

GlideScope® cobalt video laryngoscope versus direct Miller laryngoscope for lateral position-tracheal intubation in neonates with myelodysplasia: A prospective randomized study

ABSTRACT

Background and Objective: Anesthesiologists encounter difficulties during laryngoscopy and tracheal intubation of neonates with myelodysplasia. Tracheal intubation in lateral position in such cases deemed profitable but not easy because of the compromised laryngeal view. We compared GlideScope video laryngoscope (GVL) versus conventional Miller direct laryngoscope (DL) for tracheal intubation in laterally positioned neonates with myelodysplasia.

Materials and Methods: Sixty neonates scheduled for elective surgical repair of meningocele or meningocele under general anesthesia were allocated randomly for endotracheal intubation using GVL or DL. Percentage of glottis opening (POGO) scores, time to best glottis view (TBGV), endotracheal tube passage time (TPT), intubation time (IT), intubation attempts, and overall success rate of intubation were recorded.

Results: TBGV was significantly shorter in GVL group (median = 6.8 s, range = 3.5–28.2 s) in comparison with DL group (median = 8.4 s, range = 4.8–32.7 s) ($P = 0.01$); however, TPT and IT were comparable. POGO scores were significantly higher with GVL group than DL group (median = 93.8, range = 45–100 and median = 82.4, range 10–100, respectively) ($P = 0.001$). Overall success of intubation was the same; however, three patients in GVL group required a second attempt for intubation in comparison with five patients in DL group. One patient in DL group required a third attempt.

Conclusion: In laterally positioned neonates, GVL is easier than DL with a similar intubation time, comparable time required for tube passage, better views of the glottis, shorter times to obtain the best glottic view, and high success rate as compared with DL. GlideScope seems to be an effective approach for endotracheal intubation of laterally positioned neonates with myelodysplasia.

Key words: Cobalt video laryngoscope; direct laryngoscope; neonates; tracheal intubation

Introduction

Myelodysplasia is a congenital malformation of the embryologic neural groove that occurs in 1 per 1,000 live birth during the first month of gestation. Failure of neural tube fusion during fetal development may cause herniation

of nervous tissue (myelomeningocele) or only a sac-like herniation of the meninges (meningocele) that may occur at any level along the neural axis, but most commonly at lumbosacral area.^[1-3]

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Tracheal intubation in different age groups is conventionally performed in the supine position; however, lateral position may be helpful in special clinical situation such as myelomeningocele and meningocele to avoid the risk of rupture and subsequent complications. Also, in lateral position, gravity aids laryngoscopy and ensures a clear airway in anesthetized children.^[4]

GlideScope® cobalt video laryngoscope system (GVL; Verathon medical, Inc., Bothell, WA, USA) is designed for use in neonatal intubations with a high-resolution, flexible, reusable, digital camera, integrated LED light source, and antifogging mechanism. The camera baton is inserted into a single-use GVL curved stylet. The cobalt GVL video baton connects directly to a dedicated portable full-color digital video monitor allowing real-time view for all care providers. Most of recent available publications concerning GlideScope in pediatrics focus on older children^[5,6] examine manikins^[7,8] or describe single patient experience.^[9,10]

GlideScope has been proved to provide an improvement in tracheal intubation in older children; however, laryngoscopy of neonates is more challenging because of the anatomical differences between the two populations including more cranially located larynx, larger occiput, omega-shaped floppy epiglottis, and larger tongue relative to their pharyngeal space.^[11]

So, in the current study, we aimed to compare GVL with the standard Miller direct laryngoscope (DL) in laterally positioned neonates with myelomeningocele or meningocele. We hypothesized that GVL would offer superior visualization to direct Miller laryngoscope and would be noninferior regarding the intubation time in such neonates.

