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Original Article

Glidescope® video laryngoscope vs. Macintosh direct laryngoscope for the intubation of laryngeal neoplasm patients: a randomized controlled study

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Abstract: Background: Glidescope® video laryngoscope (GVL) is widely used in tracheal intubation. However, no studies have been conducted to compare the GVL and Macintosh direct laryngoscope (MDL) for intubation in patients with laryngeal neoplasm. Here, we aim to compare GVL and MDL for the intubation of laryngeal neoplasm patients. Methods: One hundred ninety-six American Society of Anesthesiology (ASA) physical status I and II adult patients were randomly assigned to either the GVL group (N=100) or the MDL group (N=96). Parameters such as the modified Cormack-Lehane grading, intubation complications, the visualization of neoplasm, the success rate, the percentage of external laryngeal manipulation (ELM) and the haemodynamic parameters were recorded in both groups. Results: The modified Cormack-Lehane grading (I/IIa/IIb/III/IV) was also significantly better in GVL than in MDL (57/31/12/0/0 vs. 27/23/46/4/0, respectively, $P<0.001$). Morever, the incidence of intubation complications in GVL was significantly lower than that in MDL (8% vs. 30%, respectively, $P=0.002$). The visualization of neoplasm in the GVL group was significantly superior to that in the MDL group (79% *vs.* 50%, respectively, $P<0.001$). The percentage of ELM in the GVL group was significantly lower than that in the MDL group (33% vs. 53%, respectively, $P=0.006$). The successful intubation rate on the first attempt and the haemodynamic changes didn't differ between the groups. Conclusion: Our study indicated that GVL provided a close visualization of the neoplasm and allowed a full view of glottis. Therefore, its complications could be limited.

Keywords: Glidescope video laryngoscope, Macintosh direct laryngoscope, laryngeal neoplasm, intubation

Introduction

Surgery is a widely used modality for treating patients with laryngeal neoplasm. However, anesthetic management of these patients often requires careful planning and management. The neoplasm overshadows the larynx, rendering the exposure of the latter by laryngoscopy poor or difficult. When a difficult airway is encountered, it potentially increases the risk of both intubation and injury to the neoplasm. Without adequate visualization, intubation is associated with elevated risk for dental trauma [1], pharyngeal trauma, tongue injury [2], and neoplasm shedding, thus essentially contributing to anesthesia related mobidity and motality. Therefore, choosing an approporiate laryngoscope for patients with laryngeal neoplasm has become an issue of great concern for anesthesiologists [3].

A Glidescope® video laryngoscope (GVL) is a commonly used clinical video laryngoscope that was designed as an alternative for managing normal and difficult airways [4]. GVL provides a consistently clear and real-time view of the airway and tube placement, thus enabling quick intubation [5]. With its high-resolution camera lens and anti-fog system [6, 7], GVL was designed to make both visualization and the passage of an endotracheal tube into the airway safe and reliable. The design of the GVL blade offers a consistent, unobstructed view of the larynx and vocal cords.

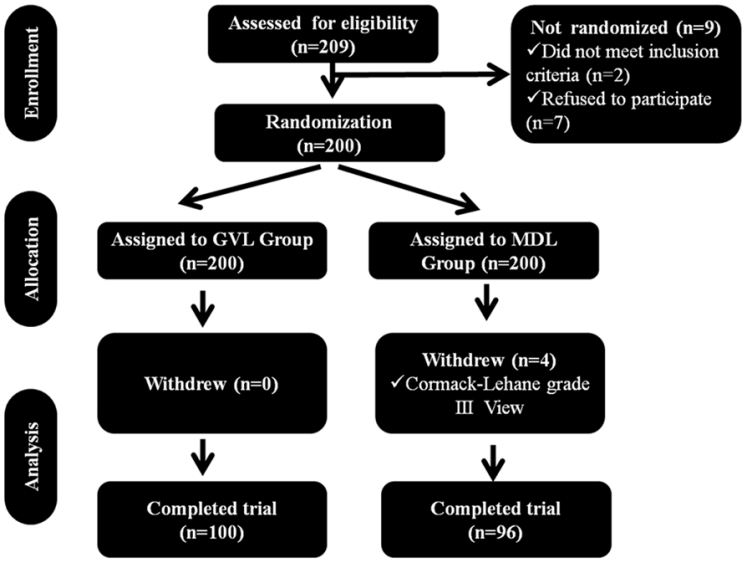

Figure 1. A flow chart describing patient enrollment, allocation and withdrawal.

