Difficult Airway Rescue Techniques

A Course for Anaesthetists

Course Handbook
Welcome to the DART course!

The course is a hands-on, practical course covering difficult airway rescue techniques described in the Difficult Airway Society (DAS) guidelines for the unanticipated difficult intubation. These techniques also form part of the Royal College of Anaesthetists competencies for Speciality Trainees.

This handbook contains a brief outline of what you will learn on the course, with some useful facts, top tips and references, and most importantly, the DAS guidelines (see Appendix).

Please try to be familiar with the DAS guidelines before you attend the course.

We have had excellent feedback from all of our courses to date, and we hope that you find the course as valuable and enjoyable as other candidates have in the past.

Thanks for your participation in the DART course.
The Severn Airway Training Society
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Introduction – the origins of the DART course

Tracheal intubation is a core skill which we perfect during our training as anaesthetists. It may, however, take longer than in previous years to become a true expert in this skill due to increasing use of supraglottic airways and decreased training opportunities with consultants in theatre (1, 2). With this in mind, it would seem sensible for us to undergo concurrent training in techniques to be employed when things go wrong.

The Difficult Airway Society (DAS) has produced evidence-based, peer-reviewed guidelines for unanticipated failed intubation in both the elective setting and during rapid sequence induction (3). These guidelines outline relatively simple airway skills, several of which are listed as core competencies for Speciality Trainee (ST) years 3 and 4 by the Royal College of Anaesthetists (RCoA) (4).

In our region, we felt that training opportunities were inadequate in the area of difficult airway rescue techniques. This was substantiated by a survey of local trainees and consultants, who felt that training was average to poor for all the techniques concerned. Such skills are rarely used in everyday practice and consequently, the RCoA has recommended that they be taught in a simulator setting (4). Furthermore, the acquisition of simple airway skills does not require a full high-fidelity simulator: for example, there is good evidence that practice on a simple model bronchial tree helps trainees gain the manual dexterity required for fibreoptic bronchoscopy in real patients (5).
The Difficult Airway Rescue Techniques (DART) course is aimed at trainees in the first half of their Speciality Training. It covers simple airway rescue techniques but not awake fibreoptic intubation.

The introductory session covers the DAS guidelines. These place a heavy emphasis on planning: Plans B, C and D should be decided in advance so that they can be implemented quickly if Plan A (the primary technique) should fail. The guidelines stress that oxygenation takes precedence over everything else during the execution of each plan, and that the best available help should be sought early in cases of difficulty. Many hospitals have developed their own difficult airway algorithms and some have been adopted on a regional level (6). We believe that the DAS guidelines are the most comprehensive, so we teach them on this course.

The five skills stations that follow are very ‘hands-on’: to allow for repeated practice in order to memorise the skills.

Competency Handbooks

We do not sign trainee competency handbooks for the skills we cover, as we feel that this should be done by a local trainer after a more prolonged period of assessment than we can offer in one day. You should rehearse the DART course skills with a trainer as soon as possible in your workplace in order to demonstrate your competence.

Acknowledgements

We would like to thank the Bristol Medical Simulation Centre for their help in setting up the course, the Severn Deanery for financial support and Storz who provide us with fibreoptic
bronchoscopes and teaching screens. Finally, we would like to thank the consultants for giving up their spare time to teach on the course.

References


Structure of the day

**Introductory session (40 minutes)**

Introduction, a clinical scenario and a run-through of the DAS guidelines

**5 Skills stations (1 hour each)**

1. The fibreoptic bronchoscope: assembly, manipulation, steering, aftercare

2. The intubating LMA: blind and fibreoptic techniques

3. Asleep fibreoptic intubation via a conduit:
   - via the Berman airway
   - via the LMA with and without the Aintree Intubating Catheter (AIC)

4. Can’t intubate, can’t ventilate: cannula and surgical cricothyroidotomy

5. Alternative laryngoscopes and supraglottic airways
   - *Candidates rotate through in groups of four or five*
   - *Each station is run by a consultant and a senior trainee*

The day is punctuated by a morning coffee break, lunch provided at a local restaurant and an afternoon tea break.
Skills station 1 – the fibreoptic bronchoscope

Background

Visually-guided techniques are always preferable to blind techniques, when appropriate equipment is available. The fibreoptic bronchoscope can be used as an adjunct for the unanticipated difficult airway in a “can’t intubate can ventilate” situation (Plan B of DAS guidelines). It can also be used *selectively* in the patient with a known difficult airway to facilitate intubation using one of the following techniques:

1. Fibreoptically guided intubating LMA technique (Station 2)
2. Asleep fibreoptic intubation via the LMA or Berman airway (Station 3)
3. Retrograde intubation in an elective setting

