Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Decreased time to intubation by experienced users with a new lens-clearing video laryngoscope in a simulated setting

Keywords:
Video laryngoscopy
Difficult airway
Hyperangulated video laryngoscope
Intublade
GlideScope

Traditionally, direct laryngoscopy (DL) has been the preferred method to perform endotracheal intubations. Over the last two decades, however, video laryngoscopy (VL) has become increasingly prevalent not only in hospital-based environments but increasingly in pre-hospital and combat settings as well [1,2]. To date, there exist several studies that compare VL to DL in both pre-hospital and hospital settings with varied results, however not all uniformly show any of the VL systems to be superior to DL [3–9]. A known disadvantage of using VL is that the lens may become soiled while in the oropharynx, requiring the user to remove and clean the device [10–13]. This may prolong intubation times and result in increased attempts and desaturation [14–17].

A recently released video laryngoscope named Intublade® (IVL; Bear Creek Medical, Tampa, Florida, USA) was developed to help improve views during video laryngoscopy. The IVL is equipped with an internally placed saline-filled syringe and tubing that is aimed to spray directly onto the lens of the device, by control of the user, to remove contents obstructing the user's view. In this study, the IVL was compared to the GlideScope® Ranger which is a hyperangulated video laryngoscope (HVL), and DL, in a simulated setting.

We undertook a non-randomized, group-controlled trial that compared the performance of the DL, HVL, and IVL in both non-soiled and soiled simulated airway conditions to simulate difficult airway conditions that an operator may face during intubation.

After receiving an exemption from the Florida International University Institutional Review Board, 21 emergency medicine physicians participated in the study. Each emergency physician was given a standardized 15-min training session as well as an overview of the simulated soiled airway. For DL, participants were given a Macintosh blade size #4 and for both VL systems, users were provided a size #4 blade as well. Participants were provided an endotracheal tube size #7.5. Participants were then asked to intubate a high-fidelity airway manikin with each of the three intubation devices: DL, HVL, and IVL. After this, mock blood was then applied to the lenses of the video laryngoscopy systems, and additional intubations were then performed. For the simulated soiled airway, the participant was allowed to clear their visual field by their preferred means, including allowing the use of the liquid jet spray provided by the IVL system. Participants were given 90 s to complete an intubation attempt and successful intubations were defined as inflation of the lungs of the manikin. Participants were then given a Cormack-Lehane (CL) scoring sheet to score the views obtained after each intubation attempt (See Fig. 1.).

The primary outcome measure for this study was a comparison of the time needed for successful ETI in soiled airways for each device. The secondary outcome measures of the study were the glottic views of each device and time until successful ETI in clean airways.

Of the 21 physicians who participated in this study, 16 were EM residents and 5 were EM attendings. A total of 105 intubations were performed among the multiple scenarios and the results of these intubation attempts can be seen in Table 1. The mean amount of time for successful endotracheal intubation in the normal airway for DL was 17.5 s (SD of 7.1 s), for HVL was 26.3 s (SD of 19.3 s), and for IVL was 14.3 s (SD 5.1 s). One-way ANOVA comparing DL, HVL, and IVL shows there is a statistical difference among the groups ($p = 0.007$). In particular, average intubation times with IVL were 12 s faster than with HVL ($p = 0.008$). Upon directly comparing IVL and DL, no statistical difference in intubation time was found ($p = 0.09$). In the soiled airway scenario, the mean amount of time to ETI with IVL was 19.0 s (SD 9.3 s), and for HVL it was 28.6 s (SD of 11.3 s). A *t*-test comparing IVL and HVL for soiled airways shows the difference to be statistically significant ($p = 0.004$). Utilizing the CL score on established ranges from 1 to 4, the average score in the clean airway scenario for DL was 1.38, for HVL the average was 1.19, and for IVL it was 1.05. One-way ANOVA comparing the views of the scores obtained of each device showed that there was no statistical difference among the groups ($p = 0.14$). In the soiled-airway scenario, the average CL score for the HVL was 1.29 and for the IVL it was 1.19. A *t*-test comparing HVL and IVL shows no statistical difference between the views obtained ($p = 0.53$).

