

# A comparative study of the efficacy of Glidescope versus Macintosh direct laryngoscopy for intubation in pediatric patients undergoing cardiac surgery

## ABSTRACT

**Background:** The Glidescope is a novel, portable, reusable video laryngoscope that has provided superior laryngeal visualization to facilitate tracheal intubation, especially in the management of difficult airways. In this study, we aimed to compare the efficacy of the Glidescope (video-laryngoscope) against the Macintosh direct laryngoscope. **Methods:** Fifty patients were randomly selected via simple randomization using computer-generated random numbers, and sorted into two groups of 25 patients: the Glidescope group and the Macintosh group. We included pediatric patients undergoing cardiac surgery for the repair of congenital heart disease. Those with suspected difficult intubation, preterm babies with low body weight, and patients at risk of aspiration were all excluded. **Results:** Patients' baseline demographic and clinical characteristics were found to be comparable in the two groups. The mean intubation time was  $24.1 \pm 13.6$  s in the Glidescope group, as compared to  $18.1 \pm 5.9$  s in the Macintosh group. Blade insertion was easy in 92% and 96% of the patients in the Glidescope and Macintosh groups, respectively. Tracheal intubation was considered easy in 84% of the Glidescope group, compared to 92% of the Macintosh group. There was a statistically significant correlation between the ease of tracheal intubation and the used intubation method ( $\rho = -0.35$ ;  $P = 0.014$ ). **Conclusion:** Our findings indicate that the Glidescope can be used as an efficient modality for obtaining successful intubations with no complications. Ease of tracheal intubation was the only outcome that was found to be affected by the used modality. Further investigations with proper sample sizes are needed.

**Key words:** Airway, general anesthesia, intubation, laryngoscopy, pediatric

## Introduction


Successful tracheal intubation is a very necessary skill for the management of critically ill patients. The glidescope has been developed to facilitate the tracheal intubation process with ease in all scenarios.<sup>[1]</sup> Previous studies reported superiority of the glidescope in comparison to the standard direct laryngoscope.<sup>[1]</sup> Furthermore, cardiac surgeries are

usually associated with an increased risk of developing complications that can worsen the prognosis of the relevant patient and increase their risk of morbidity and mortality.<sup>[2,3]</sup> Therefore, reduced hospital stay and intensive care unit (ICU) admissions, in addition to early extubation and mobilization are encouraged in these patients to reduce the risk of the

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development of potential complications and to alleviate the economic burden.<sup>[4,5]</sup> Maintaining adequate and competent airways during intubation is a priority for anesthesiologists. A previous review by Cook *et al.*<sup>[6]</sup> indicated that adverse events related to the management of airways during anesthesia for patients with cardiac arrests are the main cause for half of these cardiac events. Although most tracheal intubations are easily performed with no impairment of the airways, it has been reported that up to 8.5% of anesthesiologists may find it difficult to maintain proper airway management during intubation. This can lead to the development of serious complications such as mortality due to hypoxic brain damage.<sup>[7]</sup> Other complications can also include laryngospasm, bronchospasm and dental damage as a result of forceful and repetitive intubation. Therefore, it was essential to address this experience of performing anesthesiologists and to enhance the quality of the equipment that is used for the delivery of the intubation process.

The Macintosh laryngoscope is commonly used for performing tracheal intubation and is often associated with difficult intubation in 1-4% of cases.<sup>[8]</sup> As a result, the Glidescope video laryngoscope (GVL, Glidescope®, Saturn Biomedical Systems Inc.) has been developed for use in cases of difficult intubation processes.<sup>[9,10]</sup> Previous studies have shown its superiority over the Macintosh laryngoscope technique.<sup>[11-14]</sup> However, the comparison between the two modalities in terms of intubation time is controversial. Previous studies have shown that the GVL can significantly increase the period of intubation.<sup>[11-13,15]</sup> However, other investigations have reported that the intubation time difference between the two modalities is not significant,<sup>[14,16]</sup> and some even reported that GVL may significantly reduce the intubation period.<sup>[17,18]</sup> GVL is also not always affordable and cannot be obtained in the required sizes and shapes to suit all patients.<sup>[19]</sup> Few studies have investigated the differences between the Macintosh laryngoscope and GVL in pediatric cardiac surgeries. We aim to compare the efficacy of the Glidescope versus Macintosh direct laryngoscopy for intubation in pediatric patients undergoing cardiac surgery.