It has been suggested that a learning curve can be constructed to predict the number of fibreoptic intubations that are necessary to become competent (1). This study suggested that trainees can become “reasonably proficient” after 18 supervised intubations (two half lives) and expert after 45 intubations (five half lives). However, research suggests that *preliminary practice on simple bronchial models* allows trainees to gain the manual dexterity required to perform fibreoptic intubations, and *improves performance when confronted with real patients* (2). Various home-made models have been described, as well as the Dexter™ training model (3) and the more lifelike airway training manikins such as the Laerdal Airway Trainer™ and the Trucorp Airsim™, which have been found to be superior for teaching simple and advanced airway management skills (4). Video cameras are especially useful in the early stages of teaching and allow for feedback and guidance (5). You are encouraged to seek out and make use of any training bronchoscopes, bronchial models or training manikins in your own hospital. If there is no such equipment, you are encouraged to ask your department to provide it!

Learning objectives

You will receive practical instruction on the following:
1. Assembly, manipulation and steering of the bronchoscope

2. Aftercare of the bronchoscope

You will be given lots of time to practice on three different models: an anatomically realistic airway model, the ‘Oxford box’ and the ‘Viper pit’. This will be followed by a demonstration of the aftercare process. During the station the indications, contraindications and complications of fibreoptic techniques will be revised as follows:

**Indications**

- Aid to intubation
  - Known / suspected difficult airway
  - Unstable C-spine
  - Confirm placement of tracheal tube (TT) / double lumen tube / bronchial blocker
  - High aspiration risk with potentially difficult airway

- ITU uses
  - Percutaneous tracheostomy
  - Bronchoalveolar lavage (diagnostic or therapeutic)

- Airway assessment (usually ENT)
  - Upper airway anatomy
  - Laryngeal / cord pathology
  - Infraglottic pathology – stenoses / masses / compression

- Teaching and Training

**Contraindications**
• Absolute
  o Patient refusal

• Relative (depending on operator skill)
  o Patient cooperation
  o Bleeding
  o Extensive facial / neck trauma
  o Critical upper airway obstruction
  o Requirement to secure airway immediately

**Complications**

• Malposition

• False passage

• Haemorrhage

• Oesophageal perforation

• Surgical emphysema

• Barotrauma / pneumothorax

**Techniques you will learn**

**Assembly, Manipulation and Steering of Scope**

**Description**

• Standard 60cm length (some are 55cm)

• Commonly 4mm diameter. Available 1.8 - 6.4mm diameter
• ↑ diameter = larger picture, better definition

• ↓ diameter = easier manipulation, less trauma, fewer ports

**Main components**

- **Body**
  - Eyepiece
  - Dioptre ring (focus)
  - Lever (steering)
  - Port

- **Flexible insertion cord**
  - 10 - 50,000 fibres depending on diameter
  - Lens to focus image on fibres
  - Working channel
  - Control wires to flex and extend tip

- **Light transmission cord and light source / battery**

**Using the fibreoptic bronchoscope**

1. Attach and turn on the light source.
2. Attach suction or oxygen at 2l.min⁻¹.
3. Check focus and colour / white balance.
4. Hold body with lever facing toward operator.
5. Place thumb on lever, index finger on suction port.
6. The other hand guides the distal insertion cord.

7. Keep cord taut between hands so that the orientation of the tip remains the same as the body, and movements of the body are translated to the tip.

8. There are only 3 movements:
   - Rotation – directed from the body of the bronchoscope
   - Flexion and extension – using the lever
   - Advancement / withdrawal

9. Advance the bronchoscope through a manikin or Oxford box.

**Tips**

- Preparation – local anaesthetic, antisialogue
- Assistant applies jaw thrust to increase space in posterior pharynx
- Maintain straight scope at all times
- Orientate yourself using the triangular 12 o’clock marker
- Aim for black
- Bring target (“black”) into flexion plane (i.e in line with marker, between 6 and 12 o’clock) by rotating, then advance towards it by flexing / extending.
- Keep target in the centre of the field of vision
- If you see red, withdraw until re-orientated, don’t push further

**Common reasons for failure**

- Operator inexperience
• Failure to negotiate nares → ensure good topical anaesthesia, check nostril patency beforehand

• Advancing TT too early → advance bronchoscope to carina before advancing TT and take care when detaching TT

Care and Aftercare of the Scope

• Avoid excessive bending

• Avoid knocking insertion cord

• Keep hanging up with insertion cord straight

• Clean immediately after use
  
  o Don’t let secretions dry – difficult to remove

  o Brush through suction port

  o Suck 1L water through suction port

  o Clean outside with weak detergent / sterets

  o Steris treatment (takes about 30min)

Tip

Use of the fibreoptic bronchoscope may result in a significantly increased workload for the anaesthetic assistant. Helping them out as much as possible will make their lives easier and improve your chances of being able to use it on the next patient / list.

