Equipment for airway management

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Abstract

Airway management provides gas exchange, protects the lungs from injury and permits treatment. This requires safe, effective and reliable use of equipment, often in combination. A management plan with backups is essential, but a sequence of logical plans forming an airway management strategy is better. Correct equipment use needs correct knowledge, skill and attitudes. There are five approaches to airway management in which equipment is used: facemask ventilation with adjuncts, use of supraglottic airway devices, tracheal intubation with a variety of laryngoscopes (including the flexible fibreoptic bronchoscope), front of neck (transtracheal) access using cricothyroidotomy or tracheostomy and airway clearance with suction or foreign body removal. Tracheal tubes and aids for placement are described.

Keywords Airway; bougie; cricothyroidotomy; flexible fibreoptic bronchoscope; laryngeal mask airway; laryngoscope; optical stylet; tracheal intubation; tracheal tube; tracheostomy

Royal College of Anaesthetists CPD Matrix: 1C01, 1C02

Learning objectives

After reading this article, you should be able to:

- list the approaches to airway management, giving examples of equipment for each
- discuss the types of supraglottic airway devices available, knowing their strengths and weaknesses
- discuss the types of laryngoscopes, tracheal tubes and aids to intubation available

The aim of airway management is to facilitate gas exchange (i.e. delivery of oxygen to, and removal of carbon dioxide from, the lungs) and to protect the lungs from aspiration of foreign material.

The 4th National Audit Project (NAP4) notes that all anaesthetists should employ 'an airway management strategy', a 'coordinated logical sequence of plans'. As such, practitioners need to be competent in the use of a variety of different pieces of equipment in order to formulate and execute 'plan B'.[1] This notion of planning for failure is core to the Difficult Airway Society (DAS) guidelines for the management of the unanticipated difficult tracheal intubation.[2]

Even the most simple of strategies involves a variety of equipment, often used in sequence, and therefore functional compatibility is important (e.g. a tracheal introducer or stylet must fit the chosen tracheal tube). Moreover, all equipment must have standard dimensions when matching is needed (e.g. adoption of standard 15/22 mm connectors to allow connection to breathing systems). All equipment must be biologically compatible and supplied sterile.

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The detection of expired carbon dioxide as a marker of airway patency is vital; capnography is considered an essential monitor in the latest guidelines from the Association of Anaesthetists of Great Britain and Northern Ireland (AAGBI).

Recently, there has been an increase in the number and type of equipment, especially supraglottic airway devices (SADs) and various laryngoscopes.[3] In many cases, there is little clinical evidence to support their use. In response, DAS has introduced the 'ADEPT' scheme for device evaluation, which stipulates that a device be considered for purchase following evaluation of evidence at 'level 3', a case series.[4]

There are four broad stages of airway management, listed in order of invasiveness:

1. **Facemask ventilation (with or without adjuncts).**
2. **Supraglottic airway devices.**
3. **Tracheal access from above the vocal cords.**
4. **Tracheal access from below the vocal cords.**

There is also a fifth stage, airway clearance, which may occur at any point and so does not fit neatly into the above list.

These stages may be used alone, or in a sequence, planned or unplanned. Similarly, one stage may be used to facilitate another (e.g. using a supraglottic airway to permit tracheal intubation).

Facemask ventilation (FMV) with adjuncts

A facemask consists of a mount typically connected to a breathing system via an angle piece, a body and an edge (preformed or inflatable cuff). This technique requires the practitioner to possess the technical skill to maintain the patient's head and neck in an optimal position and to keep a good seal between mask and face.

The Han grading of FMV[5] is:

0: Not attempted
1: Ventilated by mask
2: Ventilated, adjuncts needed
3: Ventilated, difficult (two-handed, adjuncts needed)
4: Impossible

Adjuncts include oropharyngeal ('Guedel') and nasopharyngeal airways.

Supraglottic airway devices (SADs) (Figure 1)

These occupy the middle ground between FMV and endotracheal intubation regarding anatomy, security and invasiveness. There are over 15 devices, single-use or reusable, but all are inserted blindly. There is no clear evidence as to which device is clinically superior.

