PAEDIATRIC AIRWAY MANAGEMENT

I. AIRWAY EQUIPMENT

This document provides guidance on paediatric airway equipment, aiming to offer a framework from which a safe and robust system can be built. The focus will be on essential airway equipment, optional airway equipment and the importance of training, especially if significant system changes are to be made. This document is a consensus opinion of the authors listed below:

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Introduction

Airway difficulty in children is most likely in neonates, children less than 1 year old and in those with medical conditions predisposing to airway difficulty. This latter group may genuinely pose a difficult airway and require careful planning and advanced airway equipment to safely proceed. In the majority of cases falling into the former two categories (neonates and children less than 1 year old), poor technique is more likely to be the cause of encountered difficulty. This is usually be remediable with careful, effective airway technique and appropriate use of basic airway equipment. Despite the attention attracted by advanced airway equipment, the focus in the first instance with any difficult airway must be on basic equipment and techniques.

When considering what equipment to stock, thought should be given to what airway management techniques are to be catered for. In a tertiary paediatric centre it may be appropriate to stock a large amount of advanced airway equipment, but in a non-specialist centre it is unlikely that the same level of advanced airway management will be undertaken, so reducing the need for such equipment.

Similar to the AAGBI guidelines which are clear about what monitoring is expected peri-operatively, the APAGBI and Difficult Airway Society (DAS) have compiled and published national guidance on airway management. These algorithms are available from the APAGBI website (www.apagbi.org.uk/publications/apa-guidelines), the DAS website (www.das.uk.com/guidelines/paediatric-difficult-airway-guidelines) and the SPAN website (http://www.span.scot.nhs.uk). These guidelines offer algorithms designed to manage difficult mask ventilation, difficult tracheal intubation and "can't intubate, can't ventilate". Working through these guidelines systematically allows us to compile a list of airway management techniques which the APAGBI and DAS seem to be suggesting are 'minimum standard' when managing the paediatric airway. If this is analysed further then the yield is a list of "essential equipment".

Essential Equipment

"The minimum selection of airway equipment which must be available in all areas where airway management occurs"

The following table lists essential airway equipment;

Facemask	Appropriate sizes should be stocked for all sizes of child
Self-inflating bag	Available with 500ml, 1 litre and 2 litre reservoir bags. Essential for non-trained personnel performing ALS and in the event of oxygen failure
Breathing circuit(s)	Examples include Ayre's T-Piece or Bain circuit for older children. It is easier to manage the airway with familiar equipment
Shoulder roll(s)	Allows better positioning of smaller children. A piece of rolled-up Gamgee or a towel may be altered to fit different sizes of child
Oropharyngeal airway	Available in sizes 000 - 5
Nasopharyngeal airway	Limited sizes available. For smaller children an endotracheal tube can be cut to size and used as an effective NPA
Supraglottic airway device (SAD/LMA)	Available in sizes 1, 1 ½, 2, 2 ½, 3, 4, 5 (First generation devices are adequate)
Endotracheal tube	Consideration should be given to the use of endotracheal tubes with low-pressure cuffs, available in a limited range of sizes
Magill forceps	Small and large, useful for directing ETT during intubation and essential for removing airway foreign bodies
Direct laryngoscope	Limit the number of different blades available to avoid confusion. In general one or two different straight blades are adequate, but a curved blade will be required for older children
Intubating fibrescope *(*see note, page 4)*	A fibrescope must be available for use at all times, including in an emergency. This is essential as part of a 'failed intubation' plan where intubation is still required
Intubating stylet	There must be an appropriately sized stylet for all sizes of endotracheal tube. (ETTs down to size 2.5mm ID)
Intubating introducer *(bougie)*	Must be available to the smallest gauge. Intubating introducers will not fit the very smallest ET tubes, and an intubating stylet will be required below this size
Gastric tube	Gastric tubes of all appropriate sizes must be available, as well as the correct syringes
Suction apparatus	Essential for clearance of blood, secretions or gastric content from the airway
Throat pack	Must be used with care and in conjunction with national guidance on their use. Can easily cause trauma during insertion http://www.nrls.npsa.nhs.uk/resources/?entryid45=59853

Optional/Desirable Equipment

The following table lists some equipment which, although not essential, can be viewed as potentially desirable depending on local case mix and expertise. This must be interpreted with caution, as advanced airway equipment which is to be relied upon in an emergency should be familiar to all staff, and efforts must be made to ensure exposure for all staff to maintain skills in its' use.