References


Skills station 2 – the Intubating LMA

Background

The ILMA is used in Plan B of the DAS guidelines (the “can’t intubate can ventilate” situation). Outside the DAS guidelines, they can also be useful in the elective management of the known difficult airway and in patients with C-spine injuries. Fibreoptic guidance is the gold standard, but when used correctly, blind techniques have a success rate of greater than 90%:

- Blind insertion in patients without difficult airways: 95.7% (1).
- Blind insertion in patients with known or anticipated difficult airways: 64% first pass, 92% overall, other 8% achieved with fibreoptic technique (2).
- In unanticipated difficult airways: one study of 23 patients – 75% first pass blind insertion, 100% overall insertion (2).
- Using the blind technique, oesophageal intubation may be up to 5% (3).
- Fibreoptic technique improves first attempt success rate (2), overall insertion success rate (4), and nearly always succeeds when blind technique fails (5).
- A learning curve of about 20 insertions has been described (6).

Learning objectives

You will receive practical instruction on the following:

1. Use of ILMA for blind intubation.
2. Use of ILMA using fibreoptic guidance.
During the station the indications, contraindications, and complications of the ILMA, and its role in the DAS guidelines will be revised as follows:

**Indications**

- “Can’t intubate, can ventilate” i.e. DAS Plan B (recommends fibreoptic guided intubation via an ILMA or LMA).
- “Can’t intubate, can ventilate” where no fibreoptic bronchoscope is available (recommends blind insertion of TT via ILMA).

**Contraindications**

- No previous experience
- High aspiration risk / rapid sequence induction (no plan B in RSI)
- Upper airway abnormality

**Complications**

- Failure
- Oesophageal intubation
- Trauma / bleeding
- Dental damage

**Techniques you will learn**

**ILMA for blind intubation**

1. Ensure that the head and neck are supported in the *neutral* position.
2. Lubricate the TT and pass through the ILMA several times up to the black 15 cm marker. Fully deflate the ILMA cuff and lubricate the mask tip. Insert the ILMA by applying the tip to the palate and advancing using a circular movement along the curvature of the device.

3. Inflate the cuff, confirm adequate ventilation then administer a muscle relaxant.

4. Pass the lubricated TT as far as the transverse 15 cm black marker with the longitudinal black line facing the nose. This is the line point at which the TT reaches the epiglottic elevator bar.

5. Advance the TT cautiously through the larynx. If any resistance is felt, stop and reposition the ILMA before further attempt (see “Tips” below).

6. Confirm placement of the TT using auscultation and capnography.

7. Remove the connector and use the stabiliser to hold the TT in place whilst the ILMA cuff is deflated and the ILMA is removed. Reapply the TT connector and check ventilation.

Reasons for failure

- Misalignment of ILMA
- Inadequate depth of anaesthesia / relaxation
- Incorrect size of ILMA
- Wrong head and neck position

Tips

- If using cricoid pressure, reduce or release this when inserting the ILMA
- The Chandy manoeuvre: adjust ILMA position with sagittal rotation until optimal ventilation is obtained, then apply slight anterior lift with the ILMA handle before passing TT
• Failure to pass TT commonly means:
  
  a) ILMA too deep – try withdrawing device slightly / smaller size ILMA
  
  b) Epiglottis folded over – try withdrawing ILMA 4 - 5cm then reinserting
  
• ILMA can be reinserted (over TT left in place) for extubation to facilitate recovery and airway maintenance or enable deep extubation

**ILMA for fibreoptic assisted intubation**

1. Ensure the head is supported in the *neutral* position.

2. Lubricate the TT and pass through the ILMA several times up to the black 15 cm marker. Fully deflate the ILMA cuff and lubricate the mask tip. Insert the ILMA by applying the tip to the palate and advancing using a circular movement along the curvature of the device.

3. Inflate the cuff and confirm adequate ventilation, then administer a muscle relaxant.

4. Pass the lubricated TT as far as the transverse 15 cm black marker with the longitudinal black line facing the nose. Advance the TT a further 1.5cm to elevate the epiglottic elevator bar which lies at 16cm (the fibreoptic bronchoscope will not do this as it is too narrow) then pass fibreoptic bronchoscope. This also helps to prevent damage to the tip of the bronchoscope.

5. Guide the fibreoptic bronchoscope into trachea and railroad the TT into the trachea. Observe placement of the TT when withdrawing the bronchoscope.

