

Unanticipated difficult tracheal intubation - during routine induction of anaesthesia in an adult patient

Direct laryngoscopy → Any problems → Call for help

Plan A: Initial tracheal intubation plan

Direct laryngoscopy - check:
 Neck flexion and head extension
 Laryngoscope technique and vector
 External laryngeal manipulation - by laryngoscopist
 Vocal cords open and immobile
 If poor view:
 Introducer (bougie) - seek clicks or hold-up and/or Alternative laryngoscope

No more than 4 attempts maintaining:
 (1) oxygenation with face mask and
 (2) anaesthesia

succeed

Tracheal intubation

Verify tracheal intubation
 (1) Visual, if possible
 (2) Capnograph
 (3) Oesophageal detector
 "if in doubt, take it out"

failed intubation

Plan B: Secondary tracheal intubation plan

ILMA™ or LMA™
 Not more than 2 insertions
 Oxygenate and ventilate

succeed

Confirm: ventilation, oxygenation anaesthesia, CVS stability and muscle relaxation - then fibreoptic tracheal intubation through ILMA™ or LMA™ - 1 attempt.
 If LMA™, consider long flexometallic, nasal RAE or microlaryngeal tube
 Verify intubation and proceed with surgery

failed oxygenation
 (e.g. $\text{SpO}_2 < 90\%$ with $\text{FiO}_2 1.0$)
 via ILMA™ or LMA™

failed intubation via ILMA™ or LMA™

Plan C: Maintenance of oxygenation, ventilation postponement of surgery and awakening

Revert to face mask
 Oxygenate and ventilate
 Reverse non-depolarising relaxant
 1 or 2 person mask technique
 (with oral ± nasal airway)

succeed

Postpone surgery
 Awaken patient

failed ventilation and oxygenation

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation



Difficult Airway Society Guidelines Flowchart 2004 (use with DAS guidelines paper)

Figure 1. Reproduced by kind permission of the Difficult Airway Society (UK) and available for download at: www.das.uk.com/files/ddl-Jul04-A4.pdf

Management of unanticipated difficult tracheal intubation: routine induction and rapid sequence induction of the non-obstetric patient

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INTRODUCTION

Difficult intubation of the trachea is rare, but it can be encountered after routine induction of general anesthesia even if the airway examination did not provide any suspicion of a difficult airway. A difficult intubation may be defined as not being able to visualize any portion of the vocal cords after multiple attempts of conventional laryngoscopy by an experienced person. However it might be difficult to intubate the trachea even if the larynx can be visualized. Such a situation may be associated with the feared ‘can’t ventilate, can’t intubate’ scenario, which may result in brain damage or death if not managed appropriately. In order to avoid this catastrophic outcome, several societies have developed algorithms to provide a decision tree for managing the unanticipated difficult tracheal intubation. The British Difficult Airway Society (DAS) has developed very simple algorithms that break the management strategy into four plans (A to D) using only a few airway devices which are available in many settings, mainly the classic laryngeal mask airway (cLMA) and the intubating LMA (ILMA). There is an algorithm for standard anaesthesia induction and a second algorithm dealing with rapid sequence induction.

COMMENTARY ON ALGORITHMS (Figures 1 and 2)

PLAN A

The initial intubation plan has to be carried out under optimal conditions, including:

1. Optimal head and neck position

The head should be in the sniffing position, where the external auditory meatus is at the level of the sternal notch.

2. Sufficient muscle relaxation

Use either a non-depolarizing agent or suxamethonium, depending on the clinical scenario.

3. Optimal external laryngeal manipulation

Use your right hand to apply backwards, upwards, rightwards pressure on the larynx (BURP manoeuvre).

If these manoeuvres do not improve the laryngeal

view to better than a Cormack and Lehane grade III or IV (i.e. some part of the vocal cords are visible), alternative intubation techniques should be used. Different laryngoscopes are useful, such as straight blades (Miller) or flexible tips (McCoy). An introducer ('gum elastic bougie', 'Eschman') is inexpensive and should be readily available. It is easy to use and has a great success rate. The 'gum elastic bougie' can be inserted blindly under the epiglottis in case of a Cormack and Lehane grade III or IV view. The laryngoscope should be kept in place to optimize the view and success rate. Bougie insertion is a blind technique and indications of correct placement of the bougie are:

1. Tracheal clicks

Clicks can be felt when the flexed tip of the bougie is advanced along the tracheal rings.