Endoscopy mask	Designed for flexible endoscopy whilst oxygenating through anaesthetic facemask, useful if a fibrescope is to be used for endotracheal intubation
Second-generation SAD (e.g. Proseal LMA, iGel)	Second-Generation SADs have design features that help reduce risk of aspiration. Their efficacy is not universally proven or accepted, though they are gaining popularity
Intubating LMA (iLMA)	Designed as a conduit for tracheal intubation, but is also an effective SAD. Requires experience to use effectively. Only available in sizes 3,4 and 5
Videolaryngoscope *(*see note below)*	Many devices are available; it is recommended to trial devices of interest before committing to a purchase. Use likely to increase in the next decade, in common with adult practice
Airway exchange catheter	Limited in paediatric practice somewhat by their relatively large size, these still have a role in endotracheal tube exchange, including after intubation through a SAD
Guidewire	In conjunction with a fibrescope and airway exchange catheter, can be used for endotracheal intubation. But this is a specialised technique and must not be undertaken without training and familiarity
Rigid bronchoscopy equipment *(Dependent on ENT surgeon availability)*	If the staff and equipment are available to competently perform rigid bronchoscopy, this is an excellent option in difficult or impossible tracheal intubation

* It must be acknowledged that the use of fibreoptics in airway management is diminishing with the popularity of videolaryngoscopy. The tables above reflect current guidelines set by the APAGBI recommending the use of fibreoptics to intubate as a Plan B. SPAN recognizes that in some departments, videolaryngoscopy is more widely practiced, more familiar and therefore may prove safer than relying on fibreoptics. Therefore we recommend that at least one device be available with the ability for indirect laryngoscopy (i.e. something that looks around the corner). This is a discussion which must be undertaken within each department.

Specific Considerations

For some airway devices there may be some debate amongst clinicians as to whether they are essential or desirable. The following sections further outline the uses and potential drawbacks of some airway equipment.

1. Supraglottic Airway Device (SAD)

SADs have been in use for over 20 years, transforming modern anaesthesia and airway management. They are available from size 1 (designed for use in children under 5kg) to size 5 for use in large adults. Second-generation SADs, a more recent innovation, incorporate features designed to allow higher inflation pressures during IPPV and improve airway protection by providing a better supraglottic seal. They incorporate a gastric drainage channel, offering a means of emptying the stomach during airway management without displacement of the device or loss of the airway seal. Although not an exhaustive list, examples of 2nd generation SADs include the iGel (Intersurgical) and the ProSeal (Intavent) .

SADs are an excellent option for elective anaesthesia in the fasted patient not requiring endotracheal intubation. They may also be useful as a conduit for fibre-optic intubation as part of a secondary intubation plan. In an airway emergency it must be appreciated that SADs form key elements of ***all*** airway rescue plans and can prove life-saving during difficult mask ventilation and difficult intubation.

In the presence of difficult oxygenation/ventilation, supraglottic airway device insertion must be considered, possibly in combination with a muscle relaxant if functional airway obstruction is present or suspected. Urgent (ENT) assistance should be sought early in all cases of airway difficulty.

2. Videolaryngoscopy

With the ascendancy of videolaryngoscopy (VL), medical equipment manufacturers have been quick to recognise the potential for use in paediatric practice. As a result, there are many devices from which to choose, creating confusion for clinicians. Some are used in a similar manner to the conventional Macintosh or straight-bladed *direct* laryngoscopes, but have the benefit of an *indirect* (i.e. screen) view. Examples include the Storz C-MAC (Karl Storz) and the McGrath MAC (Aircraft Medical). Others are used to 'look round the corner' to a greater extent, and require the acquisition of new skills to be used safely and effectively.

