

Which airway devices should be on difficult intubation trolleys in resource-constrained settings?

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Airway management publications tend to prevail in Europe and the USA predominantly, with an emphasis on technology that may be unaffordable in countries where resources are far more constrained. However, difficult airways present just as often or even more frequently in South Africa due to a large burden of trauma, late-presenting infectious diseases and cancer.

New devices are now available that may facilitate airway management. The proliferation of new devices has created some confusion as to the most appropriate ones to have available for airway management, particularly where budgets are constrained.

The first step in the management of a difficult airway is identification. An airway that is obstructed by trauma, infection or malignancy may be obvious and require urgent surgical intervention.¹

Where the airway and gas exchange are compromised, the quickest means of restoring oxygenation is a single-stab tube cricothyrotomy.² Where airway obstruction is apparent and likely to become critical, a tracheostomy may be performed, either by dissection under local anaesthesia by an experienced surgeon, or percutaneously using a Seldinger technique by an anaesthesiologist/intensivist experienced in the technique.³

Assessment of the intact airway has been formalised by the ASA difficult airway algorithm, which has been in use since 1993 and was revised in 2003.⁴

The ASA algorithm may be summarised by answering three questions:

- Is laryngoscopy likely to be difficult?
- Is mask ventilation likely to be difficult?
- Is rescue going to be difficult by:
 - Supraglottic airway (SGA)?
 - Cricothyrotomy?

The ASA assessment algorithm evaluates the likelihood that laryngoscopy may be difficult, by examining 11 features:

- Teeth: missing: buck teeth, upper lip bite test.
- Mouth opening: 2.5cm, Mallampati score, high arched palate.
- Jaw: thyromental distance > 5 cm, compliance.
- Neck: sternomental distance < 11.5 cm or unable to raise chin above level occiput, short, fat (dorsal skin folds).

Difficult mask ventilation may be expected by evaluating features according to the mnemonic BONES:

- B: Beard
O: Obese
N: No teeth
E: Extremes of age – infants or elderly
S: Snores

The two can be combined in the LEMON score:⁵

- L: Look externally for features described above
E: Evaluate 3-3-2 in fingers
3: Inter-incisor distance
3: Hyoid mental distance
2: Thyroid to floor of mouth
M: Mallampatti score

O: Obstruction
N: Neck mobility as described above

Problematic rescue by SGA may be due to difficulty with placement of the device and/or subsequent ventilation evaluated by the mnemonic RODS:

R: Restricted mouth opening
O: Obstruction of upper airway (on lateral neck X-ray with soft tissue penetration)
D: Distortion/disruption
S: Stiff lungs: ↓compliance (ALI)/
↑resistance (asthma)

Difficult invasive rescue may be expected if the cricothyroid membrane is impalpable. In the case of anticipated difficulty, the cricothyroid membrane should be identified and clearly marked before any airway intervention.

Airway assessment will allow patients to be divided into three groups:

- Anticipated easy airway: No difficulty anticipated with laryngoscopy, mask ventilation or rescue. Airway may be secured with sedation ± muscle relaxation. Anticipated difficulty with two of the three interventions: airway may be secured under sedation without muscle relaxation.
- The advent of sugammadex changes this recommendation, as this drug can completely reverse muscle relaxation by rocuronium at doses of up to 1.2 mg/kg in under three minutes.⁶
- Anticipated difficulty with all three interventions: Airway to be secured awake – patient has > 10% risk of death with sedation, secured awake if possible, especially if considered a difficult laryngoscopy.

Equipment for elective management of the recognised difficult airway

Equipment guidelines for airway management were published by SASA in 2008.⁶ A summary of the guideline for elective management of the difficult airway is as follows:

- Devices for elective airway management should be contained in an airway resource trolley, the contents of which are clearly indicated and regularly checked.
- The device of choice for management of the difficult airway with supraglottic access is a flexible fibre-optic intubation scope (FIS). The presence of a functioning FIS is considered mandatory in operating theatres where anaesthesia for the following disciplines is performed:
 - Neurosurgery;
 - Head and neck surgery, including ENT and

maxillofacial surgery;

– Cardiothoracic surgery.

- Tracheostomy will be required in the airway where supraglottic obstruction is imminent, but not yet complete. This may be done surgically or percutaneously, depending on the expertise of individual practitioners working in an operating theatre complex. If the percutaneous route is chosen, appropriate kits should be available on the airway resource trolley.
- An alternative device for laryngoscopy is desirable.
- An alternative supraglottic device is desirable.
- A retrograde intubation kit should be considered, particularly in theatre complexes where a FIS is not available.

