Comparison of Glidescope® Video Laryngoscopy and Conventional Laryngoscopy for Endotracheal Intubation in the ED: An Observational Study

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Directed by Professor Sung Phil Chung

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ABSTRACT

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Objectives

In a previous manikin study, we suggested that the GlideScope® Video Laryngoscope (GVL) could be an option for airway management by emergency physicians and might be useful in patients with difficult airways compared to the classic Macintosh laryngoscope (ML). The purpose of this study was to compare GVL with ML in emergency endotracheal intubation.

Materials and methods

A prospective multicenter observational study was performed. Emergency physicians performed tracheal intubations using ML or GVL at their discretion. The time required to intubate, the success rate, number of intubation attempts, Cormack and Lehane (C&L) grade, and percentage of glottis opening (POGO) scores were recorded and compared between the two groups.

Results

GVL was used in 27 (37.5%) of 72 endotracheal intubations at three emergency centers. The overall success rate in the GVL group on the first attempt was not higher than that in the ML group (66.7% vs 60.0%, P=0.572). Although the success rate for difficult airway patients on the first attempt seemed to be higher in the GVL group than in the ML group, there was not a statistically significant difference between the two groups (70% vs 46.7%, p=0.250). The overall time required to successfully intubate was shorter in the ML group than in the GVL group (18.3 sec vs. 36.8 sec, p<0.05). In the difficult airway subgroup, the time required to successfully intubate was shorter in the ML group (15.9 sec vs. 36.3 sec, p<0.05). The POGO score and the C&L grade were not statistically different between the two groups although the GVL group appeared to allow a better glottic view in the difficult airway subgroup (POGO: 39.3 ± 36.9 vs. 55.5 ± 32.7, p = 0.394; GEG I & II: 55.3% vs. 70%, p=0.405).

Conclusion

The emergency airway management using GVL did not show difference in success rate compared with ML. However, the required time for intubation was longer in GVL than ML. This study suggests that GVL is not as suitable for emergency airway management as ML, even in patients with difficult airways.

Key Words: airway management, endotracheal intubation, laryngoscopy

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I. INTRODUCTION

Successful management of an unanticipated difficult airway is critically important in the practice of emergency medicine and is frequently achieved. In the emergency medicine literature, difficult intubation occurs in 3.1% of patients and failed intubation occurs in 1.1% to 2.7% of patients.[1-3] Although most cases of difficult intubation are managed satisfactorily, the results of failed intubation are catastrophic to patients as well as physicians. Many strategies including rapid sequence intubation and new devices have been developed for airway management in these uncommon but critical failures.[4-6]

The GlideScope Video Laryngoscope (GVL; Saturn Biomedical Systems, Burnaby, British Columbia, Canada) is a novel video laryngoscope that was developed for difficult airway management. The GVL is a laryngoscope with a high-resolution camera embedded within the blade and a light source mounted beside the camera. The image is displayed on a 7-inch liquid crystal display screen. The blade design differs from a standard laryngoscope blade in that it is not detachable, has a maximum width of 18 mm at any point, and has a 60 degree midline angle. This design provides a view of the supraglottic anatomy with minimal distortion compared with the conventional Macintosh laryngoscope (ML; Welch Allyn Inc, New York, USA).

GVL provides similar or superior laryngeal visualization for both normal and difficult airways.[7] Several studies have been carried out for adult and pediatric endotracheal intubation (ETI) using GVL in the operating room by anesthesiologists.[8-13] Several studies have reported on ETI using GVL in simulated difficult airways performed by anesthesiologists and emergency physicians.[14-17] However, there are few reports of GVL use by physicians in emergency departments (EDs).[18-20]

In a previous manikin study, we suggested that GVL could be an option for airway management by emergency physicians and might be useful in difficult airway patients compared to classic ML.[14] Thus, the aim of this study was to compare GVL with ML for ETI. We hypothesized that GVL would prove superior to ML in difficult airway management cases.

II. MATERIALS AND METHODS

1. Study design and participants

A prospective multicenter observational study was designed. After institutional review board approval at each hospital, we performed a prospective multicenter observational study using the emergency airway registry from 2008 to 2009. All data collected were verified for completeness by the site investigator at each hospital and all registry papers were collected by one investigator (HJK). We included all intubations in the emergency departments of three tertiary teaching hospitals located in an urban area. We excluded intubations in children under 15 years of age.

