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Research Article

A Prospective Randomized Comparison Between the Glidescope® Ranger Single use Video Laryngoscope and Direct Vision Laryngoscopy (DVL) by Skilled Providers for Urgent and Emergent Intubation Outside the Operating Room

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Abstract

Objective: The objective of our study was to discover if skilled anesthesia residents, clincal training years CA-2 and higher, would realize the same benefits lay providers and non-anesthesioligist physicians do with the Glidescope® for difficult intubations.

Design: Over a three month period, experienced anesthesia residents intubated 85 consecutive patients on request in an emergency context. Each patient was randomized to have either DVL or Glidescope® Video Laryngoscopy (GVL).

Setting: The study was conducted at Virginia Commonwealth University Medical Center, a large urban trauma center. All intubations were performed outside the operating room.

Patients: 85 patients participated in the study and consisted of any adult patient outside the peri-operative area in need of urgent or emergent intubation of the trachea.

Interventions: Patients were either intubated with a direct vision technique or with the Glidescope® Ranger Single use.

Measurements: Data recorded included apnea time in seconds, Cormack and Lehane grade of view, number of intubation attempts, and complications.

Main Results: Apnea times did not differ significantly between groups (p=0.20) with DVL averaging 25.9 seconds (95% CI 20.9-31.0) and GVL is averaging 30.4 seconds (95% CI 25.8-35.0). A Mann-Whitney test comparing grade of view between groups showed that GVL performed significantly better (p=0.02). The first attempt success rate for the DVL group was 94.7% (95% CI 87.6-100%) and the GVL group 86.1% (95% CI 75.1-97.1%). This difference was not significant (Phi=-0.16, p=0.26). Number of attempts at intubation also did not differ significantly between study conditions (p=0.52).

Conclusions: In the hands of skilled anesthesia residents there are no differences in apnea time, number of attempts, or first attempt success rates between GVL and DVL groups. Cormack and Lehane grade of view however, was improved in the GVL group. Skilled anesthesia providers in this context do not realize the same benefits of video laryngoscopy over DVL that non-anesthesiologist providers do.

Keywords: Laryngoscopy; Critical care; Airway management; Intubation; Laryngoscopes; Difficult airway

Introduction

Intubating patients outside of the operating room emergently can be very challanging due to positioning of the patient, movement during a resucitation, and or patient factors such as having a full stomach. Even expert providers often find an unstable patient in a less than desirable intubation position and at the center of an active resuscitation effort. In a recent prospective study examining 3,423 emergent non-operating room intubations, difficult intubation was identified in 10.3% of patients with a complication rate of 4.2% [1]. In spite of this obvious challenge, no study has examined the potential benefit of using a portable video laryngoscope by an anesthesia staffed airway team performing these out-of-operating room (OR) emergency

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intubations. Video laryngoscopy has become progressively more common as the initial means of intubation over the last decade. As devices have been developed they have become more portable. Many studies have examined the role of the video laryngoscope for routine intubation and in simulated difficult airways, but few have examined its use on real patients prospectively, in emergent situations, and specifically in the hands of skilled operators. Further, no studies have examined the portable GlideScope® Ranger Single Use (Verathon Medical, USA) in the emergent setting. The GVL has emerged as one of the most popular devices; however, most studies examining the GlideScope® have focused on its ease of use among novice operators on simulated patients [2-5]. Studies that examined its use by skilled providers have either been under controlled conditions in the operating room or in simulation [6-8]. The portable GVL Ranger Single Use has been less studied with only one manikin study showing promise in the pre-hospital setting for entrapped patients [9]. More importantly, only one prospective observational study examined the use of the GVL for airway emergencies on real patients [10]. More recently a non-randomized study utilizing a historical cohort of DVL intubations in comparison with GVL intubations performed by pulmonary critical care fellows in the medical intensive care unit showed that GVL was superior with regards to first attempt success and incidence of complications to DVL in the hands of non-anesthesia trained physicians [11].

GVL studies have shown improvement in Cormack and Lehane grade of view over conventional Direct Vision Laryngoscopy (DVL) [10]. In the patient population requiring rapid intubation under poor intubating conditions, a favorable grade of view is vital for optimal intubation success.