Materials and Methods

After approval of hospital ethics committee and obtaining written informed consent for all enrolled subjects, 60 American Society Anesthesiology (ASA) physical status I or II neonate patients (age ≤ 28 days) with normal craniofacial anatomy presenting for elective surgical repair of meningocele or meningocele under general anesthesia were recruited for this prospective observational study between August 2016 and May 2018. The study was registered at www.pactr.org with ID: PACTR201808699072894.

The exclusion criteria include the presence of suspected difficult intubation, high risk of pulmonary aspiration, and hemodynamic instability.

Patients were randomly allocated using computer generated numbers into intubation with GVL group using size 1 single-use blade or DL group using Miller blade size 0.

Randomization was performed by an independent statistician, and allocation concealment was done by sequentially numbered sealed opaque envelopes in 1:1 ratio. The random numbers were concealed from the anesthesiologists and delivered to the operating room in the sealed envelopes. So, the used laryngoscope was decided at the induction time of anesthesia.

Babies were kept fasting before surgery as per ASA recommendations. Intravenous line was inserted and Ringer lactate was started at the rate of 14 mL/hour by infusion pump. In the operating theater, a warming blanket was placed over the baby to avoid hypothermia. Electrocardiography, noninvasive arterial pressure, pulse oximetry, and capnography were attached for monitoring. Before induction of anesthesia, glycopyrrolate 10 $\mu\text{g}/\text{kg}$ was administered intravenously and then anesthesia was induced in the right lateral position with sevoflurane (3%–5%). Injection rocuronium 0.6 mg/kg i.v. was given 90 seconds before laryngoscopy and after confirming adequate mask ventilation. All intubations were performed by the same highly expertise, board certified, senior anesthesiologists (performed tracheal intubation for >50 pre-study neonates with the GlideScope) using a 3.0 mm inner diameter styletted reinforced endotracheal tube without a cuff by the study-assigned device.

The time to best glottis view (TBGV) was measured from the time the assigned device passing the patient's gum until the announcement of the best glottis visualization. The laryngeal view was graded by the laryngoscopist using the percentage of glottis opening (POGO) score, once the best glottis exposure had been announced. The POGO score is a method to assess the laryngeal exposure and provides a percentage of the visualized glottis. The POGO score is considered to be 100%, if the glottis is seen completely from the anterior commissure to the interarytenoid notch and the POGO score is 0% if the glottic opening is not visualized at all.^[12] So, a subjective score between 0% and 100% was given for partial visualization of the glottis.

Optimal external laryngeal maneuvers (OELM) was applied for best glottic visualization if the initial POGO was $<75\%$. POGO after application of OELM was also recorded. The intubation time (IT) was measured from the time the assigned device entered the patient's mouth until the time it was taken out after the placement of endotracheal tube in the trachea. In addition to direct visualization, correct placement of

endotracheal tube was confirmed by auscultation and end tidal carbon dioxide detection. Endotracheal tube passage time (TPT) was derived by subtracting TBGV from IT. The number of attempts was defined as withdrawing the tube to the angle of the mouth and reintroducing it again. The American Heart Association and the American Academy of Pediatrics has established the Neonatal Resuscitation Program, which recommends a ≤ 20 seconds for the intubation time in neonates.^[13-15] In the light of this, we assumed that if more than three attempts or >60 seconds required to secure an endotracheal tube, it was considered as failed intubation. Esophageal intubation (if any) or any trauma caused during laryngoscopy were recorded. Trauma was defined as any bleeding or abrasion on the lips, gums, and angle of mouth of the neonate or blood on the device blade after intubation. Any decrease in oxygen saturation to $<95\%$ on the pulse oximeter was also recorded and the lungs were ventilated with 100% oxygen. Except for the POGO score, all data were recorded by an independent observer not involved in the study.

The laryngeal view graded by the POGO scores was set as the primary outcome measure for the study, whereas TBGV, TPT, IT, POGO scores after OLEM, intubation attempts, and overall success rate of intubation were set as the secondary outcome measures.