6. Confirm placement of the TT using auscultation and capnography.

7. Remove the connector and use the stabiliser to hold the TT in place whilst the ILMA cuff is deflated and the ILMA is removed. Reapply the TT connector and confirm ventilation.
References


4. Pandit JJ, Maclachlan K, Dravid RM, Popat MT. Comparison of times to achieve tracheal intubation with three techniques using the laryngeal mask or intubating laryngeal mask airway. *Anaesthesia* 2002; **57**: 128–32.


Skills station 3 - Asleep fibreoptic intubation via a conduit

Background

Much like the ILMA, asleep fibreoptic techniques using the LMA or Berman airway as conduits can be employed in the unanticipated difficult airway (the “can’t intubate can ventilate” situation, Plan B). Outside the DAS guidelines, they can also be useful in elective management of the known difficult airway and in patients with C-spine injuries. However, unlike the ILMA, these techniques should always be carried out under fibreoptic guidance, as blind success rates are low (1, 2). With the aid of a fibreoptic bronchoscope, success rates of 90-100% can be achieved (3, 4). There is also evidence to suggest that the LMA facilitates asleep fibreoptic intubation as compared to the conventional technique (without a conduit) (4).

There are many examples in the literature of successful difficult airway management using the Aintree Intubating Catheter (AIC) in combination with the cLMA (5) and PLMA (6). A recent manikin study suggests that passage of the AIC via the PLMA is as easy and reliable as via the cLMA (7). The Supreme™ LMA (see Skills Station 5) does not seem to be suitable for this purpose as the angle of exit of the AIC from the device is unpredictable due to the epiglottic fins in its bowl (8).

Learning objectives

You will receive practical instruction on the following:

1. Asleep fibreoptic assisted intubation via the Berman airway
2. Asleep fibreoptic assisted intubation via the LMA
3. Asleep fibreoptic assisted intubation via the LMA using an AIC
During the station the indications, contraindications and complications of asleep fibreoptic techniques, and their role within the DAS guidelines will be revised as follows:

**Indications**

- Unanticipated difficult intubation (Plan B)
- Known straightforward bag-mask ventilation but difficult laryngoscopy (anticipated difficult intubation)

**Contraindications**

- Any possible difficulty with bag and mask ventilation (i.e can’t ventilate)
- High risk of aspiration
- Upper airway abnormality

**Complications**

- Failure
- Oesophageal intubation
- Desaturation

**Techniques you will learn**

**Fibreoptic-assisted intubation via the Berman airway**

1. The head and neck should be supported in the *neutral* position. Confirm adequate bag and mask ventilation then administer a muscle relaxant.

2. Insert the Berman airway as a conduit to aid ventilation and for the fibreoptic bronchoscope.
3. Preload the bronchoscope with a TT then manoeuvre through Berman airway into the larynx.

4. Jaw thrust and anterior displacement of tongue may help to increase space in the posterior pharynx.

5. Once the carina is visualised, remove the Berman airway laterally from the fibreoptic bronchoscope and railroad the TT over the bronchoscope.

6. Gentle rotation of the TT can help prevent its tip from getting caught in the piriform fossae (this is easier with a reinforced TT).

7. Confirm placement of the TT using auscultation and capnography.

Fibreoptic-assisted intubation via the LMA

**LMA / TT COMPATIBILITIES**

- LMA sizes 3 and 4 have ID of 10mm, allowing passage of a cuffed TT size 6.0
- LMA size 5 has ID of 11.5 mm, allowing passage of a cuffed TT size 7.0

1. Passage of the TT through classic LMA should always be fibreoptically guided as blind success rates are low.

2. The head and neck should be supported in the neutral position. Insert the LMA in the usual fashion. Inflate the cuff and confirm adequate ventilation, then administer a muscle relaxant.

3. Pass a heavily lubricated uncut TT through the LMA. Some resistance may be met at the grille of the cLMA.
4. Guide the bronchoscope into the trachea until the carina is visualised, then railroad the TT over the bronchoscope. Observe placement of the TT when withdrawing the bronchoscope.

5. Confirm placement of the TT using auscultation and capnography.

6. The LMA should stay in place due to the difficulty and potential failure of techniques to remove it (9). The Aintree Intubating Catheter can solve this problem (see below). This is especially useful if the LMA will interfere with surgical access.

Notes

- A maximum of two LMA insertion attempts should be made before proceeding to PLAN C.