Recently, many studies have confirmed the safety and efficacy of GVL in a wide variety of clinical applications [8-11]. However, no studies have focused on comparing GVL and Macintoshdirect laryngoscope (MDL) for the intubation of laryngeal neoplasm patients. We hypothesized that GVL would improve the glottic view and reduce the incidence of intubation complications in laryngeal neoplasm patients. Therefore, we designed a prospective randomized study to compare GVL and MDL for the intubation of laryngeal neoplasm patients. Then, parameters such as the modified Cormack-Lehane grading, visualization of neoplasm, intubation complications, intubation time, the success rate of intubation on the first attempt, the percentage of external laryngeal manipulation (ELM) and haemodynamic response to the laryngoscope were compared.

Materials and methods

Study design

This was an 8-month prospective study of laryngeal neoplasm patients between 1 February 2013 and 1 September 2013. This study was conducted with American Society of Anesthesiology (ASA) physical status I-II patients between 18 and 70 years of age who were undergoing elective laryngeal surgery. 196 patients were randomly allocated to the GVL or MDL groups based on computer-generated random numbers that were sealed in an envelope and disclosed prior to anesthesia. Before anesthesia, an anesthesiologist who was unaware of the study opened the sealed envelope and performed the intubation.

Selection of participants

Patients who had laryngeal haemangioma, laryngeal papilloma, large neoplasm, a history of cardiovascular diseases or who had taken medicine affecting either blood pressure or heart rhythm before their operations were excluded. Patients were excluded from the study if they presented oral ulcers, coagulation abnormalities or difficult intubation. The neoplasm located in glottic area leading to dyspnoea was defined as large neoplasm [12].

Ethics issues

This study was approved by the Ethics Committee of the West China Hospital, Sichuan University. Written informed consent was obtained from all patients. This study was also registered at www.chictr.org (identifier: ChiCTR-TRC-12002867).

Methods of measurement

The size and location of neoplasm were evaluated by fibrolaryngoscope before operation. After entering the operating room, the electrocardiography, noninvasive blood pressures, and pulse oximetry saturation (SpO_2) were normally monitored for each patient. All patients were anesthetized by a senior anesthesiologist using a standard protocol. The patients were placed in the "sniffing" position with their head on a pillow. General anesthesia was induced with intravenous propofol 2 $mgkg^{-1}$, sufentanil 1 μgkg^{-1}, cisatracurium 0.15 $mgkg^{-1}$, and remifentanil 1 μgkg^{-1}. Intubation was performed by the senior anesthesiologist using GVL (Verathon Inc, Bothell, WA, USA) or MDL (International Ltd, Truphatek, Netanya, Israel) in both groups. The patients randomized for laryngoscopy were orally intubated with an endotracheal tube

Table 1. General information of patients and airway characteristics

	GVL group (n=100)	MDL group (n=100)	*P*-value
Gender (M/F)	66/34	78/22	0.059
Age (yr)	50±11	48±10	0.206
Weight (kg)	64±10	67±11	0.085
Height (cm)	165±6	166±7	0.216
Disease Type			0.356
Vocal Cord Polyps	53	57	
Vocal Cord Cysts	10	3	
Laryngeal Tumor	23	23	
Vocal Leukoplakia	8	11	
Epiglottis Neoplasm	6	6	
Mallampati (I/II/III)	66/31/3	62/34/4	0.850
Thyromental Distance (cm)	7.9±1.1	8.1±1.1	0.132
Mouth Opening (cm)	4.0±0.5	4.0±0.4	0.368
Jaw Protrusion (protruding/matching)	86/14	81/19	0.341

The value are shown as the numbers or mean ± SD.

