A Prospective, Feasibility Assessment of a Novel, Disposable Video Laryngoscope With Special Operations Medical Personnel in a Mobile Helicopter Simulation Setting

Steven G. Schauer, DO, MS*; Jessica Mendez, BS2; Nguvan Uhaa, LVN3; Ian L. Hudson, DO, MPH4; Wells L. Weymouth, MD5

ABSTRACT

Background: Video laryngoscopy (VL) is shown to improve first-pass success rates and decrease complications in intubations, especially in novice proceduralists. However, the currently fielded VL devices are cost-prohibitive for dispersion across the battlespace. The novel i-view VL is a low-cost, disposable VL device that may serve as a potential solution. We sought to perform end-user performance testing and solicit feedback. Methods: We prospectively enrolled Special Operations flight medics with the 160th Special Operations Aviation Regiment at Hunter Army Airfield, Savannah, Georgia. We asked them to perform an intubation using a synthetic cadaver model while in a mobile helicopter simulation setting. We surveyed their feedback afterward. Results: The median age of participants was 30 and all were male. Of those, 60% reported previous combat deployments, with a median of 20 months of deployment time. Of the 10, 90% were successful with intubation, with 60% on first-pass success with an average of 83 seconds time to intubation. Most had a grade 1 view. Most agreed or strongly agreed that it was easy to use (70%), with half (50%) reporting they would use it in the deployed setting. Several made comments about the screen not being bright enough and would prefer one with a rotating display. Conclusions: We found a high proportion of success for intubation in the mobile simulator and a high satisfaction rate for this device by Special Operations Forces medics.

KEYWORDS: i-view; medic; airway; intubation; flight; helicopter; laryngoscopy

Introduction

Airway compromise is the second leading cause of preventable death in the prehospital setting.1,2 Endotracheal intubation (ETI) is a crucial skill for prehospital medical personnel, especially during the Role 1 phase of care, in which critical interventions are likely to have the largest impact. Part of the Role 1 phase of care includes the initial transport of casualties from the point-of-injury (POI) to a battalion aid station or forward-staged surgical teams. Airway management is the first priority in the hospital setting in trauma patients who are unable to protect their airway, according to Advanced Trauma Life Support guidelines.3 However, historically, ETI by direct laryngoscopy has been hindered by suboptimal success rates (72–89%) in several studies, which is most pronounced in the prehospital setting.4–6

The widespread use of VL in the early 2000s offered a new intubation modality. This was put in place to address this critical capability gap to reduce complications, including better first-pass success. VL allows the operator to view the airway anatomy indirectly through a camera that projects onto a monitor.7,8 Observational evidence suggests that first attempt ETI success is higher with VL compared to direct laryngoscopy (DL), which is particularly noted among operators with less airway management experience. Many of the military end users share this characteristic such as Special Operations medics that may be intubating at or near the POI, including en route to forward stage resuscitation teams.9,10 Special Operations combat medics and flight paramedics are unique compared the basic 68W combat medic in their training specific to ETI. This is because they undergo the Special Operations Combat Medic Course, which trains in advanced procedures and enables them to sustain a casualty for up to 72 hours. That course includes approximately 21.5 hours of ETI training (1.5 hours didactic, 20 hours practice course, personal communication with COL Cord Cunningham, previous program director). VL offers a potential benefit for improved airway management in these settings, particularly flight personnel where procedures have the additional technical challenges of performing them during transport. Supplying all Role 1 and 2 facilities with VL equipment commonly used in US emergency departments, such as the currently fielded Glidescopes (Verathon; www.verathon.com/glidescopes), is not logistically possible due to the cost of the device, power supply requirements, and periodic maintenance/repairs of this equipment at far forward locations. The US Army currently fields the Glidescopes to the forward surgical teams and the emergency/operating rooms of Combat Support Hospitals (with conversion into the new Field Hospital model) at a cost of $12,292.67 each (National Supply Number 6515-01-572-7262). A new disposable, single-use video laryngoscope is on the market – the i-view (Intersurgical; https://us.intersurgical.com/info/iview) – at a cost of approximately $100–$200 per unit (Figure 1). Given that this single-use device does not require maintenance and power sources, the i-view offers a potential opportunity to bring VL technology to Role 1 and 2 facilities. Furthermore, the i-view as an expendable item

