

Video laryngoscopy in paediatric anaesthesia in South Africa

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Abstract

This article provides a summary of the types of video laryngoscopes available in South Africa, and highlights some interesting paediatric cases in which video laryngoscopes were used at the Steve Biko Academic Hospital, Pretoria.

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Introduction

Video laryngoscopy (VL) has been used for paediatric anaesthesia for just over a decade. The introduction of video laryngoscopy technology has provided the laryngoscopist and the bystander personnel in the theatre with an all-inclusive view of the airway. VL provides high-quality resolution and a better view than that obtained through direct laryngoscopy.^{1,2} The obvious appeal of VL explains why it has rapidly become an integral part of paediatric airway management.

The implications of the paediatric airway anatomy for airway management are of paramount importance and need to be considered at intubation at all times, regardless of the choice of equipment.

In the younger child and infant, the salient anatomical features include the following:

- The head (occiput) is relatively larger.
- The tongue is large relative to the size of the mouth.
- The larynx is more cephalad in the infant (C2–3).
- The epiglottis is narrow, omega-shaped and projects above the glottic opening.
- The vocal cords slant anteriorly and rostrally.
- The cricoid cartilage is the narrowest part of the larynx.

In the 1880s, Joseph O'Dwyer was the first to introduce emergency intubation by blindly using the fingers to palpate the larynx and direct the endotracheal tube (ETT) into the airway. Today, most intubations are performed by direct laryngoscopy.³

Unfortunately, there are paediatric patients who cannot be intubated with a conventional laryngoscope, because a direct line of vision cannot be obtained from the anaesthetist's eyes to the larynx. The Miller, Wisconsin, Wis-Hipple and Robertshaw blades have been developed as speciality blades for use in infants. These are straight blades with a distal curvature in order to obtain a better line of vision of the anterior larynx.

Indirect fibre-optic laryngoscopes, such as the Bullard scope, can be effective alternatives to direct laryngoscopy. However, they have limitations, such as fogging of the lens with secretions and being very rigid, with the potential of causing trauma to the soft mucosa at insertion.

Video laryngoscopes incorporate video and optical technology to augment the function of the laryngoscope. They operate as specialised laryngoscopes, used for examination and diagnosis within the oropharynx, glottis and larynx, for removal of foreign bodies and to assist tracheal intubation. Unlike conventional laryngoscopes, video laryngoscopes employ digital technology, such as the CMOS active pixel sensor (CMOS APS) video camera, which is mounted on a laryngoscope blade to generate a view of the anatomical structures.

Although video laryngoscopes are based on the same technique as direct laryngoscopy, their use requires a different skill set. The VL blade is inserted in the midline, with avoidance of a tongue sweep by looking in the patient's mouth. Then, looking at the display monitor, the laryngoscope blade is gently fitted and advanced until the larynx becomes visible. As with direct laryngoscopy, external

laryngeal manipulation may be necessary to improve the laryngeal view. Viewing the monitor while advancing the VL and inserting the ETT through the glottis opening demands fine hand-eye coordination, a skill that requires practice to polish.

Types of video laryngoscopes

Airtraq®

Airtraq® is a non-reusable, inexpensive optical laryngoscope with various colour-coded sizes according to the appropriate ETT that can be placed in the guiding channel. Airtraq® consists of a light source, an anti-fog system and two channels: the optical channel which contains the high-tech optical system, and the guiding channel for the ETT (Figure 1).³



Figure 1: Airtraq® video laryngoscope system

After turning on the light source, the ETT should be lubricated and placed within the guiding channel. With the device positioned midline into the opened mouth, the laryngoscopist looks through the eyepiece as the device is advanced to view the epiglottis. Once in the vallecula, Airtraq® is lifted slightly with a side-to-side motion to obtain a centred view of the vocal cords. The ETT is then inserted through the vocal cords.

A high success rate is achievable in paediatric patients only by using the correct size of Airtraq® according to the applicable size of ETT selected (Table I).

Table I: Matching Airtraq® and endotracheal tube sizes

Airtraq®	Endotracheal tube (mm)
0 (grey)	2.5–3.5
1 (purple)	4.0–5.5
2 (green)	5.5–7.0

One should take care not to insert the Airtraq too deeply, a common mistake with the VL. Once the glottis is in view, the angle is usually correct and the ETT can be guided easily. If there is difficulty, the device should be withdrawn slightly rather than advanced to reposition it. Since the ETT cannot be manipulated by the operator, the Airtraq® must be adequately positioned and aligned in front of the glottis entrance for successful intubation.³

Airtraq® is portable, lightweight and well suited for settings other than the operating room. It provides a clear enough view of the glottis for successful intubation at a lower price.² The anti-fog technology is an added benefit, providing adequate clarity for intubation.³

The Airtraq® system has the following limitations:²

- Some mouth opening is required.
- It is best suited for oral intubation.
- A learning curve exists.
- The quality of its optics is poorer than that of the other video laryngoscopes.
- It is easy to lose direction, owing to the small viewing area.
- Caution needs to be exercised during insertion in order not to cause any trauma to the fragile mucosa.