We wished to determine if the same benefits of video laryngoscopy found by operators other than anesthesia personnel would also be realized by physicians proficient in airway management in the context of critically ill patients with presumed difficult airways. We hypothesized that our senior anesthesia residents would obtain better Cormack and Lehane views with the GVL. We also hypothesized that, unlike novice providers, no difference would exist between DVL and video laryngoscopy where success rate and time to intubation were concerned.

Materials and Methods

Prior to beginning this study Institutional Review Board (IRB) approval was obtained. A waiver of consent from human subjects was granted by the IRB due to the emergent necessity of intubation and thereby the inappropriate risk that obtaining consent would pose. The study population consisted of any adult patient in need of urgent or emergent intubation as determined by the referring service and the anesthesia personnel responding to the request. Persons excluded included: anyone under 18 years of age, patients in the preoperative ward, operating room and post anesthesia care unit, prison inmates, pregnant women, and patients with known contraindications to direct vision laryngoscopy such as those requiring awake intubation or nasal intubation. Other exclusions included extenuating circumstances not within the proceduralist's control that may preclude a fair comparison of the devices.

The study was carried out by the anesthesia consult service at Virginia Commonwealth University Hospital. This service consists of anesthesia residents in their second and third year of clinical anesthesia training under attending anesthesiologist supervision who respond to requests for intubation outside the peri-operative care area. Examples of the care areas involved include: Intensive care units, the emergency department, and cardiopulmonary arrest situations on the wards or in clinics. The participating residents had previously demonstrated intubation competence with both conventional DVL as well as intubation with the GVL. Two Glidescope® Ranger Single Use video laryngoscopes (Verathon Inc., Bothell, WA, USA) and disposable blades were supplied by the company.

A random number generator was utilized to randomize subjects to either DVL or video laryngoscopy. Data collected by the intubating provider included: apnea time (defined as the commencement of the intubating process signified by either removal of bag-valve-mask in the case of full arrest requiring cardiopulmonary resuscitation or induction of apnea in the spontaneously ventilating patient requiring relaxants or induction agents until confirmation of endotracheal tube placement by end tidal CO2 color change), Cormack and Lahane grade of view, number of intubation attempts, use of rescue devices, and any complications. When DVL was randomly assigned, the resident was permitted to use either a Macintosh or Miller blade. Our rationale for this was that CA-2-3 residents have demonstrated proficiency with both Macintosh and Miller blades but individuals may prefer one or the other. The best chance for successful DVL is when the operator can use the blade they are most facile with and which is most approriate for the given situation.

Data analysis was performed using Minitab 16.1.1. Data are expressed as mean ± standard deviation for continuous variables or median in the case of ordinal values. The Two-Sample t-test was used to compare apnea time. A Mann-Whitney test was used to compare grade of view for the first attempt at intubation and number of attempts at intubation. Fisher's Exact Test was used to compare first attempt success rate. A P value of <0.05 was considered significant throughout our analyses.

Results

A total of 85 consecutive patients were studied although intubation method failed to be recorded for 4 patients. Of the 81 remaining cases, 40 had an initial attempt at intubation by DVL, and 41 by GVL. The overall mean apnea time was 35.6 seconds (Quartile1 = 15.0 seconds, Quartile 3 = 39.8 seconds). Outlier analysis revealed 4 subjects with apnea times (83, 116, 152, and 360 seconds) more than two standard deviations away from the mean. These subjects included two patients with emesis in the airway subsequently suctioned (both GVL), one with light source failure (DVL), and one with an exhausted battery (GVL) (Table 1).

The mean apnea time for intubation with DVL was 25.9 seconds (95% CI 20.9-31.0) and GVL 30.4 (95% CI 25.8-35.0). Two Sample t-test between the DVL and GVL groups failed to detect a significant difference between the mean apnea times ($T = 1.29$, $p = 0.200$).

The median grade of view for the first attempt at intubation was I for both DVL and GVL groups. Table 2 summarizes the distribution of data. Closer examination of the distributions around the median via a Mann-Whitney test showed a significant difference in grade of view between the DVL and GVL groups ($W = 1200$, $p = 0.0199$).