Table 2. Comparison of glottis exposure between the groups

Cormack-Lehane Grading	GVL group* (cases [%]) (n=100)	MDL group (cases [%]) (n=100)
I	57 (57%)	27 (27%)
IIa	31 (31%)	23 (23%)
IIb	12 (12%)	46 (46%)
III	0	4 (4%)
IV	0	0

*P<0.001 when compared between groups.

(6.5 mm inner diameter for female and 7.0 mm inner diameter for male) using the Macintosh or glidescope with a size 3 blade. If the size of neoplasm was larger than 8 mm, an endotracheal tube which is 0.5 mm smaller than that was used by the anesthesiologist. A Cormack-Lehane grade III or IV view was marked as patients withdrawn from both groups and then intubated with a bronchofiberscope. All patients undergoing elective laryngeal surgery with a modified Cormack-Lehane grade I and II [13] view were enrolled in this clinical trial. All intubations were performed by the senior anesthesiologist who had experience with using GVL and MDL in more than 100 intubation cases. The intubation time was measured from the laryngoscope passing the patient's lips until the endotracheal tube was deemed to be correctly positioned by each participant. An intubation time more than 60 s or a SpO_2 less than 92% was defined as an intubation failure. If intubation was attempted twice by laryngoscope, this patient was not enrolled in this trial.

Primary outcomes of this study were the success rate of intubation on the first attempt, the modified Cormack-Lehane grading [13] and intubation complications (e.g., oral mucosal haemorrhages, dental trauma, neoplasm bleeding or neoplasm shedding). Secondary outcomes included the visualization of neoplasm, intubation time, the percentage of ELM and the haemodynamic response to the laryngoscope.

Statistical analysis

The sample size was estimated based on the intubation complications with a type I error of 0.05 and a power of 80%. Based on our pilot study, a sample size of 82 patients in each group was necessary. To allow for missing cases and dropouts due to various reasons, we calculate that we would need 100 patients for each group. The data were analysed using the statistical software SPSS 18.0 (SPSS, Chicago, IL, USA). All demographic data were analysed for homogeneity and normality of variance for age, weight, height, intubation time, thyromental distance and mouth opening of patients (mean ± standard deviation). A comparison between these groups was performed by *t*-test. Percentage data comparison was performed using the chi-square test or Fisher's exact test. Ananalysis of ordinal data was performed using the Mann-Whitney U test. Differences in the haemodynamic responses to the laryngoscope were compared by repeated-measures ANOVA. A *P* value less than 0.05 was considered statistically significant.

Results

Of the 209 patients, 7 patients refused to participate, 2 cases were cancelled, and 4 patients were withdrawn due to a Cormack-Lehane grade III view; finally, 196 patients were enrolled in this study (**Figure 1**). There were no statistically significant differences between the groups in terms of the demographic data or airway assessments (**Table 1**).

Table 3. Intubation data of the two laryngoscopes

	GVL group (cases [%]) (n=100)	MDL group (cases [%]) (n=96)	*P*-value
Neoplasm size	7.6±3.1	7.7±2.9	0.833
The location of neoplasm			0.602
Anterior 1/3 of vocal cord	63	58	
Middle 1/3 of vocal cord	23	18	
Posterior 1/3 of vocal cord	5	10	
The whole vocal cord	3	5	
Epiglottis	6	5	
Neoplasm visualization			<0.001
Yes	79 (79%)	48 (50%)	
No	21 (21%)	48 (50%)	
Intubation successful			
Yes/No	100/0	95/1	
Success (%)	100%	99%	0.054
Intubation time (s)	23±9 s	26±8 s	0.033
Externallaryngeal Manipulation (Yes/No)	33/67	51/45	0.006
Complications	8 (8%)	29 (30%)	<0.001
Neoplasm bleeding	1 (1%)	8 (8%)	0.035
Neoplasm shedding	0	2 (2%)	0.497
Oropharyngeal mucosal trauma	7 (7%)	25 (26%)	<0.001

Values are shown as the numbers or mean ± SD.