2. Resistance after approximately 45cm

If there is no resistance felt after about 45cm, the bougie is likely in the esophagus and not in the bronchial tree.

3. Coughing

The sensitive tracheal mucosa will often make the patient cough if there is a foreign body (bougie) in the trachea. If muscle relaxation has been used this sign will be absent.

Once the bougie is in the trachea, an endotracheal tube is railroaded over it. A laryngoscope and approximately 90 degrees of anti-clockwise rotation of the tube will facilitate the passage of the tube past the vocal cords.

Plan A should be abandoned after a total of four attempts (with no more than 2 different techniques) to intubate the trachea, otherwise the risk of trauma and swelling of the upper airway with the potential to result in a ‘can’t ventilate, can’t intubate’ situation, becomes too high.

In case of a routine induction of general anesthesia (Figure 1), the next step is Plan B. In case of a rapid sequence induction (Figure 2), Plan B should be skipped and Plan C instituted. Plan B consists of

Summary

Call for help early.

Always have a backup plan.

No more than 4 attempts at the initial intubation plan.

Be familiar with the various types of laryngeal mask airways.

No more than 2 attempts at the use of a laryngeal mask airway.

Do not traumatize the airway – maintain oxygenation and postpone surgery.

If necessary, do not delay cricothyroidotomy.

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Unanticipated difficult tracheal intubation - during rapid sequence induction of anaesthesia in non-obstetric adult patient

Direct laryngoscopy → Any problems → Call for help

Plan A: Initial tracheal intubation plan

Pre-oxygenate
Cricoid force: 10N awake → 30N anaesthetised
Direct laryngoscopy - check:
Neck flexion and head extension
Laryngoscopy technique and vector
External laryngeal manipulation - by laryngoscopist
Vocal cords open and immobile
If poor view:
Reduce cricoid force
Introducer (bougie) - seek clicks or hold-up and/or Alternative laryngoscope

succeed

Tracheal intubation

No more than 3 attempts maintaining:
(1) oxygenation with face mask
(2) cricoid pressure and
(3) anaesthesia

Verify tracheal intubation
(1) Visual, if possible
(2) Capnograph
(3) Oesophageal detector
"if in doubt, take it out"

failed intubation

Plan C: Maintenance of oxygenation, ventilation postponement of surgery and awakening

Maintain 30N cricoid force

Plan B not appropriate for this scenario

Use face mask, oxygenate and ventilate
1 or 2 person mask technique
(with oral ± nasal airway)
Consider reducing cricoid force if ventilation difficult

succeed

failed oxygenation
(e.g. $\text{SpO}_2 < 90\%$ with $\text{FiO}_2 1.0$) via face mask

LMA™
Reduce cricoid force during insertion
Oxygenate and ventilate

succeed

Postpone surgery and awaken patient if possible or continue anaesthesia with LMA™ or Proseal LMA™ if condition immediately life-threatening

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation



further intubation attempts with an unprotected airway, which is considered not appropriate in a patient with a full stomach because of a higher risk for aspiration.

PLAN B

Plan B consists of a secondary intubation plan using either the classic LMA (cLMA) or the intubating LMA (ILMA). The primary goal is to establish and confirm ventilation and oxygenation. If oxygenation fails ($\text{SaO}_2 < 90\%$ with $\text{FiO}_2 1.0$) after no more than two attempts at inserting the device, the next step is moving on to Plan C.

If the patient can be ventilated and oxygenated, remains hemodynamically stable and is anesthetized and paralyzed, one attempt at intubating the trachea through either the cLMA or the ILMA should be performed. Ideally this would be performed with the guidance of a fiberoptic bronchoscope, but blind intubations through either the cLMA or the ILMA have high success rates.