## Materials and Methods

### Study design and population

This is a randomized control study that included 25 patients in each group to detect a difference of at least 12 s in intubation between the two groups with a significant level of 0.05, and a power of 80%. Data collection was conducted at King Faisal Specialist Hospital and Research Center in Jeddah, Saudi Arabia. Fifty patients were randomly selected via simple randomization using computer-generated random numbers into two groups – the Glidescope group and the Macintosh

group – with 25 patients in each group. The study was concluded upon the completion of the required sample size. We included pediatric patients undergoing cardiac surgery for the repair of congenital heart disease. The patient's body weight had to be within the range of 3 to 30 kg. Those with suspected difficult intubation, preterm babies with low body weight, and patients at risk of aspiration were all excluded. The study was reported using the CONSORT statement for randomized control trials.

### Study procedures

The anesthetic techniques were standardized; patients were premedicated via midazolam 0.03 mg/kg IV. Induction of anesthesia was done via Ketamine 1.5- 2.5 mg/kg IV, Fentanyl 1 5-10 µg/kg. Endotracheal intubation was performed using Rocuronium as a muscle relaxant with a dose of 0.5 mg/kg IV. Intubation was conducted by one senior anesthesiologist, to exclude variation in intubation skills, and the choice of the intubation device was dependent on the randomization program. The second operator was responsible for monitoring the time taken for intubation in seconds, the incidence of desaturation, incidence of airway injury, the ease of intubation, and recording the data in the excel spreadsheet alongside the patient medical number and name.

### Statistical analysis

Data was collected, coded, tabulated, and analyzed using the SPSS 26.0 statistical package. Continuous variables were represented as means and standard deviation and nominal variables were presented as counts and percentages. The skewness and Kurtosis tests were used for testing the normal distribution of continuous variables. To compare patients based on the intubation method used, the Chi-square test (or Fisher's exact test, when appropriate) was used for categorical data while an independent *t* test was used for normally distributed continuous variables, and the Mann-Whitney H test was used for continuous variables not normally distributed. Moreover, the Spearman rank correlation coefficient ( $\rho$ ) was used to determine the relationship between the endotracheal intubation method and patient outcomes. Statistical significance was considered when the *P* was < 0.05.

### Ethical consideration

The study was approved by King Faisal Specialist Hospital and Research Center Institutional Review Board (IRB) with approval number RC-J/483/40. An informed written consent was obtained from the guardian of the patients who were enrolled in the study to include their data in the study without revealing any personal information. All methods were performed in accordance with the relevant

guidelines and regulations Declaration of Helsinki 1975. In addition, the clinical trial was registered in the UMIN Clinical Trials Registry (UMIN-CTR) with registration number UMIN000044474.

## Results

Patients' baseline demographic and clinical characteristics were found to be comparable in two groups, with no statistically significant differences [Table 1]. The mean age in the Glidescope group was  $29.3 \pm 37.0$  months, as compared to  $25.2 \pm 30.6$  months in the Macintosh group. Similarly, the mean BMI in the Glidescope group was  $14.6 \pm 2.3$  Kg/m<sup>2</sup>, as compared to  $13.9 \pm 2.5$  Kg/m<sup>2</sup> in the Macintosh group. All patients included in the study had a Class II Mallampati classification and most (Glidescope group = 88%; Macintosh group = 72%) did not have any anatomical abnormalities.

