Rapid Sequence Intubation (RSI)

SCGH ED, Author Dr R Swift, February 2017

The first aim of airway management is to maintain oxygenation

This document is a learning aid. It is derived from many sources that have not been referenced and is intended as an education document for staff at SCGH ED. It is recommended trainees research their own approach to RSI and this document may be a useful template to annotate, amend and rearrange.

1. Preparation

Assess the Airway

Many patients may need RSI without commonly used airway assessment methods because the patient is non-cooperative, unconscious, has trismus, has C spine immobilisation, or urgency mandates immediate intubation.

In a time critical situation, assessment is done in tandem with active airway management (i.e. airway manoeuvres and adjuncts) and pragmatically may be limited to the following;

Look
- Facial and neck swelling, scars or asymmetry
- Mouth opening, prominent anterior dentition, dentures and oropharyngeal swelling or abnormalities
- Receding chin
- Short neck
- Neck immobility
- Obesity

Feel
- Head and neck movement during positioning for management of airway and intubation
- Tracheal position (i.e. palpable?, midline?)

Listen
- Stridor
- Dysphonia
- Wheeze

If there are gross signs to suggest difficult intubation and intubation can be safely delayed, then seeking the most skilled operator or operator with advanced intubation skills may be possible. Otherwise, if immediate RSI is required then plan for failed intubation.

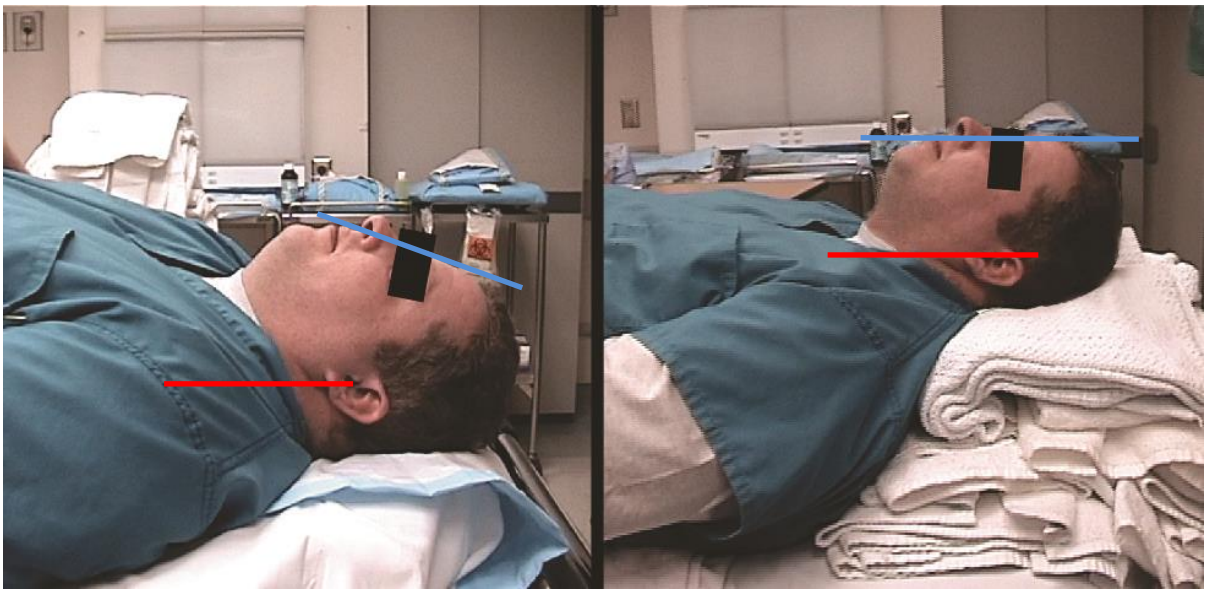
NOTE: Patients with no evidence of risk for difficult intubation can still be difficult; *every patient has a potentially difficult airway until intubated!*

Positioning

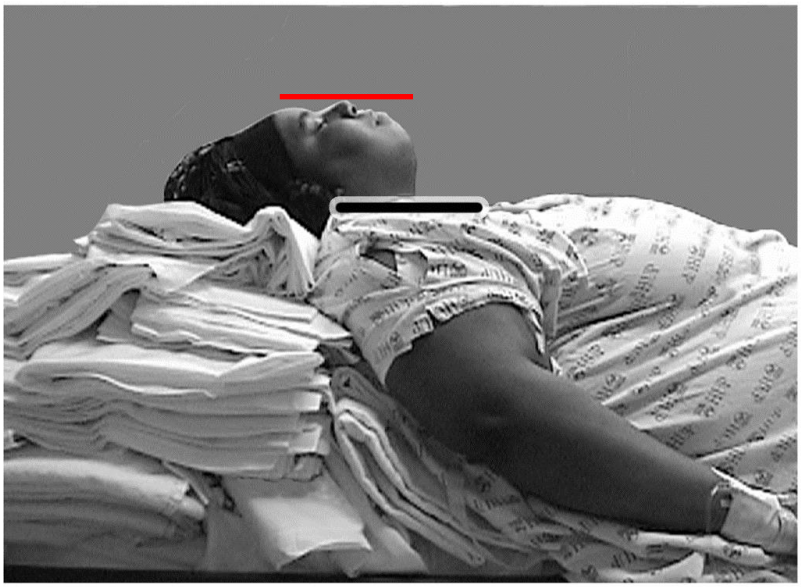
- Head up (i.e. torso) minimum 30^{o} while pre-oxygenating if possible
- When intubating lay flat on their back – may delay lying flat till the point you are ready to insert laryngoscopy
- Top of the head level with head end of the bed
- Body in the centre of the bed
- Trolley at belt height or patient head at the level of the lower sternum of the Airway Doctor
- If spinal precautions are required, have a plan for collar removal and inline manual immobilisation.

