Brief Communication

Simulation study of nasotracheal and orotracheal fiberoptic intubation with the Aintree Intubation Catheter

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Aim: Fiber-optic tracheal intubation is an essential technique to secure the airway for difficult airway and cervical cord injury victims. However, there is an anxiety about the vocal cord passage of tracheal tubes because of the potential of collision with the surroundings of the vocal cords. This study aimed to examine the utility of the Aintree Intubation Catheter in nasotracheal and orotracheal intubation.

Methods: Participants were 21 anesthesiologists with more than 2 years of experience in clinical anesthesia. Participants attempted fiber-optic tracheal intubation through the oral or nasal cavity with or without the Aintree Intubation Catheter in random order. The success rate of tracheal intubation, intubation time, and collision with the glottis were recorded. Participants also evaluated the subjective difficulty of the entire intubation process and passing the tracheal tube through the glottis using a Visual Analogue Scale.

Results: There were no significant differences in intubation time or Visual Analogue Scale scores for passing the tracheal tube through the glottis between nasal and oral intubation, regardless of the use of the Aintree Intubation Catheter. However, the catheter significantly reduced the number of collisions with the glottis in both routes (nasal, $P = 0.026$; oral, $P = 0.017$).

Conclusion: Our findings that the Aintree Intubation Catheter is effective in reducing collisions with the glottis during nasal and oral fiber-optic intubation suggest that Aintree Intubation Catheter use may reduce the risk of mechanical injury related to airway obstruction.

Key words: Aintree intubation catheter (AIC), fiber-optic intubation, nasotracheal intubation, orotracheal intubation, simulation

INTRODUCTION

FIBER-OPTIC INTUBATION IS an essential skill for difficult airway management and cases of restricted cervical vertebra mobility such as a cervical cord injury victim.^{1,2} Although training is required to smoothly carry out fiber-optic intubation, patients with difficult airways pose a particular challenge. Thus, simulation-based training that involves using a fiberscope via a tracheal tube would be beneficial. However, there is a major issue that structures around the vocal cords, such as the arytenoids, may hinder tracheal tube insertion.³ We previously reported that the Aintree Intubation Catheter (AIC), which is used for fiber-optic-guided intubation or tube exchange, might help the passage of a tracheal tube through the glottis when used in

conjunction with supraglottic airway devices for tracheal intubation (ISGAs). We considered that the reason is due to its ability to shift the fiberscope to the center of the larynx and fill in the gap between the fiberscope and tracheal tube.⁴ In the present study, as a different approach, we assessed the utility of the AIC during nasal and oral fiber-optic intubation using a manikin.

METHODS

THE INSTITUTIONAL REVIEW Board of Hyogo College of Medicine (Nishinomiya City, Japan) approved the study (No. 1332), and written informed consent was obtained from each participant. A total of 21 medical doctors with more than 2 years of clinical experience in anesthesia were invited to participate. The average career as anesthesiologists of the 21 participants was 13.9 ± 8.3 years (mean $\pm$ SD).

Each participant attempted fiber-optic intubation four times orally and nasally with and without the AIC. The order of intervention was randomized by lottery. The time limit for

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Fig. 1. Instruments used in the study. (A) Aintree Intubation Catheter (AIC). (B) Tip of the fiberscope coming out of the AIC. (C) Before intubation without using AIC through the oral cavity. (D) Removing the fiberscope and AIC after intubation using AIC through the oral cavity.

tracheal intubation was set as 3 min, and giving up on an intubation attempt was considered a failed attempt. We used the following instruments: the Airway Management Trainer (Laerdal, Stavanger, Norway) manikin that models an adult male,^{5,6} a 7.0-mm internal diameter Portex tracheal tube (Smiths Medical, London, UK), a bronchofiberscope with an external diameter of 3.4 mm and working length of 60 cm (Pentax, Tokyo, Japan), the AIC (Cook Medical, Bloomington, IN, USA) (external diameter, 6.3 mm; internal diameter, 4.5 mm; working length, 56 cm), and a video system (Machida Endoscope, Tokyo, Japan) (Fig. 1).

Olive oil (Yoshida Pharmaceutical, Saitama, Japan) was spread on the surface of the fiberscope and AIC as a lubricant, and 8% lidocaine (AstraZeneca, London, UK) was used to lubricate the inside of the tracheal tube. In the nasal intubation trial, the tracheal tube was inserted to a depth of 15–16 cm through the nasal cavity before starting the trial. In the oral intubation trial, the tracheal tube was inserted through the fiberscope, and the end of the tracheal tube was placed at the proximal side of the fiberscope until the fiberscope passed through the glottis, regardless of whether the AIC was used or not. We used the VBM airway as the oral airway (VBM bronchoscope bite block; Smiths Medical) for guiding the fiberscope and tracheal tube in the oral intubation trial.