Thus, while we expected the IVL to be beneficial for soiled airways, we found faster intubation times with IVL as compared to the GlideScope® for normal and soiled airways. Given that we found no significant difference in the glottic views that the IVL obtained when compared to the HVL, it is possible that the difference in time was due to the difficulty of passing the tube through the cords with HVL. It is possible that results may have been different with a group of physicians more experienced using HVL.

The difference in intubation times we found between HVL and IVL was fairly small. A small reduction in intubation time like this may not be substantial in healthy patients undergoing anesthesia in the operating room, however, patients that are undergoing emergent intubations have been shown to desaturate more rapidly than their healthy counterparts [18]. This becomes even more significant in patients with

https://doi.org/10.1016/j.ajem.2021.02.028
0735-6757/

Please cite this article as: A. Napier and T. Zitek, , American Journal of Emergency Medicine, https://doi.org/10.1016/j.ajem.2021.02.028

CORMACK-LEHANE CLASSIFICATION

Grade 1: Full view of the glottis

Grade 2: Partial view of the glottis

Grade 3: Only epiglottis seen, none of the glottis seen

Grade 4: Neither glottis nor epiglottis is seen

Fig. 1. Cormack-Lehane score. Cormack-lehane classification. Grade 1: Full view of the glottis. Grade 2: Partial view of the glottis. Grade 3: Only epiglottis seen, none of the glottis seen. Grade 4: Neither glottis nor epiglottis is seen.

Table 1
Intubation time, intubation attempts, Cormack-Lehane grade.

	Macintosh(n = 21)	Hyperangulated VL (n = 21)	Intublade® (n = 21)	*P*-value
Intubation time (s)				
Clean airway (s)	17.55 (13.1–20.9)	26.3 (13.6–32.9)	14.3 (10.7–16.7)	0.0007
Soiled airway (s)	–	28.6 (20.8–34.6)	19 (12–27.2)	0.004
Mean number of intubation attempts				
Clean airway	1.0	1.0	1.0	1
Soiled airway	–	1.1	1.0	0.32
Cormack-Lehane grade, 1/2/3/4				
Clean airway	16/3/1/1	17/4/0/0	20/1/0/0	0.14
Soiled airway	–	16/4/1/0	17/4/0/0	0.53

severe traumatic injuries as it has been demonstrated that minor changes in their oxygenation are poorly tolerated [19]. As such, the IVL should be further evaluated in clinical settings to compare its effectiveness to other methods of video laryngoscopy.

In summary, a statistically significant reduction in time for successful ETI in a group of emergency medicine physicians was noted with the Intublade® video laryngoscope (IVL) when compared to a hyperangulated video laryngoscope (HVL) in both normal and soiled airways in a simulated setting. Additional study of the IVL is warranted in clinical settings.

IRB exemption number

IRB-20-0005 (Florida International University Institutional Review Board).

Financial sources

None.

Declaration of Competing Interest

AN is the inventor on a patent (filing number: 16/352723) that is filed or issued by the United States Patent and Trademark Office relevant to the material in this paper.