Positioning (cont)

- **Ear canal level with sternal notch** – neck *flexion* of 35° and **face plane parallel to the ceiling**. Usually need to place pillow or padding under head to achieve this. May need to place pillow under head and shoulders, but never just between shoulders alone (this extends the neck, which is the opposite of what is required)



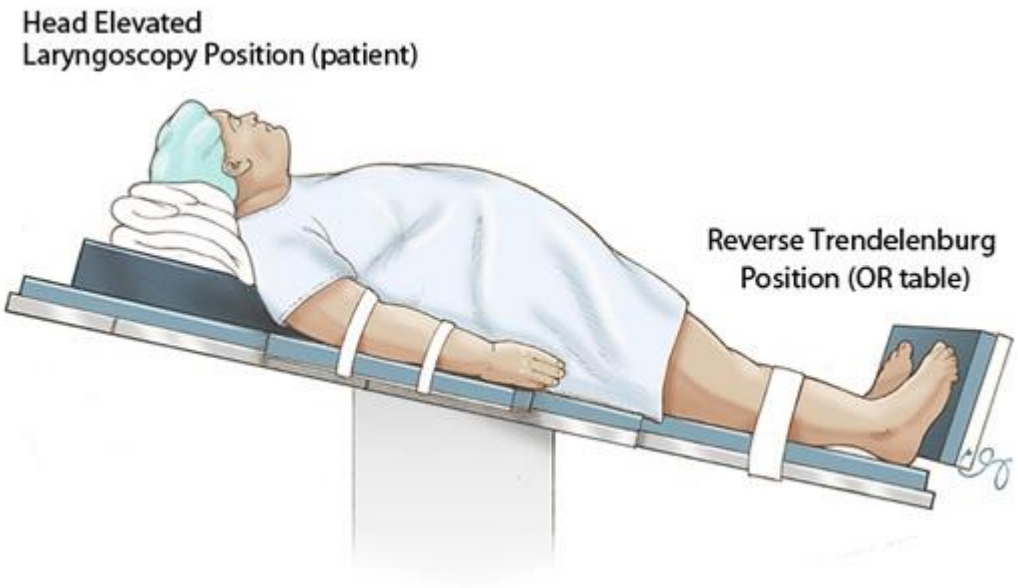
- **RAMP** obese patients



Obese patients will usually require substantial padding to elevate their head high enough to achieve ear canal the same level as the sternal notch.

Positioning (cont)

- For obese patients and those on spinal precautions, it is reasonable to use Reverse Trendelenburg to achieve adequate position.



Monitoring

- ECG
- NIBP – non-drip arm! (ensure BP recorded just before start of intubation and 3 minutely during)
- ± IBP (if patient's BP unstable may delay RSI, if safe to do so, to insert arterial line)
- Oximetry – non-NIBP arm!
  Finger, Forehead or ear probe

- $EtCO_2$ – Philips monitors use side-stream gas sampling that does not require airway filter.

- FeO_2 (Fraction of expired Oxygen) is a routinely monitored in Anaesthetics and is a measure of adequacy of pre-oxygenation (de-nitrogenation) but is not yet a standard in ED.
- **Slave Monitor**
  - Computer on Wheels (COW) with Philips IntelliVue XDS Application

    It is recommended that the COW in T1 and T2 are used as slave monitors so the intubating doctor can see the monitored vital signs

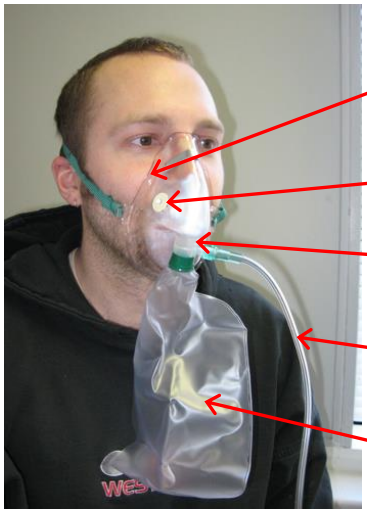
    These COWs have a network cable that link them to the main Philips monitor in each cubicle

    To bring up the monitor screen, go to the Windows applications start menu and select the Philips folder and then the IntelliVue XDS Application folder

    Open the XDS application

Equipment

- **Oxygen** – Note; unlike anaesthetic circuits, the O_2 delivery devices below are 'variable performance' and the FiO_2 delivered will vary according to the minute volume. To overcome this, use high or very high flows of oxygen, e.g. 30 – 40 Lpm.
  - **Non-rebreather Mask (NRM) [+ Nasal Prongs (NP)]** – O_2 30^+ Lpm (High flow wall meter). For patients breathing spontaneously and not requiring ventilatory or airway pressure support



Airtight fit between the mask and the patients face

Valve on either side of the mask prevents entry of room air

Valve allows oxygen to enter the mask and prevents exhaled air entering the reservoir.