An anesthesia specialist judged the success of the procedure and measured the intubation time for each trial. The start point of intubation was when the fiberscope set with or without the AIC began to advance, and the end point was when tracheal intubation was confirmed by the fiberscope. The number of collisions of the tracheal tube with the glottis

was also counted by the same specialist. We defined the collision as the situation that the tracheal tube could not be inserted into the trachea even if it was pushed harder by the participant. At that time, the participant pulled the tracheal tube once and tried to insert it again. When it was inserted into the trachea successfully by pushing harder, the pushing was not counted as a collision. Participants evaluated the difficulty of the entire intubation procedure and passage through the glottis using a Visual Analog Scale (VAS).

The sample size was calculated based on a preliminary study that evaluated the time required for eight participants to complete intubation. The longest and the shortest mean (SD) times required to confirm successful tracheal intubation were 48.0 (20.4) s and 28.1 (17.0) s, respectively. To detect a 33% difference in intubation time with a power of 0.8, we estimated that 17 operators would be adequate for each device.

Data were expressed as mean $\pm$ SD and analyzed with two-way repeated ANOVA, Tukey's multiple comparison test for intubation time, and the Kruskal–Wallis test for the number of collisions of the tracheal tube with the glottis and VAS. $P < 0.05$ was considered significant.

RESULTS

THERE WERE NO failures in either the nasal or oral intubation trials ($n = 21$ per trial). Nasal intubation times with and without AIC were 41.3 ± 29.5 s and 38.8 ± 26.4 s, respectively, and oral intubation times were 52.7 ± 30.6 s and 49.6 ± 22.3 s, respectively (no significant difference between the four groups). These results suggest that AIC use did not shorten intubation times for nasal and oral intubation.

As shown in Figure 2, there were more collisions without AIC use than with AIC use for both nasal and oral intubation (without AIC, nasal 0.71 ± 1.2 , oral 2.43 ± 2.4 ; with AIC, nasal 0.10 ± 0.3 , oral 0.90 ± 1.2 ; nasal, $P = 0.026$; oral, $P = 0.017$). Figure 3 shows VAS scores for the difficulty of the entire intubation procedure and the difficulty of passage through the glottis (0, easiest; 100, most difficult). The VAS scores for the difficulty of the intubation procedure did not significantly differ for either route with or without the AIC, although the VAS score for passage through the glottis was lowest in the nasal intubation trial with the AIC.

DISCUSSION

THE DIFFICULT AIRWAY Society Algorithm and the ASA Difficult Airway Algorithm 2013 recommend awake fiber-optic intubation as an alternative approach when spontaneous breathing is maintained or face mask

Fig. 2. Number of collisions with the glottis ($n = 21$) during nasotracheal and orotracheal intubation with or without the Aintree Intubation Catheter (AIC). The graph shows the number of collisions in four groups: Nasal, nasotracheal approach without AIC; Nasal with AIC, nasotracheal approach with AIC; Oral, orotracheal approach without AIC; Oral with AIC, orotracheal approach with AIC. The graph is expressed by box plot. It contains the sample minimum, the lower quartile, middle value, the upper quartile, the sample maximum. The value between the lower quartile and the upper quartile was drawn as a box. If the values overlapped, the lines were put together. Differences were analyzed by the Kruskal–Wallis test. $*P < 0.05$, without AIC versus with AIC.

ventilation is practical.^{7,8} Although anesthesiologists are familiar with this technique, knowledge of airway anatomy and fiberscope use training are needed. Moreover, one issue with this procedure is that, in some cases, although the fiberscope can pass through the glottis, the tracheal tube cannot. This can be attributed to collision of the tracheal tube with the surroundings of the glottis.⁵ To address this, we previously showed that AIC use in conjunction with ISGAs reduces collisions with the glottis.⁴ Other studies have also reported on AIC use to guide fiber-optic intubation through the laryngeal mask airway (LMA) and ISGA for patients with difficult airways,^{9–12} as well as manikin studies.^{13,14} However, only one study has reported on AIC use to guide nasotracheal fiber-optic intubation.¹⁵

In this study, we limited our participants to medical doctors with more than 2 years of experience in clinical anesthesia—at least in this population, the AIC appears to reduce the number of collisions with the glottis during nasotracheal and orotracheal fiber-optic intubation. Given that frequent collisions can increase the risk of mechanical injuries such as laryngeal edema, bleeding, and subluxation of arytenoid cartilage, reducing this risk by using the AIC

Fig. 3. Difficulty of nasotracheal and orotracheal intubation with or without the Aintree Intubation Catheter (AIC) and passage through the glottis ($n = 21$). This graph shows the difficulty of the entire procedure and passage through the glottis as evaluated by participants using the Visual Analog Scale (VAS) for each group: Nasal, nasotracheal approach without AIC; Nasal with AIC, nasotracheal approach with AIC; Oral, orotracheal approach without AIC; Oral with AIC, orotracheal approach with AIC. The graph was expressed by box plot. It contains the sample minimum, the lower quartile, middle value, the upper quartile, and the sample maximum.

