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GlideScope® video laryngoscope: a randomized clinical trial in 203 paediatric patients†

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Background. The GlideScope® intubating device has been reported to provide a comparable or superior laryngoscopic view compared with direct laryngoscopy in adults. This study compared the use of the GlideScope® with direct laryngoscopy for the laryngoscopic view and intubation time in children.

Methods. The laryngoscopic view in 203 children was scored using both the Macintosh laryngoscope and the GlideScope® using Cormack and Lehane (C&L) grades. After scoring each laryngoscopic view with and without BURP, the patients were randomly allocated to two groups. The trachea was intubated using direct laryngoscopy (Group DL, $n=100$) or the GlideScope® (Group GS, $n=103$). We compared C&L grades for the two views in the same patient, and also the time to intubate for each group.

Results. The GlideScope® improved the view without BURP in the patients with C&L grade 2 (16/26, $P<0.01$) and with C&L grades 3 and 4 (7/11, $P<0.05$). The view with BURP was also improved by the GlideScope® in C&L grade 2 (4/9, $P<0.05$) and with C&L grades 3 and 4 (4/5, $P=0.059$). The mean time for tracheal intubation was 36.0 (17.9) s in the GS group and 23.8 (13.9) s in the DL group ($P<0.001$).

Conclusions. In children, the GlideScope® provided a laryngoscopic view equal to or better than that of direct laryngoscopy but required a longer time for intubation.

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The GlideScope® video laryngoscope (Saturn Biomedical System Inc., Burnaby, BC, Canada) is a recently developed device for intubation, designed to allow a view of the glottis without aligning oral, pharyngeal, and tracheal axes. Previous studies have shown that, in adults, it can provide a laryngoscopic view equal to or better than that of direct laryngoscopy.[1–3] Several reports have also demonstrated the usefulness of the GlideScope® for adults with difficult airway.[4–6] Although some reports suggest the utility of the GlideScope® in children,[7 8] there are little data on children.

In children, the larynx is more cephalad and the mouth opening smaller than in adults. The small and mid-sizes of the GlideScope® blades differ from the large blade in the blade length from a camera pod, the width of the camera pod, and the thickness at the camera pod (Fig. 1). The object of this study is to evaluate the usefulness of the GlideScope®, compared with direct laryngoscopy in children, by comparing the laryngoscopic view and the time taken for tracheal intubation.

Methods

After approval of hospital ethics committee and informed written consent from the parents or guardians, we studied 203 children aged 3 month to 17 yr presenting for surgery under general anaesthesia. Those with a risk of pulmonary aspiration or increased intracranial pressure were excluded. Mallampatti classification and degree of neck extension were evaluated before induction. The patients were allocated by the computer-generated randomization into the direct laryngoscopy group with a Macintosh bladed Welch

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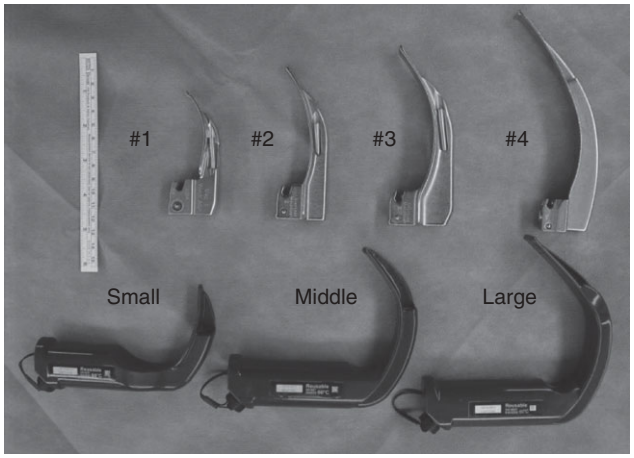

Fig 1 GlideScope® video laryngoscope blades and conventional laryngoscopic Macintosh blades.

Allyn™ laryngoscope (Group DL) or the GlideScope® group (Group GS).

Patients were not premedicated. In the operating theatre, monitoring consisted of electrocardiography, non-invasive arterial pressure, pulse oximetry, capnography, and inspired and expired sevoflurane concentration (Solar 8000M, GE, Milwaukee, WI, USA). After administration of atropine 0.02 mg kg^{-1}, anaesthesia was induced with thiopental sodium 5 mg kg^{-1} i.v. Rocuronium 0.6 mg kg^{-1} was administered to enable tracheal intubation. The lungs were ventilated with 4–8 vol% sevoflurane in 100% oxygen using a facemask before laryngoscopy.

