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The Effect of Stylet Choice on the Success Rate of Intubation using the GlideScope Video Laryngoscope in the Emergency Department

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Abstract

Objectives—To determine whether the using the GlideRite rigid stylet (GRS) compared with a standard malleable stylet (SMS) affects the success rate of intubation using the GlideScope in emergency intubations.

Methods—This was a retrospective analysis of prospectively collected continuous quality improvement (CQI) data based on intubations performed in an academic emergency department (ED) over a four year period. Following each intubation the operator completed a data form regarding multiple aspects of the intubation, including the device used, type of stylet used, procedural complications, outcome of the intubation, difficult airway predictors (DAPs), and the operator's postgraduate year (PGY). Intubation was considered successful if the GlideScope was used as the initial device and resulted in successful intubation of the trachea.

Results—Over the four year study period, the GlideScope video laryngoscope was used for 473 intubations. Of these, 322 (68%) used the GRS, while 151 (32%) used the SMS. When the GRS was used, operators were ultimately successful in 93.5% of cases (301 out of 322), whereas when the SMS was used, operators were successful in 78.1% of cases (118 out of 151) ($p < 0.0001$). The first-attempt success rate for the GRS group was 82.9% (267 out of 322), and for the SMS group was 67.5% (102 out of 151) ($p < 0.001$). The mean (± standard deviation [SD]) complication rate was 0.25 (±0.5) in the GRS group and was 0.47 (±0.7) in the SMS group ($p = 0.0003$). In the GRS group, 18% of patients (58 out of 322) had oxygen desaturation, while in the SMS group, 31% of patients (46 out of 151) had oxygen desaturation ($p = 0.003$). The mean number of DAPs was 2.0 (±1.5) in the GRS group, and 2.0 (±1.5) in the SMS group ($p = 0.65$). The average PGY of the operator was 2.2 (±0.8) years in the GRS group, and 2.2 (±0.8) years in the SMS group ($p = 0.79$).

Conclusions—Both first-attempt and ultimate success rates were higher with GlideScope intubations in the ED when the rigid stylet was used as compared to the malleable stylet. The number of complications, and in particular, the incidence of oxygen desaturation, was lower in the

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GRS group than the SMS group. The two stylet groups were similar regarding difficulty of the airway and experience level of the operator.

INTRODUCTION

The GlideScope (Verathon Medical Inc., Bothell, WA) video laryngoscope (GVL) was introduced into clinical practice over a decade ago, and its use is becoming increasingly more common for emergency intubations. Many studies have shown improved glottic visualization with the GVL; however, this does not necessarily translate to improved intubation success.[1–3] This is largely due to the fact that directing the endotracheal tube (ETT) tends to be more challenging because the distal portion of the GVL blade has an angle of 60 degrees, which requires the tube to be passed over a very steep angle from the oropharynx into the trachea. Also, the hand-eye coordination required to direct the tube when performing video laryngoscopy (VL) is a learned skill that is different from placement of the tube under direct vision, as in direct laryngoscopy (DL). To facilitate intubation with the GVL, the manufacturer has developed a reusable, rigid stylet called the GlideRite rigid stylet (GRS) that has a shape and angle that mimics that of the GVL blade. The rigidity of the GRS allows it to maintain its shape throughout the procedure.

Studies in the operating room (OR) have failed to demonstrate a difference in success rates when the GRS was used as compared to a standard malleable stylet (SMS) when using the GVL. This was found to be true with both novice and experienced anesthesiologists.[4,5] However, no studies have been published comparing success rates when the GRS versus the SMS is used for intubation in the emergency department (ED) setting. Although no difference was shown in the surgical setting, there may be differences in ED intubations that could reveal a difference in success rates. Patients intubated in the ED include a higher percentage of difficult airways, and often have limited oxygen reserves, thus limiting the duration of intubation attempts. We hypothesize that due to these differences, the GRS may provide an advantage over the SMS.

METHODS

Study Design

This was a retrospective analysis of 1,846 ED intubations prospectively recorded in a continuous quality improvement (CQI) database from July 2007 to June 2011. This project was granted exemption from informed consent requirements by the University of Arizona Institutional Review Board prior to conducting the study.

Study Setting and Population

This study was conducted in a 61-bed tertiary care academic ED with approximately 70,000 annual visits. This ED, at a Level 1 trauma center, has a three year emergency medicine (EM) residency program as well as a five year combined pediatrics/EM residency program. The vast majority of intubations in this ED are performed by EM residents under direct supervision of the EM attending. All decisions regarding the method of intubation and the devices used were at the discretion of the operator.

All patients requiring intubation in the ED were entered into the database. Only patients who were intubated using the GlideScope Standard, Cobalt, or Ranger as the initial device were included in this study.

