Brief Communication

Comparison of the conventional Macintosh laryngoscope, the Pentax Airwayscope, and the McGrath MAC video laryngoscope under restricted cervical motion: a manikin study

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Aim: We compared the utility of the conventional Macintosh laryngoscope, the Pentax Airway Scope, and the McGrath MAC video laryngoscope under restricted cervical motion using a manikin.

Methods: We recruited 36 participants into the simulation study. The manikin's cervical motion was restricted with a cervical collar and a head immobilizer, as occurs in trauma cases. We recorded the time to intubation and the success rate of the intubations.

Results: Data are medians and ranges. The time to intubation under normal and restricted cervical motion were 22.5 (10–78) and 23 (9–119) s with the Macintosh laryngoscope, 13.5 (5–50) and 14 (7–119) s with the Airway Scope, and 13 (6–32) and 18 (7–80) s with the McGrath MAC video laryngoscope. The differences in the time to intubation between normal and restricted cervical motion were significant only with the McGrath MAC ($P = 0.0008$). With restricted cervical motion, the times to intubation in the Airway Scope attempts were significantly shorter than those in the Macintosh laryngoscope ($P = 0.0005$) and McGrath MAC ($P = 0.0282$) attempts. The success rates under normal and restricted cervical motion were 100% and 80.6% with the Macintosh laryngoscope ($P = 0.0054$), 100% and 100% with the Airway Scope, and 100% and 97.2% with the McGrath MAC, respectively.

Conclusion: In the present study, the Airway Scope was the best among the three devices. However, the differences between the Airway Scope and the McGrath MAC video laryngoscope may not be serious in a clinical situation. Data were gathered using a manikin, and further studies will be necessary.

Key words: Macintosh laryngoscope, McGrath MAC video laryngoscope, Pentax Airway Scope, sniffing position, tracheal intubation

BACKGROUND

COMPARED TO THE conventional Macintosh laryngoscope (MCL), video laryngoscopes can improve glottis visualization.^{1,2} However, each video laryngoscope has its own advantages and disadvantages.²

In trauma cases, cervical motion is restricted with a cervical neck collar and a head immobilizer to protect the trauma victim's cervical spinal cord. Endotracheal intubations using the MCL in those patients are difficult; hence, the Pentax

Airway Scope (AWS; Pentax, Tokyo, Japan) is generally recommended.¹ However, the McGrath MAC video laryngoscope (McG; Covidien, Tokyo, Japan) has been developed recently. It has been reported that the McGrath Series 5 video laryngoscope (Aircraft Medical, Edinburg, UK), which is similar to the McG, can improve glottis visualization in patients whose cervical movements were restricted manually.³ Here, we hypothesized that the McG could also facilitate endotracheal intubation in trauma cases, and we compared the utility of MCL, AWS, and McG using a manikin.

METHODS

INFORMED CONSENT FOR publication of the present report was obtained from all of the participants. We recruited 36 participants (29 medical university students and

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Fig. 1. A, A manikin model under normal cervical motion. B, A manikin model under restricted cervical motion with a cervical collar and a head immobilizer, as occurs in trauma cases.

seven medical vocational college students) into the simulation study. Each participant was a novice at using McG and AWS; however, each participant had experienced MCL in other manikins.

We used the intubation training device (Koken, Tokyo, Japan) as a manikin model (Fig. 1A). A restricted cervical motion (RCM) model was made by stabilizing a manikin's neck with a cervical collar and a head immobilizer as in a trauma case (Fig. 1B). The participants practiced tracheal intubations twice with each of the three devices with normal cervical motion (NCM) allowed. After the practice, they carried out intubation attempts in the following order: MCL, AWS, and McG under NCM, and MCL, AWS, and McG under RCM. We used an endotracheal tracheal tube (Portex, St. Paul, MN, USA) with an internal diameter of 7.0 mm and inserted a stylet into the endotracheal tube in the MCL and McG intubation attempts.

We measured the time to tracheal intubation (TTI) of each intubation attempt. For the MCL and McG intubation attempts, the TTI was defined as the duration from grasping the device to removing the stylet from the intubated tube, and for AWS intubation attempts, the TTI was defined as the duration from grasping the device to removing the blade from the manikin's mouth, as was done in the study by Shin *et al.*⁴ In the MCL and McG attempts, the endotracheal tube was inserted until the 21-cm scale of the tube was located at the right corner of the manikin's mouth, and then stylet was removed. In the AWS attempts, the endotracheal tube was inserted until the tube's thick black line was located at the manikin's glottis. We also recorded the success rate (SR) of the intubations, and we defined "failed tracheal intubation" as either esophageal intubation or exceeding the time limit of 120 s for the attempt.

Statistical analysis was carried out using Excel Tokei 2012 software (Social Survey Research Information Co., Tokyo, Japan). The Mann–Whitney *U*-test was used to test for

differences in continuous variables. Intergroup differences were assessed with the χ^2 -test with Yates' correlation for continuity in categorical variables. We considered *P*-values < 0.05 to be significant.

RESULTS

THE MEDIAN AGE of the participants was 23 years (range, 19–38), and 28 participants were men. In MCL intubation attempts under RCM, glottis visualization was Cormack–Lehane grade –2 in 2 participants, grade –3 in 25 participants, and grade –4 in 9 participants. In AWS intubation attempts, all the participants could see the glottis on the monitor quickly even under RCM. In McG intubation attempts under RCM, 21 participants elevated the epiglottis directly and could obtain a clear view of the glottis on their first attempts. The remaining 15 participants tried to elevate the glottis indirectly on their first attempts; however, most of them changed the maneuver to direct elevation of the glottis at a comparatively early stage of their attempts.

