Assessment of the Storz Video Macintosh Laryngoscope for Use in Difficult Airways: A Human Simulator Study

Aaron E. Bair, MD, MSc, Kalani Olmsted, MD, Calvin A. Brown III, MD, Tobias Barker, MD, Daniel Pallin, MD, MPH, and Ron M. Walls, MD

Abstract

Objectives: Video laryngoscopy has been shown to improve glottic exposure when compared to direct laryngoscopy in operating room studies. However, its utility in the hands of emergency physicians (EPs) remains undefined. A simulated difficult airway was used to determine if intubation by EPs using a video Macintosh system resulted in an improved glottic view, was easier, was faster, or was more successful than conventional direct laryngoscopy.

Methods: Emergency medicine (EM) residents and attending physicians at two academic institutions performed endotracheal intubation in one normal and two identical difficult airway scenarios. With the difficult scenarios, the participants used video laryngoscopy during the second case. Intubations were performed on a medium-fidelity human simulator. The difficult scenario was created by limiting cervical spine mobility and inducing trismus. The primary outcome was the proportion of direct versus video intubations with a grade I or II Cormack-Lehane glottic view. Ease of intubation (self-reported via 10-cm visual analog scale [VAS]), time to intubation, and success rate were also recorded. Descriptive statistics as well as medians with interquartile ranges (IQRs) are reported where appropriate. The Wilcoxon matched pairs signed-rank test was used for comparison testing of nonparametric data.

Results: Participants (n = 39) were residents (59%) and faculty. All had human intubation experience; 51% reported more than 100 prior intubations. On difficult laryngoscopy, a Cormack-Lehane grade I or II view was obtained in 20 (51%) direct laryngoscopies versus 38 (97%) of the video-assisted laryngoscopies (p < 0.01). The median VAS score for difficult airways was 50 mm (IQR = 28–73 mm) for direct versus 18 mm (IQR = 9–50 mm) for video (p < 0.01). The median time to intubation in difficult airways was 25 seconds (IQR = 16–44 seconds) for direct versus 20 seconds (IQR = 12–35 seconds) for video laryngoscopy (p < 0.01). All intubations were successful without need for an invasive airway.

Conclusions: In this simulation, video laryngoscopy was associated with improved glottic exposure, was perceived as easier, and was slightly faster than conventional direct laryngoscopy in a simulated difficult airway. Absence of secretions and blood limits the generalizability of our findings; human studies are needed.

ACADEMIC EMERGENCY MEDICINE 2010; 17:1134–1137 © 2010 by the Society for Academic Emergency Medicine

Keywords: endotracheal intubation, video laryngoscopy, difficult airway management
with an 80-degree visualization field (45 degrees beyond what is routinely obtained with direct laryngoscopy). However, intubating the trachea using video laryngoscopy requires the operator to look at the screen rather than directly at the vocal cords during tube insertion. This can make tube passage challenging despite adequate visualization and has been reported as an issue with the GlideScope video laryngoscope. However, the GlideScope (Verathon, Inc., Bothell, WA) has different geometry, which might contribute to difficulty with tube passage in some airways.\(^4\) We hypothesized that use of the Storz video Macintosh would result in improved glottic exposure as well as ease of intubation when compared to conventional direct laryngoscopy in a simulated difficult airway.

**METHODS**

**Study Design**

This was a prospective, nonrandomized trial at two academic centers. Written informed consent was obtained from all participants, and this study was approved by the institutional review boards of both institutions.

**Study Setting and Population**

A convenience sample of emergency medicine (EM) residents and faculty were eligible if they had performed at least three standard intubations in the emergency department (ED); residents had to also have completed their anesthesia training, which included 50–80 intubations in the operating room. Experience with video laryngoscopy was not required. Participation was voluntary, and no volunteer participants were excluded.

**Study Protocol**

Participants intubated medium-fidelity human airway simulators (AirMan, Laerdal, Wappingers Falls, NY) with rigid teeth inserts in place. Each participant was allowed unstructured time to become familiar with the manikin (without difficult feature activation) and the video laryngoscope. Each participant performed the same three intubations. The first was a normal airway with direct laryngoscopy only. The second was a difficult airway simulation (maximal cervical spine stiffness and trismus), managed with direct laryngoscopy only. The third was the same difficult airway simulation (maximal cervical spine stiffness and trismus), managed with video laryngoscopy. A standard 7.0 cuffed endotracheal tube with standard stylet was used for all intubations.

Direct laryngoscopy was performed using the Macintosh blade of the videolaryngoscope with the screen shielded from the intubator (but visible to the investigator). A single investigator recorded the Cormack-Lehane grade of glottic view seen on the screen while the participant recorded the grade of view with direct laryngoscopy (in the direct only scenarios). Various adjuncts were made available to participants: bougie, a Miller blade, an intubating laryngeal mask airway, and the option of cricothyrotomy.