Statistical analysis

Sample size was calculated to detect a difference of $>20\%$ of the POGO score among the two groups to achieve a power of 80% using SPSS Sample Power (IBM Corp, Armonk, NY, USA), a minimum of 25 patients were required for each group. Accordingly, 32 patients were enrolled in each group to compensate for missing data or dropout.

Statistical analysis of this study was conducted using SPSS version 17 (SPSS Inc., Chicago, IL, USA). Continuous data were represented in the form of mean and standard deviation or median and range. Categorical data were presented in the form of number and percentage. Data were checked for normality using Shapiro–Wilk test. We compared the mean between the two groups by using unpaired Student's *t*-test. We compared the median between the two groups using Mann–Whitney *U*-test. Categorical data were compared between the two groups using Chi-square test. *P* value <0.05 was considered statistically significant.

Results

Patients flow through the study was shown in Figure 1. In total, 72 neonates were assessed for eligibility; however,

only 64 parents signed the consent for participation in the study. Afterward, four patients were excluded because of laryngospasm in one patient and errors in timing calculation during intubation in three patients. Both groups had similar demographic data [Table 1]. Site and type of neural tube defects were depicted in Table 2.

There was a statistically significant difference between the two groups in terms of TBGV. TBGV was shorter in GVL group (median = 6.8 s, range = 3.5–8.2 s) in comparison with DL group (median = 8.4 s, range = 4.8–32.7 s; *P* = 0.01) [Table 3 and Figure 2]. However, there were no difference regarding TPT and IT [Table 3 and Figures 3, 4]. The POGO scores were significantly higher with GVL group (median = 93.8,

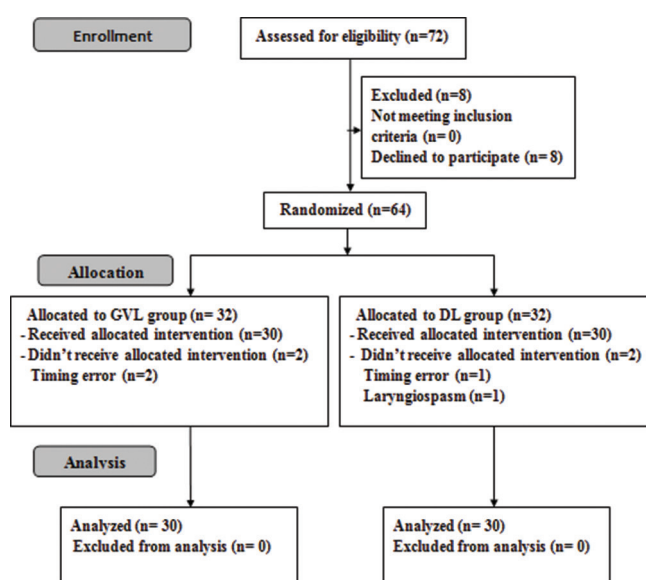


Figure 1: The consort diagram illustrating patients flow through the study

Table 1: Patient characteristics of the randomized groups

Variable	GVL group (n=30)	DL group (n=30)	P
Age (days)	3.9±3.1	4.1±3.6	0.862
Sex (male:female)	19/11	22/8	0.405
ASA I/II	14/16	20/10	0.118
Weight (kg)	3.15±0.79	3.40±0.61	0.486

GVL: GlideScope video laryngoscope, DL: Direct laryngoscope, ASA: American Society of Anesthesiology, SD: Standard deviation. Data expressed as numbers or mean±SD

Table 2: Type and site of neural tube defects

Variable	GVL group (n=30)	DL group (n=30)	P
Type			
Myelomeningocele	5/30	7/30	0.427
Meningocele	25/30	23/30	
Site			
Lumbar	9/30	12/30	
Lumbosacral	21/30	18/30	0.316
Cervical	0	0	
Dorsal	0	0	