The role of new laryngoscopes

Video laryngoscopes like the GlideScope®, McGrath® scope, Pentax Airway Scope (AWS®) and Airtaq® provide an improved laryngoscopic view compared with conventional laryngoscopy, but require significant modification of the technique of laryngoscopy for success.⁷

These video laryngoscopes are useful in the non-emergency (can't intubate, can ventilate) scenario as the view may be improved from a grade 3-4 to a grade 1-2 with appropriate use.⁸ This should be considered as an intervention to optimise view in addition to optimal axial alignment, external laryngeal manipulation (ELM) or backward upward rightward pressure (BURP) and changes in blade size and/or type.

The modified video laryngoscopes that require an alteration in the technique of laryngoscopy should be introduced to trainees only after assurance of competence with the Macintosh and Miller laryngoscopes in common use. These devices should only be used by, or under the supervision of, a specialist in airway management (anaesthesiologist, intensivist or emergency medicine specialist).

The use of these devices in an emergency (can't intubate, can't ventilate) cannot be justified by current literature and may delay rescue with a supraglottic airway (SGA) or cricothyrotomy.

The Storz C-MAC® is a video laryngoscope based on the Macintosh and Miller blades with an additional multi-purpose (Doerges®) blade. The use of conventional blades simplifies airway training as the trainer has a clear view of what is being seen by the trainee and can provide clear direction to improve the view.¹⁰

With a difficult airway, the magnification and distal placement of the viewing bundle may improve view by at least one grade.¹⁰

The use of the C-MAC® in the Emergency (can't intubate, can't ventilate) also cannot be justified by current literature.

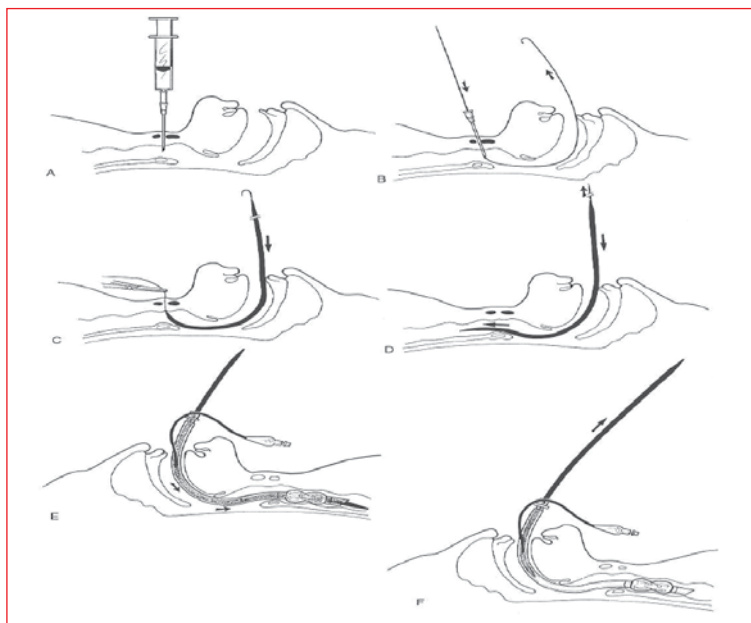
Retrograde intubation¹¹

The Seldinger wire may be considered an alternative to a fiberoptic scope. If the trachea can be punctured and a cannula passed, a wire fed upwards will emerge through the mouth or nose. If necessary, the wire can be retrieved with McGill forceps during gentle laryngoscopy. The wire should be protected by a catheter that serves two purposes:

- The wire is prevented from kinking.
- The discrepancy between the diameter of the wire and the diameter of the endotracheal tube is minimised, reducing the risk of arytenoid hang-up when the tube is passed.

This catheter may be a single-lumen central line with extraneous wings removed. The central line guide wire may be too short for retrograde intubation and the use of a 60 cm urological guide wire may be required.

A custom retrograde intubation kit has been developed by Cook, incorporating a modified airway exchange catheter. This allows the Seldinger wire to be removed from below, rather than above, leaving the exchange catheter in the trachea, so that different-sized endotracheal tubes can be tried if necessary. A diagram of the technique of retrograde intubation using the Cook kit is shown below:



Airway rescue – managing the unanticipated difficult airway

Emergency pathway: can't intubate, can't ventilate

The first attempt to salvage an unrecognised difficult laryngoscopy (where to mask ventilation is also difficult) should be made with the LMA.²

The LMA Classic is used to facilitate ventilation and allow the patient to awaken.

If the need for an endotracheal tube is anticipated, the intubating LMA (Fastrach) is ideal.

In the pregnant or morbidly obese patient, an LMA that allows higher inflation pressures (Proseal, Supreme) is preferred.

Alternative supraglottic airways (SGAs) with an accepted role in management of the difficult airway include the Combitube (Tyco) and its two most recent variants: the Laryngeal Tube (VBM) and Easytube (Rusch).

Other SGAs, like the I-Gel, may find a place in the future.

