A guide to Difficult airway management for anaesthetists

Introduction
A difficult airway can involve difficult mask ventilation, intubation or both (Apfelbaum et al, 2013). Anticipating the difficult airway is a vital skill of the anaesthetist. Once the risk of a difficult airway has been defined, a plan must be devised to secure the airway in the safest way, as well as an overall strategy to maintain or secure the airway in case of failure. If a method fails there must be seamless transition to the next stage at clearly defined points.

Managing the difficult airway
There is no specific consensus for managing the anticipated difficult airway, because the skill and experience with different techniques...
varies among anaesthetists (Cook et al, 2011). The definitive airway is a tracheal tube with its cuff inflated in the trachea, allowing control of ventilatory pressures, gas exchange and protection from pulmonary aspiration. However, it is not always necessary to secure the airway at the level of the trachea and using a supraglottic airway device or even face mask ventilation may be suitable depending on the nature of the surgery and patient characteristics.

**Face mask ventilation**

Face mask ventilation is a skill that should not be underestimated. If there is difficulty managing the airway using other techniques face mask ventilation is a rescue for maintaining oxygenation. Face mask ventilation is the usual technique for anaesthetic induction.

Decreased consciousness, whether from anaesthesia or critical illness, reduces muscle tone in the upper airway which can contribute to airway obstruction. Airway manoeuvres improve patency by applying chin tilt and jaw thrust. A hollow oropharyngeal or nasopharyngeal tube can also be inserted for airway patency and to aid face mask ventilation. Two, or even four-handed, mask technique can aid ventilation if it becomes difficult. If airway compromise is severe to start with there may be little reserve for further compromise during anaesthetic induction.

Besides the usual types of anaesthetic breathing circuits, a self-inflating bag, e.g. Ambu bag, has the advantage that no gas flow is required to re-inflate the reservoir bag between breaths, especially useful for use outside theatres.

The risk of gastric reflux should be considered with face mask ventilation because the glottis is exposed. The unconscious patient risks pulmonary aspiration as airway reflexes are obtunded. If there is significant risk of reflux either a rapid sequence induction is performed, with application of cricoid pressure, or intubation is performed awake.

**Supraglottic airway device**

This is a mask airway device inserted through the oropharynx that sits above the vocal cords in the larynx. Second generation devices are now routinely used that are defined by:

- Integral bite block
- Increased gastric aspiration safety
- Higher oropharyngeal leak pressures.

Some devices contain a gastric port to insert a suction catheter for secretions or refluxed gastric contents (*Figure 1*).

A supraglottic airway device is not usually used for first-line management of the difficult airway, but can be an appropriate rescue plan for difficult face mask ventilation or intubation. When a supraglottic airway device is inserted, the adequacy of ventilation must be assessed to ensure it is seated well. A change of size or type may improve conditions, but difficult ventilation may remain if the problem is distal to the larynx.

If the rescue supraglottic airway device is performing effectively it could remain in situ. Considerations for this include the level of confidence in its ongoing performance, the urgency and nature of the surgery, risk of aspiration and the complexity of further

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*Figure 1. a. ProSeal LMA laryngeal mask (Teleflex Medical, Morrisville, NC, USA). b. i-gel (Intersurgical, Wokingham, UK). From Kwanten and Madhivathanan (2018).*
airway management in the event of supraglottic airway device failure. Any preceding vigorous face mask ventilation may have insufflated the stomach causing a risk of reflux. Continuing with an inadequate supraglottic airway device predisposes the patient to serious airway complications (Cook et al, 2011). If the patient can be woken up this should be considered. It is also possible to intubate via supraglottic airway device under the guidance of a flexible bronchoscope, e.g. a size 6 tracheal tube will pass through a size 4 i-gel (Intersurgical, Wokingham, UK), to provide a more definitive airway.

**Tracheal intubation**

**Direct laryngoscopy**

Direct laryngoscopy is the traditional method of intubation. The glottis is visualised by lining up the three planes of the mouth, pharynx and glottis. The ideal position is flexion at the base of the neck with head extension. The laryngoscopy blade is used to sweep the tongue aside and elevate the mandible to gain a view of the glottis.

If there is difficulty passing the tracheal tube, a malleable gum-elastic bougie may be used. Airway exchange catheters are similar devices but the hollow tubing and a connector allows simultaneous oxygenation if required. Alternatively, a tracheal tube can be preloaded onto a stylet which can be rigid and curved, or straight and malleable to modify the shape.