GVL: GlideScope video laryngoscope, DL: Direct laryngoscope

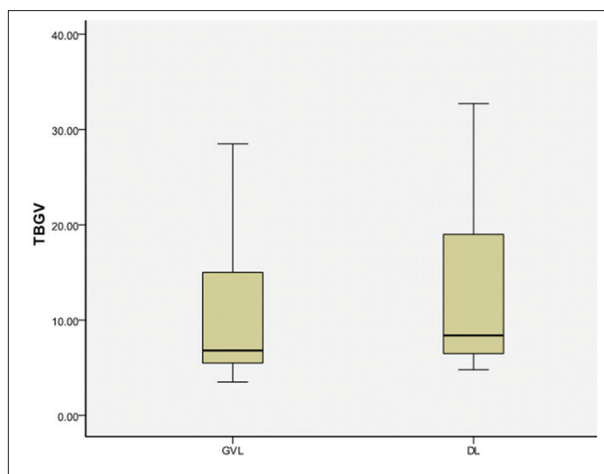


Figure 2: Time to best glottis view in seconds represented by Box and whisker plots. The horizontal solid line inside the box gives the median time and the upper and lower limits of the box correspond to the 25th and 75th quartiles. The horizontal limits of the whiskers correspond to the 5th and 95th percentiles

range = 45–100) as compared with DL group (median = 82.4, range: 10–100; $P = 0.001$). In addition, 9 out of 30 patients (30%) in GVL group required OLEM in comparison with 17 out of 30 patients (57%) in DL group with a significant difference among the two groups ($P = 0.001$). The median POGO scores after OLEM reached 100% (range = 89–100) in GVL group in comparison with 94.8% (range = 69–100; $P = 0.02$) [Table 3].

Although the overall success of intubation was the same in both groups (100%) with no failed intubation, successful intubation at the first attempt was reported in 90% of the patients in group GVL, whereas only 80% in group DL. Three patients in the GVL group required a second attempt for intubation in comparison with five patients in the DL group. Also, one more patient in the DL group required a third attempt [Table 4]. There was no significant difference regard to study related complications [Table 5].

Discussion

Endotracheal intubation in neonates with myelodysplasia in lateral position is a beneficial maneuver to alleviate the risk of its rupture and increased intracranial pressure that may occur due to compression of the sac during laryngoscopy in supine position.^[12]

Technological advancements of airway management in the recent years have elaborated the development of various video laryngoscopic devices for adults that enable tracheal intubation, whereas displaying the glottic view on a monitor screen; however, the range of options available for pediatrics is limited. Recently, a proliferation of new devices for infants

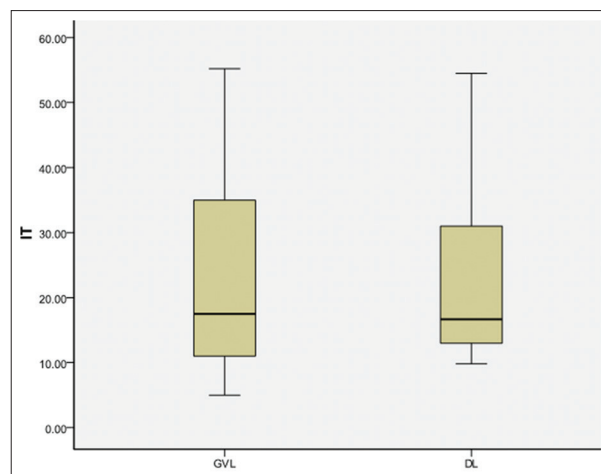


Figure 3: Intubation time in seconds represented by Box and whisker plots. The horizontal solid line inside the box gives the median time and the upper and lower limits of the box correspond to the 25th and 75th quartiles. The horizontal limits of the whiskers correspond to the 5th and 95th percentiles

Table 3: Comparison of intubation parameters between the GlideScope video laryngoscope and Miller laryngoscope