These latter indirect laryngoscopes almost invariably provide an improved Cormack and Lehane laryngoscopic view, but due to their increased angulation require specific techniques to successfully intubate the trachea. For some devices, this involves the passage of the tracheal tube down a channel on the device. The Airtraq (Prodol Meditec) is probably the commonest such device in UK practice. For other VLs, such as the Glidescope (Verathon), there is no channel and the tracheal tube needs to be directed 'around the corner' with the aid of an intubating stylet. Flexible intubating introducers (i.e. bougies) tend to be inferior adjuncts for such devices, although may be effective with the less angled (Macintosh curved) devices.
The evidence for the efficacy and safety of videolaryngoscopes is limited and this is particularly true in paediatric airway management. Like all equipment, videolaryngoscopes have limitations, such as their use in certain airway scenarios (e.g. blood in the airway), although the majority of failures are likely to relate with poor user familiarity with a device. However, it seems very likely that they are 'here to stay' and will enhance paediatric airway management if implemented properly. This involves several issues including training/education, device availability, audit of use (and misuse) and infection control. Simplicity is the key for most departments to minimise confusion and, arguably, departments should limit videolaryngoscope choice to only one device. Clinicians must use devices routinely to optimise their technique prior to use in 'difficult airway' scenarios.

3. Fibre-Optics

Awake fibre-optic intubation in young children is not possible. Fibre-optic intubation is therefore usually performed in the anaesthetised child. In order to accomplish this safely, it must be possible to oxygenate and ventilate the child (+/- deliver volatile agent) at all times. If this is predicted to be difficult or impossible then senior (preferably ENT) surgical assistance should be present from the outset.

Tracheal intubation with an intubating fiberscope can be achieved in a variety of ways. An endoscopy mask (similar to a standard anaesthesia facemask with a self-sealing port for introduction of fibrescope), can be used to oxygenate, ventilate and deliver volatile anaesthesia during both nasal and oral fibre-optic intubation (FOI). Nasal FOI, although arguably an easier route to the glottis, must be performed with great care due to the highly vascular nasal septum. A small amount of blood can significantly impede fibre-optic view, and airway bleeding increases risk of laryngospasm. The oral route, without guidance, is more difficult to navigate. For this reason, devices such as an oral intubation (Berman) airway may be used. Another choice, as mentioned previously, is to insert a SAD and use this as a conduit for oral FOI: A guide to this technique is available on the SPAN website:
http://www.span.scot.nhs.uk/?page_id=685

4. "Can't Intubate, Can't Ventilate" (CICV)

"The situation where attempts to manage the airway by facemask, (usually also supraglottic airway device) and by placing a tracheal tube have failed. The patient is using oxygen faster than the clinician can deliver it: profound hypoxia will occur if the situation is not rapidly resolved and cardiac arrest will typically occur within 5–10 minutes of complete airway obstruction." (NAP4: Major Complications of Airway Management in the United Kingdom, Chapter 13 p105)

CICV is very uncommon in children. Despite this rarity, management of CICV in children generates a great amount of debate amongst anaesthetists. A heterogeneous patient population makes it much more difficult to apply a single 'best approach'. All other methods of tracheal intubation must be completely exhausted before front of neck access (FoNA) is considered. This includes, if available, bronchoscopic assistance from a skilled ENT surgeon. The chances of successful FoNA in a small child are extremely low, particularly if performed by a non-ENT surgeon; the most likely methods to succeed in rescuing CICV will be tracheal intubation via rigid bronchoscopy or surgical tracheostomy, both performed by an ENT surgeon.

There must be discussion in every department regarding equipment used to manage CICV. There is a risk that the stocking of such equipment alongside other familiar airway devices may make somebody focus on the wrong piece of equipment at a stressful time and reach for it inappropriately. However, in the moribund child who is impossible to oxygenate with no surgical support, there may be no option but to attempt FoNA as a last resort. By avoiding this discussion, a department may leave itself open to criticism if the unthinkable happens.

Adequate depth of anaesthesia, full paralysis and supraglottic airway device placement will rescue most cases of difficult or impossible ventilation before CICV occurs. Early recognition and treatment of functional and anatomical problems is the cornerstone of prevention of CICV. If CICV does occur, ENT surgical assistance is the most likely to be successful.