Forty emergency physicians with varying levels of experience were voluntarily recruited as intubators from three emergency medicine residency programs. All participants were briefed on the study and written informed consent was obtained. We included emergency physicians with at least one year of clinical experience who had performed at least 50 intubations using the Macintosh laryngoscope. Emergency physicians performed endotracheal intubation using their choice of ML or GVL. They had more experience in ETI with ML than GVL. Some physicians were familiar with GVL from emergency airway management courses offered by the Korean Emergency Airway Management Society (KEAMS) and had experience with GVL from workshops and emergency airway management in the ED. Still, most physicians were not familiar with GVL.

2. Study protocol

Before beginning the study, participants received a 60 minute lecture on general airway management and a 30 minute demonstration and instructions on intubation with GVL by one of the study investigators (HJK). Participants were then allowed 30 minutes to familiarize themselves with GVL and practice intubation on a Laerdal airway management trainer (Laerdal Medical AS, Stavanger, Norway). After instructions and practice time, they performed ETI on the manikin using GVL without difficulty.

When physicians decided to perform endotracheal intubation in the ED, they had the choice of ML or GVL. Before endotracheal intubation, they evaluated the patient's airway briefly to assess the difficulty of intubation. The easy, difficult, failed, or crash airway algorithm was selected and either GVL or ML was chosen. To determine the proper airway algorithm, we followed the flow of the universal emergency airway algorithm.[21] After finishing emergency airway management, the physicians completed the KEAMS emergency airway registry themselves.

The main data in the emergency airway registry included patient demographics, difficulty assessment, airway algorithm, number of attempts, time to intubate, intubation methods, devices used in each attempt, Cormack and Lehane (C&L) grade (Glottic exposure grade: GEG), percentage of glottis opening (POGO) score for each attempt and immediate complications, subjective ease of intubation on a visual analogue scale (VAS), and operator's choice. An ETI attempt was defined as a single pass of a blade into the mouth. Rescue attempts were defined as next attempts after failure of an initial attempt. The time required to intubate was defined as the time in seconds from touching the laryngoscope to passage of the tracheal tube past the vocal cords. Verification of passage was performed by direct visualization or auscultation or by use of various confirmatory devices (i.e., capnometer). A difficult airway was defined before attempting intubation as a case that satisfied more than one of the four components (look externally, evaluate 3-3-2, obstruction, neck mobility) of the LEMON method.[22]

The mnemonic LEMON is a useful guide to identify as many of the risks as possible as quickly as possible to meet the demands of an emergency situation. The elements of the mnemonic are assembled from an analysis of the difficult airway prediction instruments in the elective anesthesia literature and are the subject of a validation study (NEAR III). The mnemonic is recalled by the popular idiom that a defective product is a "lemon." Therefore, the difficult airway is a LEMON. The first letter, L, is "look externally." The external look specified here describes the physician's "feeling" that the airway will be difficult. This feeling may be driven by a specific finding, such as external evidence of lower facial disruption and bleeding that might make intubation difficult, or it might be the ill-defined composite impression of the patient, such as an obese, agitated patient with a short neck and small mouth whose airway appears formidable even before any formal evaluation is undertaken. The second letter, E, is "evaluate 3-3-2." This step is an amalgamation of the much-studied geometric considerations that relate mouth opening and the size of the mandible to the position of the larynx in the neck in terms of likelihood of successful visualization of the glottis by direct laryngoscopy. The first "3" assesses mouth opening. A normal patient can open his or her mouth sufficiently to accommodate three of his or her own fingers between the upper and lower incisors. The second “3” evaluates the length of the mandibular space by ensuring the tum and chin-neck junction (hyoid bone). The “2” assesses the position of the glottis in relation to the base of the tongue. The space between the chin-neck junction (hyoid bone) and the thyroid notch should accommodate two of the patient’s fingers. The ability to accommodate significantly more than or less than three fingers is associated with greater degrees of difficulty in visualizing the larynx on laryngoscopy. The third letter, M, is “Mallampati score.” Mallampati determined that the degree to which the posterior oropharyngeal structures are visible when the mouth is fully open and the tongue is extruded reflects the relationships among mouth opening, the size of the tongue, and the size of the oral pharynx, which defines access via the oral cavity for intubation, and that these relationships are loosely associated with intubation difficulty. In Class I, the oropharynx, tonsillar pillars and entire uvula are visible. In Class II, the pillars are not visible. In Class III, only a minimal portion of the oropharyngeal wall is visible. In Class IV, the tongue is pressed against the hard palate. The fourth letter, O, is “obstruction/obesity.” Upper airway obstruction should always be considered as a marker of a difficult airway. The four cardinal signs of upper airway obstruction are a muffled voice (hot potato voice), difficulty swallowing secretions (because of either pain or obstruction), stridor, and a sensation of dyspnea. Obese patients frequently have poor glottic views on direct laryngoscopy, and obesity should be considered to portend difficult laryngoscopy. The glottic view may be difficult whether a direct or video laryngoscope is used. The final letter, N, is “neck mobility.” The ability to position the head and neck is one of the seven factors necessary to achieve an optimal laryngoscopic view of the larynx. Cervical spine immobilization will make intubation more difficult and will compound the effects of other identified difficult airway markers. Intrinsic cervical spine immobility, such as in cases of ankylosing spondylitis or rheumatoid arthritis, can make intubation by direct laryngoscopy extremely difficult or impossible.[22]