Set oxygen flow at 12-15 l/m or fully open for severe hypoxia or preoxygenation

The reservoir should be full on expiration and partially collapse during inspiration

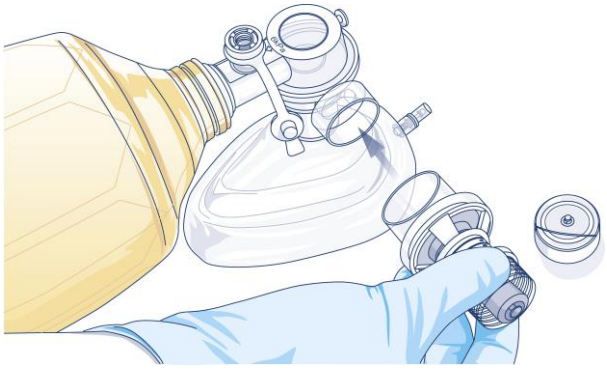
  - OR

    Bag-Valve-Mask (BVM) (+ NP)

    BVM - O_2 20^+ Lpm (Wall meter fully open);
    - ensure expiratory port valve or PEEP valve
    - Attach CO_2 monitor (Note: Philips monitors do not need airway filter for CO_2 monitor)
    - Airtight seal
    - Slow inflation if manual ventilation required to prevent gastric insufflation
    - 10-12 bpm (higher if hypercapnia or severe acidaemia)
    - One handed vs two handed

This one-way valve prevents entrainment of room air at the expiratory port

Equipment (cont)

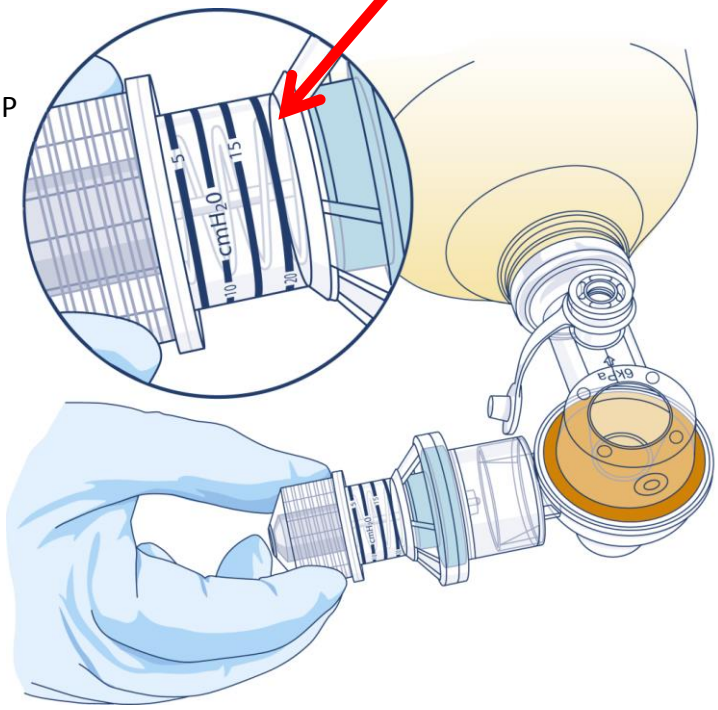


Mayo BVM

Rotate the cap until the desired PEEP number is in line with the base of the cap

Rotate out for lower PEEP and in for higher

The Oxylog ventilator default PEEP is set at 5 cm H_2O



Resus EZY BVM (Adult)

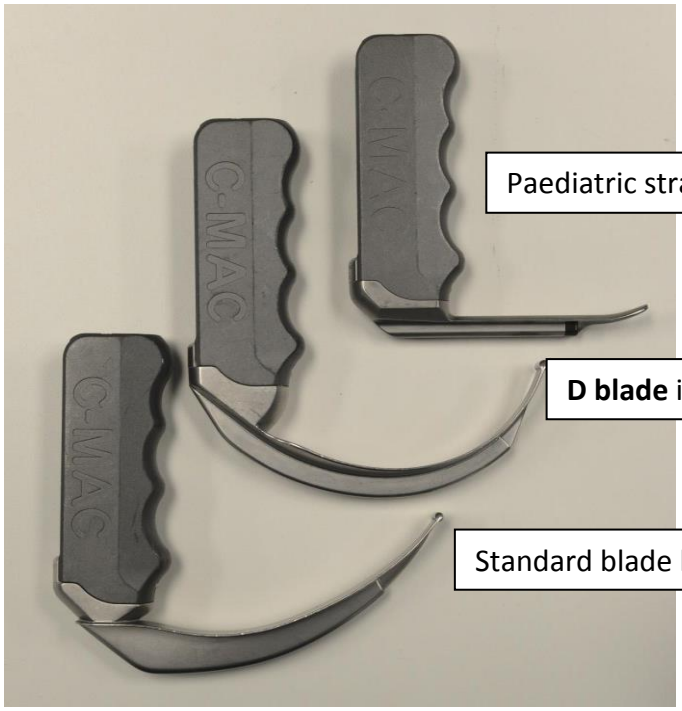
The blue 'Resus EZY™' BVM, introduced in February 2017, is very similar to the Mayo BVM with 2 main differences;

- There is no pop-off valve / pressure relief plug (not particularly important in our current practice)
- The Expiratory Flow Diverter valve is built into the pale blue expiratory port. Unlike the Mayo, it doesn't need a separate valve. The PEEP valve can be optionally attached to this port.

Description: Blue transparent 2.6 litre self-inflating bag with oxygen reservoir and oxygen inlet; patient can be ventilated on oxygen or room air (i.e. doesn't rely on oxygen flow for ventilation); inlet valve to allow entrainment of room air to prevent high negative airway pressures during high inspiratory gas flows (spontaneously breathing patient); inspiratory and expiratory valves to allow fresh gas flow from the bag and prevent rebreathing of exhaled gas (spontaneously breathing patient); standard 15 mm airway connectors for mask or ETT; option of attaching a PEEP valve.

Equipment (cont.)

