Royal College of Anaesthetists

Difficult Airway Society

Tayside Mastery Learning Programme

Airway assessment and endotracheal intubation

Authors: Claire Wallace, Naveeta Maini (Dundee)

LEARNING OUTCOMES

By reviewing this module, a trainee should gain an understanding of the following:

1. the ethos of tracheal intubation.
2. the principles of airway assessment.
3. the principles of endotracheal intubation.

1: THE ETHOS OF TRACHEAL INTUBATION

Tracheal intubation is an essential skill in anaesthesia for the care of the unconscious, anaesthetised or critically ill patient. It can be a difficult and traumatic process causing both morbidity and mortality. The risk of complication is reduced by:

- careful preoperative assessment to predict risk of difficulty
- an appropriate plan and preparation for intubation
- judicious technique using appropriate personnel
- a strategy for managing unanticipated difficulty that prioritises oxygenation over intubation.

Intubation involves more than the acquisition of technical skills in the use of both basic and advanced airway equipment. It requires an ability to recognise different clinical scenarios and to translate that information into a sensible airway management strategy, involving the whole team.

As with basic airway management, our goal is safe intubation through the principles of:

- airway management in the RIGHT PLACE: a suitable location with appropriate monitoring and assistance.
- airway management with the RIGHT EQUIPMENT: using equipment with which one is familiar.
- airway management by the RIGHT PERSON: identifying our own limitations, anticipating the need for assistance in managing predicted difficulty and recognising the need for early, more expert help in difficulty that was unanticipated.
- airway management with the RIGHT MIND: maintaining good situational awareness, avoiding cognitive overload and task fixation through the implementation of checklists and cognitive aids/algorithms, and utilisation of good communication.

Remember that failure to intubate is not necessarily a critical problem, but failure to oxygenate the patient is.

Indications

It is important to remember that there are no absolutes; however, the main indications for intubation include:

- enabling mechanical ventilation, where muscle relaxants are used to facilitate surgery and in critical care situations.
- prone positioning and other positions of the patient that make maintenance of the airway difficult.
- the shared airway, such as when there is competition between surgeon and anaesthetist for the airway (e.g. operations on the head and neck).
- patients in whom the airway cannot be satisfactorily maintained by any other technique (e.g. morbidly obese patients).

Contraindication

The only contraindication to intubation is total airway obstruction of the upper airway preventing laryngeal access and necessitating a front-of-neck-airway.

Equipment

A variety of equipment exists and is selected based on the clinical situation and the anaesthetist's preference. All equipment should be checked to ensure that it is functional prior to use.

The basic requirements include those outlined below.

Monitoring – full monitoring (ECG, BP, SpO_2) including end-tidal capnography is essential.

Laryngoscope – a device to allow visualisation of the larynx. Generally, these have a curved blade and a light source. The Macintosh laryngoscope is the most commonly used and can provide direct visualisation from the operator's eye to the patient's larynx by lifting the jaw and tongue away from the posterior pharyngeal wall. The most commonly used sizes in adults are 3 and 4 (large adult).

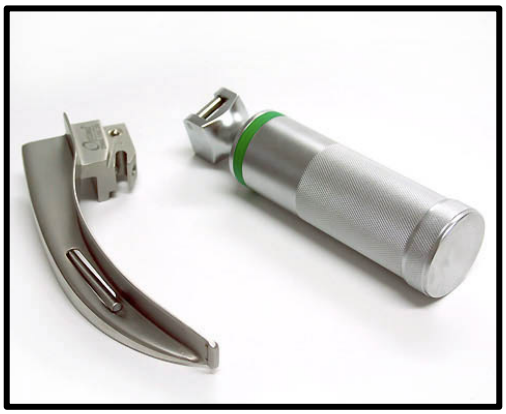


Fig 1: A Macintosh laryngoscope.

Image courtesy of RCOA E-learning Anaesthesia, © e-Learning for Healthcare 2020. Used with permission

Videolaryngoscopes incorporate cameras and provide an indirect view of the larynx, viewed on a screen. This can be used first line or following failure of direct laryngoscopy. The most common devices are Macintosh-shaped and can provide a direct as well as an indirect view. At intubation, there should always be a second laryngoscope available in case of failure.

Tracheal tubes – these come in a variety of sizes and shapes with a cuff that is inflated via a pilot valve. Standard endotracheal tubes (ETT) have a preformed curve that vaguely conforms to the anatomical shape of the pharynx. The cuff, when inflated, forms a seal between the tube and the tracheal wall, sealing and protecting the distal airway. The internal diameter (ID) is expressed in mm and the length in cm. Recommended sizes for males are 8–9 mm ID and for females 7–8 mm ID. The cuff may be lightly lubricated to aid smooth passage through the larynx.