In the DL group, the initial laryngoscopic view was scored using GlideScope® according to the Cormack and Lehane grade (C&L grade). Thereafter, the second laryngoscopic view was scored using a Macintosh laryngoscope and the trachea was intubated. In the GS group, the initial laryngoscopic view was scored using the Macintosh laryngoscope. The second laryngoscopic view was scored using the GlideScope® and the trachea was intubated. All laryngoscopic views were graded both with and without applying the BURP manoeuvre, which includes backward, upward, and right lateral displacement of the thyroid cartilage.[9] All intubations were performed using a tracheal tube reinforced by a similarly shaped stylet. The angle of the ETT stylet was approximately 60° for the first attempt. If the angle was inappropriate, the angle was adjusted. The GlideScope® blade size selected was similar to the Macintosh blade size (Fig. 1). The size of Macintosh blade was selected as follows: size 1 for infant and small children, size 2 for older children, and size 3 for adolescents. The ETT sizes were determined using the formula, age (yr)/4+4. Time to intubate (TTI) was measured from the time the device entered the mouth until end-tidal carbon dioxide was detected. If more than one attempt was required, the patient received mask ventilation between the attempts. TTI included the time between the attempts.

The intubations were performed by three different anaesthetists who had used the GlideScope® more than 20 times, and were also skilled in conventional laryngoscopy.

The sample size was calculated based on the first 60 patients collected for the pilot study (difference in means 0.12, SD 0.45). For 90% power to show a statistically significant difference, the required sample size for the Wilcoxon signed ranks test with an alpha error of 0.05 was approximately 187. The paired C&L grade and the change of the C&L grade with BURP were compared using the Wilcoxon signed ranks test. Data distribution was first evaluated using the Kolmogorov–Smirnov test. Time for intubation between the groups was compared using unpaired *t*-test. Correlations between Mallampatti classification *vs* TTI and between C&L grades *vs* TTI were evaluated using Pearson's correlation coefficient. A *P*-value of <0.05 was considered statistically significant.

Results

Two hundred and three patients were recruited. There were no significant differences in patient characteristics between the two groups (Table 1). The TTI using both the Macintosh laryngoscope and the GlideScope® correlated with C&L grade (Pearson correlation coefficient 0.45 and 0.35, respectively, each $P<0.01$). The TTI using the Macintosh laryngoscope was related to the Mallampatti classification ($n=83$, Pearson correlation coefficient 0.46, $P<0.05$), but the TTI using the GlideScope® did not ($n=89$).

Table 1 Patient characteristics and airway data. Mean (SD) (range). M, missed case. In small children, it was impossible to check the Mallampatti class. Therefore, some data are missed

	DL group ($n=100$)	GS group ($n=103$)
Age (yr)	6.1 (3.8) (0.5–17)	6.5 (4.2) (0.3–17)
Height (cm)	116.3 (24.9) (64.6–176.6)	115.6 (26.0) (66.7–173.0)
Weight (kg)	24.4 (11.9) (6.6–60.7)	27.3 (16.2) (6.7–80)
Sex (M/F)	57/43	65/38
Mallampatti class (1/2/3/4/M)	59/27/2/1/11	47/32/2/2/20
Neck extension (good/bad)	97/3	100/3

Table 2 Comparison of laryngoscopy grades. C&L grade, Cormack and Lehane grade. The GlideScope® improved the C&L grade compared with the direct laryngoscopy. The number in parentheses means the number of C&L grade during BURP

Direct laryngoscopy C&L grade	GlideScope® C&L grade				
	Grade 1	Grade 2	Grade 3	Grade 4	Total
Grade 1	165 (189)	1 (0)	0 (0)	0 (0)	166 (189)
Grade 2	16 (4)	9 (5)	1 (0)	0 (0)	26 (9)
Grade 3	1 (0)	5 (3)	4 (1)	0 (0)	10 (4)
Grade 4	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
Total	183 (194)	15 (8)	5 (1)	0 (0)	203 (203)

Table 3 TTI with direct laryngoscope and with GlideScope®. Mean (SD) (range). Overall TTI and TTI for C&L grade 1 take longer in the GS group. *$P<0.05$, compared with the DL group