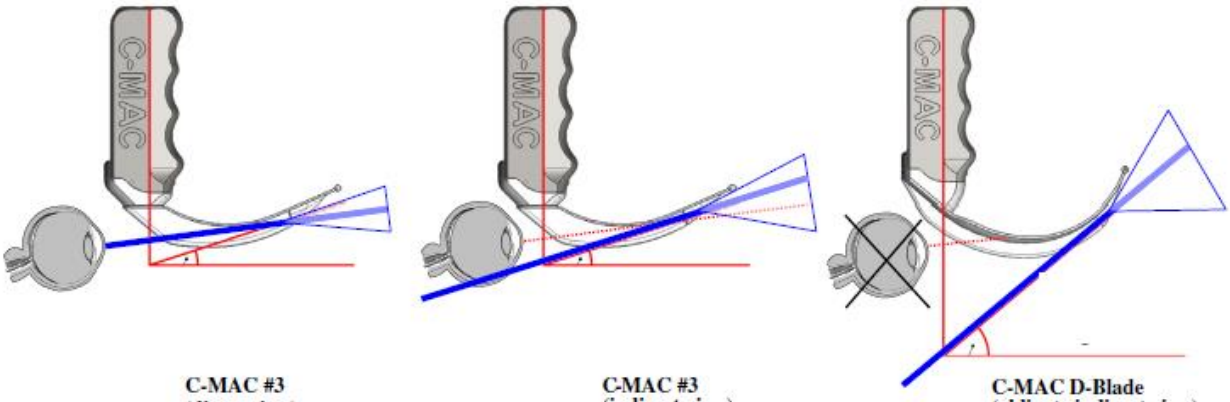
- Oxygen (cont.)
  - **Nasal Prongs (NP)** – standard NP (usually used to deliver ≤ 4 Lpm) should be set to O_2 15 Lpm or highest tolerated until sedated and then increase to 15 Lpm.
- Oropharyngeal Airway (OPA) – Guedel (Size = angle of the mouth to tragus)
- Nasopharyngeal Airway (NPA) (Size = tip of nose to tragus)
- Suction – 2 x Yankour catheters under mattress, both turned on (one inevitably falls on floor)
- Laryngoscope (light working?);
  - Direct laryngoscope
    - Large curved (Macintosh 4) or small curved (Macintosh 3) blade – old axiom; "easier to intubate someone with a blade too big and a tube too small"
    - 2 handles (back-up)
  - **C-Mac**™ video-laryngoscope



Paediatric straight blade

D blade in Difficult Airway Trolley

Standard blade large (4) or small (3)



Can use standard C-mac blade for either direct or indirect laryngoscopy

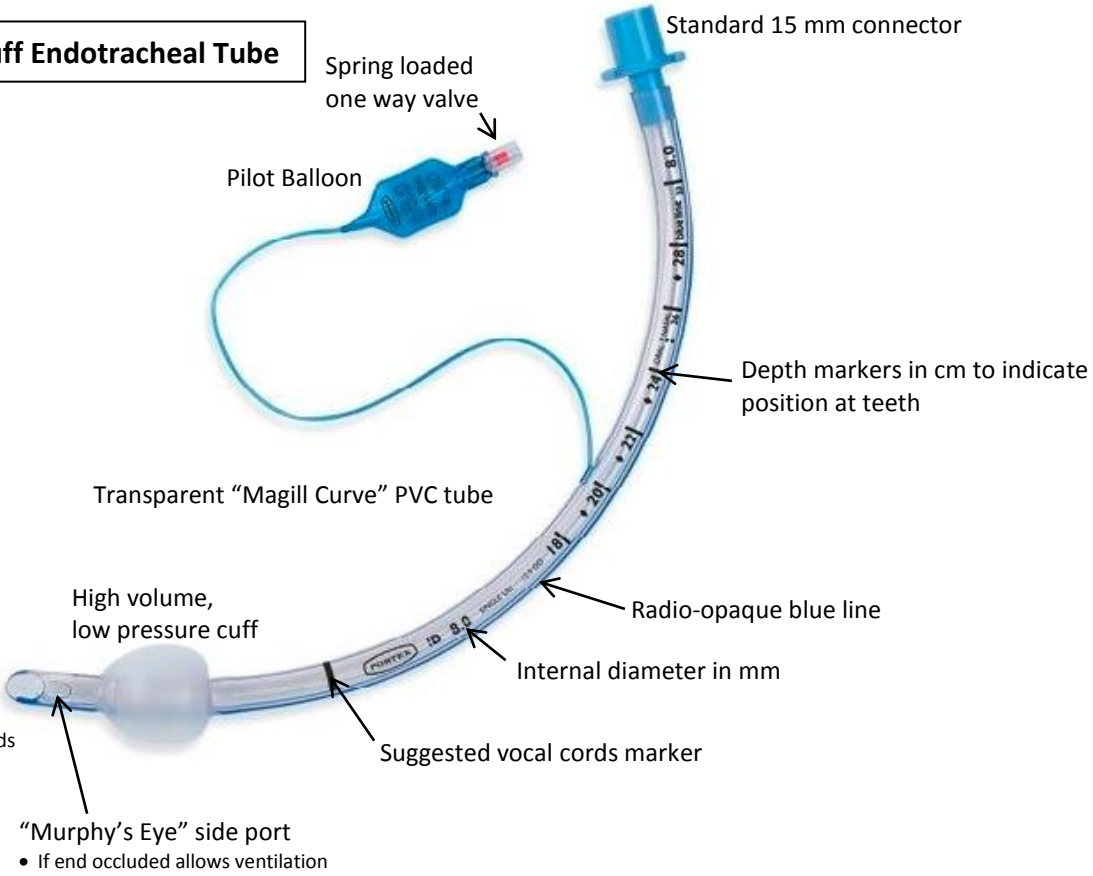
D blade can only be used for indirect (video) laryngoscopy, is useful for anterior larynx

Equipment (cont.)