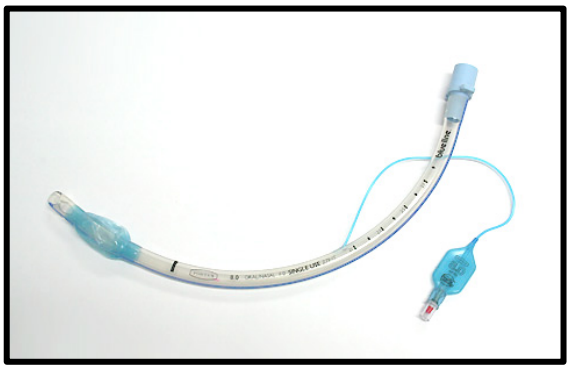


Fig 2: An endotracheal tube.

Image courtesy of RCOA E-learning Anaesthesia, © e-Learning for Healthcare 2020. Used with permission

Syringe – to inflate the cuff.

Suction – including yankauer to clear the pharynx of secretions to improve view or to perform airway toilet if regurgitation occurs.

Stethoscope – to confirm correct ETT placement.
Intubation aides – these include a bougie (a long, malleable device that can be placed through the larynx and used to railroad the tube into position) and the stylet (a shorter, malleable device that is placed inside an ETT and used to alter its shape to aide correct placement).
Tapes or ties – to secure the tube in position.
Cuff pressure manometer – to measure and limit pressure within the ETT cuff to reduce the risk of tracheal mucosa injury.
Personal protective equipment – depending on local and national policy at the time of intubation. This may be aerosol- or droplet-precaution PPE. Intubation is an aerosol-generating procedure (AGP).

2: THE PRINCIPLES OF AIRWAY ASSESSMENT

All patients should undergo a pre-operative evaluation by an anaesthetist. This must include a careful history and relevant examination; it helps the anaesthetist plan the most suitable anaesthetic approach and increases the safety of the procedure.

When assessing the airway both history and examination are important.

Some useful questions to ask:

- Any problems with previous anaesthetics? (Review previous anaesthetic charts.)
- Any history of gastric reflux?
- Fasting time ($\geq$ 6 hours for solids, $\geq$ 2 hours for liquids.)
- Any caps, crowns, loose teeth or dentures?
- Any previous radiotherapy to the neck? (If known to have had a head and neck cancer.)
- New hoarseness/voice change/swallowing difficulties?
- Any history of obstructive sleep apnoea?
- Review patient's history of presenting complaint and past medical history to identify any potential for delayed gastric emptying.

Examination

There are several important aspects of examination that each anaesthetist needs to consider:

- mouth opening – Mallampati Score and incisor gap.
- ability to protrude lower jaw.
- thyromental distance.
- neck extension (atlanto-occipital).
- awkward dentition – can make intubation difficult.
- obesity – can make bag mask ventilation (BMV) difficult.
- facial hair – can make BMV difficult.
- appearance of scars/radiation burns to face and neck – may indicate distorted anatomy.

Mallampatti Score

This examination is used to assess the patient's oropharynx, and relative tongue size, by asking them to open their mouth as wide as possible and stick out their tongue. The classes are divided as follows:

i. Soft palate, fauces, uvula and tonsillar pillars seen.
ii. Soft palate, fauces, some of uvula seen.
iii. Soft palate and only base of uvula seen.
iv. Soft palate not visible at all.

Class 3 and 4 are associated with increased difficulty in intubation.

