

Equipment and monitoring for paediatric anaesthesia

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Abstract

There have been considerable developments in the equipment and monitoring available for paediatric anaesthesia over the past 3 years. Advances in airway management have come about primarily through the increased use of videolaryngoscopes. Numerous second-generation supraglottic airway devices are also now available with features aimed at improving both their safety profile and utility during difficult airway management. Concerns surrounding the endocrine effects of phthalates have led to the introduction of phthalate-free airway devices. The role of ultrasound continues to expand, with good evidence for its use where vascular access is challenging, while evidence in favour of alternative vascular access aids remains sparse. Smartphones and tablets have become an almost ubiquitous part of the paediatric anaesthetist's armoury, functioning as distraction devices for children and providing a wealth of useful information through applications. A number of cardiac output monitors are now available for use in paediatric anaesthesia and, with the advent of enhanced recovery programmes after surgery, it is likely that their use will increase in the future. This review will discuss a number of these devices and provide insight into the rationale for their use, focusing on those for which the best evidence is available.

Keywords Anaesthesia; cardiac output monitoring; equipment; monitoring; paediatric; videolaryngoscopes

Royal College of Anaesthetists CPD matrix: 2A04, 2D02, 2D03, 3D00

Equipment

Airway

Videolaryngoscopes: paediatric airway management can be challenging for numerous reasons; the well-documented anatomical features of babies, infants and young children, physiological differences including higher oxygen consumption with lower functional residual capacity, and the regular occurrence of children with syndromic features that predispose to difficult laryngoscopy and intubation. For many years this has

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Learning objectives

After reading this article, you should be able to:

- name some videolaryngoscopes suitable for paediatrics and understand their role
- describe the features of second-generation supraglottic airway devices commonly used in children
- discuss the role of smartphones and tablets in paediatric anaesthesia
- understand the principles of cardiac output monitoring and describe some devices used in paediatrics

been solely the domain of the fiberscope. More recently a considerable interest in the use of videolaryngoscopy for difficult airway management in children has developed and a number of videolaryngoscopes suitable for paediatrics are now available. These include:

- Storz C-MAC[®] Video Laryngoscope (Karl Storz GmbH & Co KG, Tuttlingen, Germany)
- McGrath[®] MAC Enhanced Direct Laryngoscope (Aircraft Medical Limited, Edinburgh, UK)
- Airtraq[™] (Prodol Meditec SA, Vizcaya, Spain)
- Pentax Airway Scope[™] AWS-S200 (Pentax, Tokyo, Japan)
- Glidescope[®] (Verathon Medical, Bothell, WA, USA)
- TruView PCD[™] (Truphatek, Netanya, Israel)
- Bullard Elite[™] laryngoscope (Olympus America, Center Valley, PA, USA).

This review will focus on the Storz C-MAC[®], McGrath[®], Airtraq[™] and Pentax Airway Scope[™] as the other products have either been discussed previously in this journal, or are rarely used in the UK.

Storz C-MAC[®] Video Laryngoscope (Karl Storz GmbH & Co KG, Tuttlingen, Germany) – The Storz C-MAC[®] Video Laryngoscope (Figure 1) is available in a number of reusable blade shapes and sizes, including Miller size 0 and 1 and Macintosh sizes 2, 3 and 4. It comes with either a laryngoscope-mounted 2.4-inch LED display powered by a rechargeable Li-ion battery with a battery life of approximately 60 minutes, or a separate 7-inch, cable-attached monitor, also powered by rechargeable Li-ion battery with a battery life of approximately 120 minutes. The larger monitor has an integrated SD card to record video sequences and stills in MPEG4 or JPEG formats, respectively. It may be used in the same way as a conventional Miller laryngoscope blade, to elevate the epiglottis directly; however, it is a feature of several videolaryngoscopes that the best view of the glottic opening is achieved by placing the tip of the blade above its 'normal' end point, just proximal to the vallecula. The shallow blade, depth only 5 mm, allows insertion into the mouth of small premature infants (down to 500 g), and syndromic children with abnormal oral, facial or mid-face anatomy. Disposable blades have recently been introduced but are not available in Macintosh 2 or Miller 0 or 1. There are also concerns that the disposable versions currently available do not perform as well as their reusable counterparts, primarily as a consequence of the reduced tensile strength of plastic compared to metal necessitating thicker blades. If this lack of fidelity to the original blade design were to



Figure 1 Storz C-MAC[®] Video Laryngoscope with C-MAC[®] pocket monitor.

be replicated in disposable versions of the paediatric blades then this could be problematic in the paediatric population where mouth size is limited.