Figure 2 shows the TTIs for each device. The data are given as medians and ranges. The TTIs (s) under NCM and RCM were 22.5 (10–78) and 23 (9–119) with the MCL, 13.5 (5–50) and 14 (7–119) with the AWS, and 13 (6–32) and 18 (7–80) with the McG, respectively. The difference in the TTIs between NCM and RCM was only significant for the McG ($P = 0.0008$). Under RCM, the TTIs in the AWS attempts were significantly shorter than those in the MCL ($P = 0.0005$) and McG ($P = 0.0282$) attempts.

The SRs of the intubations under NCM and RCM were 100% and 80.6% with the MCL ($P = 0.0054$), 100% and 100% with the AWS, and 100% and 97.2% with the McG, respectively. In MCL intubation attempts under RCM, seven participants failed; four displaced the tube into the esophagus and three did not finish the attempt within 120 s. In McG

Fig. 2. Graph of the time to tracheal intubation (TTI) by all participants using a conventional Macintosh laryngoscope (MCL), Pentax Airway Scope (AWS), or McGrath MAC video laryngoscope (McG). Normal cervical motion (NCM) and restricted cervical motion (RCM) are shown. The box indicates the median and interquartile range. N.S., not significant; X, failed tracheal intubation.

intubation attempts under RCM, one participant failed. He could see the glottis on the monitor; however, he could not advance the endotracheal tube within 120 s.

DISCUSSION

IN MCL INTUBATION attempts, the alignment of the oral, pharyngeal, and laryngeal axes (i.e., a sniffing position) is necessary to see the glottis directly.¹ Therefore, under RCM, to see the glottis was difficult because the oral axis and laryngeal axis meet at right angles (Fig. 3A). Most of the participants could not obtain a clear view of the glottis, and abandoned their attempts to confirm the glottis at a comparatively early stage of their intubation attempts. Hence, the TTIs were not prolonged. However, the SRs of the intubations were nearly 80% without seeing glottis. Before starting MCL intubation attempts under RCM, all the participants performed intubation attempts under NCM with two types of video laryngoscopes. Therefore, they might grasp the structure and arrangement of the manikin's pharyngeal inlet and glottis.

In AWS intubation attempts, placing the manikin in a sniffing position is not necessary to see the glottis directly.¹ With the AWS, the visual field direction and laryngeal axis are aligned because of the AWS' original curvature of the laryngoscope blade (Fig. 3B). Hence, the SRs of the intubations were 100%, and the TTIs were not prolonged.

In McG intubation attempts, placing the manikin in a sniffing position is also necessary to see the glottis directly.¹ However, in this simulation study, we could not compare the glottis visualization statistically between the MCL and the McG. It has been reported that the McGrath Series 5 video laryngoscope could not always reduce the TTI even when a clear view of the glottis was achieved.³ For the McG, the visual field direction and laryngeal axis are not aligned (Fig. 3C). The angle of the McG blade relative to the axis of the trachea improves the view of the glottis on the monitor; however, it is necessary to redirect the endotracheal tube more anteriorly, and doing so can make it difficult to successfully achieve tracheal intubation.³ In order to advance the endotracheal tube into the trachea, it is necessary to bend the stylet endotracheal tube to a greater degree than with the MCL. As a result, the TTIs were prolonged in spite of the higher SRs of the intubations. However, the prolonged median TTIs were 5 s. Additionally, the difference in the median TTIs between the AWS and the McG under RCM was 4 s. We believe these differences may not be serious in a clinical situation.

The present study has several limitations. First, this is a manikin-based rather than a clinical study. The manikin model may not reproduce the precise intubation conditions of real patients. Second, the participants were students who did not have the skills needed for tracheal intubation. Third, the measured TTI did not include the time required for

Fig. 3. A, Under restricted cervical motion, the oral axis (OA) and the laryngeal axis (LA) meet at right angles. B, In tracheal intubation attempts using the Pentax Airway Scope, the visual field direction and LA are aligned under restricted cervical motion. C, In attempts using the McGrath MAC video laryngoscope, the visual field direction and LA are not aligned under restricted cervical motion. PA, pharyngeal axis.

inflating the cuff, connecting a self-inflating bag to the intubated tube, and starting manual ventilation. We should have defined the TTI as the duration from grasping the device to the first successful ventilation of the lungs, as was reported in the previous study.⁵ Fourth, this was not a randomized crossover study, and improvement in the participants' skills may have occurred as they progressed through their attempts. Actually, in McG intubation attempt (the third order), the width from the shortest TTI to the longest TTI were narrower than that observed in MCL or AWS intubation attempts. To avoid this problem and to minimize any learning effects during the trial, we should have done a randomized crossover trial.

CONCLUSION

IN THE SIMULATION study, the AWS was the best among the three devices, and the McG could not facilitate the endotracheal intubation under RCM. However, the differences between the AWS and the McG may not be serious in a clinical situation. Data were gathered using a manikin, and the intubation attempts were carried out by novices; further studies are necessary.

CONFLICT OF INTEREST

NONE.

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