	DL group ($n=100$)	GS group ($n=103$)
Overall TTI (s)	23.8 (13.9) (11–130)	36.0 (17.9) (15–110)*
TTI for C&L grades 1 and 2	22.6 (8.9) (11–82) ($n=98$)	34.4 (16.5) (15–110) ($n=94$)*
TTI for C&L grades 3 and 4	80.0 (70.7) (30–130).(21.2) ($n=2$)	52.8 (24.1) (25–100) ($n=9$)

The GlideScope® provided a laryngoscopic view equal to or better than that under the direct laryngoscopy (Table 2). Without BURP, of the 37 patients with C&L grade >1 by direct laryngoscopy, 23 had a better laryngoscopic view with the GlideScope® ($P<0.001$). With BURP, of the 14 patients with C&L grade >1 by direct laryngoscopy, eight had a better laryngoscopic view with the GlideScope® ($P=0.007$). The GlideScope® improved the laryngoscopic view without BURP in 16 of 26 patients with C&L grade 2 and in seven of 11 patients with C&L grades 3 and 4 ($P<0.01$ and $P<0.05$, respectively). The laryngoscopic view with BURP was also improved by the GlideScope® in four of nine patients with C&L grade 2 and in four of five patients with C&L grades 3 and 4 ($P<0.05$ and $P=0.059$, respectively).

In two patients, the view with the GlideScope® was worse than that with the Macintosh laryngoscope, but the grade improved by applying the BURP. This technique significantly improved the laryngoscopic grade in 29 patients (14%) with the Macintosh laryngoscope and 15 patients (7%) with the GlideScope® (each $P<0.001$).

There were 10 (seven for C&L 1, one for C&L 2, and one for C&L 3) reattempts at intubation in the GS group, as opposed to two (one for C&L 1 and one for C&L 3) in the DL group ($P=0.02$). The overall mean TTI and the TTI for C&L grades 1 and 2 were greater in the GS group ($P<0.001$) (Table 3). However, the TTI for C&L grades 3 and 4 was similar between the groups. There were no failed intubations or complications associated with intubation.

Discussion

The GlideScope® is designed to allow a view of the glottis with a camera without the alignment of oral, pharyngeal, and tracheal axes. In an adult study, the view in 68% of patients with a C&L grade >1 was improved with the GlideScope®.[3] In this study, 62% of children with a C&L grade >1 had an improved view with the GlideScope®. The laryngoscopic view was improved in seven of 11 C&L grades 3 and 4 without BURP, and four of five C&L grades 3 and 4 with BURP. The GlideScope® provides a laryngoscopic view equal to or better than that of direct laryngoscopy and may be useful in children.

We have shown that the GlideScope® is useful for tracheal intubation in children, but the time taken was longer and more attempts were required. Although the GlideScope® rarely worsens an easy laryngeal view in children, it makes tracheal intubation more awkward and slower with an increased first attempt failure rate and longer TTI, especially in patients with an easy laryngoscopic view. Of 10 reattempts in the GS group, eight patients had C&L grade 1 or 2. The potential explanations for this are the mismatched angle of the stylet to the laryngeal inlet and unfamiliarity compared with direct laryngoscopy. The manufacturer's guidelines recommend bending the tip of the stylet to at least 50–60° to match the angle of the GlideScope® blade. However, an angle of 60° was not appropriate in some cases and configuring the stylet to nearly 90° at distal part of ETT, like a hockey-stick, was more useful.

The BURP manoeuvre was effective in improving the laryngoscopic views with both devices. Because BURP improved the C&L grade, the C&L grade without BURP can overestimate frequency of difficulty at laryngoscopy. There were only five patients who had C&L grade 3 or 4 with direct laryngoscopy with BURP. Therefore, we cannot draw a conclusion about the efficacy of the GlideScope® in children with a difficult airway from this study.

The recommended blade sizes are the large device for patients over 30 kg, the mid-size for patients 10–110 kg, and the small for patients 1.5–20 kg. Because this covers a very wide range and the laryngoscopic view varies with the size of the blade, we selected the blade which was closest to the Macintosh blade in size. We used a second-generation GlideScope® which has a slightly smaller blade profile, ~14 *vs* 18 mm which may be more useful for laryngoscopy and intubation in children with a small mouth. A relatively large blade may be disadvantageous in paediatric patients, but further studies are required in children with a difficult airway and in neonates.

In conclusion, although the GlideScope® provides a laryngoscopic view equal to or better than that of direct laryngoscopy, it can make easy intubation slightly more difficult in children.

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