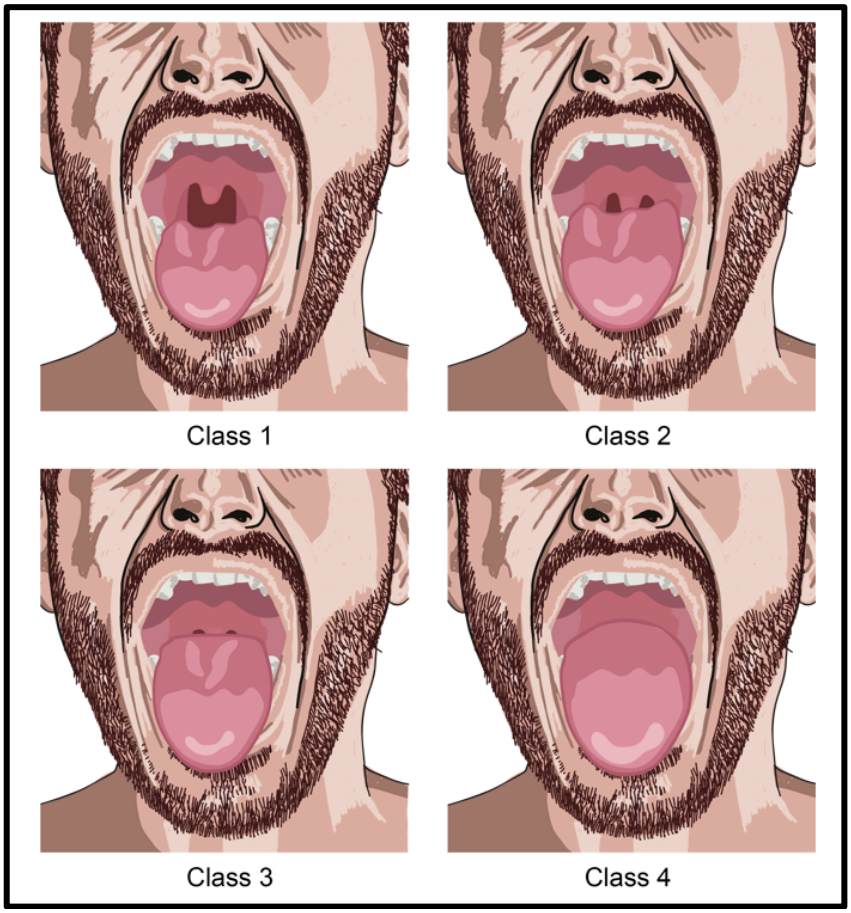


Fig 3: Mallampatti score.

Image courtesy of Airway Matters MOOC, © UCL 2019. Used with permission

Jaw protrusion

This is performed by asking the patient to protrude their lower jaw ("can you bite your top lip?"). An overbite (Class 3) can make BMV and intubation more difficult.

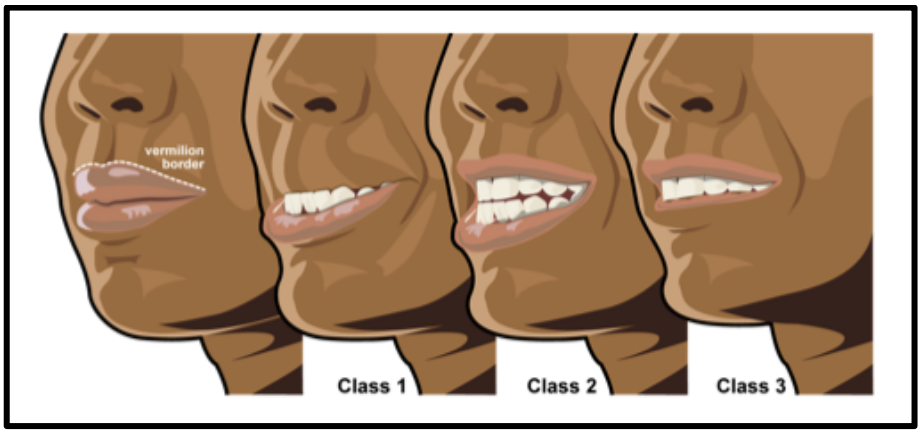


Fig 4: Jaw protrusion.

Image courtesy of Airway Matters MOOC, © UCL 2019. Used with permission

Thyromental distance

Ask the patient to tilt their head back as far as they can and measure the distance from their thyroid cartilage to the tip of their chin with your hand**.** A thyromental distance of less than 7 cm suggests potential difficulty with intubation. This is not always possible in those with neck injuries/arthritis.

Fig 5: Thyromental distance.

Image courtesy of Airway Matters MOOC, © UCL 2019. Used with permission

Many difficult intubations can be predicted by using a combination of these bedside tests and findings should not be ignored. Patients who you anticipate being difficult may turn out to be straightforward and airway management is uneventful.

However, it is important to recognise that airway assessment is not an exact science and one should always be prepared for unanticipated difficulty (i.e. airway assessment did not predict difficulty). Therefore, every anaesthetist must be prepared, and have a plan for managing an unanticipated difficult airway or intubation.