Variable	GVL group (n=30)	DL group (n=30)	P
TBGV (s)	6.8 (3.5-28.2)	8.4 (4.8-32.7)	0.01*
POGO (%)	93.8 (45-100)	82.4 (10-100)	0.001*
POGO after OLEM (%)	100 (89-100)	94.8 (69-100)	0.02*
OLEM, n (%)	9/30 (30)	17/30 (57)	0.001*
IT (s)	17.5 (7.3-55.2)	16.8 (9.8-54.5)	0.361
TPT (s)	8.7 (3.2-35.3)	7.6 (2.9-33.5)	0.586

GVL: GlideScope video laryngoscope, DL: direct laryngoscope, TBGV: Time to best glottis view, POGO: Percentage of glottis opening, OLEM: Optimal external laryngeal maneuver, IT: Intubation time, TPT: Endotracheal tube passage time. Data expressed as median and range. *Means significant

Table 4: Comparison of intubation data between the two groups

Variable	GVL group (n=30), n (%)	DL group (n=30), n (%)	P
Intubation attempts (1/2/3)	27/3/0	24/5/1	0.821
Successful intubation at first attempts	27/30 (90)	24/30 (80)	0.258
Overall success of intubation	30/30 (100)	30/30 (100)	-
Failed intubation	0/30	0/30	-

GVL: GlideScope video laryngoscope, DL: Direct laryngoscope

Table 5: Comparison of complication data

Variable	GVL (n=30)	DL (n=30)	P
Desaturation	2/30	2/30	-
Trauma	1/30	4/30	0.165

GVL: GlideScope video laryngoscope, DL: Direct laryngoscope

has been introduced into the market as scaled-down versions of the adult counterparts.^[16,17] GVL, with a 60° angulation blade and digital camera at its distal end, allows glottis visualization without alignment of the laryngeal, pharyngeal, and oral axes. Furthermore, GVL can improve viewing the glottis by providing a more anterior laryngeal exposure.^[18]

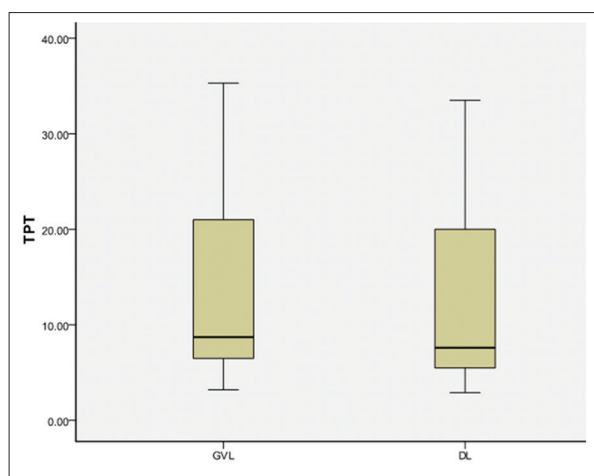


Figure 4: Endotracheal tube passage time in seconds represented by Box and whisker plots. The horizontal solid line inside the box gives the median time and the upper and lower limits of the box correspond to the 25th and 75th quartiles. The horizontal limits of the whiskers correspond to the 5th and 95th percentiles

The main findings in this study are the significantly better POGO scores and shorter TBGV in the GVL group as compared with DL group; however, TPT and IT was comparable between the two groups. Although the overall intubation success rate was similar in both groups, successful intubation at the first attempt was accomplished in 27 out of 30 neonates (90%) in group GVL in comparison with only 24 out of 30 neonates (80%) in group DL. Moreover, three patients in the GVL group required a second attempt for intubation in comparison with five patients in the DL group. Also one more patient in the DL group required a third attempt. OLEM was required in 9 patients (30%) in GVL group in comparison with 17 patients (57%) in DL group with a statistically significant difference among the two groups. The POGO scores after OLEM reached 100% in GVL group that was significantly higher than that in the DL group (94.8%). There was no significant difference among the two groups regard to the traumatic injuries and desaturation.