Before operation, the size and location of neoplasm were evaluated by fibrolaryngoscope. Our data demonstrated that the size and location of laryngeal neoplasm was comparable with the two groups (P>0.05). Our results showed that the visualization of neoplasms and Cormack-Lehane grading in the GVL group were significantly superior to those in the MDL group (*P*<0.001), where as the intubation complicationsin MDL group, including neoplasm bleeding and damage to the oropharyngeal mucosa, were significantly more frequent than those observed in GVL group (*P*=0.001, **Tables 2** and **3**).

In the MDL group, only one patient required two attempts to successfully intubate the trachea, whereas the remaining patients were successfully intubated on the first attempt. In the GVL group, all patients were successfully intubated on the first attempt. The intubation time in the GVL group was significantly shorter than that in MDL group (23±9 s vs. 26±8 s, respectively, *P*=0.033), and the percentage of ELM in GVL group was significantly lower than that in MDL group (33% vs. 53%, respectively, *P*=0.006). However, the rates of successful intubation on the first attempt in both groups did not show a statistically significant difference (**Table 3**).

A total of 196 patients with SpO_2 values greater than 92% were included in the haemodynamic analysis in our study. The magnitude of the haemodynamic response to the laryngoscopeat each time point was not significantly different between the groups. An intragroup comparison indicated that in both groups, both the mean blood pressure (MBP) and heart rate (HR) before intubation or at 1 min after intubation were significantly increased compared with those after anesthesia (**Figure 2**).

Discussion

There have been many studies comparing the use of MDL and GVL. But to our knowledge, this is the first study comparing the use of MDL and GVL for the intubation of laryngeal neoplasm patients. We showed that GVL provided a better exposure of neoplasm and glottis and facilitated intubation, which was similar to studies carried out by Koh L [13] and Dolinaj V [14]. In present study, the glottic view was evaluated on the modified Cormack-Lehane grading which is very familiar to anesthesiologists for assessing the laryngeal view, in particular with the MDL. We found that the distribution of the modified Cormack-Lehane grading for GVL was better than that for MDL. Our data indicated that the GVL enhanced glottic visualization in laryngeal neoplasm patients.

Literatures have introduced that vocal cord nodules/polyps usually occur slightly anterior to the middle of the vocal cord on each side (more specifically, in the anterior 1/3 of the vocal cords [15] and even at laryngeal anterior commissure). The video technique, like GVL, allows a magnified display on the monitor. Due to its camera and anti-fog system, it allows all at-

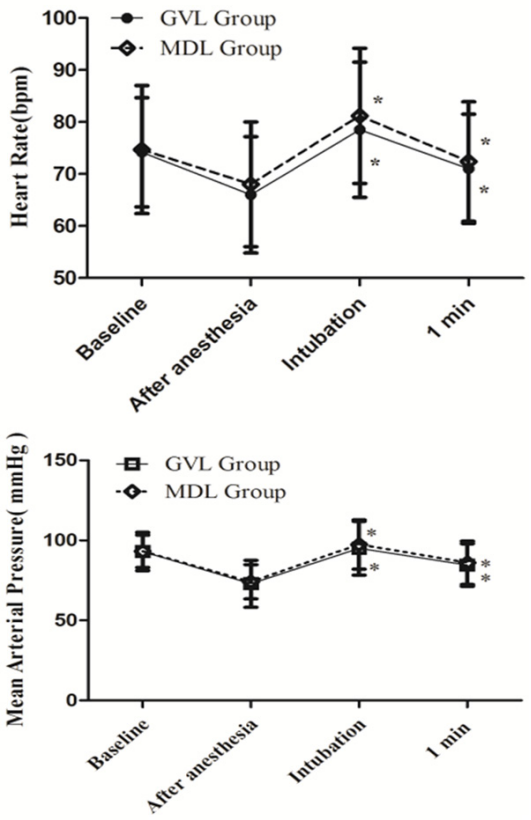

Figure 2. Changes of HR and MBP in GVL (n=100) and MDL (n=96) groups after intubation. *P<0.05, compared with HR and MBP after anesthesia.