3: THE PRINCIPLES OF ENDOTRACHEAL INTUBATION

Laryngoscopy

Traditional direct laryngoscopy depends on achieving line of sight from the maxillary teeth to the larynx. This requires alignment of three axes: the oral axis, the pharyngeal axis and the laryngeal axis. This is achieved by optimal positioning of the patient, whereby the lower neck is flexed and the head extended on the atlanto-occipital joint (sniffing the morning air position) while resting on a pillow or raised surface and extending the head with your right hand. The laryngoscope is then used to lift the anterior structures off the posterior pharyngeal wall.

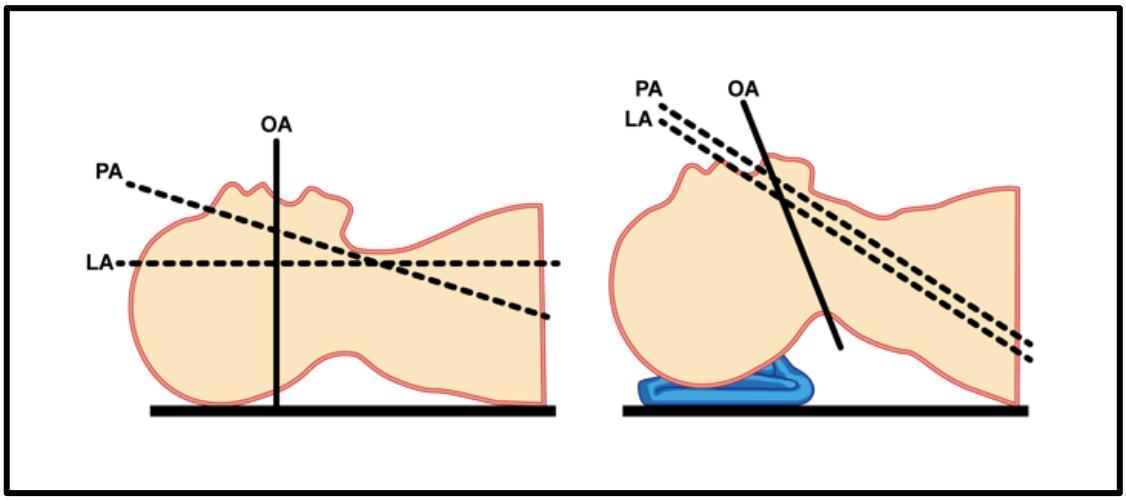


Fig 6: Alignment of three axes.

Image courtesy of Airway Matters MOOC, © UCL 2019. Used with permission

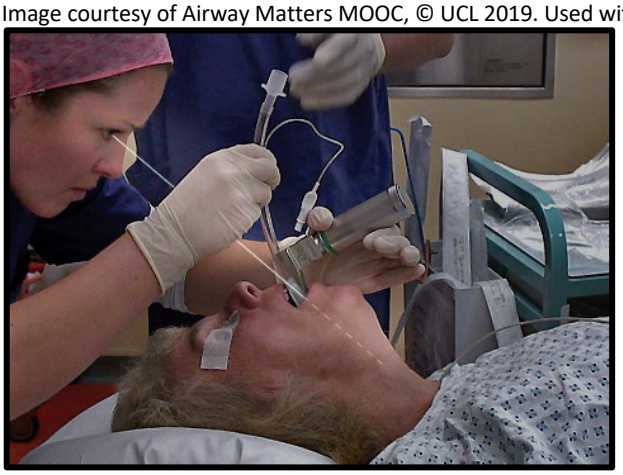


Fig 7: Direct line of sight.

Image courtesy of RCOA E-learning Anaesthesia, © e-Learning for Healthcare 2020. Used with permission

Preparation and procedure

Prior to induction of general anaesthesia there are a few principles that all anaesthetists should follow to ensure safe induction and airway management:

- ensure that you have a trained assistant and senior supervision
- perform a WHO sign in to confirm correct patient and procedure
- confirm your airway plan with the anaesthetic assistant
- ensure that the patient has a patent IV cannula
- apply full monitoring, including waveform capnography
- optimise the patient position (sniffing the morning air)
- pre-oxygenate until $ETO_2 > 0.8$
- ensure adequate depth of anaesthesia and paralysis

- maintain oxygenation (+/- anaesthesia) with BMV.