Study Protocol

Immediately following each intubation, the operator completed a CQI form which included various parameters such as indication for intubation, method of intubation, devices used, stylet used, number of attempts, complications, and outcome of intubation. Experience of the operator as defined by postgraduate year (PGY), presence of difficult airway predictors (DAPs), and the Cormack-Lehane (CL) view were also documented. DAPs included cervical immobilization, obesity, blood or vomit in the airway, facial or neck trauma, short neck, large tongue, small mandible, and airway edema. Complications included oxygen desaturation, aspiration, and airway trauma. Oxygen desaturation was defined as any drop in oxygen saturation below 90% during the procedure, or a drop in saturation of more than 10% if the starting saturation was less than 90%. The data contained on these forms were then extracted by one of the authors (LK) and entered into an electronic database (HanDBase 4.0, DDH Software, Inc., Wellington, FL). The CQI forms were reviewed by the senior author (JS) and if they had missing data points they were returned to the operator for completion. CQI forms were cross-referenced to billing records to identify any missing forms not completed by the operator. If an intubation was performed without a corresponding CQI form, the operator was given a blank form to complete.

Primary outcomes measured were first-attempt and overall success rates. An attempt was defined as placing the GVL blade into the patient's mouth regardless of whether an attempt to pass a tube occurred. Intubation was considered successful if the endotracheal tube (ETT) was correctly inserted into the trachea.

Data Analysis

The two stylet groups were compared statistically using GraphPad InStat, version 3.10 for Windows (GraphPad Software, San Diego CA). Patient demographics were compared descriptively. For categorical data, Fisher's exact testing and 95% confidence intervals (CI) were used. For normally distributed continuous data, two-tailed t-tests were used. For non-normally distributed continuous data, the Mann-Whitney test was used. P values of less than 0.05 were considered significant, with no adjustments for multiple comparisons. Based on pilot data, we estimated that there would be a 10% increase in success rate using the GRS. A power analysis revealed that we would need 141 patients in each group to detect this difference at $\beta = 0.8$. The senior author, who was not blinded to the objectives of the study, extracted the data from the database.

RESULTS

Over the four year study period 1,846 patients were intubated. A total of 1,738 of the data forms were turned in immediately, and 108 were turned in on a delayed basis. There were no missing data forms. Four hundred ninety of the 1,846 intubations were performed using the GlideScope as the initial device (26.5%). Two patients were excluded from analysis because

no stylet was used, and 15 patients were excluded because the GlideScope Direct Intubation Trainer was used, leaving 473 GVL intubations for analysis. The GRS was used in 322 out of 473 (68.1%), and the SMS in 151 out of 473 (31.9%) of the GVL intubations. When the GRS was used, operators were ultimately successful in 301 of 322 cases (93.5%, 95% CI = 90.2% to 95.7%), and when the SMS was used, operators were ultimately successful in 118 of 151 cases (78.1%, 95% CI = 70.9% to 84.0%; $p < 0.0001$). The first-attempt success rate with the GRS was 267 out of 322 (82.9%, 95% CI = 78.1% to 86.4%), and with the SMS was 102 out of 151 (67.5%, 95% CI = 60.4% to 75.1%; $p < 0.001$) (see Table 1). In the GRS group, of the successful intubations, 266 patients were intubated in one attempt (88.4%), 25 in two attempts (8.3%), and 10 in three or more attempts (3.3%). Of the successful intubations in the SMS group, 103 patients were intubated in one attempt (87.3%), 8 in two attempts (6.8%), and 7 in three or more attempts (5.9%). Of the 53 failed GVL intubations, 50 were rescued with direct laryngoscopy, two with an intubating laryngeal mask airway, one with a C-MAC video laryngoscope, and one with a flexible fiberoptic scope. In the GRS group, 89.1% of patients (257 out of 322) had airways with Grades 1 or 2 CL views, and in the SMS group, 85.4% of patients (129 out of 151) had Grades 1 or 2 views ($p = 0.40$) (Table 1). The mean complication rate was 0.25 (±0.5) in the GRS group and 0.47 (±0.7) in the SMS group ($p = 0.0003$). In the GRS group, 18% of patients (58 out of 322) had oxygen desaturation while in the SMS group, 31% of patients (46 out of 151) had oxygen desaturation ($p = 0.003$). No cases of airway trauma were observed in either group.

The two groups had similar patient and operator characteristics. Specifically, the GRS was used in 221 trauma patients (68.6%) while the SMS was used on 99 trauma patients (65.6%) ($p = 0.53$). The mean number of DAPs was 2.0 (±1.5) for both groups ($p = 0.65$). The mean PGY of the operator was 2.2 (±0.8) years for the GRS group and 2.2 (±0.8) years for the SMS group ($p = 0.79$) (Table 1).

DISCUSSION

We found that when using the GVL for emergency intubations, the operators were more successful when they used the GRS as compared to the SMS. Of particular note, the first-attempt success rate for the GRS group was higher. This is important, as other investigators have found an increased number of complications associated with multiple laryngoscopic attempts.[6] Our results are in contrast to studies performed in the operating room, which have demonstrated no difference in success rates between the two stylets.[4,5] An explanation for this may be that ED patients have a higher incidence of difficult airway attributes, such as cervical immobilization, facial trauma, or blood or vomit in the airway. The OR studies were performed on elective surgical patients, and subjects were excluded for known or suspected difficult airways. Thus, for routine intubations there may be no difference between the two stylets, whereas for emergency intubations with more difficult airways, the effect of stylet choice may be more evident. In addition, ED patients are frequently unstable and have limited oxygen reserves. Thus operators have less time to complete the procedure and may be more likely to abandon one device for another when the intubation is not immediately successful.