If direct laryngoscopy is difficult one variable should be changed for each additional attempt, including (but not limited to):
1. Optimising patient position
2. Change blade size, type or handle
3. External laryngeal manipulation
4. Use of a bougie or stylet
5. Release of cricoid pressure, if being applied.

Suctioning any secretions or blood to improve the view is also crucial.

**Videolaryngoscopy**

Videolaryngoscopy is a method of intubation achieved by means of indirect visualisation of the glottis. Either an image is projected from the tip of the blade or the operator looks down a channel which projects the view via a prism. Videolaryngoscopes are usually characterized by:

- Blade style – standard Macintosh-type or hyperangulated (Figure 2)
- Presence of a channel for preloading and guiding a tracheal tube.

Videolaryngoscopy is used when it is thought to be difficult to traverse the angle of the upper airway anteriorly during direct laryngoscopy, e.g. fixed flexion deformity of the neck or manual in-line neck stabilisation during trauma.

Despite good visualisation of the glottis, a common problem with videolaryngoscopy is difficulty directing the tracheal tube into the glottis. A stylet or bougie is helpful, and should be used from the outset with a hyperangulated videolaryngoscope. Another problem may be hold up at the glottic inlet on structures such as the epiglottis or arytenoid cartilage. Rotating the tracheal tube may overcome the obstacle, change the angle of approach or direction of the bevel. Videolaryngoscopy for awake intubation with

![Figure 2. C-MAC® videolaryngoscope (KARL STORZ, Tuttlingen, Germany).](image-url)
using topical local anaesthetic is emerging as an alternative method for awake tracheal intubation (Rosenstock et al, 2012; Fitzgerald et al, 2015).

A systematic review (Lewis et al, 2016) reported that, in all settings, videolaryngoscopy results in:

- Improved view of the larynx
- Improved ease of use
- Decreased airway trauma
- Reduced failures.

Difficult Airway Society guidelines recommend that all anaesthetists should be skilled in use of videolaryngoscopy and that the devices are universally available (Frerk et al, 2015). In intensive care, it is also recommended that if a poor view is gained at the outset during intubation subsequent attempts should use videolaryngoscopy (Higgs et al, 2017). Routine practice is advocated to develop expertise and understand how videolaryngoscopy may fail.

Gaining a view of the larynx is one part of the process of facilitating intubation. Blind intubation techniques should be avoided in favour of real-time visualisation of the effects of cricoid pressure, external laryngeal manipulation and advancing a tracheal tube or bougie. A screen enables this to be a coordinated team effort. Current recommendations are based on expert consensus, but ongoing research hopes to determine if one type of videolaryngoscopy is better for a given patient group or setting.

**Flexible bronchoscopic intubation**

A tracheal tube is loaded onto a flexible bronchoscope through which the operator looks or an image is projected from the distal tip onto a screen. The scope is manoeuvred by rotation and by directing the tip up or down with a thumb lever (Figure 3). Narrow passages can be traversed via the oral or nasal routes. A side port allows suctioning, insufflation of oxygen or application of local anaesthetic.

If the main problem is simply limited access via the mouth the procedure can be done asleep. However, awake tracheal intubation using a flexible bronchoscope can be performed if anaesthetic induction presents a significant risk to securing the airway. The procedure is well tolerated with effective use of topical local anaesthetic and handling of the scope, in conjunction with ongoing oxygenation. Sedation is often administered for patient comfort but this should be carefully titrated as conditions could deteriorate. A separate sedationist is recommended (Johnston and Rai, 2013). Awake tracheal intubation can be safely abandoned without having compromised the airway through anaesthesia or neuromuscular blockade (El-Boghdadly et al, 2017b). Various methods of performing awake tracheal intubation are described elsewhere.

The patient should be assessed for cooperation. Awake tracheal intubation may not be possible with cognitive impairment or anxiety. Railroading the tracheal tube through the nostril and glottis may result in some degree of discomfort.

Flexible bronchoscopic intubation is not without its limitations. Tumours may be friable and prone to bleed, resulting in loss of visualisation through the scope. Distorted anatomy may sometimes be too difficult to navigate. On rare occasions narrowing at or below the level of the glottis may prevent the passage of a tracheal tube. In these scenarios, supraglottic ventilation can be performed via an inserted rigid bronchoscope, jet ventilation delivered through narrow catheters, or front of neck access may be required.