McGrath[®] MAC Enhanced Direct Laryngoscope (Aircraft Medical Limited, Edinburgh, UK) – The McGrath[®] MAC Enhanced Direct Laryngoscope (Figure 2) is a compact, lightweight (200 g), portable videolaryngoscope, incorporating a 2.5-inch LCD colour display, powered by a 3.6 V lithium battery pack, with a battery life of approximately 250 min. It uses disposable laryngoscopy blades constructed from a fog-free medical-grade optical polymer, currently available down to Macintosh size 2 for use in children. The technique is intuitive because it is similar to direct laryngoscopy with a Macintosh laryngoscope; this device is marketed as being suitable for both conventional and videolaryngoscopy.

Aitraq[™] (Prodol Meditec SA, Vizcaya, Spain) – The Airtraq[™] (Figure 3) is a complete single-use laryngoscope. The larynx is viewed either through the incorporated eyepiece (not a true videolaryngoscope) or on a variety of screen options. These include an endo cam attachment, an iPhone[®] adapter (Figure 4), and for adult size blades only, a wifi camera which enables live streaming to an iPhone[®] (Apple Inc., Cupertino, CA, USA), iPad[®] (Apple Inc., Cupertino, CA, USA) or computer. The iPhone[®]

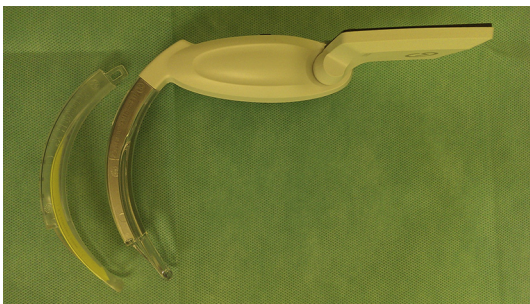


Figure 2 McGrath[®] MAC Enhanced Direct Laryngoscope with size 2.0 MAC blade.



Figure 3 Size 1.0 (Infant) Airtraq[™]. Suitable for tracheal tube sizes 2.5–3.5 mm. Requires mouth opening of 11 mm.



Figure 4 Airtraq[™] iPhone[®] adapter.

adapter is currently only suitable for iPhone 5S[®] but a universal adapter is to be made available imminently. This enables visualization and recording using the iPhone's high-definition camera. The ability to live stream has significant advantages, particularly for teaching, and the iPhone[®] adapter allows costs to be kept down. The Airtraq[™] is used by inserting the blade into the midline of the mouth and advancing until the glottis is visualized in the centre of the screen. The preloaded tracheal tube is then advanced out of the tube channel on the side of the device. It is available in sizes 0 (Infant), 1 (Paediatric) and 2 (Small) for use in children and is suitable for tracheal tubes with internal diameters of 2.5–3.5 mm, 4.0–5.5 mm, and 6.0–7.5 mm respectively. The infant and paediatric blades require 12.5 mm mouth opening and the small blade 15 mm.

Pentax Airway Scope[™] (Pentax, Tokyo, Japan) – The Pentax Airway Scope[™] AWS-S200 is another compact, lightweight (235 g), portable videolaryngoscope, incorporating a 2.4-inch LCD display, powered by 2 AA batteries, with a battery life of approximately 60 minutes. It has a micro USB interface allowing connection to a separate monitor for training or recording purposes. Disposable paediatric and neonatal blades with a tracheal tube channel are available, precluding the need for a stylet. The paediatric blade is suitable for external tube diameters

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