Fiberoptic technique for intubation via a laryngeal mask airway:

1. Choose an endotracheal tube which will fit into the stem of the LMA.
2. Ensure that the scope and the endotracheal tube are well lubricated.
3. Pass the fiberoptic scope through the endotracheal tube.
4. Insert the fiberoptic scope into the stem of the LMA, and advance the scope to visualize the aperture bars.
5. Pass between the bars, visualize the vocal cords and pass the scope between the cords.
6. Slide the endotracheal tube over the scope and into the trachea.
7. It is advisable to use a longer than normal endotracheal tube to intubate through a cLMA, because of the longer tube of a cLMA compared to the ILMA.
8. If available, an Aintree tube exchange catheter makes the removal of the LMA possible.

The intubating laryngeal mask airway (ILMA)

The ILMA consists of a metal tube that is shaped to match the

curvature of the upper airway. It has a cuff similar to the classic LMA. An epiglottis elevation bar is situated at the distal end of the ILMA stem. It is raised by the inserted endotracheal tube to move the epiglottis out of the way of the tube.

Patient weight	ILMA size
< 50 kg	Size 3
50 - 70 kg	Size 4
> 70 kg	Size 5

The correct size of ILMA must be selected. The manufacturer's recommendations are:

Before starting the procedure it is important to check that the equipment is complete and functional, in particular that there is no cuff leak. The use of an intubating LMA requires 6 pieces of equipment, shown in Figure 2.

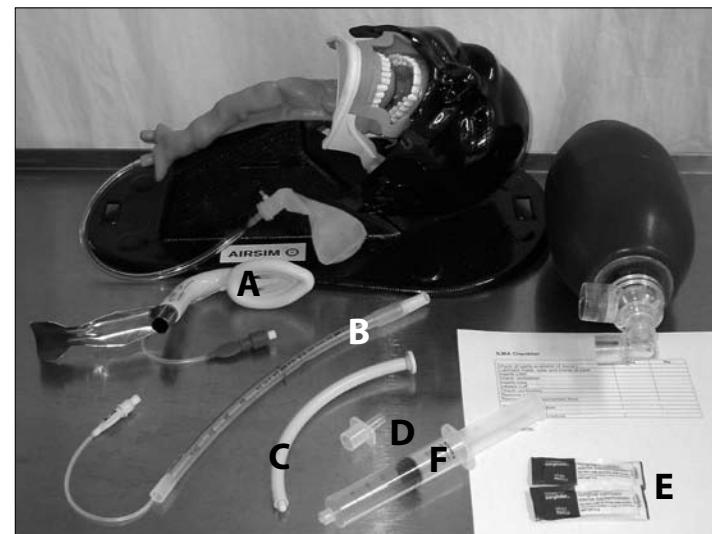


Figure 2. The components of the ILMA; A – the ILMA itself, B – a flexible wire-reinforced endotracheal tube, C – bougie to secure endotracheal tube position as ILMA is removed from mouth, D – 15mm tube connector and syringe for cuff, E – lubricating gel, F – a syringe to inflate the cuffs of both the LMA and the tube

The inside of the ILMA stem needs to be lubricated and the ETT should be pushed through the ILMA stem repeatedly until it slides without resistance.



Figure 3. Intubation using the ILMA

Insertion of the ILMA

After insertion of the ILMA following its curvature and inflation of the cuff, the ventilation device can be connected to the ILMA. Easy manual ventilation should be confirmed. If ventilation is appropriate one can proceed to intubation. If ventilation is inappropriate, several maneuvers can be performed and repeated, if necessary:

1. Lift ILMA towards anterior neck of the patient to get a better seal using the handle.
2. Rotate ILMA left or right.
3. Remove the ILMA 6cm (markings on tube) out of its position keeping the cuff inflated to allow for a down folded epiglottis to lift up (Up/down or Chandy manoeuvre).

Intubation

Once ventilation is established, push the ETT through the ILMA. The ETT has two black lines, one long longitudinal line and one short vertical line. The longitudinal line should face cephalad. In this position the bevel of the ETT tip will pass between the vocal cords in a sagittal position, allowing for an easier passage. The vertical line will enter the ILMA stem when the tip of the ETT exits the ILMA. At this stage a small resistance will be felt. With further advancement of the ETT there should be no more resistance, otherwise the ETT has likely entered the esophagus. After placement of the ETT and cuff inflation, ventilation should again be confirmed. If there are problems with ETT placement or ventilation, the above maneuvers should be performed.