The primary outcome measured was the time required to intubate. Additional outcomes were success rate, number of intubation attempts, GEG, and percentage of glottis opening scores. We analyzed the data of three EDs that have GVL. The time required to intubate and success rates on the first attempt with anticipated difficult airways and the time required to intubate were investigated. The χ^2 test was used to compare the success rates of ETI using GVL and conventional laryngoscopy. Student’s t-test was used to compare the POGO score in ETI using GVL and conventional laryngoscopy. SPSS 18K for Windows was used for all statistical analyses, and p-values less than 0.05 were considered significant.

III. RESULTS

Twenty-five emergency physicians performed endotracheal intubation during the study period. The median emergency department experience of the participating physicians was 2.0 (1.1-2.3) years. Nineteen participants (73.6%)

were male (Table 1).

Seventy-two cases of intubation on the first attempt were included. Most cases were performed by first and second year emergency physicians (40.3% and 33.3% respectively).

Table 1. Demographic characteristics of intubators (N=25)

Parameter	N
Sex	
Male	19 (73.6%)
Female	6 (26.4%)
Age, yr	28.6 ± 2.31
Training year, yr	
1st	5 (M = 3, F = 2)
2nd	8 (M = 6, F = 2)
3rd	6 (M = 4, F = 2)
4th	6 (all male)
Median (SD)	2.0 (1.1-2.3) yr
Experience of intubator (n=72), yr	
1st	29 (40.3%)
2nd	24 (33.3%)
3rd	9
4th	10
Attending the airway management course	11 (44%)
1st/2nd/3rd/4th year	2/4/3/2

Seventy-two patients were included and 51 patients (70.8%) were male. There were 50 patients with medical disease (59.4%). A difficult airway was anticipated in 25 (34.7%) patients, and most cases had decreased neck mobility (Table 2).

Table 2. Demographic characteristics of patients (N=72)

Parameter	ML	GVL	P-value
Age, yr	59.2 ± 17.3	55.5 ± 17.9	0.736
Sex			0.547
Male	33 (73.3%)	18 (66.7%)	
Female	12 (26.7%)	9 (33.3%)	
Disease entity			0.355
Medical	33 (73.3%)	17 (63)	
Trauma	12 (26.7%)	10 (37)	
Anticipated difficult airway, N = 25 (34.7%)			0.498
Look externally	2	1	
Evaluate 3-3-2	4	0	
Obstruction	2	1	
Neck mobility	11	8	

GVL was used in 27 (37.5%) of 72 endotracheal intubations performed at three emergency centers. The overall success rate in the GVL group on the first attempt was not higher than that in the ML group (66.7% vs. 60.0%, P=0.572). Although the success rate of patients with difficult airways on the first attempt seemed to be higher in the GVL group than in the ML group, there was not a statistically significant difference between the two groups (70% vs. 46.7%, p=0.250). The overall time required to successfully intubate was shorter in the ML group than in the GVL group (18.3 sec vs. 36.8 sec, p<0.05). In the difficult airway subgroup, the time required to successfully intubate was shorter in the ML group (15.9 sec vs. 36.3 sec, p<0.05) (Table 3).

The time required to intubate and success rate were not correlated with previous experience with GVL and attendance of the KEAMS emergency airway management course. There was also no statistically significant difference in subgroups of physicians stratified based on their year in the emergency medicine residency program. There were no differences in experience with GVL between the ML group and the GVL group.