Numerous children and infants weighing 2 kg and above were successfully intubated at our institution using various applicable Airtraq® sizes.

GlideScope®

Designed in Vancouver, Canada in 2001, GlideScope® was the first commercially available video laryngoscope.² It incorporates a high-resolution digital camera, connected by a video cable to a high-resolution video monitor (Figure 2).

GlideScope® owes its superior results to a combination of five key factors:²

- The 60-degree angulation of its blade improves the view of the glottis by reducing the requirement for anterior displacement of the tongue. The view of the larynx is more anterior than the operator would expect.
- The CMOS APS digital camera is located at the point of the angulation of the blade and not at the tip, which allows the operator to view the field in front of the camera more effectively.
- The video camera is recessed to protect it from blood and secretions, which may obstruct the view.
- The video camera has a wide viewing angle of 50 degrees.
- The heated lens innovation or anti-fog mechanism very effectively prevents fogging of the lens and obscuring the view, and provides the clearest, sharpest image possible under difficult circumstances.



Figure 2: The GlideScope® system with reusable blades

Even novice healthcare practitioners can easily identify and navigate the glottis inlet with GlideScope®. Most senior registrars at Steve Biko Academic Hospital were able to intubate various paediatric patients of different ages with minimal guidance the first time with GlideScope®. However, it requires a fair amount of hand-eye coordination, that improves with more regular use. A rigid intubating stylet that is curved to follow the 60-degree angulation of the blade, inserted in the ETT, is mandatory for intubation with this video laryngoscope.

All three types of GlideScope® currently on the market, discussed in detail below, accommodate paediatric-sized blades.

The original GlideScope® has four blades: No. 2 (over 1.8 kg) and 3 (over 10 kg) blades are used for paediatric patients, while No. 4 and 5 are used for adults. An infant weighing 1.9 kg was easily intubated successfully with the No. 2 blade in our practice.

To date we have intubated more than 130 children and infants with the reusable GlideScope®, with only one failure in a two-day-old infant weighing 3.6 kg with cystic hygroma of approximately 1 kg (Figure 3). This infant was ultimately intubated successfully with a straight Miller 1 laryngoscope blade and a stylet ETT (after a Macintosh laryngoscope blade also failed).

In concurrence with the literature,^{1,4} we found that GlideScope® provides a view equal or superior to direct laryngoscopy albeit with increased time to pass the ETT, especially in the case of smaller infants (reduced space of the oral opening for both blade and stylet ETT) and more novice operators.



Figure 3: Infant with cystic hygroma

The GlideScope Cobalt® is a newer system that consists of a camera and light source embedded in a baton, with nonreusable blades or stats that slide over the baton. Disposable blades are well suited for preterm infants or neonates. For blade size recommendation for weight, see Table II.

Table II: GlideScope Cobalt® blade sizes matched with infant weight

Blade size	Infant weight (kg)
Stat 0	< 1.5 (can go down to about 600 g)
Stat 1	1.5–3.0
Stat 2	1.8–10 .0

The advantages of the GlideScope Cobalt® include reduction of transmitting infectious pathogens between patients, and eliminating the downtime of the GlideScope® during the sterilisation process.

An infant weighing 1.4 kg was successfully intubated for gastroschisis repair with the stat 0 blade, and an infant weighing 1.9 kg with bilateral cleft palate, hypoplastic left ventricle, a tracheo-oesophageal fistula and lower limb and genital abnormalities with the stat 1 blade. Both required external laryngeal manipulation, but superior or equal views were obtained compared to direct laryngoscopy. Increased time to pass the ETT, when compared to intubating these small infants by direct laryngoscopy, was probably due to relative inexperience with the GlideScope Cobalt®. The stat 1 blade was especially useful to locate the smaller opening of the abnormal oesophagus posterior to the vocal cords (Figure 4).

The GlideScope Ranger®, the most versatile unit, has reusable blades as well as interfaces with nonreusable blades. It was designed for use in pre-hospital airway management, including air, land and sea applications. It weighs about 800 g, is waterproof and is airworthy to 20 000-feet altitude.

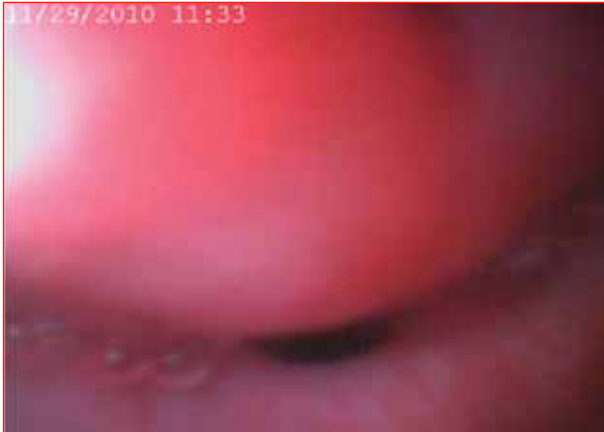


Figure 4. The smaller opening of the abnormal oesophagus posterior to the vocal cords in an infant

GlideScope® often provides a superior glottis view compared to the traditional Macintosh blade, but external laryngeal manipulation is needed to improve the glottis view. The BURP (backward, upward and right-sided pressure on the larynx) manoeuvre may be needed especially in patients with a short neck, restricted neck movement or significant macroglossia, owing to the GlideScope® having a blind spot just below the tip of the blade. A 13 mm blind area exists just below the tip of the reusable blade No. 3, as the field of view of the camera does not cover the tangent of the distal half of the blade. The blind spot for the No. 2 reusable blade is 2 mm wide.⁵ This may affect neonates with a high and anterior positioned larynx, in particular.

