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Endotracheal Tube Insertion Time for a Cervical Stabilized Manikin using Airway Scope and Multi View Scope: A Randomized Manikin Study

Genji Shimpuku*, Takeshi Yano, Isao Tsuneyoshi, Shuuji Uchimura, Shunsuke Kuroki, Yoshihumi Kodama and Yoshihiro Nagamine

Department of Anesthesiology and Critical Care, Faculty of Medicine, University of Miyazaki, Japan

***Corresponding author:** Genji Shimpuku, Department of Anesthesiology and Critical Care, Faculty of Medicine, University of Miyazaki, 5200Kihara, Kiyotake, Miyazaki, 889-1692, Japan, Tel: +81-985-85-9357; Fax: +81-985-85-7179; E-mail: genji_shinpuku@med.miyazaki-u.ac.jp

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Abstract

Context: Cervical spine injury is one of the most difficult cases of airway management.

Objective: The aim of this study was to evaluate whether Multi View Scope (MVS) intubated more quickly and easily than conventional laryngoscope and Airway Scope (AWS).

Design: A randomized crossover trial using a manikin.

Setting: An airway-management training manikin was attached to the cervical neck collar. The manikin had inline cervical stabilization and it was difficult to open its mouth. The investigator counted the time of intubation and conducted post-intubation interviews of the participants.

Patients or other participants: 20 experienced anesthetists.

Interventions: The participants intubated the cervical injured manikin using 3 devices (laryngoscope, AWS, and MVS).

Main outcome measures: The first endpoint was the time to achieve insertion of the device and tracheal intubation. The second endpoint was the quality of intubation by measuring the Cormack-Lehane grade, the number of injuries to the manikin's teeth, and the use of cricoid pressure. The data for the first endpoint were analyzed using the Bonferroni-Dunn test. The data for the second endpoint were analyzed using the Kruskal-Wallis test, followed by the Wilcoxon test with Bonferroni correction. Statistical significance was considered $P<0.05$.

Results: The time for intubation with LS, AWS, and MVS averaged 22.65 ± 8.29 s, 18.35 ± 6.66 s, and 14.70 ± 6.28 s, respectively. The time for intubation with MVS was shorter than that with LS. The time for inserting the device with LS, AWS, and MVS were, on average, 2.55 ± 1.19 s, 4.65 ± 1.63 s, and 2.10 ± 0.45 s, respectively. The time for inserting the device with LS and with MVS was shorter than that with AWS. With AWS and with MVS, all participants could intubate in grade 1. There was no clicking sound with MVS. There was no participant to push the manikin's cricoid using AWS or MVS.

Conclusions: The time for intubation with MVS was shorter than that with LS or AWS. Using MVS, the participants were able to intubate without injuring the manikin's teeth. MVS might be a useful device for a patient under manual inline axial stabilization without opening the mouth.

Keywords: Multi view scope; Difficult airway management; Manual inline axial stabilization

Introduction

Endotracheal intubation is an important medical treatment for maintaining the airway of trauma patients. The head of the cervical spine injured patient should be maintained in the median neutral position [1]. Some guidelines recommend using manual inline axial stabilization during endotracheal intubation [2-4]. However, intubation of this type may be difficult because cervical spine movement is limited and the patient is not in a "sniffing" position (an upright position in which the patient's head and chin are thrust slightly forward and the patient appears to be sniffing) [5-7]. In addition, patients with inline cervical stabilization have difficulty opening their mouth [8,9], problems that make airway management difficult. Many studies of special devices have reported higher success rates for tracheal intubation in difficult airway cases. For example, Airway Scope (AWS; Hoya, Tokyo, Japan) and Airtraq (Prodol-Mediteq S.A., Madrid, Spain), and Multi View Scope (MVS; Covidien, Dublin, Ireland) are 3 of these devices [10,11]. The aim of this study was to compare the MVS with the laryngoscope (LS) and AWS in terms of intubation time, quality of view, and difficulty of tracheal intubation when used on a cervical injured manikin.

Methods

Ethical approval for this study (Research Ethics Committee No.928) was provided by the Research Ethics Committee of University of Miyazaki, 5200 Kihara, Kiyotake, Miyazaki, Japan (Chairman Prof K. Itai) on 5th March 2012.

The study design was a randomized crossover trial using a manikin. The participants were 20 experienced anesthetists. We created a cervical injured manikin that had inline cervical stabilization and difficulty of opening mouth at the same time (Figure 1). A neck collar (Stifneck Select, Laerdal Medical) was attached to a manikin (Airway Management Trainer Manikin, Laerdal Medical) to keep its head in the median neutral position. The collar caused its mouth to be limited opening 2 cm at the same time. This manikin made a clicking sound when the upper teeth were pushed strongly. The click avoided the risk of broken and dislocated teeth.