Table 3. Time and success rate between ML and GVL in overall and subgroup analysis with easy and difficult airways

	Macintosh®	Glidescope®	P-value
	Overall in first attempt		
Cases	45/72 (62.5%)	27/72 (37.5%)	
Time (s)	30.18 ± 19.9	37.54 ± 19.5	0.556
Time to success*	18.25 ± 9.1	36.79 ± 17.3	0.001
Success rate	27/45 (60%)	18/27 (66.7%)	0.572
	Easy airway in the first attempt		
Cases	30/45 (66.7%)	17/27 (63%)	
Time overall	28.96 ± 19.1	34.47 ± 13.9	0.182
Time to success*	19.08 ± 9.9	37.10 ± 16.9	0.011
Success rate	20/30 (66.7%)	11/17 (64.7%)	0.892
	Difficult airway in the first attempt		
Cases	15/45 (33.3%)	10/27 (37%)	
Time (s)	32.62 ± 21.8	42.74 ± 26.55	0.872
Time to success *	15.91 ± 5.8	36.30 ± 19.2	0.027
Success rate	7/15 (46.7%)	7/10 (70%)	0.25

*$p<0.05$

The POGO score and the C&L grade were not statistically different between the two groups although the GVL seemed to allow a better glottic view in the difficult airway subgroup. POGO was 39.3±36.9 and 55.5±32.7 (p = 0.394) and the easy GEG (GEG I & II) was 8 of 15 (55.3%) and 7 of 10 (70%) in both groups (p=0.405) (Table 4, 5).

Table 4. POGO (percentage of glottic opening) on the first attempt, %

	Macintosh®	GlideScope®	P-value
	Overall		
Overall (mean)	49.1 ± 37.4	54.3 ± 32.8	0.300
Success	69.6 ± 26.7	71.7 ± 22.3	0.615
Fail	18.3 ± 29.4	19.4 ± 20.1	0.273
	Easy airway		
Overall (mean)	54.0 ± 37.3	53.5 ± 33.9	0.512
Success	70.0 ± 27.3	71.8 ± 23.6	0.839
Fail	22.0 ± 34.6	20.0 ± 21.9	0.220
	Difficult airway		
Overall (mean)	39.3 ± 36.9	55.50 ± 32.7	0.394
Success	68.6 ± 26.7	71.43 ± 21.9	0.667
Fail	13.8 ± 22.6	18.33 ± 20.2	0.642

Table 5. Glottic opening grade (GEG) on the first attempt

	Macintosh®	GlideScope®	P-value
	Overall		
Overall			0.454
easy	26	18	
difficult	19	9	
Success			0.131
easy	21	17	
difficult	6	1	
Fail			0.326
easy	5	1	
difficult	13	8	
	Easy airway		
Overall			0.750
easy	18	11	
difficult	12	6	
Success			0.070
easy	15	11	
difficult	5	0	
Fail			0.137
easy	3	0	
difficult	7	6	
	Difficult airway		
Overall			0.405
easy	8	7	
difficult	7	3	
Success			1.000
easy	6	6	
difficult	1	1	
Fail			0.782
easy	2	1	
difficult	6	2	

Easy: Cormack and Lehane grade I & II
Difficult: Cormack and Lehane grade III & IV

IV. DISCUSSION

In this study, the primary outcome was the time required to intubate, not the success rate. The reason for this was that all participants succeeded in ETI using

GVL in our previous manikin study.[14] This study showed GVL was not obviously better than ML with regard to the time required to intubate and glottic opening view. These results were different from prior study results. A number of reports have suggested that GVL provides shorter intubation time, better glottic view, higher success rate and fewer attempts to intubate than ML for difficult airways, although some studies showed that GVL had better than or similar outcomes with ML for easy airways.[7-20,23] The results were independent of formal instruction, practice session experience, and previous experience with the GVL.[7-20,23]

There are several possible reasons for the difference. In this study, most emergency physicians were more familiar with conventional laryngoscopes and had different levels of experience with GVL. Although 30 minutes of instruction and 30 minutes of practice were given before beginning the study, the relative lack of experience with GVL and perception that GVL is difficult to use could result in a lower utilization rate and lower success rate. Ayoub CM et al. reported that novice medical students showed shorter intubation time with GVL than ML.[23] They considered the intubation learning curve and recommended that further studies would be needed to determine whether or not the ML group could catch up with more practice or if the difference is maintained over time.[23] We recommend further studies to compare GVL with ML in groups similarly experienced with the devices.