The GlideScope® is also used for placing nasogastric and transoesophageal echocardiogram probes when difficulty is encountered, as well as for performing bilateral glossopharyngeal blocks for awake insertion of a laryngeal mask airway in infants with difficult airways, such as those with Pierre Robin syndrome.⁶

C-MAC® and Storz® video laryngoscope

The Storz® video laryngoscope used during the trial in 2010 consisted of the TELE PACK® system with a digital coupler interface (DCI) camera and cable unit that combined image processing, a light source and liquid crystal display monitor, with Miller size 0, 1 and 2 VL blades (Figure 5). Clinical trials have shown, as with the GlideScope® that although better views were obtained with this VL in normal and difficult paediatric airways, intubation time was greater compared with direct laryngoscopy.⁶ The magnified image is displayed on the screen with a viewing angle of 80 degrees, compared to the viewing angle of 15 degrees with direct laryngoscopy.^{7,8}

Although the Storz DCI has a similar shape to that of the Miller 1 blade, just slightly longer (0.5 cm) and the tip slightly more angulated (10 degrees for direct laryngoscopy,



Figure 5: The Storz® video laryngoscope with Miller blades and TELE PACK®

12 degrees for VL), the technique of intubation is not identical to direct laryngoscopy and the learning curve is significant: the technique of advancing an ETT under video guidance requires training and experience.^{8,9} Novice registrars at Steve Biko were quick to obtain a view but slower to pass the ETT in our institution, similarly to the literature.^{8,10}

An 11-month-old baby, weighing 3 kg, with severe split palate and lip and holoprosencephaly, was successfully intubated on two occasions two months apart, for repair of the palate and lip respectively, with the reusable No. 2 GlideScope® and the Miller size 2 Storz® DCI respectively. Both intubations were achieved with equal ease with superior view of the vocal cords (Cormack-Lehane grade 1). Using a video laryngoscope in a paediatric patient with split palate and lip defects has the additional advantage of not dislodging into the cleft as easily as the direct laryngoscope handle, because the video laryngoscope handle only needs to be lifted and not tilted as anteriorly as compared to direct laryngoscopy. It also displays a more anterior view of the larynx and therefore less neck extension is needed.

C-MAC® is a lightweight compact system with a smaller monitor compared to the TELE PACK, but produces images of very high resolution that fill the whole screen (Figure 6). In our study in 2010, the C-MAC® could be connected to the sturdy reusable Nos. 2, 3 and D-blades for difficult intubations. Blade No. 2 is recommended for use in children weighing 4 kg and above (although a 2 kg infant was successfully intubated with relative ease with blade No.2 in our experience). It is slightly larger and bulkier than the GlideScope® blade No. 2, which is used in babies weighing 1.8 kg and above. Blade No. 3 is used in children weighing 10 kg and above, while the D-blade has an anterior curved point for difficult intubations in bigger children and adults, including morbidly obese patients.



Figure 6: The C-MAC® with the D-blade

Since June 2011, the Miller 0 and 1 blades can be fitted to the C-MAC® itself. We easily intubated various babies with the Miller 1 blade, including a nine-day-old 1.93 kg infant suffering from a tracheo-oesophageal fistula with superior all-inclusive views of the glottis, in comparison to the blade connected to the TELE PACK®.

The Storz® video laryngoscopes lack the integration of an effective anti-fogging mechanism, which in most circumstances necessitates quickly warming the blade in hot water or by hand before using it.¹⁰

Conclusion

Because the video laryngoscopes available currently combine the shape and function of a standard laryngoscopy blade with the advantages of indirect laryngoscopic fibre-optic visualisation, operators experienced with direct laryngoscopy can use VL without much need for specialised training.^{3,7}

VL can also function as a useful teaching tool, as the trainer and learner share the same view through the screen, allowing the trainer to guide the student to optimise laryngeal visualisation and tracheal intubation.^{3,7}

A better, more anterior view of the larynx may reduce neck movement during the intubation of children with cervical spine injuries, and can specifically be of more value in this area.⁸

Although these new VL systems may appear to require increased time to achieve intubation, the increased time

does not appear to be clinically significant.^{8,10} By providing a superior shared view of the larynx, these airway tools are definitely of value in the management of the difficult paediatric airway.

Declarations

The author declares no conflict of interest.

Permission for patient photographs was obtained from the parents.

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