**Figure 3. FIVE flexible videoscope (KARL STORZ, Tuttlingen, Germany).**
Front of neck access
This directly accesses the trachea via the cricothyroid membrane in the anterior neck or between tracheal cartilage rings below. The cricothyroid membrane can be felt between the thyroid cartilage and cricoid cartilage. Difficult Airway Society guidelines advocate surgical rather than needle cricothyroidotomy in an emergency, using a scalpel, bougie and tracheal tube (Frerk et al, 2015). Needle techniques have a higher failure rate (Cook et al, 2011). The optimum position for performing front of neck access is with the head and neck extended. This invasive technique may be a last resort in a ‘can’t intubate, can’t oxygenate’ scenario, or may be the plan of choice in some cases of anticipated difficult airway. Front of neck access should always be considered if all airway management strategies fail and hypoxia ensues. If the risk of losing the airway is significant, the cricothyroid membrane should be identified before embarking on airway management, using a landmark technique or ultrasound. If time allows the procedure is best performed in theatre. For all plans where front of neck access is a rescue option, appropriately trained surgeons must be scrubbed with equipment prepared and available so that the transition can be made in minimal time. Front of neck access may be performed awake under local anaesthesia if there is concern of losing the airway once asleep, ideally inserted between the first and second tracheal rings as this is more comfortable for the patient long term. If performed asleep conditions should be optimised with the patient paralysed. Front of neck access may be difficult in patients with short large necks, neck masses, e.g. goitre, limited neck extension, previous head and neck surgery or radiotherapy.

Transnasal humidified rapid-insufflation ventilator exchange
Transnasal humidified rapid-insufflation ventilator exchange (THRIVE) is a novel method for delivering high flow rates of humidified oxygen via nasal cannulae at up to 70 litres/min. Supplementary oxygenation is achieved through mass flow and low grade positive airway pressure thereby splinting the airways. It also reduces the work of breathing. During intubation attempts THRIVE can maintain oxygenation until intubation has been achieved, preventing the stop–start approach with re-oxygenation between intubation attempts (Mir et al, 2017). The applications of THRIVE are being realised in a variety of hospital settings.

Guidelines

Difficult intubation
The Difficult Airway Society has produced guidelines for a standardised approach to the unanticipated difficult airway (Frerk et al, 2015) (Figure 4). These recommend plans A to D with a specified number of attempts at each stage to prevent fixation on a technique that has failed and enable the anaesthetist to move on. There are also algorithms for the unanticipated difficult airway in obstetric and paediatric patients.

Extubation
One third of airway events occur during emergence or recovery. The commonest cause is obstruction. Difficult intubation and blood in the airway predispose to complications around extubation (Cook et al, 2011). The ‘at risk’ algorithm (Figure 5) suggests advanced extubation techniques, and the option of extubating at a later point (Popat et al, 2012).

Tracheostomy
Tracheostomy tube displacement is the greatest cause of major morbidity and mortality in intensive care (Cook et al, 2011). Guidelines are available for tracheostomy emergencies for patients with a patent upper airway and those without who have had a laryngectomy (McGrath et al, 2012). The latter accounts for 1 in 10 tracheostomies and these patients have only one route of airway access. The steps for emergency tracheostomy management are:
1. Assess ventilation by attaching Mapleson C system (‘Waters circuit’) with high-flow oxygen
2. Remove speaking valve or cap (if present)
3. Remove inner tube
4. Pass suction catheter to assess patency
5. If obstructed, deflate cuff (if present)
6. If patient not improving, remove tracheostomy tube
7. Attempt oxygenation via either the oral route or the stoma via bag–valve–mask, supraglottic airway device or tracheal tube.

When further intervention is needed, smooth transitions are possible with prompt action and team coordination. There is a range of airway devices and techniques for the difficult airway. In this continually developing field, technology and innovation play an important role in improving patient safety.

Figure 1 is reproduced from Kwanten and Madhivathanan (2018), Figure 4 is reproduced from Frerk et al (2015) by kind permission of the Difficult Airway Society and Figure 5 is reproduced from Popat et al (2012) by kind permission from the Association of Anaesthetists of Great Britain & Ireland/Blackwell Publishing Ltd.

Conclusions
The vast majority of airway management is uneventful. The operator must be dispassionate about failure of an airway technique and prepared to move on. If necessary control should be handed over to a more experienced colleague or ear, nose and throat surgeon. Sometimes this is recognised before executing an airway plan. At each point during difficult airway management the adequacy of the airway must be assessed and continually monitored. It cannot be overemphasized that maintaining oxygenation is the key priority throughout.


Fitzgerald E, Hodzovic I, Smith AF. ‘From darkness to light’: time to make awake intubation with videolaryngoscopy the primary technique for an anticipated difficult airway? Anaesthesia. 2015; 70:387–392.


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