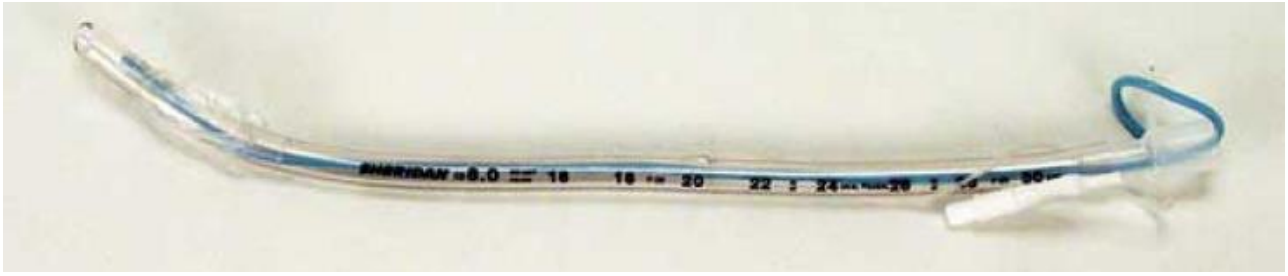
- Magill's forceps

- ETT – 7.0 for smaller female and 8.0 for larger male. Test cuff and back-up ETT one size smaller

Portex Soft Seal® Cuff Endotracheal Tube



- ± Stylet – straight to beginning of cuff, then 30 degree bend



- Syringe – 10mls attached to ETT before and during intubation
- Airway filter – used on ventilator circuit but not required on BVM when using the Philips $EtCO_2$ monitor

- Cotton tape ties

Equipment (cont.)

- NGT
- Difficult Airway Trolley;
  - **Laryngeal Mask** – size 3 or 4 (see later)
  - **Silastic Intubation Catheter** (aka "Bougie" or "Gum Elastic Bougie").
    We use **Cook Medical Frova™ Intubating Introducer** – blue, pliable, silastic, radiopaque, 70 cm long, 14 French (4.67 mm external diameter), 3 mm internal diameter lumen, blunt end, 30° angled tip ("coudé"), distal side-port, and graduations in cm from the tip.
    Can attach oxygen tubing to the proximal end or use **15 mm Rapi-Fit Adapter** that allows attachment of BVM. (see later – Cricothyroidotomy).
  - Surgical Airway Equipment (see later)
- Oxylog 3000™ with Circuit and airway filter attached. Ventilation is powered by Oxygen pressure (it will no ventilate if O_2 supply fails!) and requires electrical power for monitoring and servo settings.
  - Circuit and airway filter attached and ventilator running
  - Ventilator settings;

Parameter	Normal lungs	ARDS / ALI		Asthma/COPD		Metabolic acidosis	Head injury	Severe Obesity
Aim	Lung protective strategy Do no harm	Recruitment, shunt reduction, avoid atelactatic trauma, achieve adequate oxygenation		Oxygenation, adequate exhalation avoiding breath stacking and volutrauma		Ensure adequate respiratory rate to maintain and even improve compensation for metabolic acidosis	Avoid reduced venous return by avoiding high intrathoracic pressures	Avoid atelectasis and shunting due to obesity
Position	20-30 degrees head up unless hypotensive and reduced cerebral perfusion a concern							
Mode	VC (SIMV)	VC (SIMV)	PC (APRV equiv)	VC (SIMV)		VC (SIMV)	VC (SIMV)	VC (SIMV)
Vt (ml/kg) lean body weight	8 lbw	6 lbw	Monitor	5-8 lbw		8-10 lbw	6-8 lbw	8-10 lbw
Resp rate	14	14	14	8-10		20-30	16	14
I:E ratio	1:2	2:1	2-4:1	1:4 – 1:5		1:1 - 1:2	1:2	1:1 – 2:1
Pinsp (cm H_2O)	-	-	25-30	-		-	-	-
PEEP (cm H_2O)	5	10-15	10-15	Asthma 0	COPD 5	5	5	10-15
FiO2	Start at 100% and rapidly titrate down, ideally achieving FiO_2 0.4. Avoid significant hyperoxia. Aim for oxygen saturations ≥ 95%; pO_2 >70. Aim Pplat <30.							
Other	Adjust parameters to ensure O2 and CO2 in normal limits	Watch pressures; may need to lower Vt and accept higher CO_2 Titrate FiO_2 & PEEP	Minimise derecruitment ie minimize suctioning & disconnection Consider recruitment manoeuvres	Watch for breath stacking and volu/barotrauma Consider permissive hypercapnoea. pH should > 7.15 May need to accept higher peak pressures in asthmatics. Aim Pplat <30		Begin with high respiratory rate Titrate RR and TV as guided by serial blood gases	Avoid high PEEP if possible Aim PCO2 35-40 Tape rather than tie ETT to avoid impeding jugular vein flow	Minimise derecruitment ie minimize suctioning & disconnections
SEEK ADVICE EARLY IF ANY CONCERNS Dr James Rippey For review 2018 This document suggests initial ED ventilator settings in different scenarios and has been created in consultation with ICU; monitor and modify as appropriate								

  - FiO_2 100% initially then reduce to maintain SaO_2 ~ 95% (prolonged high FiO_2 is toxic to the lungs)

- BiPAP settings
  - IPAP 12, EPAP 6 mmHg
  - Frequency 12 bpm
- IV x 2 & Fluids (± IO)
  - Free flowing drip running to demonstrate patency (avoid injecting intubating drugs into tissue) – non NIBP arm!!
  - Consider IV fluid bolus for RSI for hypovolaemic patients
  - 2nd IV access in situ (in case of failure of 1st line)
- Collar – leave on till intubation, then have manual inline immobilisation and loosen collar. Can abandon immobilisation if unable to intubate i.e. airway takes priority over C spine.

Drugs (doses based on Lean Body Weight)

ALLERGIES?

