Accepted October 2013

ORIGINAL ARTICLE

Endotracheal intubation by inexperienced registrars in internal medicine: a comparison of video-laryngoscopy versus direct laryngoscopy

H. Biermann*, E. van der Heiden*, A. Beishuizen, A.R.J. Girbes, M.C. de Waard

Department of Intensive Care, Institute for Cardiovascular Research, VU University Medical Centre, Amsterdam, the Netherlands, *equal contribution

Correspondence

M.C. de Waard – e-mail: mc.dewaard@vumc.nl

Keywords – **Video-laryngoscope, GlideScope®, Macintosh, inexperienced personnel, successful tracheal intubation**

Abstract

One of the most important tasks involved in the management of critically ill patients is to secure the airway. The preferred method for securing the airway is tracheal intubation followed by mechanical ventilation, but intubation is a difficult skill to acquire. When tracheal intubation using direct laryngoscopy is carried out by inexperienced personnel, there is a high risk of failure. Indirect laryngoscopy which uses a video-laryngoscope requires fewer skills to successfully secure the airway. We hypothesized that the use of the classical Macintosh laryngoscope is less effective in inexperienced hands compared with the video-laryngoscope GlideScope®, both in terms of successful intubation of the trachea and the time needed to achieve it. We asked thirty-nine registrars in internal medicine with negligible intubation experience to intubate a manikin airway model using a Macintosh laryngoscope and a video-laryngoscope GlideScope®. Inexperienced registrars with a mean duration of clinical experience as medical doctor of 1.7±1.0 years had a higher intubation success rate using the GlideScope® technique compared to the Macintosh technique (92% versus 69% respectively, $P<0.05$). However, the mean time needed for successful intubation was longer using the video-laryngoscope GlideScope® compared to the classical Macintosh laryngoscope (75±40 versus 39 ± 12 seconds respectively, $P<0.05$). In this study inexperienced registrars in internal medicine were able to intubate a manikin with a very high success rate using indirect video-laryngoscopy; however, the technique took more time to complete when compared with direct laryngoscopy.

Introduction

To obtain a secure airway is of vital importance in the management of a critically ill patient. The preferred method of securing the airway is endotracheal intubation followed by mechanical ventilation. Direct laryngoscopy with intubation remains difficult for medical personnel who do not have sufficient clinical experience with the technique. Indirect video-laryngoscopy may require a lower level of technical expertise and experience to successfully intubate and these laryngoscopes are now commercially available. The image obtained by the video-laryngoscope GlideScope® is displayed on a monitor[1] and provides better laryngeal views than conventional laryngoscopes.[2-3] In a meta-analysis of Griesdale et al. the GlideScope® video technique was associated with improved glottis visualisation compared to direct laryngoscopy.[2]

Several studies have assessed the use of video and conventional laryngoscopes in terms of success rate. A manikin study for emergent intubation during cardiopulmonary resuscitation by inexperienced medical practitioners demonstrated that when the GlideScope® video-laryngoscope was used, the time to successful intubation was shorter and the success rate higher than when the Macintosh laryngoscope was used.[3] Controversially, data from studies in the emergency department suggest that the success rate of intubation by emergency medicine residents on the first attempt did not differ between GlideScope® and Macintosh[6-7] and that intubation using GlideScope® required more time.[4] Also, studies with inexperienced medical students[5] and experienced anaesthesiologists[6] showed that intubation with the GlideScope® took more time when a manikin was used and with easy intubation conditions. After extensive training of medical personnel and under close supervision of an anaesthesiologist, the intubation success rate in a manikin was over 90% when the GlideScope® technique was used.[10]

In this study we compared the use of the classical Macintosh laryngoscope and the GlideScope® video-laryngoscope by inexperienced untrained registrars in internal medicine in terms of successful endotracheal intubation, using an airway model.

Materials and methods

Protocol

Registrars in internal medicine, with no or negligible prior experience of laryngoscopy, performed tracheal intubation on an airway model (SimMan®, Laerdal Benelux B.V., Netherlands) using a conventional laryngoscope (Macintosh, Welch Allyn Inc., USA) and a video-laryngoscope (GlideScope®, Verathon Inc., USA). Whole-class explanation and demonstration of both intubation scenarios was given by an experienced specialist. Before the first intubation attempt, the registrars were randomly assigned to either the Macintosh or GlideScope® group by lot. When the GlideScope® was used in the first attempt, the Macintosh was used in the second attempt, and vice versa. The time from the first insertion of the laryngoscope in the mouth until successful intubation was recorded. A maximum time of three minutes was allowed for each intubation attempt. The registrars were allowed to perform only one intubation attempt for each laryngoscope type.