In the emergency pathway, failure of an SGA to restore ventilation means that a cricothyrotomy should be performed. The simplest cricothyrotomy requires a size-six endotracheal tube on an introducer and a scalpel. The cricothyroid membrane is identified at the base of the thyroid cartilage. A single horizontal incision is made through skin and membrane. The scalpel is reversed and the handle advanced into the

Retrograde intubation using guide wire and antegrade sheath.

- Placement of needle through the cricothyroid membrane (note: needle bevel is oriented cephalad).
- Placement of the J-wire directed cephalad through the translaryngeal needle.
- Passing antegrade sheath over the guide wire.
- Removal of guide wire with advancement of sheath into trachea.
- Advancement of tracheal tube over sheath into trachea.
- Removal of sheath.

(Courtesy of Department of Emergency Medicine, Hennepin County Medical centre, Minneapolis)

incision and rotated to dilate the tract. The tube is then placed as the handle is withdrawn.

Custom-designed kits are available, of which the Portex PCK and Cook Melker are the most useful. Seldinger cricothyrotomy increases the time for the procedure by 20-30 seconds, but may be essential in the semi-conscious patient where coughing and swallowing may obliterate continuity of the tract.¹²

Each operating theatre complex should have an emergency airway box that may be stored with the airway resource trolley, but should be portable and easily available.⁶ This box should only contain two types of device:

- An SGA in a range of sizes, appropriated to the patients being treated in that complex. The LMA Supreme is the most versatile choice at present in adults.
- A cricothyrotomy kit. This should have at least a size cuffed tube for adults. For children < 30 kg a 14G needle cricothyrotomy kit with an appropriate airway connector should be available.

Non-emergency pathway: can't intubate; can ventilate

There are a number of innovative, but inexpensive solutions for managing a non-emergency airway (difficult laryngoscopy, but easy mask ventilation) in a resource-constrained environment:

- Double tube: The most common malposition of an endotracheal tube is oesophageal. It is essential to recognise oesophageal intubation (most reliably by capnography) to avoid serious adverse events.¹⁴ The normal response to oesophageal intubation is to remove the tube. However, where laryngoscopy is difficult, an oesophageal tube serves two useful functions:¹⁵
 - After cuff inflation, the oesophageal tube provides a conduit for spontaneous or controlled evacuation of gastric content (gas, liquid and small particles) while providing almost complete airway protection.
 - The oesophageal tube provides a useful guide to subsequent endotracheal tube placement. The larynx should lie between the oesophageal tube and the epiglottis, even if the larynx itself cannot be seen.
- Transillumination:¹³ The lighted stylet is a useful device for endotracheal intubation where no luminal obstructive lesions are suspected. Devices available include:
 - Simple malleable stylets, such as Surch-

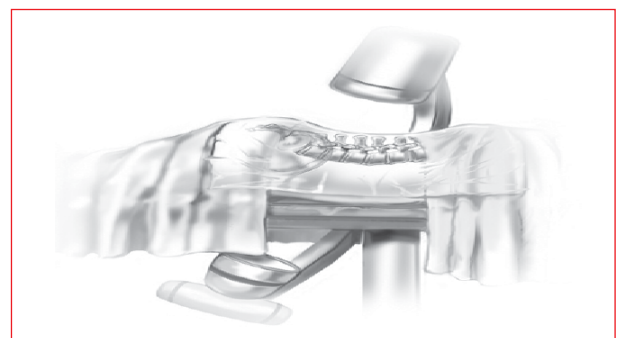
Lite, Aaron Medical, costing US\$10-20 each



- A more versatile, but more expensive (US\$300) device with a flexible stylet with removable wire stiffener that may be reused up to 10 times and a battery-powered handle: the Trachlight, Laerdal.
- The larynx is located by a characteristic transillumination pattern in the anterior neck that then allows the passage of an endotracheal tube.



- Reverse transillumination:¹⁴ If a cold light source is available, the end of the light source cable may be held against the cricothyroid membrane externally. During laryngoscopy, the likely location of the larynx is indicated by the glow transmitted through the trachea.
- X-ray screening:¹⁵ The high incidence of motor vehicle-related trauma in countries such as Pakistan and South Africa means that X-ray screening equipment may be available in many hospitals. Lateral screening can facilitate endotracheal intubation in combination with laryngoscopy/lightwand intubation.



- 5. Ultrasound:¹⁶ May be used to locate an impalpable cricothyroid membrane to facilitate emergency cricothyrotomy.⁵

Conclusion

The essential step in difficult airway management is recognition, so that appropriate preparations may

be made. There are a number of simple and cost-effective interventions that can be made available in even the most resource-constrained medical services to ensure that recognised difficult airways can be appropriately managed. An unrecognised difficult airway is considerably more dangerous for the patient and much more stressful too. In the words of Ron Walls: “The difficult airway is something you manage, the failed airway is something you experience”.

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