would be important in preventing the worsening of airway obstruction. However, problems with the procedure include the need of an additional step (i.e., use of the AIC), as well as the need to adjust the fiberscope such that it is 4 cm from the tip of the AIC. With respect to the difficulty of the procedure, although no significant differences were observed with or without AIC use, participants may have felt it easier to pass the tracheal tube through the glottis when the AIC was used. Despite this, participants did not feel that the AIC facilitated the entire intubation procedure, possibly due to the extra step of having to use the AIC.

This study has some limitations. First, there is a difference in tenderness around the glottis between a manikin and human. Second, intubation was carried out on a manikin with a non-difficult airway. Third, we only used one tube size; results may have differed with a different tube size. Finally, although we used 8% lidocaine as a lubricant, lidocaine may degrade the fiberscope. Thus, other lubricants should be considered for use with the AIC. Future studies with clinical cases that compare the cough reflex and friction at the glottis with or without the AIC are warranted.

In conclusion, our findings suggest that the AIC may reduce collisions of the tracheal tube to the glottis during nasal and oral fiber-optic intubation. Further studies are necessary to evaluate the validity of this method in critical

situations because the procedure requires the extra step of using AIC.

CONFLICT OF INTEREST

NONE.

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REFERENCES

- 1 Rosenstock CV, Thøgersen B, Afshari A *et al.* Awake fiberoptic or awake video laryngoscopic tracheal intubation in patients with anticipated difficult airway management: A randomized clinical trial. *Anesthesiology* 2012; 116: 1210–6.
- 2 Crosby ET. Airway management in adults after cervical spine trauma. *Anesthesiology* 2006; 104: 1293–318.
- 3 Johnson DM, From AM, Smith RB *et al.* Endoscopic study of mechanisms of failure of endotracheal tube advancement into the trachea during awake fiberoptic orotracheal intubation. *Anesthesiology* 2005; 102: 910–4.
- 4 Ueki R, Komazawa N, Nishimoto K *et al.* Utility of the Aintree Intubation Catheter in fiberoptic tracheal intubation through the three types of intubating supraglottic airways: A manikin simulation study. *J. Anesth.* 2014; 28: 363–7.
- 5 Jackson KM, Cook TM. Evaluation of four airway training manikins as patient simulators for the insertion of eight types of supraglottic airway devices. *Anaesthesia* 2007; 62: 388–93.
- 6 Scutt S, Clark N, Cook TM *et al.* Evaluation of a single-use intubating videoscope (Ambua-Scope™) in three airway training manikins for oral intubation, nasal intubation and intubation via three supraglottic airway devices. *Anaesthesia* 2011; 66: 293–9.
- 7 Henderson JJ, Popat MT, Latto IP *et al.* Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004; 59: 675–94.
- 8 Apfelbaum JL, Hagberg CA, Caplan RA *et al.* Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* 2013; 118: 251–70.
- 9 Berkow LC, Schwartz JM, Kan K, Corridore M, Heitmiller ES. Use of the Laryngeal Mask Airway–Aintree Intubating Catheter–fiberoptic bronchoscope technique for difficult intubation. *J. Clin. Anesth.* 2011; 23: 534–9.
- 10 Wong DT, Yang JJ, Mak HY *et al.* Use of intubation introducers through a supraglottic airway to facilitate tracheal intubation: A brief review. *Can. J. Anaesth.* 2012; 59: 704–15.
- 11 Cook TM, Bigwood B, Cranshaw J. A complication of transtracheal jet ventilation and use of the Aintree Intubation Catheter during airway resuscitation. *Anaesthesia* 2006; 61: 692–7.
- 12 Doyle DJ, Zura A, Ramachandran M *et al.* Airway management in a 980-lb patient: Use of the Aintree Intubation Catheter. *J. Clin. Anesth.* 2007; 19: 367–9.
- 13 Heard AM, Lacquiere DA, Riley RH. Manikin study of fiberoptic-guided intubation through the classic laryngeal mask airway with the Aintree intubating catheter vs the intubating laryngeal mask airway in the simulated difficult airway. *Anaesthesia* 2010; 65: 841–7.
- 14 Blair EJ, Mihai R, Cook TM. Tracheal intubation via the Classic and Proseal laryngeal mask airways: A manikin study using the Aintree Intubating Catheter. *Anaesthesia* 2007; 62: 385–7.
- 15 Grider JS, Van Sickels JE, Lock RL. Novel use of the Aintree intubating catheter for nasal fiberoptic intubation in a patient with temporo-mandibular ankylosis. *J. Clin. Anesth.* 2009; 21: 151–2.