- Pre-treat (titrate);
  - Fentanyl 1 – 2 mcg/kg titrate in 25 – 50 mcg increments
  - Ketamine 0.25 – 0.5 mg/kg titrated in 20 mg increments
  - Midazolam 0.5 – 1 mg increments
  - Metoclopramide 10 mg
- RSI (bolus push);

Intubation Drugs

	Drug	Normotensive dose	Normotensive dose in 70kg patient	Hypotensive dose
SEDATION	Ketamine	2mg/kg	140mg	0.5mg/kg
SEDATION	Thiopentone	3-5mg/kg	300mg	0.5-1mg/kg
SEDATION	Propofol	1.5-3mg/kg	150mg	0.2mg/kg
PARALYSIS	Suxamethonium	1.5-2mg/kg	100mg	2mg/kg
PARALYSIS	Rocuronium	For RSI 1.2mg/kg	85mg	1.6mg/kg
PARALYSIS	Sugammadex	16mg/kg reversal of rocuronium 2min post administration	1120mg As 100mg/ml solution In 2 or 5ml vials	16mg/kg

  - ± Fentanyl 1 mcg/kg bolus
  - Suxamethonium 1.5 – 2 mg/kg
    - There is currently no high level evidence that Suxamethonium is inferior to Roc for intubation (when not contraindicated)
    - Contraindications to Sux;
      - Malignant Hyperthermia History
      - Strokes with hemiparesis > 72 hours old
      - ICU Stay > 2 weeks
      - Burns/trauma > 72 hours old
      - NMJ Disease
      - Myopathies/Muscular Dystrophies
      - Pre-existing hyperkalaemia or Strong suspicion
      - Guillain-Barre
      - Penetrating eye injury of acute glaucoma
  - Rocuronium 1.2 mg/kg

Drugs (cont)

- Post RSI;

Initial post intubation analgesia / sedation infusions

Infusion	Dose	Mixer	Bolus	Rate	Indication
Morphine & Midazolam	50mg 50mg	50ml NS	0.05 ml/kg	0.05-0.1 ml / kg / hr 70kg adult = 5 ml / hr	Maintain analgesia & sedation
Propofol	500mg (50ml)		0.5 mg / kg	20-30 mcg/kg/min 70kg adult = 10 ml / hr	Stable, with severe neurologic injury.
Ketamine	200mg	50ml NS	0.5mg/kg	0.5mg/kg/hr 70kg adult = 9 ml / hr	Unstable

  - Vecuronium 0.1 mg/kg
- Pressor;
  - **Metaraminol 0.5 – 1 mg bolus**
  - Adrenalin Infusion (6mg/100ml) start at 1 ml/hr, up to 20 ml/hr
- Bradycardia – Atropine 600 mcg bolus
- Reverse paralysis – Sugammadex 16mg/kg (100mg/ml ≈ 12 mls for adult 70 – 80 kg)
- Bronchospasm – Salbutamol MDI and ETT adapter
  - The MDI adapter is placed between the ETT and BVM or ventilator (on the patient side of an airway filter if present)
  - A puff is given at the beginning of inspiration and inspiration held for 2 – 3 seconds
  - Ventilate normally for 20 -30 seconds and repeat until adequate dose given

Team Roles

- PPE – Gown, gloves, gag and goggles
- Roles – allocation of roles will vary with staffing levels; one person may have multiple roles
  - Team Leader and Scribe
  - Airway Doctor and Nurse
  - IV / Drugs Doctor and Nurse
  - Laryngeal manipulation
  - In-line cervical immobilisation

Plan

- Delayed RSI (see later);
  - Ketamine 0.25 – 1.5 mg/kg IV titrated increments
  - BiPAP
- Intubation Plan (i.e. "**Can't Intubate, Can't Oxygenate**" for all intubations, explicit description for each step)

Plan A Initial intubate strategy (Limit time – 60 seconds)	• Optimise patient position (ear vs sternal notch, ramp) • Pre-oxygenate (aka de-nitrogenation) • Apnoeic oxygenation • Direct Laryngoscopy and blade size choice • Stylet • Intubation catheter (aka "Bougie" e.g. Cook Medical **Frova** Introducer found on difficult intubation trolley) • External laryngeal pressure (BURP) • Direct Laryngoscopy vs Video Laryngoscopy
IF HYPOXIC – *Rescue oxygenation and ventilation prior to further attempts to intubate*	
Plan B Alternative intubation strategy	• Video laryngoscopy (if not primary method) – C-mac – Glidescope – King Vision • Bougie / Cook catheter • Further neck flexion and head elevation (face parallel to the ceiling) • Abandon cervical immobilisation • Change operator
Plan C Can't Intubate; Rescue oxygenation and ventilation	• CALL FOR HELP • BVM – one operator (one hand on mask)/two operator (two hands on mask) ± Oxylog 3000 to ventilate the patient while holding mask • Extreme head elevation (face parallel to the ceiling) • Exaggerated jaw thrust • NPA/OPA • LM /intubating LM (aka Supra-Glottic Airway [SGA]or Supraglottic Airway Device [SAD]) • Consider reversing paralysis (*Sugammadex* 16 mg/kg for Rocuronium or Vecuronium) • Prepare equipment for surgical airway if not already done
Plan D Can't Intubate / Can't Oxygenate (CICO) - aka Can't Intubate / Can't Ventilate	• Cricothyrotomy (aka Infra-Glottic Airway) • Percutaneous wide-bore cannula (e.g. Melkor) or open surgical technique (if bradycardia should occur, administration of adrenaline or atropine may forestall cardiac standstill) ***NOTE**: Patients can still have good outcomes despite prolonged (> 30 minutes) hypoxia (SaO_2 < 50%)*