All measured outcomes are summarized in Table 2. The mean intubation time was  $24.1 \pm 13.6$  s in the Glidescope

group, as compared to  $18.1 \pm 5.9$  s in the Macintosh group. Blade insertion was easy in 92% and 96% of the patients in the Glidescope and Macintosh groups, respectively. For ease of tracheal intubation, it was considered easy in 84% of the Glidescope group, compared to 92% of the Macintosh group. As for the quality of the view, it was excellent in most of the Glidescope group (84%), similar to the Macintosh group (88%). The Cormack–Lehane grade during laryngoscopy was I/II in 19/6 patients in the Glidescope group and was I/II in 16/9 patients in the Macintosh group. Intubation was attempted only once in the majority of the Glidescope group (96%) and most of the Macintosh group (88%). No complications were recorded in either group.

The correlation analysis showed a statistically significant correlation between the ease of tracheal intubation and the intubation method used ( $\rho = -0.35$ ;  $P = 0.014$ ). However, the correlation between other outcomes and the used intubation method did not reach statistical significance [Table 3].

**Table 1: Baseline demographic and clinical characteristics**

Variables	Treatment group				P	
	GlideScope		Macintosh laryngoscope			
	Count	%	Count	%		
Age (months); mean±SD	29.3±37.0		25.2±30.6		0.892	
BMI (Kg/m <sup>2</sup> ); mean±SD	14.6±2.3		13.9±2.5		0.327	
Mallampati classification	Class II	25	100.0	25	100.0	-
Anatomical abnormalities	Anterior larynx	0	0.0	1	4.0	0.241
	Down syndrome	2	8.0	5	20.0	
	Ellis-van Creveld syndrome	0	0.0	1	4.0	
	Midface Hypoplasia	1	4.0	0	0.0	
	None	22	88.0	18	72.0	

SD: Standard deviation

**Table 2: Comparison of outcomes among different intubation methods**

Variables	Endotracheal intubation method				
	GlideScope		Macintosh laryngoscope		
	Count	%	Count	%	
Intubation time (seconds); mean±SD	24.1±13.6		18.1±5.9		
Ease of blade insertion	Easy	23	92.0	24	96.0
	Medium	2	8.0	4	4.0
Ease of tracheal intubation	Easy	21	84.0	23	92.0
	Medium	4	16.0	0	0.0
	Difficult	0	0.0	1	4.0
	Challenging	0	0.0	1	4.0
Quality of view	Good	3	12.0	1	4.0
	Fair	1	4.0	2	8.0
	Excellent	21	84.0	22	88.0
Cormack-Lehane grades	Grade I	19	76.0	16	64.0
	Grade II	6	24.0	9	36.0
Number of intubation attempts	One	24	96.0	22	88.0
	Two	1	4.0	3	12.0
Complications	None	25	100.0	25	100.0

SD: Standard deviation

**Table 3: Correlation between measured outcomes and different intubation methods**

Variables	Correlation results	Endotracheal intubation method
Intubation time (seconds)	Spearman's rho <i>P</i>	-0.19 0.185
Ease of blade insertion	Spearman's rho <i>P</i>	-0.2 0.164
Ease of tracheal intubation	Spearman's rho <i>P</i>	-0.35 0.014*
Quality of view	Spearman's rho <i>P</i>	-0.19 0.202
Cormack-Lehane grades	Spearman's rho <i>P</i>	0.10 0.48
Number of intubation attempts	Spearman's rho <i>P</i>	0.09 0.537