*Correspondence to 3698 Chambers Pass, JBSA Fort Sam Houston, TX 78234; or Steven.G.Schauer.mil@mail.mil
1MAJ Steven G. Schauer, 2Jessica Mendez, 3Nguvan Uhaa, and 4MAJ Ian L. Hudson are affiliated with the US Army Institute of Surgical Research, JBSA Fort Sam Houston, TX. MAJ Schauer and MAJ Hudson are also affiliated with the Brooke Army Medical Center, JBSA Fort Sam Houston. MAJ Schauer is additionally affiliated with the 59th Medical Wing, JBSA Fort Sam Houston, and Uniformed Services University of the Health Sciences, Bethesda, MD. 5CPT Wells L. Weymouth is with the 160th Special Operations Aviation Regiment, Hunter Army Airfield, GA.
offers additional benefits with respect to US military property accountability and reporting.

**Goals of the Investigation**

We obtained end-user performance and survey feedback on the i-view video laryngoscope as a potential solution for improving intubations during flight transport.

**Methods**

**Ethics**

The US Army Institute of Surgical Research regulatory office reviewed protocol H-19-029 and determined it was exempt from Institutional Review Board oversight. This office approved a consent documentation waiver; we provided consent information sheets along with a briefing. We obtained approval from their chain of command prior to recruiting.

**Subjects and Setting**

We enrolled flight medics and flight medical officers at the with the 3rd Battalion 160th Special Operations Aviation Regiment (SOAR) at Hunter Army Airfield in Savannah, Georgia. The medical personnel completed their initial entry training and were assigned to the unit full-time.

**Protocol**

We worked with the battalion surgeon (WLW) and set up a date and time for enrollment. An emergency medicine physician study team member provided a demonstration of intubation using the i-view (Figure 1) on the SynDaver (www.syndaver.com) airway trainer model (Figure 2), along with a brief overview of troubleshooting an ETI while using the i-view. All participants utilized a cuffed 7.0 or 7.5 endotracheal tube and could use a flexible stylet, rigid stylet, or bougie based on personal preference. The medics were in the simulation trainer which was pulled behind a vehicle at 15–25 miles per hour to simulate movement of flight (supplemental Figure 1, supplemental Figure 2, supplemental Figure 3). Participants were given a verbal patient care scenario involving management of an urgent, wounded casualty requiring various interventions but culminating in the indication to intubate. Time started when the participant touched the SynDaver as part of the ETI procedure, and time was stopped when they indicated the procedure was complete. The proctor for the simulation would provide verbal prompts as the participants progressed on when the airway indication was present and changes in vital signs as the time elapsed. An emergency medicine board-certified physician team member assessed the intubation as success or failure. We defined success as the endotracheal tube inserted into the trachea to an appropriate depth. We recorded every time they inserted and removed the endotracheal tube from the oral cavity as an attempt. Participants evaluated their view of airway anatomy utilizing the Cormack-Lehane grading system.11 After completing the procedure, participants

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**FIGURE 1** Example of the i-view video laryngoscope used in this study.

**FIGURE 2** Image of the SynDaver airway trainer used in this study.

**SUPPLEMENTAL FIGURE 1** Flight simulator with dual patient setup.

**SUPPLEMENTAL FIGURE 2** Flight simulator.
filled out a demographic worksheet and survey composed of 5-point Likert items to assess end user appraisal of the i-view.

Data Analysis
We performed all analyses using Microsoft Excel (version 10, Redmond, Washington) and JMP Statistical Discovery from SAS (version 13, Cary, NC). We used descriptive statistics. Continuous variables are presented as means and 95% confidence intervals, ordinal variables as medians and interquartile ranges, and nominal variables as percentages and numbers.