**Measures**

The direct and video views were compared, with the main outcome measure being the proportion of grade I and II Cormack-Lehane views for direct versus video laryngoscopy. This variable is important as Cormack-Lehane grade I/II airways are associated with higher intubation success rates.

**Ease of Intubation.** Each participant was asked to indicate the overall difficulty of intubation at the conclusion of each scenario using a 10-cm visual analog scale (VAS) with the lowest score indicating the least difficulty.

**Time to Intubation.** During each intubation trial, the investigator recorded the time to intubate and total number of attempts. The time to intubate was recorded from when the blade passed the lips to insufflation of air into the lungs as indicated by chest rise of the manikin. An attempt was defined as insertion and removal of the laryngoscope from the mouth.

**Data Analysis**

A 25% reduction in the VAS was considered to be clinically significant. With a standard deviation of 1.0, alpha = 0.05, and beta = 0.20, the calculated sample size to power the study was 24 subjects. All statistical calculations were performed with Stata 8.0 (StataCorp, College Station, TX). We used the Wilcoxon matched pairs signed-rank test for comparison testing of nonparametric data. We report the primary outcome data using medians and interquartile ranges (IQRs).

**RESULTS**

Thirty-nine participants (16 attending physicians and 23 residents) were recruited from two academic institutions. Fifty-one percent reported more than 100 prior intubations. Familiarity with video laryngoscopy ranged from none to a limited degree of experience with the majority (62%) of participants reporting some experience (one to two prior intubations). Nine participants indicated that they had more than three intubations using the video Macintosh, and six participants had no prior experience with video Macintosh laryngoscopy.

In the difficult scenario, a Cormack-Lehane grade I or II view was obtained in 20 of the direct laryngoscopies (51%) versus 38 of the video laryngoscopies (97%; \( p < 0.01\)). Figure 1 displays the relative change in grade of view among providers in the difficult airway scenario.

The VAS for ease of use revealed a median for the difficult direct-laryngoscopy-only scenario was 50 mm (IQR = 28–73 mm) versus 18 mm (IQR = 9–50 mm) in the difficult scenario with video laryngoscopy \((p < 0.01)\) and 12 mm (IQR = 9–50 mm) in the normal airway scenario.

For the difficult scenario with direct laryngoscopy only, the time required for intubation was 25 seconds (IQR = 16–44 seconds) versus 20 seconds (IQR = 12–35 seconds) for the difficult scenario using video laryngoscopy \((p < 0.01)\). For the normal airway scenario, the mean time to intubation (with direct laryngoscopy) was 20 seconds (IQR = 15–32 seconds). All intubations were ultimately successful. No participant resorted to cricothyrotomy.
DISCUSSION

Video laryngoscopy is used commonly by anesthetists, and most of the literature reporting improved laryngoscopic views and ease of intubation relates to operating room performance. Video laryngoscopy is becoming more accessible to emergency physicians (EPs), yet whether these performance characteristics translate to emergency patients remains unclear. One recent study performed in the ED setting did not demonstrate an improvement in first-pass intubation success using the GlideScope system. GlideScope laryngoscopy, however, is different from video Macintosh laryngoscopy in both laryngoscope mechanics and tube passage. Since the video Macintosh blade has similar geometry to a standard Macintosh blade, laryngoscopy can be performed in a familiar fashion. Additionally, the angle of approach to the glottis can be straighter than with the GlideScope and this may make tube passage easier.

In our simulator-based study we found that video laryngoscopy using the Storz video Macintosh laryngoscope in the hands of EPs was associated with an improved glottic view for a particular type of difficult intubation. Additionally, video-assisted intubation was perceived as easier and was performed slightly faster. Although direct extrapolation to difficult airways in EM practice requires caution, these findings suggest an improvement over direct laryngoscopy in certain difficult airway scenarios.

LIMITATIONS

Blood, vomit, and secretions in the airway are likely to impair video laryngoscopy more than direct laryngoscopy, and thus our manikin-based results may not generalize to humans, especially trauma victims. However, use of manikins in this context is an accepted model for testing new airway devices that can provide consistency between attempts and among providers. Additionally, we chose to have participants perform the intubations in sequential rather than random order to limit the variability of a given sequence on learning. However, we acknowledge that this design of consistent sequential intubations may favor each subsequent intubation. In our study, the sequence may have favored video laryngoscopy attempts.

The heterogeneity of experience in our study population must also be acknowledged. While our population was mixed among attending and resident physicians...
with different intubation experience, each intubator served as his or her own control. While this may limit the generalizability of our conclusions, we do not feel that this limits the validity of our findings.

CONCLUSIONS

Use of video Macintosh laryngoscopy in the hands of EM faculty and residents was associated with improved glottic exposure, was perceived as easier, and was slightly faster than conventional direct laryngoscopy in a simulated difficult airway.

References