\*Statistically significant

## Discussion

In the present study, we evaluated the differences between Glidescope and Macintosh direct laryngoscopy for intubation in pediatric patients undergoing cardiac surgery, in terms of efficacy and clinical outcomes. Our results indicate that there are no apparent differences between the two groups in terms of complications, the number of intubation attempts, and ease of blade insertion. A previous study by Jafra *et al.*<sup>[20]</sup> reported that the Glidescope group showed better laryngeal views and intubation difficulty scores when compared to the Macintosh laryngoscopy group in an adult population undergoing elective surgeries. Another randomized trial by Choi *et al.*<sup>[21]</sup> also reported that in the Glidescope group, the percentage of glottis opening was significantly increased when compared to the Macintosh laryngoscopy group. Moreover, the Glidescope group had a significantly lower visual analog score and reduced intubation time than the other group, which indicated the superiority of the modality. Similar findings were also reported by a randomized simulation trial by Kim *et al.*<sup>[14]</sup>

In the present study, no complications were noticed in the two groups. However, some cases have been previously published that report a possible incidence of laryngeal trauma, potential pharyngeal injury and infections.<sup>[22-24]</sup> Previous studies have shown that the rate of successful intubation was similar between the two groups, ranging between 95.5 and 100% for both modalities.<sup>[20,23-25]</sup> First attempts at successful intubation processes were also comparable between the two groups. Jafra *et al.*<sup>[20]</sup> reported that the rate of first attempts was significantly higher in the Glidescope group. In contrast, Choi *et al.*<sup>[26]</sup> reported that similar rates of first successful intubation processes were found across the two groups. Ibinson *et al.*<sup>[27]</sup> also indicated

that Glidescope was significantly more efficient at obtaining successful intubation rates from first attempts, as compared to the direct laryngoscopy group.

The results of the correlation analysis shown that ease of tracheal intubation may be the only factor that can significantly affect the success of intubation via either of the two modalities. A previous investigation by Ayoub *et al.*<sup>[18]</sup> reported that more successful intubations could be obtained when using the Glidescope over the Macintosh laryngoscopy when both modalities were performed by inexperienced medical students. This indicates that the Glidescope may be easier to use to perform successful intubation processes. Previous reports have also shown that the Cormack–Lehane grading was significantly enhanced with the Glidescope group than the conventional group,<sup>[11,21,23,25,28-29]</sup> which is consistent with our findings.

We also found that the time of intubation was longer in the Glidescope group than the Macintosh direct laryngoscopy group. This finding is consistent with the findings of previous investigations.<sup>[11-13,15]</sup> However, other reports have shown that the period may be similar between the two modalities,<sup>[14,16]</sup> and further reports have even reported that using the Glidescope can significantly reduce the time needed for performing successful intubation.<sup>[17,18]</sup> The difference in the findings of these various reports may be attributed to many factors. First, the difference of experience between the anesthesiologists that used both modalities in the different studies could be a potential factor, which indicates the need to recruit anesthesiologists that are adequately experienced in order to ensure a better and sufficient judgment. Second, the difference in the camera scope may also constitute a reason for the differences. Third, observing the monitor is essential to viewing the vocal cords when using the Glidescope, whereas it can be easily done via simple visualization when using the Macintosh laryngoscopy. The structure of the Macintosh blade is also different, which can raise some issues when performing intubation. These factors should be considered by future investigations for a better validation of the evidence and better judgment of the differences in efficacy between the two modalities.

Although no significant differences in the baseline characteristics were observed between the two groups, our study was limited by the small sample size of both groups, which prevented us from adequately validating our reported findings. Therefore, future investigations are encouraged to enroll adequate populations for better validation and estimation of the potentially correlated factors for the efficacy of both modalities. Moreover, we recommend that

the previously discussed factors, including the experience of the performing anesthesiologists of both modalities, should also be considered for a better judgment on the efficacy of either modality.

## Conclusion

Our findings indicate that the Glidescope can be used as an efficient modality for obtaining successful intubations with no complications. However, we found that the intubation time was longer in the Glidescope group than the Macintosh laryngoscopy group. Ease of tracheal intubation was the only outcome that was found to be affected by the used modality. Further investigations with proper sample sizes are needed.

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## Conflicts of interest

There are no conflicts of interest.

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