- **Hypotension and Hypovolaemia**
  - Replace acute intravascular loss as quickly as practical prior to intubation
  - Consider giving a rapid bolus of IV fluids with intubation drugs
  - Ketamine is the analgesic or sedative drug least likely to cause hypotension
  - Metaraminol is the commonly used pressor agent for urgent management of hypotension (after replacement of intravascular volume deficit) during intubation
  - Opiates, Propofol and Thiopentone should be used with extreme caution in hypotensive patients or patients with hypovolemia who are dependent upon sympathetic drive
  - Beware PEEP can reduce cardiac return and worsen hypotension via increased intrathoracic pressure
  - Consider insertion of arterial cannula for Invasive BP monitoring if safe to delay intubation

Plan (cont)

- **Brain Injury and Raised Intracranial Pressure**
  - *Prevent or minimise hypoxaemia and hypotension*
  - Ketamine is an acceptable analgesic and sedative agent
  - Succinylcholine is an acceptable muscle relaxant for intubation
  - Fentanyl, if BP stable, may be of value
  - Opiates, Propofol and Thiopentone should be used with extreme caution in hypotensive patients or patients with hypovolemia who are dependent upon sympathetic drive

- **Severe Acidosis**
  - Maintain hyperventilation *throughout* intubation (high respiratory rate) to keep $PaCO_2$ low. Although ventilating after administration of intubating drugs has a risk of gastric insufflation, allowing the pH to fall caries a greater risk

- **Asthma**
  - Benefit of BiPAP in acute asthma is variable and unpredictable with DSI is an acceptable strategy
  - Keep patient in most comfortable position for breathing for as long as practical before intubation – usually sitting upright or sitting forward (tripod position)
  - Ketamine is believed to have the greatest bronchodilation effect followed by Propofol
  - Don't not use barbiturates

- **Persistent Hypoxaemia**
  - Too much oxygen is never enough! – may be a lung problem rather than a ventilation problem and so, DSI may not resolve hypoxaemia, e.g. shunting
  - Particular attention to; maximising ventilation e.g. torso up, increase delivered oxygen – turn up the flow meters, apnoeic oxygenation, be quick! – progress through intubation plan quickly with rescue ventilation

2. Procedure

1. Preoxygenate

- WHAT IS GOING TO BE THE SAFE APNOEIC TIME? – How long can the patient remain apnoeic before they desaturate. The answer may be zero.
- Preoxygenate for as long as possible, preferably > 5 minutes – ∴ START AS SOON AS POSSIBLE
- High FiO_2;
  - Spontaneously breathing and adequate airway –> NRM O_2 30^+ Lpm (high flow meter) + NP 15 Lpm
  - Requires airway/ventilation support –> BVM 0_2 20^+ Lpm (normal meter fully open) + NP 15 Lpm
- Sitting up at ≥ 30^o
- Consider PEEP (BVM)

2. Delayed Sequence Intubation

- Indication – Hypoxaemia or respiratory failure prior to intubation (unable to achieve SaO_2 ≥ 90%)
  – Agitated (e.g. delirium) or otherwise uncooperative with preoxygenation
- **Ketamine** IV 20mg boluses up to 1.5 mg/kg for agitation
- Continue preoxygenation as above
- If still hypoxic then apply BiPAP (this is the exception to the rule of not applying BiPAP to patients with reduced conscious state)
- Aim for SaO_2 ≥ 95% or highest achievable prior to intubation
- Occasionally, BiPAP improves the condition of the patient with respiratory failure (e.g. reduces $PaCO_2$ and improves conscious state) to the point they no longer require intubation

3. Intubation

- **NIBP** stat cycle
- Team Leader (or Airway Doctor if limited team)
  - checks each member ready
  - calls out vitals – PR, BP, SaO2
  - tells Drug Doctor to give all agreed drugs (rapid IV push)
- Manual in-line immobilisation of cervical spine and loosen collar
- **Drugs Doctor calls out when drugs given (IV push + IV fluid bolus)** – this is effectively the start of intubation
- Apnoeic Oxygenation – Leave all oxygen delivery on (high flow) until laryngoscopy
- Leave NP on at 15 Lpm until after intubation
- May require ongoing BVM ventilation for hypoxia or severe acidosis, at risk of insufflating the stomach
- *Some operators test efficacy of BVM at this point, even in a well oxygenated patient, if there is concern about ventilating for failed intubation; it runs the risk of insufflating the stomach. Identifying difficult BVM ventilation may prompt active preparation for CICO*

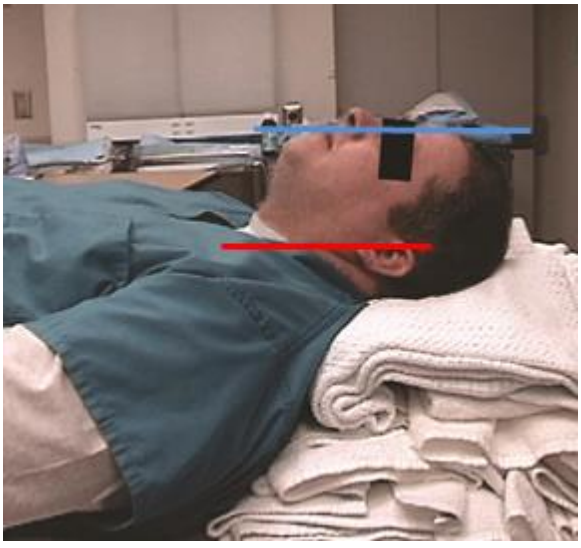
- **INTUBATION** (as per Richard Levitan, airwaycam.com) – these are steps to consider when learning intubation skills. Experienced operators have sufficient motor memory to do this subconsciously, so these steps may not be apparent watching them;
  - Cricoid Pressure – not mandatory but may assist in laryngoscopy (BURP)

1. Insert the laryngoscope – the goal is to get the laryngoscope blade onto the tongue

- Lay patient flat with head elevated as described previously for intubation position
- Ensure Yankour sucker is at hand (remember; 2 suckers because one always hits the floor)
- Laryngoscope in left hand
- Remove dentures