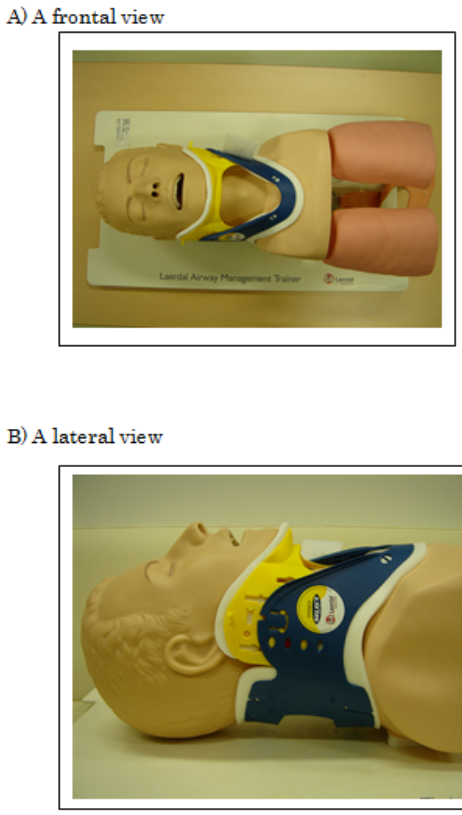

Figure 1: The cervical injured manikin model; A neck collar was attached to a manikin to keep its head in the median neutral position. This neck collar was made to restrict its mouth opening to 2 cm.

First, after explaining how to use MVS, the all participants were given at least 5 minutes to practice on each device until they felt sufficiently skilled. We prepared the laryngoscopes (#3; LS, Heine, Germany), AWS and MVS. The endotracheal tube, Profile (Smith Medical International, Saint Paul, MN, USA) had an inside diameter of 7.0 mm and an outside diameter of 10.3 mm.

Each device was prepared for its own participant. Before starting the study, the participants were permitted to set the devices in place for their own use. During intubation, the timekeeper, who was not a study participant, kept time by a stopwatch. The participants were permitted to request us to push the cricoid of the manikin if needed and to pull out the stylet from the endotracheal tube.

The first endpoints were the time for intubation and the time to insert the device into the manikin's mouth. The time for intubation was defined as the time between the participants's taking hold of the device to connecting it to the ventilator after pulling out the stylet. The time for inserting the device was defined as the time from the participant's taking hold of the device to locating the glottis of the manikin.

The second endpoints were the quality of intubation. We graded the difficulties of intubation by use of the Cormack-Lehane system (from 1 to 4), the number of clicks coming from the upper teeth, and whether or not pushing the manikin's cricoid was requested. The Cormack-Lehane system describes the best view possible at laryngoscope. Grade 1 means complete glottis visible, grade 2 means anterior glottis not seen, grade 3 means epiglottis seen, but not glottis, and grade 4 means epiglottis not seen.

Statistical analysis was performed using StatView 5.0 software (Abacus Concepts, Berkeley, CA, USA) and JMP 8.0 software (SAS Institute, Cary, NC,USA).Data are the mean ± SD. Intubation time and time for inserting the device were analyzed using the Bonferroni-Dunn test. Data for the second endpoint were analyzed using the Kruskal-Wallis test, followed by the Wilcoxon test with Bonferroni correction. Statistical significance was considered at $P<0.05$.

Results

Twenty experienced anesthetists participated in this study. All participants had sufficient practice time for each device, and no participants practiced over 5 minutes. Times for intubation with each device are shown in Table 1. Times for intubation with LS, AWS, and MVS averaged 22.6 ± 8.29 s, 18.35 ± 6.66 s, and 14.70 ± 6.28 s, respectively. The time for intubation with MVS was significantly shorter than that with LS. The P value between LS and AWS was 0.06, and that between AWS and MVS was 0.11. The time for inserting the device into the manikin's mouth is shown in Table 1. The time for inserting the device with LS, AWS, and MVS averaged 2.55 ± 1.19 s, 4.65 ± 1.63 s, and 2.10 ± 0.45 s, respectively. The time for inserting the device with LS and with MVS was significantly shorter than that with AWS. There was no difference between LS and MVS in the time for inserting the device.

	Time for intubation (s)	Time for inserting the device (s)
LS	22.65 ± 8.29	2.55 ± 1.19**
AWS	18.35 ± 6.66*	4.65 ± 1.63
MVS	14.70 ± 6.28*	2.10 ± 0.45**

Table 1: Time for intubation and for inserting the device; LS: laryngoscope, AWS: Airway Scope, MVS: Multi View Scope, Note: Time results are presented as mean ± SD. *$P<0.05$ as compared with LS. **$P<0.05$ as compared with AWS.