For each registrar, age, gender, number of years of clinical experience as medical doctor, previous anaesthesiology training and estimated total number of performed intubations and those performed during the last year were recorded. Time (seconds) needed to intubate and success of the intubation (yes/no) were scored. Intubations were scored as successful when the endotracheal tube was inserted in the trachea and the intubation attempt was finished within a three-minute timeframe. Failed attempts like unsuccessful intubation or oesophageal intubation and whether the registrar recognized this failed attempt were recorded.

Statistical analysis

Continuous variables are presented as mean ± standard deviation (sd). Categorical variables are reported as counts and percentages. To test for significant differences between the two groups we used the Student's t-test for continuous variables and the Fisher exact test for categorical variables. A wo-sided $P \leq 0.05$ was considered to indicate statistical significance.

Results

The group of participants consisted of 25 female and 14 male registrars in internal medicine of 29±3 years old, with no or negligible intubation experience. The mean duration of clinical experience as medical doctor was 1.7±1.0 years. All 39 participants performed two intubation attempts in an airway model using both the Macintosh laryngoscope and the GlideScope® video-laryngoscope. Eighteen of the 39 participants started with the Macintosh laryngoscope followed by the GlideScope® and 21 the other way round. The order in which the laryngoscopes were used did not affect intubation time or the intubation success rate. Furthermore, no effect of years of clinical experience as a medical doctor or estimated number of performed intubations in the past on intubation time was observed.

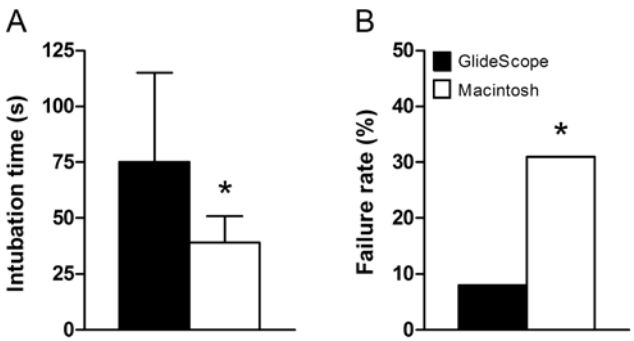
Intubation time using the Macintosh laryngoscope was 39±12 seconds (n=39) compared to 75±40 seconds (n=39) for the GlideScope® ($P<0.05$; *figure 1A*). However, more intubations failed within the three-minute time frame in the Macintosh group (12 out of 39 = 31%) compared to the GlideScope® group (3 out of 39 = 8%; $P<0.05$; *figure 1B*). All twelve unsuccessful intubations within the Macintosh group were identified as oesophageal intubations, of which only two were recognized as intubation failures by the participants. The three failed intubations in the GlideScope® group were due to exceeding the three minutes intubation attempt timeframe. Time needed for successful intubation was 35±10 seconds (n=27) in the Macintosh group and 66±24 seconds (n=36) using the GlideScope® ($P<0.05$).

Discussion

Endotracheal intubation is the preferred technique for securing an airway in compromised patients. Accordingly, the skill required to perform tracheal intubation is taught to both medical and paramedical healthcare professionals. Mulcaster et al. have shown that it takes approximately 50 intubations to acquire a 90% or higher success rate using direct laryngoscopy.[7] Taking into account that many of the trained health care professionals perform intubations infrequently, it would be beneficial to rely on a technique that is easy to learn, perform, and has a high success rate.

Our manikin study shows that the GlideScope® technique led to a higher intubation success rate in registrars in internal medicine inexperienced in performing laryngoscopy, compared to direct laryngoscopy. However, the time needed to successfully intubate was longer using the GlideScope® technique. This was consistent with another study that compared success rate and speed of intubation by novices

Figure 1A. Mean intubation time using the Macintosh laryngoscope (39±12 seconds, n=39, white bar) was shorter compared to the GlideScope® (75±40 seconds, n=39, black bar).
Figure 1B. More intubation attempts failed in the Macintosh group (12 out of 39 = 31%) compared to the GlideScope® group (3 out of 39 = 8%). * P<0.05 versus the GlideScope® group.



using the GlideScope® technique on manikins.[3] Nouruzi-Sedeh et al.[8] showed that medical personnel untrained in intubation were more successful in tracheal intubation of patients using the GlideScope compared to direct laryngoscopy, however, this study showed no difference in intubation time. It should be noted that these untrained personnel had already received manikin training for tracheal intubation in the past, which was likely to have a positive effect on intubation time. Another study also reported no difference in intubation time comparing the GlideScope® technique with direct laryngoscopy by novices on manikins;[9] this is in contrast to another study in which the GlideScope® technique was faster by novice personnel when compared to direct laryngoscopy.[10] A recent meta-analysis showed that the use of the GlideScope® video-laryngoscope is associated with improved glottis visualisation, particularly in patients with potential or simulated difficult airways.[3]