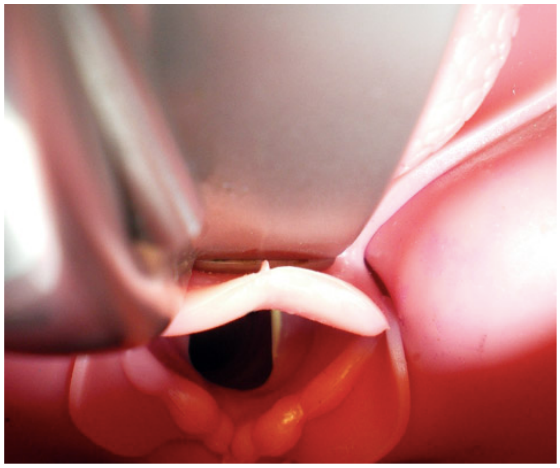
The procedure for basic tracheal intubation can be described in the following steps (Images courtesy of RCOA E-learning Anaesthesia, © e-Learning for Healthcare 2020. Used with permission):

1. Insert the blade:
    - hold the laryngoscope in the left hand
    - insert the blade of the laryngoscope into the right side of the fully open mouth
    - pass the blade to the right of the tongue
    - avoid contact with the soft tissues and teeth.

2. Advance the blade:
    - advance the blade down the right side of the tongue
    - “sweep” the tongue to the left and out of the way
    - continue to advance the blade towards the base of the tongue
    - return the tip of the blade to the midline, **identifying the epiglottis,** prior to placing the tip into the vallecula.

3. Lift the epiglottis:
    - use a moderate lifting force applied along the line of the laryngoscope handle (at a 45-degree angle to the floor) to lift the epiglottis and reveal the glottis
    - do not lever backwards on to the top teeth
    - while doing this it is essential to maintain mouth opening and head and neck position.

4. Reveal the vocal cords:
    - The larynx should now be visible (if it is not clearly visible, other manoeuvres are required – see **TROUBLESHOOTING**).



5. Achieve the best view:
    - once the best view has been achieved, the anaesthetist should not take their eye off the vocal cords.

6. Pass the ETT:
    - maintain a view of the vocal cords while your assistant hands you the ETT
    - hold the ETT towards the proximal end
    - pass the ETT from the right side of the mouth, so that it can be seen approaching and entering the glottis
    - advance the ETT until the cuff is about 2 cm distal to the vocal cords (many ETTs have a black mark, indicating the depth at the cords)
    - once positioned, take great care that the tube does not move. This is best done by holding the tube with your hand anchored on the patient's cheek until the tube is secured.

7. Inflate cuff of ETT:
    - your assistant will inflate the cuff to obtain a seal and prevent air leak from the lungs
    - your assistant will check the cuff pressure is within the normal range using a manometer.
8. Confirm correct tube position:
    - visualise tube position through cords
    - bilateral chest movement when squeezing the bag (visual +/– auscultation)
    - you should see misting of the ETT
    - **$ETCO_2$ capnography trace must be present – THIS IS CRUCIAL.**
9. Secure the ETT.

10. Record details of airway management on the anaesthetic chart. This is important to inform future care and should include:
    - ease or difficulty of bag/mask ventilation, including use of adjuncts.
    - ease or difficulty of intubation, including grade of laryngoscopy and use of stylet/bougie.

Recording the best view of the larynx obtained at laryngoscopy

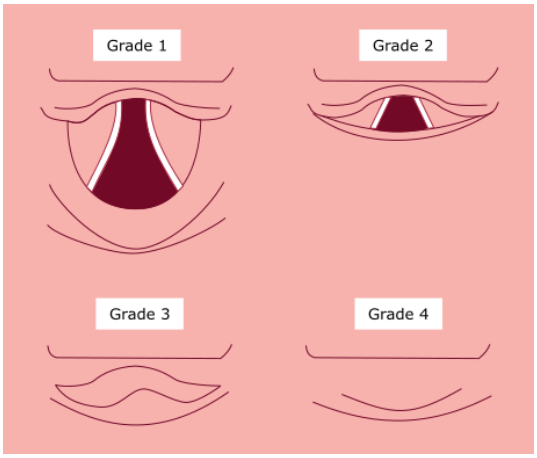
Cormack and Lehane

Most intubations are straightforward. However, awkward and difficult laryngoscopy is associated with increased morbidity and mortality.

The view at laryngoscopy must always be documented. The scale most widely used was described by Cormack and Lehane and applies to the 'best view achieved'. (Images courtesy of RCOA E-learning Anaesthesia, © e-Learning for Healthcare 2020. Used with permission).