- The length of standard Mallinckrodt size 6.0 TT (excluding the connector) is 26-27 cm. The average distance from the connector of correctly placed size 4 LMA to the vocal cords is approx 22 cm, therefore only 4-5 cm of TT protrudes beyond the LMA grille into the trachea using the above technique. The risk of the cuff sitting astride the vocal cords and accidental extubation is therefore high. This risk can be reduced by using specialised TTs such as the nasal (north-facing) RAE (which can be straightened), flexometallic / reinforced tubes or microlaryngoscopy tubes. Alternatively, other supraglottic airways can be used – such as the Proseal™ LMA (size 4 airway channel is 17cm long, though note that the internal diameter is only 9mm) or the i-gel (size 4 airway channel is 19 cm long).

- The aperture bars of a classic LMA can obstruct the passage of the tracheal tube.

Fibreoptic-assisted intubation via the LMA using the Aintree Intubating Catheter (AIC)

1. The head and neck should be supported in the neutral position. Insert an LMA in the usual fashion. Inflate the cuff and confirm adequate ventilation, then administer a muscle relaxant.
2. Load the AIC over a well lubricated bronchoscope, then guide the assembly through the LMA grille and into the trachea, until the carina is visualised.

3. Remove the bronchoscope from the AIC. The “Rapi-fit” connector (which comes with the AIC) may be fitted to allow oxygenation using any anaesthetic circuit with a 15 mm connector.

4. Remove the LMA and railroad a lubricated TT size 7.0 or above.

5. Confirm placement of the TT using auscultation and capnography.

The Aintree Intubating Catheter has an external diameter of 6.5mm, so must be used with TT size 7.0 or above

Notes

- Use of Aintree Intubating Catheter is preferable because:
  - It allows removal of the LMA
  - It reduces the likelihood of the TT getting caught in the LMA grille
  - It enables oxygenation via the “Rapi-fit” connector in case of difficulty passing TT

References


3 Pandit JJ, Maclachlan K, Dravid RM, Popat MT. Comparison of times to achieve tracheal intubation with three techniques using the laryngeal mask or intubating laryngeal mask airway. *Anaesthesia* 2002; **57**: 128–32.


5 Higgs A, Clark E, Premraj K. Low-skill fibreoptic intubation: use of the Aintree Catheter with the classic LMA. *Anaesthesia* 2005; **60**: 915-20.


Background

Cricothyroidotomy forms part of the DAS guidelines in the “can’t intubate, can’t ventilate” scenario once oxygen saturations have fallen below 90% on FiO₂ of 1.0 (Plan D).

There are three basic methods to achieve trans-tracheal ventilation (1):

- Small cannula techniques (2-3 mm) plus a high pressure gas source. These techniques rely on a patent airway for exhalation. However, inability to inflate the lungs with positive pressure ventilation via a facemask does not mean that there the airway will be obstructed in expiration, when positive intraluminal pressure tends to expand and open the upper airway. In one series, 86% of patients with CICV retained a patent expiratory route (2). Gas entrainment is also a feature of these techniques if the upper airway is not obstructed.

- Large cannula techniques (≥4 mm). These enable ventilation with a lower pressure gas source but require either a cuffed cannula or obstruction of the upper airway to achieve adequate driving pressure for ventilation.

- Surgical technique. This enables placement of a size 6.0 to 7.0 tube and conventional ventilation.

A recent systematic review came to the conclusion that surgical cricothyroidotomy should replace needle techniques as the intervention of choice for the “can’t intubate, can’t ventilate” scenario (3). The authors maintain that the surgical technique is easily taught, allows for sustained, adequate ventilation and has relatively fewer complications than needle cricothyroidotomy.
There is general agreement that a small bore needle cricothyroidotomy must be coupled with a high pressure gas source (1, 3). However, when low pressure ventilation is to be utilised, different practitioners may opt for either a large bore cannula or a surgical technique. With the advent of cuffed Seldinger-based kits (such as the Melker™), practitioners (especially those familiar with percutaneous tracheostomy) may opt for this technique. Of note, the surgical technique has been found to be quicker to perform than Seldinger techniques in a manikin (4).

**Learning objectives**

You will receive practical instruction on the following:

1. Surgical cricothyroidotomy.
2. Cannula cricothyroidotomy.

During this session you will be taught how to carry out a surgical airway and a needle cricothyroidotomy. You will also be taught to use the Manujet™ / Sanders injector. During the station the indications, contraindications and complications of cricothyroidotomy, and its role within the DAS guidelines will be revised as follows:

**Indications**

- “Can’t intubate, Can’t ventilate” situation (DAS guidelines Plan D)
- Elective trans-tracheal ventilation in the anticipated difficult airway
- Cricothyroid puncture for airway anaesthesia in awake fibreoptic intubation

**Contraindications**

- In the emergency situation - none
- In the elective situation: patient refusal, local trauma, surgical emphysema, infection, coagulopathy, goitre, aberrant vasculature

**Complications**
Techniques you will learn

Surgical Cricothyroidotomy

1. Prepare the patient as above and infiltrate with local anaesthetic (in the elective situation).

2. Place a hand on the neck to stabilize the cricothyroid membrane, and to protect the lateral vascular structures from injury.

