A comparison of the Glidescope® and Karl Storz DCI® videolaryngoscopes in a paediatric manikin*

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Summary
A new paediatric Glidescope® (Cobalt GVL® Stat) has recently become available. This varies in design from the Karl Storz DCI® videolaryngoscope, as it possesses a short curved disposable blade compared with the narrower straighter blade of the Storz®. We compared the time taken for tracheal intubation under normal and difficult intubation conditions in a paediatric manikin. A total of 32 anaesthetists completed four intubations in a random order, with each participant blinded to the airway condition. We hypothesised there would be no difference between the devices. The results showed no difference in tracheal intubation time between the Glidescope and the Storz videolaryngoscope. The mean (SD) times under normal conditions were 18.8 (5.2) s vs 19.9 (6.1) s, (p = 0.16), respectively. Under difficult conditions the times were 22.6 (10.5) vs 27.0 (14.2) s, (p = 0.13), respectively. There were no differences in the visual analogue scores for field of view, ease of use, willingness to use in an emergency, and overall satisfaction.

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Difficult intubation is uncommon but can cause significant morbidity and mortality [1, 2]. In recent years many techniques have become available to aid management of the difficult airway. However, advances in adult airway management are not always transferable to paediatric practice, for example, awake fibreoptic intubation in an uncooperative toddler is impractical and the intubating laryngeal mask airway (LMA Company, Henley-on-Thames, UK) is currently unavailable in appropriate sizes. Attention has therefore turned to the use of videolaryngoscopes which can increase the field of view and have the benefit of simplicity and rapidity of use compared with fibreoptic techniques [3–5].

A new disposable paediatric videolaryngoscope became available in October 2008, the Glidescope® Cobalt GVL Stat (GVL, Verathon Medical, Aylesbury, UK). Compared with conventional direct laryngoscopy, the Glidescope performs equally well under simulated normal and difficult airway conditions [6]. In a study of 203 children, the Glidescope provided a comparable or better laryngeal view than conventional laryngoscopy, but took a longer time to achieve intubation [7]. Conversely, Redel et al. reported similar intubation times in a randomised study of 60 children [8].

An alternative to the Glidescope is the Karl Storz® DCI videolaryngoscope (Karl Storz Endoscope, Tuttingen, Germany). The Storz device is available in a Miller size 0 and size 1 blade which are very similar in design to, but not exact replicas of, the conventional Miller blades. Fiadjoe et al. [9] compared the conventional Miller laryngoscope with the paediatric Storz Miller 1 videolaryngoscope in a manikin with a simulated difficult airway, and found that the Storz device improved the laryngeal view without increasing the time to intubation.

We aimed to compare the paediatric Glidescope Cobalt GVL Stat with the paediatric Karl Storz DCI videolaryngoscope by evaluating the time taken to intubation under normal and difficult airway conditions. Our hypothesis was that no difference would be found.
Due to ‘difficult airways’ being rare and life-threatening, we chose, for practical and ethical reasons, to evaluate the two devices in a simulator manikin which provides a realistic model of an infant airway and has been used previously to simulate difficult airway conditions [6].

Methods

After approval from the Local Research Ethics Committee and written informed consent, we recruited 32 anaesthetists. Of this group there were 14 consultants and 18 trainees. All trainees were specialist trainees in year 3 or above who had completed their competency training in paediatric anaesthesia.

In order to minimise bias due to familiarity with the devices, we demonstrated the use of each device and participants were allowed up to 15 min to practices with both devices.

We used the Simbaby® manikin (Laerdal Medical Limited, Kent, UK) which simulates an anatomically accurate 3–6 month-old infant airway which we defined as the normal airway condition. The difficult airway condition was achieved by using a combination of tongue oedema and pharyngeal obstruction. This has been previously shown to produce a difficult airway as defined by consistently prolonged intubation times compared with the normal manikin airway settings [6]. We used the paediatric rather than neonatal sized blades for each videolaryngoscope as appropriate for a 3–6 month-old infant. This corresponded to the size 2 Glidescope Cobalt GVL Stat blade and the Karl Storz Miller 1 blade.