Endotracheal intubation in lateral position is relatively difficult probably because of unfamiliarity of the anesthesiologists with this position. The movement of the laryngoscope handle during intubation in right lateral position is restricted because of the limited space with the operating room table top. This may contribute to the intubation difficulty specifically with the conventional DL that possesses longer handle than that of the GlideScope. Furthermore, another contributing factor is the tendency of the patient's tongue to slip off the laryngoscope blade due to the effect of gravity in right lateral position resulting in deterioration of the laryngeal view. So, time to best laryngeal view and intubation attempts may be increased with DL compared with video laryngoscope, which offers a magnified, brighter image with a quick insertion in the pharyngeal midline without displacing the tongue.^[11,19,20]

Dozens of previous publications and their meta-analyses studied video-assisted laryngoscopy in comparison with the traditional direct laryngoscopy for endotracheal intubation in patients with normal and difficult airway in the conventional supine position.^[5,11,21-24] Video laryngoscopy has been proved to provide an improved laryngeal view as compared with direct visualization.^[25] However, publications considering video laryngoscopes for lateral position intubation are a bit scarce.^[19,20] To the best of our knowledge, this is the first randomized prospective observational study to compare GlideScope with direct laryngoscope in lateral position endotracheal intubation in neonates with myelodysplasia.

In a previous study, GlideScope was proved to yield faster time to best glottis visualization and better views with similar time to intubation and success rates in anatomically normal neonates and infants which are similar to our results but in supine position. However, they reported a longer time to tube passage with GlideScope than direct laryngoscopy.^[11] With increased experience in GVL and development of hand-eye coordination needed for indirect intubation, the laryngoscopist becomes faster in endotracheal tube placement. This can likely explain the longer intubation times reported by novice laryngoscopists using video laryngoscopy.^[8,26] Although the number of laryngoscopies required to ensure competency with the traditional direct laryngoscopy has been determined, the number of attempts necessary for a novice laryngoscopist to act suchlike with video laryngoscopy are still undetermined.^[27]

In a study comparing endotracheal intubation in lateral versus supine position using Airway Scope, endotracheal intubation was found easier with Airway Scope than DL in patients positioned in lateral decubitus with fast and comparable intubation times.^[20] Furthermore, direct laryngoscopy was found to be more difficult in lateral position as compared with C-MAC video laryngoscope, which offered high success rates and less intubation times in patients positioned laterally.^[19] Both studies had recommended video laryngoscope as an effective approach for endotracheal intubation in lateral position.

In a previous study, investigating endotracheal intubation of 203 pediatric patients, GlideScope was reported to provide a better laryngoscopic view than a Machintosh blade with or without OLEM but with longer intubation time.^[28] Whereas in another study, GlideScope was suggested to be inferior to direct laryngoscopy in pediatrics with a normal airway.^[29] The authors referred these results to the different GlideScope generation used in their study with limited size options for the age range included in the study.

In our study, we did not include the patients with difficult airway. Video laryngoscopes have been proved to be superior for intubation in children with difficult airway when compared with traditional DLs in supine position.^[5,16] However, further investigations are needed to compare the performance of video laryngoscopes versus conventional DLs in pediatric population with difficult airways in lateral position. Other limitations to our study were the unfeasibility of blinding, probability of certain bias because POGO score and best view are subjective tools, and unmeasured train of four before laryngoscopy, but we considered 90 seconds after rocuronium injection adequate to assure good intubation condition.

Conclusion

In laterally positioned neonates, GVL is easier than DL with a similar intubation time, comparable time required for tube passage, better views of the glottis, shorter times to obtain the best glottic view, and high success rate as compared with direct laryngoscopy. GlideScope seems to be an effective approach for endotracheal intubation of laterally positioned neonates with myelodysplasia.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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