One of the limitations of our study is the fact that it is a manikin study and does not involve real-life patients. Airway management in critically ill patients is more difficult and likely to be associated with complications, especially in acute situations when accompanied by desaturation periods and aspiration.[11] With respect to this point, the airway model is not truly representative of an acute real-life situation. Another limitation of this study is the time frame of maximal three minutes which was used to perform a successful intubation. In an acute life threatening situation in critically ill patients you may not have a three minute time frame to attempt a successful intubation because of serious adverse events caused by hypoxemia during the attempt. Although the times required to perform airway interventions are generally quicker in a manikin model than in patients,[12] three out of 39 intubation attempts with the GlideScope® failed due to exceeding the three minutes allowed. With regard to this, we are unable to comment on how the results of this study could be extrapolated on patients in an acute life threatening situation. Therefore, larger studies with longer follow-up of skill improvement in patients during acute situations are needed to validate our results.

In conclusion, the use of a video-laryngoscope by inexperienced registrars in an airway manikin model appeared to be superior in terms of success rate. Although using the GlideScope® technique takes more time, a failed attempt might be more strenuous on a patient. Therefore, for health care professionals who need to acquire the skill to secure an airway but have limited time and infrequent exposure to do so, it may be advantageous to learn how to use a video assisted technique rather than the direct laryngoscope technique, which is still common practice. Currently, in our teaching level III ICU the fellows and residents who are not anaesthesiologists in training, are trained to use the GlideScope® primarily, and the GlideScope® technique has become the preferred method for intubations.

References

1. Benjamin FJ, Boon D and French RA. An evaluation of the GlideScope, a new video laryngoscope for difficult airways: a manikin study. Eur J Anaesthesiol. 2006;23:517-21.
2. Griesdale DE, Liu D, McKinney J and Choi PT. Glidescope(R) video-laryngoscopy versus direct laryngoscopy for endotracheal intubation: a systematic review and meta-analysis. Can J Anaesth. 2012;59:41-52.
3. Xanthos T, Stroumpoulis K, Bassiakou E, Koudouna E, Pantazopoulos I, Mazarakis A, et al. Glidescope((R)) videolaryngoscope improves intubation success rate in cardiac arrest scenarios without chest compressions interruption: a randomized cross-over manikin study. Resuscitation. 2011;82:464-7.
4. Platts-Mills TF, Campagne D, Chinnock B, Snowden B, Glickman LT and Hendey GW. A comparison of GlideScope video laryngoscopy versus direct laryngoscopy intubation in the emergency department. Acad Emerg Med. 2009;16:866-71.
5. Lim Y, Lim TJ and Liu EH. Ease of intubation with the GlideScope or Macintosh laryngoscope by inexperienced operators in simulated difficult airways. Can J Anaesth. 2004;51:641-2.
6. Lim TJ, Lim Y and Liu EH. Evaluation of ease of intubation with the GlideScope or Macintosh laryngoscope by anaesthetists in simulated easy and difficult laryngoscopy. Anaesthesia. 2005;60:180-3.
7. Mulcaster JT, Mills J, Hung OR, MacQuarrie K, Law JA, Pytka S, et al. Laryngoscopic intubation: learning and performance. Anesthesiology. 2003;98:23-7.
8. Nouruzi-Sedeh P, Schumann M and Groeben H. Laryngoscopy via Macintosh blade versus GlideScope: success rate and time for endotracheal intubation in untrained medical personnel. Anesthesiology. 2009;110:32-7.
9. Xanthos T, Bassiakou E, Koudouna E, Stroumpoulis K, Vlachos I, Johnson EO, et al. Inexperienced nurses and doctors are equally efficient in managing the airway in a manikin model. Heart Lung. 2011.
10. Malik MA, Hassett P, Carney J, Higgins BD, Harte BH and Laffey JG. A comparison of the Glidescope, Pentax AWS, and Macintosh laryngoscopes when used by novice personnel: a manikin study. Can J Anaesth. 2009;56:802-11.
11. Nolan JP and Kelly FE. Airway challenges in critical care. Anaesthesia. 2011;66 Suppl 2:81-92.
12. Gatward JJ, Thomas MJ, Nolan JP and Cook TM. Effect of chest compressions on the time taken to insert airway devices in a manikin. Br J Anaesth. 2008;100:351-6.