Equipment and monitoring for paediatric anaesthesia

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Abstract

In the last 3 years, most basic anaesthesia equipment has remained unchanged, but several new developments in airway and monitoring equipment have particular benefits for paediatric anaesthesia. In this review, we outline these developments and indicate the evidence for these developments, where it exists. We discuss methods of distraction and introduce a range of distraction devices coupled with an overview of devices to help with venous cannulation.

For many years, we have been using disposable equipment, and a plethora of new equipment of varying quality and reliability continues to appear. This is the most obvious in the sphere of airway management with the appearance of multiple new supraglottic airway devices and laryngoscopic equipment. The International Organization for Standardization has sought to exert some level of quality control with respect to disposable laryngoscope blades, but much airway equipment becomes available before relevant comparative studies with existing gold standards.

The role of video laryngoscopes is becoming more evident as we become familiar with these devices, though only a few of these have a role in paediatric anaesthesia. A number of innovative changes have been incorporated into routine non-invasive monitoring systems and these are discussed.

Keywords Airway management; anaesthesia; cannulation peripheral; equipment; laryngoscopes; monitoring; paediatric

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Learning objectives

After reading this article, you should be able to:

- name some devices which might help you to distract an anxious child and outline methods which may improve cannulation success
- summarize the current role of video laryngoscopy in children
- debate the pros and cons of cuffed paediatric tracheal tubes

Equipment

Devices to aid peripheral venous access

Venous access may be challenging in children due to prematurity, smaller veins and subcutaneous fat in toddlers, and recently due to the rise in paediatric obesity. Both children and parents often get anxious whilst venous access is being obtained.

Distraction methods have long been used by paediatric anaesthetists and play therapists to reduce a child's anxiety levels. These have commonly included books, blowing bubbles or story telling. Today we also have a plethora of virtual reality and interactive electronic devices to assist us:

- Sound Machine (Worldwide Company, via amazon.co.uk). A simple toy that generates familiar 'cartoon' noises and sound effects which can easily be used one handed while venous access is being obtained or during the early stages of gaseous induction (Figure 1).
- The ditto™ device (Diversionary Therapy Technologies, Toowong, Queensland, Australia) provides a range of interactive games and stories aimed at children age 3–8 years. This has been shown to reduce stress and anxiety in children undergoing treatment or procedures, especially in burns patients.
- A less robust but potentially cheaper option is the use of modern smart phones or electronic tablet devices. The iPhone and iPad (Apple Inc., Cupertino, CA, USA) have both been used to provide distraction therapy to children prior to anaesthesia. Applications such as 'Angry Birds' (Rovio Mobile Ltd, Espoo, Finland) and our personal favourite 'Talking Larry' (Outfit 7 Ltd, Limassol, Cyprus) are inexpensive tools to help ease the stressful period for the child and parent prior to anaesthesia. If these devices are to be used in a series of children then the use of a plastic cover that can be cleaned with an alcohol solution is desirable.

Devices can also be used to try to improve vein visualization. These include the use of light (cold-light transilluminators, infrared devices) or ultrasound.

Cold-light transilluminators: transilluminators have long been available on neonatal units but are not as commonly used by anaesthetists. The transillumination of an arm or leg involves shining a light through or onto the limb to show up nearby vessels. Cold-light transilluminators use a light source of low energy and which converts most of the supplied energy to light, for example halogen or light-emitting diodes (LEDs). The risk of skin heating and burns is low with these devices; in fact 38.3°C is

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Figure 1 Sound Machine. A simple but invaluable toy, helpful for distraction during cannulation and induction of anaesthesia.

the maximum-recorded temperature of the Pediascan. Red and orange LEDs are thought to transilluminate skin better than others, although white light may provide more contrast. To reduce the risk of cross-infection, the part touching the skin should be decontaminated or a disposable probe cover applied. Two small portable devices are available:

- Pediascan (Sylvan Fibreoptics, Irwin, PA, USA)

  Transmits white light to the skin through a fibreoptic cable with a blunt tip
- Veinlite (TransLite, Sugar Land, TX, USA)

  Transmits orange and red light from up to 24 LEDs arranged on a C-shaped probe

Infrared devices: devices using infrared light for vascular access have been available since 2005. Infrared light penetrates the skin deeper than visible light, to approximately 10 mm. It is also absorbed much more readily by haemoglobin (at wavelengths 700–1000 nm), than by subcutaneous tissue. This subcutaneous tissue fraction is reflected back to an infrared-sensitive camera on the probe, whilst that absorbed by haemoglobin in vessels will not be reflected back and vessels will appear as dark lines. Several devices use this principle, differing in the manner in which the image is displayed.

- Viewed through an eyepiece (Vascular Viewer, InfraRed Imaging Systems, Marysville, Ohio, USA)
- Displayed as an image on a screen (VascuLuminator, De Koningh Medical Systems, Arnhem, NL)
- Projected back onto the skin with a green background (VeinViewer, Christie Medical Holdings, Memphis, TN, USA), or a red background (AccuVein AV300, AccuVein, Huntington, NY, USA – Figure 2).

Studies are generally small, with some showing a significant improvement in first time success in average children or in those who were expected to be difficult to cannulate. However a recent large cluster randomized trial of the VascuLuminator in 770 children in the operating theatre of a paediatric tertiary referral hospital showed no difference in the success at first attempt (70% with device, 71% without), or time to success.[1]

Ultrasound: the National Institute for Health and Clinical Excellence has advocated ultrasound for central venous access in children (2002) but there are no guidelines for its use for peripheral venous cannulation. Some trials of ultrasound in peripheral venous cannulation have shown less time to successful cannulation and less skin punctures, but there are no randomized, adequately powered trials showing a significantly increased first pass success rate.

The advantages of ultrasound are:

- Veins may be visualized at a greater depth.
- Vessel size may be accurately estimated.
- Vessel patency may be assessed.
- Differentiation between vein and artery is possible. However, this difference is more subtle in neonates as even gentle pressure by the probe can make a vein disappear and an artery collapsible.

Figure 2 AccuVein AV300. An infrared device to aid vein visualization. Here the image is projected back onto the skin showing the veins as dark lines on a red background.