Each participant used the Glidescope and the Storz under both simulated normal and difficult airway conditions. The four intubations were performed in a random order determined by two tosses of a coin. The first coin toss identified which device was to be used and the second toss determined the level of airway difficulty. Participants were blinded to the level of airway difficulty. A size 4.0 uncuffed, non-styletted tracheal tube was used for all intubations.

The primary outcome measure was the time taken to intubation. This was recorded using a handheld stopwatch by the same investigator (DH) for every intubation. Timing began when the laryngoscope entered the oral cavity and ended on the first successful inflation of the lungs.

After completion of the four intubations, participants were asked to evaluate both devices using a visual analogue scale for: (i) field of view; (ii) ease of use; (iii) willingness to use in an emergency; and (iv) overall satisfaction. These were our secondary outcome measures.

We determined that a 10-s difference would be a clinically significant difference as this would represent an increase of 30–50% increase in average intubation time. Using data from our previous study [6] and the the Altman nomogram [10] we calculated that 32 participants would provide 80% power to detect a 10-s difference in intubation time at the 0.05 level of statistical significance. After confirmation that primary outcome data were normally distributed, the results were analysed using a paired t-test.

Results

Thirty-two participants were recruited to the study. Fifteen participants had never used a Glidescope before and 17 had used it less than 10 time, whereas 26 participants had never used the Karl Storz DCI videolaryngoscope before, and six had used it less than 10 times No participant had used either device more than 10 times.

Under normal and difficult airway conditions, there was no difference in the time taken to intubation for either device. Details of the primary outcome measure (time taken to intubation) are shown in Table 1. Tracheal intubation using both the Glidescope and the Storz took significantly longer under difficult airway conditions compared with normal conditions (p = 0.01 and 0.001 respectively).

There was no significant difference between the Glidescope and the Storz when rated for the secondary outcome measures (Table 2).

Discussion

Our results show there was no difference in time taken to tracheal intubation using the Glidescope Cobalt GVL Stat and the Karl Storz DCI Miller 1 blade video laryngoscopes under manikin-simulated normal or difficult airway conditions.

Videolaryngoscopes have gained popularity in recent years because they can improve the field of view by up to 65°, offering a theoretical advantage in the difficult airway scenario. The results in paediatric studies, however, are variable [6, 9, 11, 12]. Several different paediatric video systems are now commercially available and these differ from each other in a number of ways, such as the

<table>
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<th>Table 1</th>
<th>Time (s) until successful intubation with the Glidescope and Karl Storz DCI videolaryngoscopes. Values are mean (SD). No significant difference between the blades.</th>
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<tbody>
<tr>
<td>Normal conditions</td>
<td>Glidescope®</td>
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<tr>
<td>Difficult conditions</td>
<td>22.6 (10.5)</td>
</tr>
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<td>p value</td>
<td>0.01</td>
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laryngoscope blade design, the type of optical video system (fibreoptic cable or prisms, lenses or mirrors), and the technique required (‘lifting’ or ‘rocking’). These differences may account for the varying results, making thorough evaluations and comparisons of the devices essential.

The paediatric Glidescope® and Karl Storz video laryngoscopes differ in design (see Fig. 1) and utilise different intubating techniques. The Glidescope blade is short, flat and curved, and requires a ‘rocking’ action technique to optimise intubation. This technique may also be described as a smooth ‘pulling a pint of beer’ action. The Storz Miller blade is straight rather than curved, and longer and narrower than the Glidescope; it is almost identical to the standard Miller blade (although not an exact replica). Therefore a conventional ‘lifting’ manoeuvre is required for tracheal intubation in just the same way as is used with a conventional laryngoscope. Despite these differences, we found no significant differences in intubation times. The Storz device has the fibreoptic camera positioned closer to the laryngoscope tip when compared with the Glidescope. This provides a more magnified and detailed view of the glottis but a narrower angle of view. The narrower angle may cause difficulty in placing the tracheal tube after obtaining a view of the glottis, which could result in a longer intubation times with the Storz under difficult airway conditions. However, when rated for field of view and ease of use, there was no difference between the devices. When evaluating different laryngoscopes, it is important to remember that glottic view is only part of the process of intubation; for example, it is possible to achieve an excellent view and yet be unable to manoeuvre the tracheal tube into the correct position. Therefore studies that compare devices based only upon laryngeal field of view or glottic exposure rather than objective measures such as successful tracheal intubation or intubation times should be interpreted with caution. In adults, clinical experience with videolaryngoscopes suggests that we may be exchanging one difficulty for another: viewing glottic and vocal cords may be made easier by videolaryngoscopes, but the actual intubation may be more difficult due to the angles the tracheal tube is required to negotiate.

