce the J-shaped stylet than the 60° stylet into the oral cavity and deliver the tube above the glottic opening. However, it took more time to advance the tube into the tracheal lumen in Group J than in Group 60°. We believe that this is because the endotracheal tube that took off from the J-shaped stylet, in combination with its own anterior-facing curvature, tended to face more anteriorly than that in Group 60° and collided with the anterior wall of the trachea.

We conducted a multivariate regression analysis for the TTI and known risk factors for difficult airway. The TTI was significantly longer with an mMS of $\geq$3 and POGO score of $<$50 in both groups. The mMS is a predictor of difficult intubation based on the size of the tongue base.[18] Because the blade is introduced over the tongue with the MVL, we presume that a large tongue might prolong the TTI.[12] The modified Mallampati test can be performed when the patient is awake, cooperative, and stable. However, in many situations where tracheal intubation is required, patient cooperation is often impossible.[18] The POGO score provides high accuracy and inter-rater reliability under video laryngoscopy. It is simple and very useful even when the vocal cords are not totally identifiable. Moreover, because it is a continuous scale, POGO score might provide detailed information on the degree of the glottic views.[15] Therefore, we suggest that a POGO score of $<$50 under video laryngoscopy is a risk factor for a prolonged TTI with the MVL.

Our study showed a different relationship between a BMI of $\geq$30 kg/m^2 and the TTI in both groups (interaction $P = 0.009$). Specifically, in Group J, the TTI was longer with a BMI of $\geq$30 kg/m^2. However, the TTI was shorter with a BMI of $\geq$30 kg/m^2 in Group 60°, although without statistical significance. Despite the J-shaped stylet facilitating the approach of the endotracheal tube to the glottic opening, the endotracheal tube collided with the anterior tracheal wall after removing the stylet. Therefore, additional time was taken to insert the endotracheal tube into the glottic opening in Group J after the endotracheal tube was removed from the stylet. It is suggested that the tip of the endotracheal tube is often bent toward the anterior commissure because of the curvature of the endotracheal tube. Therefore, Dupanovic et al.[23] suggested that bending the tip of the stylet opposite the endotracheal tube curvature (reverse loading) might facilitate insertion of the endotracheal tube through the vocal cord after the stylet has been removed. In our study, the stylet was bent in the direction consistent with the camber of the endotracheal tube (standard loading) in both groups. Therefore, it is likely that with the standard loading of the stylet, the J-shaped bend of the stylet exacerbates the collision of the anterior commissure with the endotracheal tube in obese patients. Notably, the shape of the stylet affected the intubation performance differently in obese patients. Further studies are required to validate this finding.

This study has several limitations. First, the two anesthesiologists (E.A.C. and H.Y. L.) performing the tracheal intubation could not be blinded to the group allocation. Moreover, they were aware that time was measured while they were performing the intubations. Therefore, these factors might have affected their performances. However, neither anesthesiologist was aware of the primary outcome. Moreover, with the exception of the self-reported difficulty of intubation, the other assessments were performed by assistant anesthesiologists blinded to the group allocation. Thus, our results were unlikely to have been affected by this limitation. Second, expert anesthesiologists with sufficient experience performed the intubations after the patients had been administered muscle relaxants in this study; further studies involving anesthesiologists with less experience or without the use of muscle relaxants may show different outcomes. Third, the TTI was chosen as the primary outcome of this study. The TTI is commonly used in airway studies because it is easy to measure. Although, first-attempt intubation failure or the occurrence of airway complications such as hoarseness or airway trauma would be more important in clinical situations, these problems occur at a very low incidence. For example, all patients except one were intubated at the first attempt without bleeding in the present study. Finally, this study involved patients with a BMI of <40 kg/m^2. Therefore, we cannot ascertain whether our study results might be extrapolated to patients with a BMI of >40 kg/m^2. Further studies are needed to investigate the optimal stylet shape in morbidly obese patients. Finally, no hemodynamic variables or data regarding postoperative complications, such as postoperative sore throat, were collected in our study. This is because our study population comprised patients who had various underlying diseases and were undergoing a variety of surgical procedures, and these factors might have confused our interpretation of hemodynamic changes and the occurrence of postoperative sore throat. An adequate stylet shape might cause less severe airway trauma and fewer stylet-related airway complications,[8,9] which might reduce the hemodynamic responses to intubation and occurrence of postoperative sore throat. Therefore, whether the two different stylet shapes cause differences in hemodynamic changes or postoperative sore throat requires investigation in further studies.

Conclusions

Contrary to our hypothesis, the TTI was not different between the two groups of patients undergoing tracheal intubation under MVL guidance. An mMS of ≥3 and POGO score of <50 were associated with a longer TTI for both stylet shapes. The TTI was longer with the J-shaped stylet in patients with a BMI of >30 kg/m^2. Therefore, a J-shaped stylet should not be used in patients with a high BMI.

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Declaration of conflicting interest

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