3. Make a transverse incision through the skin and cricothyroid membrane, being careful not to damage the cricoid cartilage. Leave the scalpel in position.

4. Insert the tracheal hook in the lower edge of the incision. Pull the cricoid cartilage caudally. If no tracheal hook is available, insert the tracheal dilators / arterial forceps alongside the scalpel. Alternatively, use the handle of a scalpel by inserting it through the incision and twisting it through 90 degrees to open the airway.

5. Insert the tracheal dilators / arterial forceps and dilate the orifice.

6. Insert an appropriately sized TT or tracheostomy tube.

7. Ventilate the patient and check that this is effective.
8. Secure the tube to prevent dislodgement.

Note

- An alternative technique involves inserting a bougie into the tracheal opening (however this has been made), then railroading the TT over the bougie

**Small cannula technique (needle cricothyroidotomy)**

1. Attach a 14G intravenous cannula or a Ravussin™ cannula to a 5 ml syringe.

2. Place the patient in a supine position.

3. If there is time and no risk of cervical spine injury, extend the neck, perhaps with a sandbag under the shoulders.

4. Identify the cricothyroid membrane by palpation between the thyroid and cricoid cartilages.

5. Prepare the neck with antiseptic swabs.

6. Place a hand on the neck to identify and stabilise the cricothyroid membrane, and to protect the lateral vascular structures from injury from the needle.

7. Insert the needle and cannula through the cricothyroid membrane at a 45-degree angle caudally, aspirating as the needle is advanced.

8. When air is aspirated, advance the cannula over the needle, being careful not to damage the posterior tracheal wall. Remove the needle.

9. Re-check that air can be aspirated from the cannula.

10. Connect to Manujet™ / Sanders injector.

**Notes**
• Exhalation relies on the passive escape of gas and therefore the absence of complete supraglottic airway obstruction. This is likely as even in CICV, 80% of patients can breathe out. It may pay to leave an LMA in situ to assist this process.

• The Manujet™ / Sanders injector, a wall oxygen supply or an oxygen cylinder are the only ways of ventilating through a small cannula. Ventilation is not possible via the common gas outlet of an anaesthetic machine, or some oxygen meters on the side of anaesthetic machines which are limited by 40 KPa pressure valves.

• When using a wall oxygen flowmeter, it has been found that the flow through a transtracheal catheter is almost three times higher and the pressure just before the catheter four times higher when the flowmeter is fully opened than when it is opened to the 15 l.min⁻¹ mark (5). Care should therefore be taken when fully opening the flowmeter, just as care is taken to gradually increase the pressure when using the Manujet™.

Large cannula techniques

Seldinger techniques (Minitrach™, Cook™ and Melker™ kits)

1. Prepare patient as above and infiltrate with local anaesthetic in the elective situation.

2. Perform a cannula cricothyroidotomy with the cannula provided in the kit.

3. Insert the guidewire.

4. Make a horizontal skin incision.

5. Insert the dilator and dilate the airway orifice.

6. Insert the tube to the appropriate length.

7. Attach a catheter mount and Ambu bag and ventilate.

8. Observe chest movement and auscultate breath sounds to confirm adequate ventilation.
9. Check the neck to exclude swelling from the delivery of gas into the tissues rather than the trachea.

**Quicktrach™**

1. Prepare patient as above.

2. Place a hand on the neck to identify and stabilise the cricothyroid membrane, and to protect the lateral vascular structures from injury from the device.

3. Insert the device in a perpendicular orientation in all planes, until the plastic stopper makes contact with the skin.

4. Aspirate air.

5. Remove the needle.

6. Remove the plastic stopper and advance the cannula to its hub.

7. Attach a catheter mount and Ambu bag and ventilate.

8. Observe chest movement and auscultate breath sounds to confirm adequate ventilation.

9. Check the neck to exclude swelling from the injection of gas into the tissues rather than the trachea.

10. Secure the device.

**Note**

- The Quicktrach™ and Melker™ kits have been found to be superior to Patil’s airway and the ENK Flow Modulator™ in terms of ease and speed of insertion, failure rates and adequacy of ventilation in a simulator model (6).

- The Quicktrach presents a higher risk of complications as it cuts and dilates blindly in one go. We feel Melker or surgical airway are the most rational and evidence based options.
References


Skills station 5 - alternative laryngoscopes and supraglottic airways

Background

This station is designed to introduce you to some of the non-standard equipment you might find on the difficult airway trolley.