References

[1] Brown 3rd CA, Bair AE, Pallin DJ, Walls RM, NEAR III Investigators. Techniques, success, and adverse events of emergency department adult intubations. Ann Emerg Med. 2015;65:363–70 (e1).
[2] Zaouter C, Calderon J, Hemmerling TM. Videolaryngoscopy as a new standard of care. Br J Anaesth. 2015:181–3. https://doi.org/10.1093/bja/aeu266.
[3] Levitan RM, Heitz JW, Sweeney M, Cooper RM. The complexities of tracheal intubation with direct laryngoscopy and alternative intubation devices. Ann Emerg Med. 2011:240–7. https://doi.org/10.1016/j.annemergmed.2010.05.035.
[4] Jiang J, Ma D, Li B, Yue Y, Xue F. Video laryngoscopy does not improve the intubation outcomes in emergency and critical patients–a systematic review and meta-analysis of randomized controlled trials. Crit Care. 2017;21:288.
[5] Healy DW, Maties O, Hovord D, Kheterpal S. A systematic review of the role of videolaryngoscopy in successful orotracheal intubation. BMC Anesthesiol. 2012;12:32.
[6] Nouruzi-Sedeh P, Schumann M, Groeben H. Laryngoscopy via macintosh blade versus GlideScopeSuccess rate and time for endotracheal intubation in untrained medical personnel. Anesthesiology. 2009;110:32–7.
[7] Mosier JM, Whitmore SP, Bloom JW, Snyder LS, Graham LA, Carr GE, et al. Video laryngoscopy improves intubation success and reduces esophageal intubations compared to direct laryngoscopy in the medical intensive care unit. Crit Care. 2013;17:R237.
[8] Lascarrou JB, Boisrame-Helms J, Bailly A, Le Thuaut A, Kamel T, Mercier E, et al. Video laryngoscopy vs direct laryngoscopy on successful first-pass orotracheal intubation among ICU patients. JAMA. 2017:483. https://doi.org/10.1001/jama.2016.20603.
[9] Driver BE, Prekker ME, Moore JC, Schick AL, Reardon RF, Miner JR. Direct versus video laryngoscopy using the C-MAC for tracheal intubation in the emergency department, a randomized controlled trial. Acad Emerg Med. 2016;23:433–9.
[10] Lockey DJ, Healey B, Crewdson K, Chalk G, Weaver AE, Davies GE. Advanced airway management is necessary in prehospital trauma patients. Br J Anaesth. 2015:657–62. https://doi.org/10.1093/bja/aeu412.
[11] Naito H, Guyette FX, Martin-Gill C, Callaway CW. Video laryngoscopic techniques associated with intubation success in a helicopter emergency medical service system. Prehosp Emerg Care. 2016;20:333–42.
[12] Lockey DJ, Avery P, Harris T, Davies GE, Lossius HM. A prospective study of physician pre-hospital anaesthesia in trauma patients: the rate of oesophageal intubation, gross airway contamination and the value of the "quick look" airway assessment. Scand J Trauma Resuscit Emerg Med. 2013. https://doi.org/10.1186/1757-7241-21-s1-s26.
[13] Wong E, Ng Y-Y. The difficult airway in the emergency department. Int J Emerg Med. 2008;1:107–11.
[14] Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S. 3,423 emergency tracheal intubations at a university hospital airway outcomes and complications. Anesthesiology. 2011;114:42–8.
[15] Mort TC. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. Anesth Analg. 2004;99:607–13 (table of contents).
[16] Schwartz DE, Matthay MA, Cohen NH. Death and other complications of emergency airway management in critically ill adults. A prospective investigation of 297 tracheal intubations. Anesthesiology. 1995;82:367–76.
[17] Hasegawa K, Shigemitsu K, Hagiwara Y, Chiba T, Watase H, Brown 3rd CA, et al. Association between repeated intubation attempts and adverse events in emergency departments: an analysis of a multicenter prospective observational study. Ann Emerg Med. 2012;60:749–54 (e2).
[18] Farmery AD. Simulating hypoxia and modelling the airway. Anaesthesia. 2011;66 (Suppl. 2):11–8.
[19] Davis DP, Hwang JQ, Dunford JV. Rate of decline in oxygen saturation at various pulse oximetry values with prehospital rapid sequence intubation. Prehosp Emerg Care. 2008;12:46–51.

Andrew Napier M.D.
aDepartment of Emergency Medicine, Regional Medical Center of San Jose, San Jose, CA, United States of America
*Corresponding author at: 225 N. Jackson Ave., San Jose, CA 95116, United States of America.
E-mail address: andrewnapiermd@gmail.com

Tony Zitek M.D.
bNova Southeastern University, Dr. Kiran C. Patel College of Allopathic Medicine, Fort Lauderdale, FL, United States of America

2 February 2021
Available online xxxx