The Cormack-Lehane grades with each device were shown in Table 2. With LS, 1 is grade 1, 10are grade 2, 9 are grade 3 and zero is grade 4.With AWS and MVS, all participants could intubate in grade 1. The view of the glottis was more clearly observed with AWS and MVS than with LS. There was no difference between AWS and MVS in the view of the glottis. The numbers of clicks from the upper teeth are shown in Table 3. Of all participants' trials, the numbers of clicks were 9 with LS and 10 with AWS. There was no click with MVS. There were more clicks with AWS than with MVS. There were no requests from participants to push the manikin's cricoid using AWS or with MVS. Six participants with LS needed cricoid pressure. There were no statistical differences between devices.

	1	2	3	4
LS	1	10	9	0
AWS	20*	0	0	0
MVS	20*	0	0	0

Table 2: The Cormack-Lehane grade with each device; Note: *P<0.05 as compared with LS.

	No. of participants making clicks	No. of click sounds
LS	5	9
AWS	7	10
MVS	0	0**

Table 3: Number of clicks from the manikin's upper teeth during intubation; Note: **P< 0.05 as compared with AWS.

Discussion

Cervical spine injury is serious enough that further injury could be life threatening. It is important that manual inline axial stabilization is very useful and effective for a stationary cervical position [12]. Thus, some guidelines have recommended the use of manual inline axial stabilization during endotracheal intubation [2-4]. Although this type of stabilization is the most popular treatment, some difficulties may be faced during intubation because cervical spine movement is limited and the patient is not in a sniffing position [5-7]. Sawin et al. reported that manual inline axial stabilization makes intubation difficult because of lack of mouth opening [13].

In such a situation, it is a serious problem to maintain the airway in trauma patients [8,9].

Some new devices have been recommended for difficult airway management cases in manual inline axial stabilization. AWS and Airtraq are 2 popular devices that are useful for cervical injured patients in Japan [10,11,14,15]. Some studies recommend that AWS should be used for difficult airway management [11,14]. However, the Intlock, the part of AWS that is inserted into the patient's mouth, is 35mm in diameter. It is sometimes difficult to insert the AWS into the patient's mouth because the Intlock is larger than the mouth opening. In our results, the time required for inserting the AWS into the manikin's mouth was longer than that of LS and MVS, so that the LS and MVS may be useful when the patient is not able to sufficiently open his or her mouth. In addition, MVS may be a safer device in terms of tooth damage because there was no click with MVS during intubation. We believe that these differences would play a role for critically ill patients to prevent from lapsing into hypoxia.

In clinical cases, we must compare the merits between these special devices which were used in this study. AWS has a dedicated hole installed from the side of the endotracheal tube for use as a suction catheter to remove blood and secretions from the visual field. The Intlock, made of plastic, can prevent the patient's biting. Although difficult to insert into the patient's mouth, the Intlock affords a high-quality view with the inserted AWS. MVS has a small hole at the top through which we can administer oxygen to the patient. We cannot use this hole for suctioning because it is very narrow, and the lumen might become stacked with secretions. MVS might be difficult for the patient who has a bloody mouth or is agitated, because it has no suction lumen. We suggest not only giving oxygen through this hole to avoid hypoxia, but also to permit spontaneous breathing-very important for difficult airway management. For the patient under manual inline axial stabilization with no mouth opening, just only one device should not be suggested. We must consider bloody mouth, opening mouth, and hypoxia and which device is most effective for each case.

Some limitations of our study should be noted. First, our 20 selected participating anesthetists were all experienced in several airway devices, so there was no trouble for them to use all the devices in the study. We would not expect the same results if we had selected inexperienced anesthetists. In this study, AWS was successful for residents not belonging to the department of anesthesia [16]. In many clinical cases, most doctors intubating patients are not anesthetists. To suggest that MVS is an effective device at the emergency scene, participants not experienced in several special devices should have been included in the study. Second, the manikin with the cervical neck collar had cervical stabilization and difficulty in mouth opening at the same time. Some studies used a manikin with neck collar to investigate the difficulties of intubation [7,17,18]. Since the manual inline axial stabilization is used during intubation in clinical cases, the manikin under manual inline axial stabilization could be more valuable than the manikin without neck collar.

Ours is the first report to conclude that using AWS is difficult in the situation wherein the manikin's mouth does not open. The special device for difficult airways is not a perfect tool, so we must change any device that does not help us achieve our goal. A difficult airway is a dangerous situation for airway management, and if we can, we must prepare special devices for training with manikins. To teach both residents and experienced doctors, our manikin model must be useful, effective, and commercially available. In the future, these special devices for intubation will become more available for preventing patients' hypoxia during intubation, and we hope that manikin training will be undertaken many times before a critical situation arises.

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