Alternative laryngoscope blades can be employed to optimise the view at laryngoscopy when the Macintosh blade fails. As such, they form part of the initial tracheal intubation plan (Plan A of the DAS guidelines). Two other techniques which can facilitate intubation on the first attempt are external laryngeal manipulation (e.g. Backward Upward Rightward Pressure on the thyroid cartilage, BURP) (1), and the gum elastic or plastic bougie. The bougie can be used in combination with all of the alternative laryngoscope blades and its value cannot be over-emphasized. For example, it has been found to be significantly more useful than the stylet in Grade 3 intubations (2).

Plan A will be revised with you as follows:

PLAN A → consider:

- Better Head Position
- BURP
- Bougie

The McCoy laryngoscope can improve the view at laryngoscopy. In one study (3), it converted a Grade 3 view to a Grade 2 view in about half of the cases. Of note, it made the view worse (into a Grade 4) in 12% of cases. It had no effect on Grade 4 views (it acts by lifting the epiglottis indirectly when the tip of the blade is in the vallecula). It seems to be especially useful in patients with limited neck extension (neck pathology or immobilisation by hard collar / in-line stabilisation) (4, 5).
Use of a straight blade for laryngoscopy is especially indicated when a long, floppy posteriorly directed epiglottis obscures the view of the larynx on first look with a Macintosh blade (6). The paraglossal technique is generally employed when using a straight bladed laryngoscope, and has been shown to be useful where the Macintosh blade has failed (7). A recurrent problem with the Miller blade is that the TT is often difficult to insert with this technique even when a good view of the larynx is obtained (8). It was for this reason that the Henderson blade was developed. This has a channel to allow for passage of the TT (8).

There are several “new” supraglottic airways on the market which may be useful for difficult airway rescue techniques. These may be used in Plan B (as conduits for TT insertion) or Plan C (emergency oxygenation where facemask ventilation is failing). The Proseal™ LMA, the Supreme™ LMA and the i-gel™ have design features which may make them suitable for this purpose such as a separate drain tube (designed to separate the gastrointestinal and respiratory tracts in order to prevent gastric inflation during ventilation, allow venting of gastric contents and enable the passage of a gastric tube).

The PLMA is the most studied of all the newer supraglottic airways. It has a proven track record in difficult airway rescue (9). First-time insertion success rates are slightly lower than with the cLMA (85% vs. 93%), but a superior seal pressure can be achieved (30 cmH2O vs. 20 cmH2O) (9), making it ideal for emergency use (for example, in Plan C – emergency oxygenation). It has a large bowl and a shorter (though slightly narrower) airway channel than the cLMA, which make it suitable as a conduit.

The i-gel™ has a seal pressure of approximately 24 cmH2O (10), and is easily inserted by novices and experts alike (11, 12). It has a wide bowl with no grille and a short airway channel: features which make it suitable for use as a conduit.

The Supreme™ LMA has a first time insertion success rate and seal pressure very similar to the i-gel™ (13), though may be less well suited for use as a conduit due to the epiglottic fins in its bowl (14).
Learning objectives

You will receive practical instruction on the following:

- McCoy laryngoscope
- Polio / Kessel laryngoscope
- Straight blade laryngoscope
- The design specifics of the Proseal™ LMA, the Supreme™ LMA, and the i-gel™
- Practical use of the Proseal™ LMA and its role in clinical practice

During the station the indications, contraindications and complications of these techniques and their role in the DAS guidelines will be revised as follows:

Alternative laryngoscopes

Indications

- McCoy laryngoscope - adjunct for use in difficult laryngoscopy
- Polio blade (135°) and Kessel blade (110°) - can be of use in patients with large breasts or antesternal space restriction, particularly obstetrics (or an iron lung). Commonly fitted with a short handle
- Miller blade (curved tip and flat flange) and Henderson blade (atraumatic tip and ‘U-shape’ gutter) – can allow tracheal intubation under vision when not possible with a Macintosh blade

Contraindications

- none

Complications
as for standard laryngoscopy

Proseal™ LMA

**Indications**

- May be used in Plan B (as a conduit for TT insertion) or Plan C (emergency oxygenation where facemask ventilation with airway adjuncts is failing)

**Contraindications**

- No previous experience

**Complications**

- Failure or incorrect placement
- Dental damage

**Techniques you will learn**

**McCoy laryngoscope**

1. Obtain the optimal position for laryngoscopy: sniffing the morning air.

2. The technique for introduction of the laryngoscope is as for the Macintosh blade but with the thumb around the lever on the laryngoscope handle.