The complication rate was significantly higher in the SMS group primarily because a higher percentage of patients experienced oxygen desaturation than in the GRS group. A possible explanation for this is that intubation times may have been longer when using the SMS, thereby contributing to the greater extent of observed oxygen desaturation; however, time to intubation was not measured in our study. There were no incidences of upper airway trauma when the GVL was used in this study; however, there have been reports of specific injuries associated with insertion of the ETT when using the GVL.[7] Cases of pharyngeal injury, anterior tonsillar pillar perforation, and lingual nerve injury have been reported. In these cases, injury was attributed to blind insertion of the ETT. We believe that these injuries are not due to inherent flaws in either the GlideScope or the stylet design, but rather are due to operator error. When guiding the ETT with the stylet into the patient's oropharynx with a videolaryngoscope, the operator must direct his or her eyes to the patient, not the video monitor. This is critical, as at this point the operator is blind to the position of the tip of the ETT since it is out of the view of the camera.

LIMITATIONS

This was an observational, real-practice effectiveness study of the GRS and SMS, and patients were not randomly assigned. Thus the choice of stylet may have been biased. Also, data were collected at a single academic ED, with EM residents performing the majority of intubations. Therefore, the results may not be directly comparable to other clinical settings with operators who have more or less GVL experience. The majority of data forms were completed immediately after the procedure; however, the accuracy of the information is still subject to self-report bias. Furthermore, a small percentage of forms were turned in late, and thus there is the additional possibility of recall bias with these late forms. Although the patient and operator characteristics were found to be similar between the two groups, selection bias is still possible as it is not feasible to account for all characteristics that would affect the success of intubations. The data extraction was performed by the senior author, who was not blinded to the study objectives. Since there was only a single data abstractor, inter-rater reliability could not be assessed.

CONCLUSIONS

The success rates of GlideScope video laryngoscope intubations, both first-attempt and overall, were higher when the GlideRite rigid stylet was used as compared to the standard malleable stylet. In addition, the complication rate was lower when the GlideRite rigid stylet was used, primarily due to a lower incidence of oxygen desaturation. We recommend that the GlideRite rigid stylet be used when using the GlideScope for emergency intubation.

Acknowledgments

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Table 1

Intubation, Patient, and Operator Characteristics

	CHARACTERISTIC	GRS N=322 (%)	SMS N=151 (%)	p-value*
INTUBATION	Success rate			
	First attempt	267 (82.9)	102 (67.5)	<0.001
	Overall	301 (93.5)	118 (78.1)	<0.001
	CL view (mean ±SD)	1.3 ±0.6	1.5 ±0.8	0.0151
	Grade I	233 (72.4)	95 (62.9)	0.0423
	Grade II	54 (16.8)	34 (22.5)	0.1629
	Grade III	10 (3.1)	7 (4.6)	0.4317
	Grade IV	6 (1.9)	7 (4.6)	0.1272
	Complications (mean ±SD)	0.25 ±0.5	0.47 ±0.7	0.0003
	Desaturation	58 (18)	46 (31)	0.0028
	Aspiration	5 (1.6)	5 (3.3)	0.3010
	Airway trauma	0 (0)	0 (0)	n/a
PATIENT	Age, yrs (mean ±SD)	43.3 ±20	37.6 ±22	0.0266
	Sex			
	Male	222 (68.9)	100 (66.2)	0.3487
	Female	100 (31.1)	55 (33.8)	
	Medical or trauma			
	Medical	101 (31.4)	52 (34.4)	0.5279
	Trauma	221 (68.6)	99 (65.6)	
	Difficult airway predictors (mean ±SD)	2.0 ±1.5	2.0 ±1.5	0.6085
	C-collar	178 (55.3)	90 (59.6)	0.4260
	Blood in airway	112 (34.8)	45 (29.8)	0.2968
	Facial trauma	85 (26.4)	39 (25.8)	1.0000
	Short neck	65 (20.2)	30 (19.9)	1.0000
	Obesity	63 (19.6)	24 (15.9)	0.3743
	Large tongue	53 (16.5)	23 (15.2)	0.7893
	Vomit in airway	38 (11.8)	17 (11.3)	1.0000
	Small mandible	32 (9.9)	19 (12.6)	0.4272
	Airway edema	26 (8.1)	13 (8.6)	0.8586
OPERATOR	Resident PGY (mean ±SD)	2.2 ±0.8	2.2 ±0.8	0.9398
	PGY 1	63 (19.6)	30 (19.9)	1.0000
	PGY2	120 (37.3)	60 (39.7)	0.6129
	PGY 3	127 (39.4)	58 (38.4)	0.8406

*Fisher's exact, Mann-Whitney, and two-tailed t-tests where appropriate.

CL = Cormack-Lehane; GRS = GlideRite rigid stylet; SMS = standard malleable stylet