Table 1: Comparison of apnea time between Direct Visual Laryngoscopy (DVL) and Glidescope® (GVL) groups.

Group (N/Missing/ Outliers)	Mean Apnea Time (95% Confidence Interval) in seconds
DVL (40/0/1)	25.9 (20.9-31.0)
GVL (41/1/3)	30.4 (25.8-35.0)

Table 2: Airway data in Direct Visual Laryngoscopy (DVL) and Glidescope® (GVL) groups. M = missing data, O = outlier.

	DVL group (*n* = 40)	GVL group (*n* = 41)
Intubation attempts (1/2/3/M/O)	36/2/0/1/1	31/4/1/2/3
First attempt success rate (95% CI)	94.7% (87.6-100.0%)	86.1% (75.1-97.1%)
Grade of view (1/2/3/4/M/O	22/11/4/2/0/1	32/4/1/0/1/3
Rescue device used	6	2
Surgical airway needed	0	0
Airway trauma	0	1

The median number of attempts at intubation was one for both DVL and GVL groups. See table 2 for distribution of data. Mann-Whitney test showed no significant difference in number of attempts between the DVL and GVL groups (W = 1410, p = 0.5199). The first attempt success rate for the DVL group was 94.7% (95% CI 87.6-100%) and for the GVL group 86.1% (95% CI 75.1-97.1%). Fisher's Exact Test failed to detect a significant difference in the first attempt success rates between the DVL and GVL groups (Phi = -0.16, P = 0.26). Six patients in the DVL group and two patients in the GVL group required a rescue device, defined as a different method of intubation subsequently being used after a failed intubation attempt. A surgical airway was not needed for any patients, and only one patient (in the GVL group) had a traumatic intubation.

Discussion

Our study suggests that in the hands of skilled anesthesia personnel, GVL is not superior to DVL with respect to total number of attempts, first attempt success rate, or apnea time. In addition, we confirm previous findings that show GVL provides a better Cormak and Lehane view than DVL. We believe these conclusions remain reasonable despite minor departures from true intention to treat analysis, namely outlier exclusion and our decision to not impute missing data. Given the predominance of outliers in the GVL group, their inclusion would have only served to make differences less significant and add further support our conclusions.

The anesthesia consult team with expertise in the arena of critical airway management is a crucial part of any hospitals emergency response system. As intubation techniques change and equipment improves anesthesiologists set standards of care for airway management including emergency management. Traditionally, when called to perform emergency intubations, the anesthesiologist brings equipment consisting of conventional laryngoscope handles and blades, intubating stylets, and laryngeal mask airways. More recently video laryngoscopes have become portable, allowing them to be brought to remote locations for emergency intubations.

First attempt success rate is a crucial concept in emergency airway management. Proficiency at intubation requires repetition. It has been proposed that practitioners perform between 40 and 60 intubations to become proficient [13]. Anesthesia residents typically perform several hundred intubations prior to their CA-2 year making them the most highly proficient residents of any specialty where airway management is concerned. In a recent analysis of 2,004 GVL intubations by anesthesia providers deemed difficult airways, a 92% first attempt success rate was realized [14]. In light of our 94.7% first attempt success with DVL this appears to contradict evidence that suggests significant increases in first attempt success with the GVL are obtained over DVL [2,15]. In a comprehensive meta-analysis examining modern video laryngoscopes, the GVL first attempt success rate was reported as 96.4% a rate higher than that found in our study and most likely owing to the vast majority of intubations being performed on routine airways [16]. Further, we found a DVL success rate more approximate to the meta-analysis GVL finding with a first attempt success rate of 94.7%. Only one other study found a similar lack of difference in time to intubation and first attempt success rates between the GVL and DVL, however, it was not randomized or analyzed for significance [17]. Although we did not compare anesthesia residents to other trainees, one possible explanation for these findings is the large disparity between numbers of intubations performed by anesthesia residents when compared to other specialties. Prior cited data supports the assertion that the anesthesia trainees DVL success rate being equal to that of the GVL group is a result of significant repetition in training rather than properties inherent to the devices.