3. When the tip of device is in the vallecula, depression of the lever allows indirect elevation of the epiglottis.

4. Insert the TT and observe chest movement. Auscultate breath sounds to confirm adequate ventilation.
Polio and Kessel laryngoscopes

1. Obtain the optimal position for laryngoscopy: sniffing the morning air.

2. The technique for introduction of the laryngoscope is as for the Macintosh 3 and 4 blades (displacing the tongue laterally) but with increased emphasis on upward force towards the ceiling or the theatre doors to prevent levering on the teeth.

3. Insert the TT and observe chest movement. Auscultate breath sounds to confirm adequate ventilation.

Straight blade laryngoscope

1. Use of this laryngoscope is facilitated by maximal neck extension and mouth opening. Anterior displacement of the mandible can help in this regard (an assistant can pull mandible forward). Using a “scissor” action with the right thumb and middle finger can help to open the mouth. A dental guard may help.

2. Insert the laryngoscope lateral to the tongue in the paraglossal gutter keeping firm pressure on the tongue with the tip and observing structures as you go. The tip of the blade should pass posterior to the epiglottis close to the anterior commissure of the vocal cords. Anterior traction on the tongue may help prior to laryngoscope insertion in difficult cases.

3. If the larynx is not visible, the tip of the laryngoscope is usually in the oesophagus or the right piriform fossa. A medial sweep with external palpation on the larynx will usually locate the tip.

4. Bonfils’ retromolar technique can avoid the incisors. Neck flexion may also help.

5. Pass the TT using one of 3 techniques:
   - Direct – an 8mm ID or smaller can pass down the lumen of an adult laryngoscope (usually with a stylet to straighten the preformed TT). Sight of the larynx may be lost. This is usually the fastest technique. Alternatively, place the concavity of the TT facing the cross section...
of the laryngoscope to allow maximal steering. A microlaryngoscopy tube may be easier to pass.

- Passage over an introducer – (e.g. a gum-elastic bougie). This is reliable but requires extra steps.
- Lateral technique - for larger TTs or double lumen tubes. The tube is passed lateral to the scope lumen. The use of a stylet is recommended.

6. Confirmation of TT position is via visual inspection (when the TT is displaced manually out of laryngoscope lumen). Keep the laryngoscope in position for this. It is important that visual confirmation is combined with another method e.g. auscultation or capnography to confirm adequate ventilation.

**Proseal™ LMA**

1. The design features of the Proseal™ LMA will be demonstrated to you:
   - An extra posterior cuff which pushes the device onto the laryngeal inlet when inflated. This improves seal pressure
   - A drain tube separating the respiratory and gastrointestinal tracts. This is designed to protect against aspiration of gastric contents
   - A reinforced tube
   - An integral bite block

2. The PLMA is inserted manually, with or without the use of a metal introducer, or can be railroaded over a gum elastic bougie. The last technique has the highest incidence of success (100% in one study) **(15)**. The technique may be considered in unanticipated failed rapid sequence induction. The bougie is deliberately and carefully placed in the oesophageal inlet to guide the PLMA tip into place via the drain tube. There is a potential risk of trauma to the oesophagus.
3. Insertion of lubricated orogastric tube. The drain tube allows insertion of an orogastric tube. Inability to do so usually implies malposition of the PLMA with the tip of the mask folded back.

4. Tests to confirm correct positioning:

- Leak-free square wave capnography and ventilation should be achieved with airway pressures below 20 cmH₂O
- Gel placed on the opening of the drain tube should not be displaced during ventilation with a pressure of 20 cmH₂O. Equally, manual pressure on the chest should not displace the gel, which would suggest the tip of the drain tube has entered the glottis. Airway obstruction is likely to coexist
- When correctly positioned, the tip of the PLMA is encircled by cricopharyngeus at the top of the oesophagus. Cricoid pressure will therefore be transmitted to the drain tube and will cause movement of the gel placed there. This can be used to aid confirmation of correct positioning
- No more than a third of the bite block should be visible. More than this suggests incomplete insertion

Reasons for failure

- Misalignment of PLMA, drain tube can fold over
- Inadequate depth of anaesthesia
- Incorrect size of PLMA
- PLMA used in spontaneously breathing patients can cause partial airway obstruction and oesophageal breathing, and this can lead to gastric distension

Tips
• If using cricoid pressure, reduce or release this when inserting PLMA

• There is no grille on the airway opening of the PLMA, which may facilitate its use as a conduit for tracheal intubation. However, its airway tube is slightly narrower (size 4 and 5 will pass a size 6.5 uncuffed TT) and shorter (size 4; 190mm, size 5; 195mm to bowl) than the classic LMA, so there will be similar problems for direct tracheal access

References