tending staff members (not just the airway operator) to have a clear visualization of neoplasm and glottis [14]. In present study, we found that the percentage of neoplasm visualization in GVL group was up to 79%, which was significantly higher than the 50% achieved in MDL group. On the other hand, direct visualization of the neoplasm and glottis via GVL may help to decrease frequency of neoplasm bleeding (8% vs. 1%, *P<0.05*). The incidences of complications such as neoplasm bleeding, neoplasm shedding and oropharyngeal mucosal trauma in GVL group and MDL group were 8% and 30%, respectively (*P<0.001*).

Additionally, our findings indicated that there was no significant difference in the success rate of intubation. However, the intubation time using GVL was no longer than that with MDL (23±9 s vs. 26±8 s, *P*<0.05) and the percentage of ELM in the GVL group was lower than that in MDL group (33% vs. 53%, *P*=0.006), which was similar to that reported in Nouruzi-Sedeh's study [16]. ELM [17], also known as a simple maneuver, is a technique that is applied during intubation and is used to aid in the visualization of the glottis by a practitioner attempting intubation. ELM involves acricoid pressure- or BURP-type maneuver performed initially by the laryngoscopist. It has been shown to improve the view at laryngoscopy [17]. This result also indicated that GVL provided a large improvement in both laryngeal exposure and the ease of manipulating the laryngoscope.

Literatures demonstrated that intubation causes a haemodynamic response that might be harmful in patients [18, 19]. Russell [20] reported that the lifting force (peak, average and impulse) on the base of the tongue in adult patients during the laryngoscopy and tracheal tube delivery were 57%, 53% and 34% less using the GVL than that using MDL. Minimising the applied larygoscopy force may be beneficial in reducing the haemodynamic response, cervical spine movement and local tissue trauma associated with intubation. Our results indicated that GVL had no any special advantage over MDL in attenuating the haemogynamic response to intubation, which is similar to the study by Xue *et al.* [21]. Haemodynamic responses to tracheal intubation are mainly due to the stimulation of oropharyngeal structures produced by laryngoscopy and stimuli to larynx and trachea exerted by tracheal tube insertion. The reason that intubation with the GVL led to similar hemodynamic changes to the laryngoscope, despite less lifting stimulation from the laryngoscope, could be that the stimulation due to the passage of tracheal tube through the vocal cords has a greater impact on BP and HR than that due to the laryngoscope [22]. Hence, no differentiation in the haemodynamic responses for intubation was found using MDL and GVL. Our experience to reduce the cardiovascular response is that the distal end of the stylet with a slight bend and the proximal end with a 90-degree bend [23] such that the ETT can be manipulated from the proximal end. Other studies indicated that counter rotation [24, 25] was needed as the stylet was removed to ease the tube into the vocal cords; occasionally, more rotation of the tube was needed to achieve further advancement, which may stimulate the trachea and induce the cardiovascular response.

There are some limitations and shortcomings in our study. For example, the shape and size of two laryngoscopes are totally different, thus it was impossible to blind the anesthesiologist in this study. However, the anesthesiologist was unaware of the study purpose.

Conclusions

In conclusion, the GVL is an effective device for exposing the glottis and neoplasm, and is associated with only minor complications such as neoplasm bleeding and oropharyngeal mucosa trauma. However, further studies are needed to demonstrate the benefits of GVL in laryngeal neoplasm patients.

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Disclosure of conflict of interest

None.

Abbreviations

ANOVA=analysis of variance, GVL=Glidescope® video laryngoscope, HR=heart rate, MBP=mean blood pressure, MDL=Macintosh direct laryngoscope, SPO_2=pulse oximetry saturation.

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