In our study we showed that in the hands of skilled anesthesia residents no improvement in time to intubate was realized with video laryngoscopy. Prior studies have not looked at apnea time as a variable. Although the significance of time delay is not known we chose to measure this variable as a function of a devices ease of use. Further study might be aimed at examining outcomes related to apnea time in the setting of emergency intubation.

When grade of view was examined, we showed that initial Cormack and Lehane grade was significantly improved when the GVL was used (Table 3). This is consistent with other reports [12]. While grade of view appears to correlate well with intubation success when using DVL, the issue becomes more complicated in the GVL group as manipulation of the endotracheal tube and guidance through the vocal cords can be a challenge in spite of a grade I view [18,19].

These findings that are seemingly contradictory to the limited established evidence can, in part, be attributed to the differences in the study participants when compared to other studies. Although few previous examinations of the GVL have studied its use on real patients through a randomized design, the prior literature clearly

Table 3: Comparison of first attempt at intubation Cormack and Lehane grades of view in Direct Visual Laryngoscopy (DVL) and Glidescope® (GVL) groups.

Group (N/Missing/Outliers)	Grade of View (1/2/3/4)	Median
DVL (40/0/1)	22/11/4/2	1
GVL (41/1/3)	32/4/1/0	1

Table 4: Comparison of number of attempts at intubation between Direct Visual Laryngoscopy (DVL) and Glidescope® (GVL) groups.

Group (N/Missing/Outliers)	Attempts (1/2/3)	Median
DVL (40/1/1)	36/2/0	1
GVL (41/2/3)	31/4/1	1

Table 5: Comparison of first attempt success rate between Direct Visual Laryngoscopy (DVL) and Glidescope® (GVL) groups.

Group (N/Missing/Outliers)	First Attempt Success Rate (95% Confidence Interval)
DVL (40/1/1)	94.7% (87.6-100%)
GVL (41/2/3)	86.1% (75.1-97.1%)

demonstrates that the GVL provides better views for difficult airways. The vast majority of these investigations were made by non-anesthesiologist providers, on manikins, in simulated and controlled environments. The significance here is that differences between GVL are not so significant when the study participants are experts at intubation. In a similar randomized study whose participants were attending anesthesiologists, a corresponding increase in time to intubate was found with the GVL as well as improved views with difficult airways [18,19]. This study noted that increases in time to intubate were attributable to endotracheal tube manipulation through the vocal cords with the GVL, a task made easier with DVL (Table 4).

Limitations of our study consist of small sample size, extrapolation of prior evidence with traditional GVL with our use of the GVL Ranger single use, and the use of more than one type and size of conventional blade in the DVL group. Furthermore, there are other portable video laryngoscopes on the market today that were not studied here. It was our intention to study a population that is unpredictable but universally accepted to represent difficult intubating conditions. We believe that the portable nature of the GVL Ranger made it ideal for comparison with traditional DVL in the emergent setting and at least one study has found that the GVL single use can be used interchangeably with the traditional reusable GVL (Table 5) [7]. Another study done with the GVL Ranger reusable described its successful use on the simulated arresting patient establishing a foundation for our using it on actual arresting patients [3]. Finally, the choice to allow anesthesia residents to use the conventional blade of their choice may have introduced a confounding variable. However, we believe that senior anesthesia residents are equally facile with both Miller and Macintosh blades and feel that not allowing them to use the blade of their choice would produce an unrealistic comparison between DVL and GVL intubations. This is a comparison of DVL versus video laryngoscopy, not a particular blade such as the Macintosh size 3. We feel that including both blades distinguishes our study from others that don't truly examine the potential of DVL as compared to video methods. Lastly, we suggest that similar investigations be made with other portable video laryngoscopes in the future to illuminate their role individually on the anesthesia consult team.

Conclusion

In conclusion we conducted a prospective randomized examination of the role of video laryngoscopy for emergency intubation outside the operating room. We have shown that measurable outcomes are different when equipment is used by senior anesthesia residents then when used by novice providers, in particular that time to successful intubation did not differ between DVL and GVL. While the GVL may provide advantages over DVL for lay providers, emergency physicians and pre-hospital first responders we showed that in the hands of experienced anesthesia residents DVL remains at least as effective.

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