Difficulty with tube manipulation under indirect vision probably accounts for a major proportion of the time required for successful intubation. We sometimes have difficulty directing the endotracheal tube toward the vocal cords despite achievement of a reasonable view.[24] This is a possible reason why GVL has a longer intubation time and similar success rate with ML. Unsuccessful intubation is possible despite excellent visualization.[14] A number of solutions to this well-known problem have been suggested.[25-28] However, manipulation under indirect vision would require more practice to become skilled at it. In this study, although the success rate and glottic exposure scores (GEG and POGO) of difficult airway patients were not statistically different between the two groups, there seemed to be a higher success rate and better glottic view in the GVL group for difficult airways. A statistical difference might be demonstrated with a larger sample size as many studies have shown that GVL resulted in a higher success rate and better glottic view than ML. [7-20,23]

This study has several limitations. First, the small number of cases was not sufficient to detect a statistical difference between the two devices in patients with difficult airways. Second, the intubation situations and intubators could not be controlled because this was an observational study. Therefore, we also cannot exclude the possibility that less trained or less experienced emergency physicians prefer not to use GVL in difficult airway cases. Third, we could not control selection bias because it was an observational study. Future RCTs are needed in ED patients.

V. CONCLUSION

The emergency airway management using GVL did not show difference in success rate compared with ML. The time required to successfully intubate was also longer in the GVL group than in the ML group. This study suggests that GVL might not be suitable as the first device for emergency intubations, including difficult airways.

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ABSTRACT (IN KOREAN)

응급 기관 삽관에서 글라이드스콥 비디오 후두경과 맥킨토시 후두경의 비교 – 관찰연구

<지도교수 정 성 필>

연세대학교 대학원 의학과

성　　명 김 현 진

목적

저자는 이전 연구에서 에어맨(Airman®) 실습인형을 이용한 정상기도와 어려운 기도 모델에서 맥킨토시와 글라이드스콥을 이용한 기관삽관을 비교함으로써 글라이드스콥이 정상 및 어려운 기도에서 맥킨토시를 대신할 수 있는 유용한 기관삽관 기구임을 보고한 바 있다.[14] 저자들은 대학병원 응급실에 내원하여 기관삽관을 시행받는 환자를 대상으로 맥킨토시 후두경을 이용한 기관삽관과 비교하여 글라이드스콥 비디오 후두경을 이용한 기관삽관이 정상 및 어려운 기도에서 더 유용한지를 알아보고자 하였다.

연구 방법

3개의 대학병원 응급실에서 전향적 관찰 연구로 진행되었다.

응급의학과 전공의들은 맥킨토시 후두경과 글라이드스콥 비디오 후두경 중에서 선택하여 기관삽관을 하였다. 기관삽관에 걸리는 시간, 성공률, 기관삽관 시도횟수, 후두의 노출 정도를 기록하여 두 군간 비교하였다.

결과

3개의 대학병원 응급실에서 시행된 72건의 기관 삽관 중 글라이드스콥 비디오후두경을 이용한 경우는 27건(37.5%)였다. 첫 시도에서 기관삽관을 성공한 경우, 글라이드스콥군의 전반적인 성공률은 맥킨토시군보다 높지 않았다(66.7% vs 60.0%, P=0.572).

예측된 어려운 기도군에서 글라이드스콥군이 맥킨토시군에 비해 첫 시도 성공률이 높은 경향을 보였으나 두 군간에 통계적으로 유의한 차이를 보이지 않았다(70% vs 46.7%, p=0.250). 성공한 기관삽관에 걸리는 시간은 전반적으로 맥킨토시군이 글라이드스콥군보다 짧았다(18.3sec vs 36.8sec, p<0.05). 어려운 기도군에서 기관삽관에 걸리는 시간은 맥킨토시군에서 더 짧았다(15.9sec vs 36.3sec, p<0.05).

후두 노출정도는 어려운 기도에서 글라이드스콥군이 맥킨토시군보다 더 좋은 경향을 보였으나 두 군간에 통계적으로 유의한 차이를 보이지 않았다(POGO; 39.3 ± 36.9 vs 55.5 ± 32.7, p = 0.394, GEG I & II ; 55.3% vs 70%, p=0.405).

결론

본 연구에서 글라이드스콥은 맥킨토시와 비교하여 첫번째 시도된 기관삽관 성공율에서 차이를 보이지 않았으나 삽관에 걸리는 시간을 증가시켰다. 본 연구는 어려운 기도를 포함하여 응급기도관리에서 글라이드스콥이 맥킨토시를 대신할 만한 유용한 기구라는 결과를 보여주지 못했다.

핵심되는 말 : 기도관리, 기관삽관, 후두경

PUBLICATION LIST

1. Kim HJ, Chung SP, Park IC, Cho J, Lee HS, Park YS. Comparison of the Glidescope video laryngoscope in simulated tracheal intubation scenarios. Emerg Med J 2008;25:279-282.