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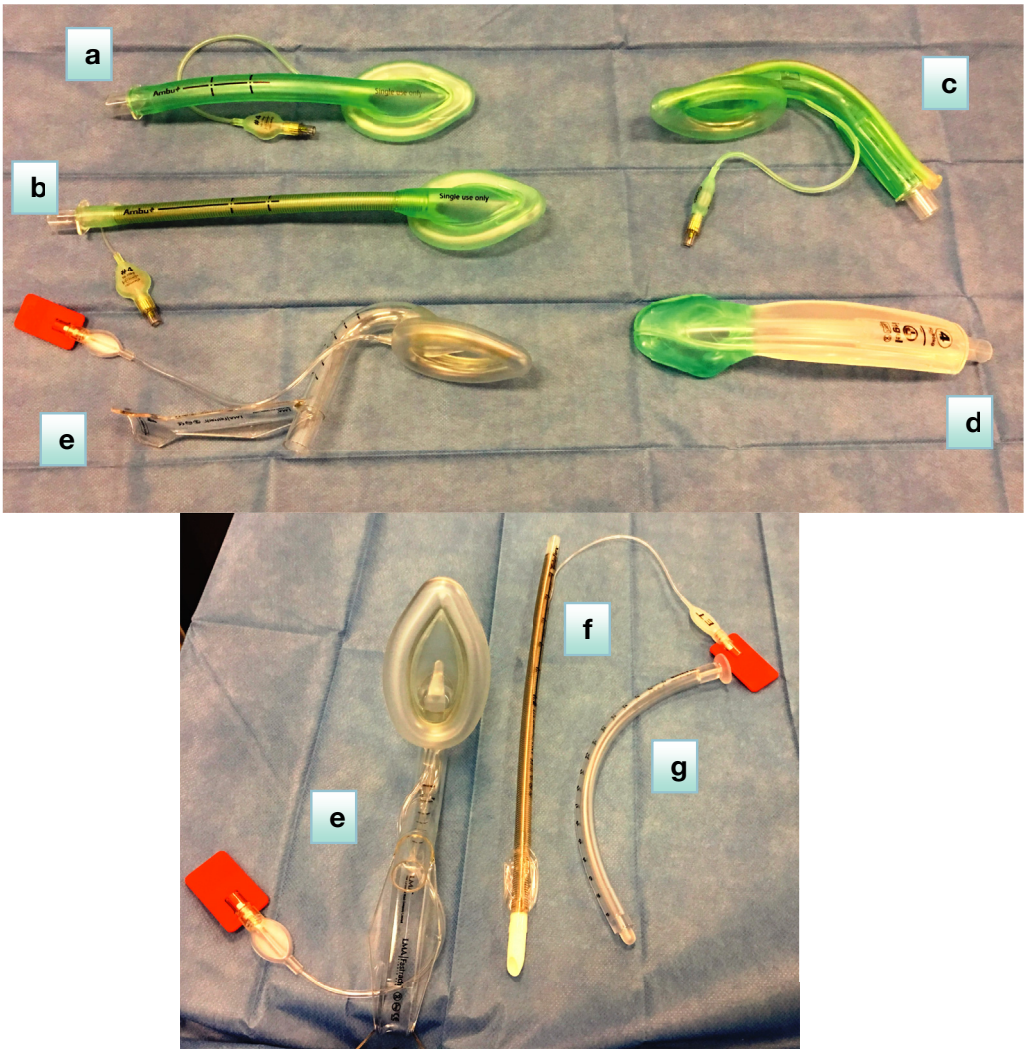

Figure 1 Supraglottic airway devices (single use). (**a**) Classic LMA (Ambu® AuraStraight™ disposable laryngeal mask). (**b**) Flexible LMA (Ambu® AuraFlex™ disposable laryngeal mask). (**c**) Second Generation LMA (Ambu® AuraGain™ disposable laryngeal mask). (**d**) i-gel® supraglottic airway. (**e**) Intubating LMA (LMA Fastrach™) with, (**f**) Dedicated tracheal tube (LMA Fastrach™ ETT) and (**g**) Stabilizing rod.

SADs may be classified as *first*- or *second*-generation devices. The first-generation devices typically provide an airway with a low pressure (<20 cm water) seal. Second-generation devices have various modifications to provide a greater seal pressure, drainage of gastric content, reduce dental damage, or allow easier endotracheal intubation.

First-generation devices

Laryngeal mask airway (LMA): the 'classic LMA' was introduced into clinical practice in 1988 and has been used in over 500 million patients. It is made of silicone and has an airway tube (with connector), an inflatable cuff (mask) and a tube for cuff inflation. The cuff extends inferiorly to the upper oesophagus, bilaterally to the pyriform fossae and superiorly to the tongue base. A seal is formed upon cuff inflation — the manufacturer recommends inflation to no more than 60 cm water, which can be measured by manometers or estimated by pilot balloon palpation. Cuff pressure commonly contributes to sore throat but may rarely cause recurrent laryngeal, hypoglossal or lingual nerve damage.

The original classic LMA could be reused 40 times. Following concerns about possible prion transfer, single-use devices (e.g. LMA Unique™) have since been introduced and these are very similar physically. LMAs come in a variety of sizes based on patient weight (Table 1).

An LMA may be used for:

- Elective anaesthesia: either in spontaneous or controlled, low-pressure (<20 cm water) ventilation in patients with a low risk of gastric regurgitation.
- Rescue airway device: where FMV or endotracheal intubation is difficult, worsening or has failed ('plan C' of the DAS guidelines).
- Intubating conduit: where endotracheal intubation is difficult, an LMA may be used to aid passage of a flexible fibreoptic bronchoscope.

However, they have their limitations, including:

- Aspiration risk: the inflated cuff sits above the larynx and as such, reflux of gastric content into the lungs is possible.

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