Results
Over the course of one day, we enrolled 10 medical personnel into our study assessing the feasibility of this novel, disposable, i-view VL device in a mobile helicopter simulator. Nearly all were able to intubate with only one intubation failure noted during the study and was related to a consistent approach that was too deep for the relatively shallow and anterior Syndaver airway model used. While we believe this is one of the better airway models on the market, in comparison to our experiences as emergency physicians, the airway is shallower and more anterior than the typical military-aged male. Of note, the preparation time was minimal, and none had used the device before. We believe the success proportion would likely have been all 10 had we provided more significant training before use and the medics had more advanced training with the device. We were seeking to determine whether this device could readily enter the supply chain for rapid implementation – it is likely that some device-specific training would be needed within this population that does not routinely do intubations, with the exception of the only flight medical officer enrolled.

Of most interest to us was the feedback we received on the device as part of the free text comments. There appears to be a preponderance of flight medical personnel requesting that the device have several features to significantly enhance the device for deployed, flight medicine use. Based on their comments, they would like to see the manufacturer develop a military-specific version that includes the following:

1. A collapsible design that would allow it to be easier to store within the equipment storage bags used during flight and other transport mediums.
2. A brighter screen with better contrast – we used these devices during the daytime in the flight simulator and it appears that the bright light from the sun caused some difficulty with visualization.
3. A rotating screen would allow for ease of use in the setting of a space-confined area such as a helicopter or truck. In this setting, the operator is not standing at the head of the bed as the intubating operator may be in the hospital-based setting. The airway may be managed from an angle or even from the side depending on the height of the patient (Supplemental Figure 3).

Our study has several limitations that we must consider. First, our sample size was relatively small with only 10 subjects. However, we must note that accessing operational medical personnel, especially within the Special Operations Command (SOCOM), is challenging with their extensive operational requirements including training and deployment time. As such, our sample size was limited for this reason. Our study was primarily scoped as a pilot, proof-of-concept study. Second, the training for this study was minimal. We provided a brief training opportunity before the enrollment; however, this is not inconsistent with the reality of operational medicine as the need to perform a procedure may be removed by months from the last training on the device or procedure. It appears, as previously stated, that device-specific training for skills attainment and sustainment would be optimal. Last, we did not have a control arm and thus our study was strictly observational.
These medics do not routinely have access to VL technology so we did not believe that it would be appropriate to compare to another device they do not have routine access to. Given the challenges associated with accessing Special Operations medics, we could not get access to a large enough number of participants to support a cross-over design study comparing to direct laryngoscopy. Moreover, this was our first such study in this setting, and we were seeking to demonstrate feasibility of such studies involving the intended end-users in this simulation platform. While we could have performed serial iterations of enrollment with the same participants, we were seeking to determine how well the device performed in those with minimal to no experience. Thus, such repeat iterations would have created a learning effect with likely increasing skills as the iterations progressed. To this end, we are launching a clinical study as part of the overall military funded effort comparing the i-view to the more established reusable VL technologies, including the previously cited GlideScope. Our clinical study will address additional challenges, such as the previously documented injuries secondary to VL use, that cannot be assessed when using a mannequin platform. We must also note limitations with using simulation models. Future studies using more realistic models, such as cadavers, would be beneficial. Additional challenges, such as airway debris (e.g., blood, vomit, etc.) and anatomical disruptions would further enhance the realism of the procedure.

Conclusions
We found a high proportion of success for intubation in the mobile simulator and a high satisfaction rate for this device by Special Operations Forces medics. We demonstrate the feasibility to collaborate with the US Army Medical Research and Development Command funded airway research with Special Operations medical forces. A clinical trial is needed to validate the use of this device before fielding is recommended.

Ethics
The US Army Institute of Surgical Research regulatory office reviewed protocol H-19-029 and determined it was exempt from Institutional Review Board oversight.

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Conflicts
The authors have no conflicts of interest to disclose.

Authorship Statement
SGS is the principal investigator and was involved in all aspects of this study. JM and NU are study coordinators that participated in protocol development, data collection, data aggregation, and critical revisions of the manuscript. ILH is an associate investigator and participated in data collection and critical revisions of the manuscript. WLW is the unit flight surgeon that coordinated access to the medical personnel and participated in critical revisions of the manuscript. All authors contributed substantially to this study and accept responsibility for publication.

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