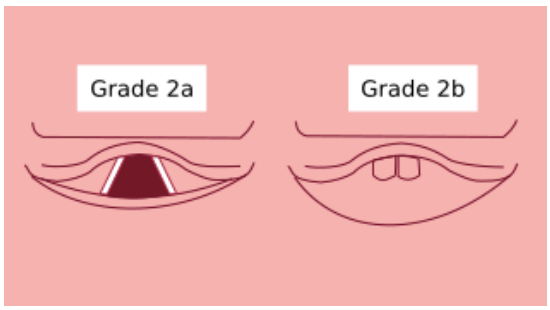
Grade 1	Most of the glottis is visible
Grade 2	Only the posterior extremity of the glottis is visible
Grade 3	No part of the glottis, but only the epiglottis, is visible
Grade 4	Not even the epiglottis can be seen

One of the problems with the Cormack and Lehane classification is that very different views may be graded the same. For example, Grade 2 includes both a view of nearly 50% of the vocal cords (easy), and a view of only the tips of the arytenoid cartilages (pretty difficult).



Several modifications of this classification have been suggested. In one modification Grade 2 is subdivided:

Grade 2a	Part of the vocal cords are visible
Grade 2b	Only posterior elements (arytenoids or of the posterior commissure) of glottis visible



TROUBLESHOOTING

1. It is not uncommon for the anaesthetist to achieve a good view of the larynx, yet have difficulty in passing the tube between the vocal cords.
    - Always check that the patient is in the optimal position.
    - Passage of the tube can be facilitated if an assistant retracts the right side of the mouth laterally and the tube has an optimal shape (consider a stylet).
    - You can perform external laryngeal manipulation (ELM) with your right hand and then ask your assistant to replicate this to improve the laryngeal view. Some refer to this manoeuvre as BURP (backwards, upwards, rightwards pressure). ELM should also be applied when a sub-optimal view of the larynx is obtained at laryngoscopy.
    - Good views on a Macintosh videolaryngoscope screen and difficulty passing a tube can be a sign of poor laryngoscopy technique. Focusing on optimising the direct view first, prior to looking at the screen, should ensure optimal technique.
2. Oesophageal intubation.
    - Signs of oesophageal intubation include:
        - capnography: absent or decaying trace – **THIS IS CRUCIAL**
        - progressive hypoxia (may take 3 minutes or more for onset)
        - abnormal sounds heard in axillae or epigastrium.
    - Action plan:
        - **remove ETT (If in doubt, pull it out)**
        - default to bag and mask ventilation (+/– adjunct)
        - administer 100 % oxygen
        - call for senior help
3. Endobronchial intubation.
   Occurs when the ETT is advanced too far, entering one of the main bronchi (most commonly the right). The best way to avoid endobronchial intubation is to insert the ETT to the correct distance in the first place, and then ensure it does not move while it is being secured.

Signs of bronchial intubation:

- uneven chest expansion
- reduced breath sounds unilaterally (can be subtle)
- high airway pressures
- desaturation to around 85–88% (may take several minutes).

Action plan:

- administer 100 % oxygen
- observe the chest and auscultate both axillae
- deflate the cuff and withdraw the ETT carefully until breath sounds are heard bilaterally
- ensure adequate re-expansion of non-ventilated lung – patient may require hand ventilation, continuous positive airway pressure (CPAP) or positive-end expiratory pressure (PEEP)**.**

It is important to communicate details of problems with airway management on the anaesthetic chart so that this information is available to any future anaesthetist.

Intubation Checklist Date:

Trainee Name: Tutor:

Step	1st attempt	2nd attempt
Pre-procedure		
Assessment of patient and airway		
Ensures trained assistant & senior supervision		
Confirms airway plan with anaesthetic assistant		
Performs WHO sign in		
Full monitoring including capnography		
Ensures patent IV cannula		
Optimises patient position		
Pre-oxygenation until ETO_2 > 0.8		
Procedure		
Supports airway using simple manoeuvres		
Supports ventilation using bag mask ventilation		
Assesses adequacy of anaesthesia/relaxation		
Inserts laryngoscope correctly in to mouth and obtains view – vocalises view		
Inserts endotracheal tube to correct distance		
Uses additional manouevres or adjuncts, if required (e.g. external neck pressure; bougie)		
Anchors ETT to ensure it does not move		
Removes laryngoscope carefully from mouth		
Attaches ventilator tubing to ETT		
Confirms ventilation – chest rising, $ETCO_2$, auscultates chest		
Secures ETT		
Post-procedure		
Documentation of airway management		
Throughout		
Appropriate communication with assistant & patient		
Aware of patient condition/vital signs		
Shows understanding of adequate anaesthetic/paralysis for intubation/maintenance		

Comments