This study has a number of limitations. Firstly, manikin studies are not automatically transferable to ‘real life’ and can therefore only provide data to support further work. Secondly, there was a greater proportion of participants with prior experience with the Glidescope. Fifty-three per cent (17/32) of our participants had used the Glidescope previously compared with 19% (6/32) for the Karl Storz. Although none of those who had used the Glidescope previously had used it more than 10 times, this may have biased results in favour of the Glidescope. However, participants could be assumed to be already familiar with the Storz device because the same technique of ‘lifting’ is required as is used in standard conventional laryngoscopy, and no difference was found between the devices under normal conditions. Additionally, we attempted to control for any bias by demonstrating each device to the participants and allowing them up to 15 min practice time before starting the study.

Time taken to tracheal intubation using both devices differed significantly between the ‘normal’ and ‘difficult’ conditions. This in consistent with the SimBaby’s® being an effective model for evaluating difficult airway

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<th>Glidescope®</th>
<th>Karl Storz DCI®</th>
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<tr>
<td>Field of view</td>
<td>7.2 (1.7)</td>
<td>7.7 (1.1)</td>
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<tr>
<td>Ease of use</td>
<td>7.4 (1.7)</td>
<td>7.2 (1.6)</td>
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<tr>
<td>Willingness to use in an emergency</td>
<td>6.2 (2.0)</td>
<td>6.2 (2.2)</td>
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<tr>
<td>Overall satisfaction</td>
<td>7.0 (1.7)</td>
<td>7.1 (1.4)</td>
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**Figure 1** Comparison of a conventional laryngoscope with Miller 1 blade (top); Karl Storz DCI Miller 1 blade (middle) and Glidescope Cobalt GVL Stat size 2 blade (bottom).
equipment, as is reported elsewhere [6]. We used the time taken to tracheal intubation as our primary outcome measure. However, it is not simply failure to intubate that endangers lives, but failure to oxygenate. Difficult intubation is less common in children compared with adults but is still life-threatening. Therefore, in vivo evaluation of ‘difficult airway’ equipment is both practically and ethically challenging, hence the importance of having good models in which to undertake evaluations. Good models also allow training for the acquisition and retention of skills. This is essential because failure rates for intubation vary enormously, and can be improved by training and use of specialised airway equipment [13–15]. Furthermore, manufacturers are continuing to produce increasingly more intubation aids, many of which are expensive, and there is a lack of robust data evaluating their performance and making informed purchasing choices difficult. This study shows that there is no difference between the Glidescope and the Karl Storz DCI videolaryngoscope under simulated normal or difficult airway conditions. Therefore, the purchasing choice between these two devices will rest upon issues such as initial cost, ongoing maintenance costs, portability if the device is to be moved between locations, local preferences and potential for other uses. The Glidescope costs in the region of £6000 (€6900; $8600) and uses disposable laryngoscope blades that cost just under £10 (€11; $14) per blade. The Karl Storz endoscopy system is more expensive, costing approximately £20 000 (€23 200; $28 700), but consists of a series of reusable blades (that require sterilisation), and a telepack camera system with a DCI camera head connection that is suitable for use with other Karl Storz endoscopy devices.

There are currently no guidelines on management of the difficult paediatric airway, and much of the evidence comes from small case series or manikin studies. Manikin studies have become increasingly used in airway equipment research, and while their limitations are well known, they do help overcome the practical and ethical difficulties of studying rare, life threatening events and also offer the benefit of consistency. Evidence gained from both case reports [11, 12] and the simulated environment [6, 9] should be used to guide paediatric airway management, inform purchasing choices and direct further clinical research. Our findings support the study of either the Glidescope or the Karl Storz DCI videolaryngoscope in a follow-up in vivo study as both performed equally well. Furthermore, this study suggests that both devices can be used effectively by novice users, such as if the devices had been newly purchased by an anaesthetic department. We did not attempt to assess the impact of training on the effectiveness of either device.

Acknowledgement

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References