Removal of the ILMA

After confirmation of ventilation the ILMA can be removed. The ETT connector has to be removed and is best left on the ventilation device to prevent it from being lost. If it does get lost, a connector from any regular tube should be readily available. The rod is used to hold the ETT in place while the ILMA is being gently removed. The ETT cuffs should stay inflated while the ILMA cuff can be deflated. As soon as the ETT can be grabbed in the mouth of the patient the rod has to be removed to allow the ETT cuff to fit through the ILMA tube. Now the ETT can be reconnected to the ventilation device and ETT depth can be readjusted, guided by auscultation.

PLAN C

There are two slightly different versions of Plan C, depending on whether the induction is a routine induction of anesthesia or a rapid sequence induction.

Routine induction

If the initial intubation plan as well as the backup plan using a laryngeal airway fails, Plan C involves reverting to facemask ventilation. The goal is to awaken the patient and to postpone surgery after reversal of muscle relaxation. Any further attempts at intubating the trachea can traumatize the airway and may lead to airway obstruction very rapidly.

If face mask ventilation turns out to be difficult every effort should be made to optimize the patency of the upper airway. Successful maneuvers can be:

1. Maximal jaw thrust and chin lift

2. Two handed mask technique

3. Oral airway

4. Nasal airway.

Rapid sequence induction

In the case of a rapid sequence induction, there is a higher risk for regurgitation and vomiting with the subsequent risk for pulmonary aspiration and pneumonitis. Therefore the use of cricoid pressure is still recommended, however its use is controversial. Since the airway may be further compromised by cricoid pressure, one should consider reducing its force or releasing it when ventilation proves to be difficult. If this does not improve ventilation and oxygenation, the use of a laryngeal mask airway is recommended. The patient should be awoken unless surgery is emergent and the patient's condition is immediately life threatening. In this case one should consider performing the surgery with the use of a LMA.



Figure 4. The proseal LMA and LMA supreme

In this situation, the Proseal LMA or the LMA Supreme, where available, may be safer alternatives to the classic LMA because of an additional channel to drain the stomach. Placement of both devices is slightly more complex than using a cLMA. Different test should be performed to confirm their correct positioning, i.e separation of the alimentary track and the airway.

1. The "Bubble Test"

The gastric channel is sealed with lubricant. With positive pressure ventilation, there must be no bubbles appearing at the gastric tube opening. Bubbles would indicate an incomplete separation of the airway from the esophagus with the risk of gastric inflation. With the tip of Proseal or Supreme LMA sitting in the upper esophagus, an unobstructed gastric tube would include an air column. Pressing on the sternal notch over the esophagus would move this air column and produce bubbles at the opening of the gastric tube.

2. Gastric tube

A gastric suction tube should be inserted through the gastric tube of the LMA. The tube should pass without problems and the stomach should be suctioned. After suctioning of the stomach the gastric suction tube should be removed. If left in place, the distal opening of the LMAs gastric tube would be occluded and the gastric suction tube could worsen reflux of gastric contents, leading to a higher aspiration risk.

For either of the pathways, routine induction or rapid sequence induction, it is of utmost importance to recognize inadequate

oxygenation of the patient. Any delay in moving on to Plan D may result in severe hypoxia with potentially catastrophic consequences, i.e. brain damage or death.

PLAN D

Plan D is the rescue technique for the feared 'cannot intubate, cannot ventilate' scenario. Its endpoint consists of a cricothyroidotomy, using either a large bore cannula or a scalpel. A thorough discussion of Plan D has been published elsewhere in this issue.

FURTHER READING

Henderson J, Popat M, Latto I, Pearce A. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004; **59**: 675-94.

Hagberg C. Benumof's Airway Management. 2nd ed. Philadelphia: Mosby Elsevier 2007.

Walls R, Murphy M, Luten R, Schneider R. Manual of Emergency Airway Management. 2nd ed. Philadelphia: Lippincott Williams Wilkins 2004.

Website of the Difficut Airway Society, UK: <http://www.das.uk.com>. guidelines.html

Brimacombe J, Keller C. The Proseal Laryngeal Mask Airway. *Anesthesiology Clinics of North America* 2002; **20**: 871-91.

Bogetz, MS. Using the laryngeal mask airway to manage the difficult airway. *Anesthesiology Clinics of North America* 2002; **20**: 863-70.