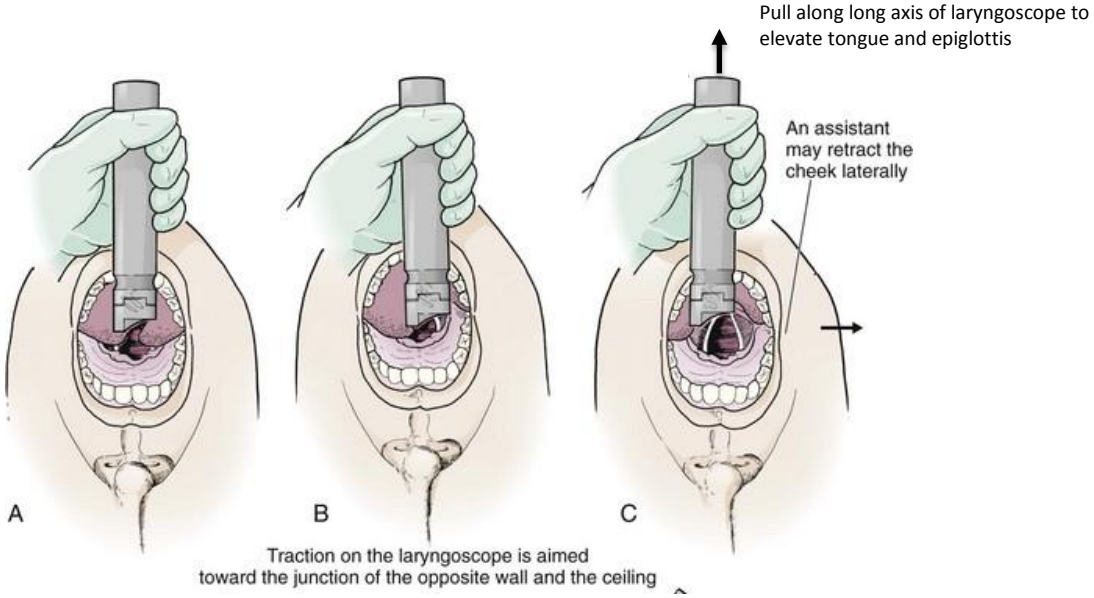
Some operators put right hand on the top of the head and push down to help open the mouth – this is only for insertion of the laryngoscope. This manoeuvre extends the head too much for intubation; remember that the face needs to be parallel to the ceiling.

The correct position for intubation!



- **Intubation (cont.)**
  - Alternatively, open mouth with scissor grip right hand

  - Insert laryngoscope to the right of the midline of the tongue

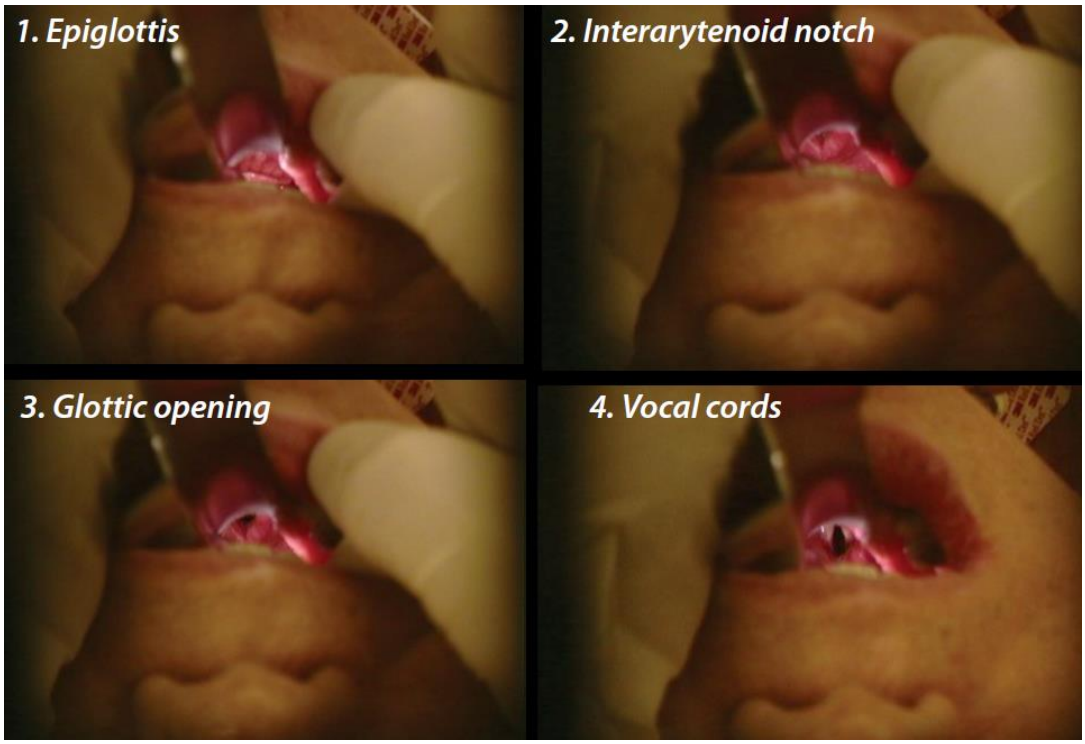


- *2. View the epiglottis* ('epiglottoscopy') – the goal is visualise the epiglottis
  - Slowly advance the laryngoscope around the curve of the tongue towards the vallecula at the base of the tongue
  - The epiglottis should become visible just below the tongue on the posterior pharynx but may be obscured by secretions, blood or debris. Occasionally, the blade has gone too far and needs to be withdrawn a little.
  - When the tip of the laryngoscopy is in the vallecula at the base of the tongue the epiglottis usually lifts of the pharyngeal wall

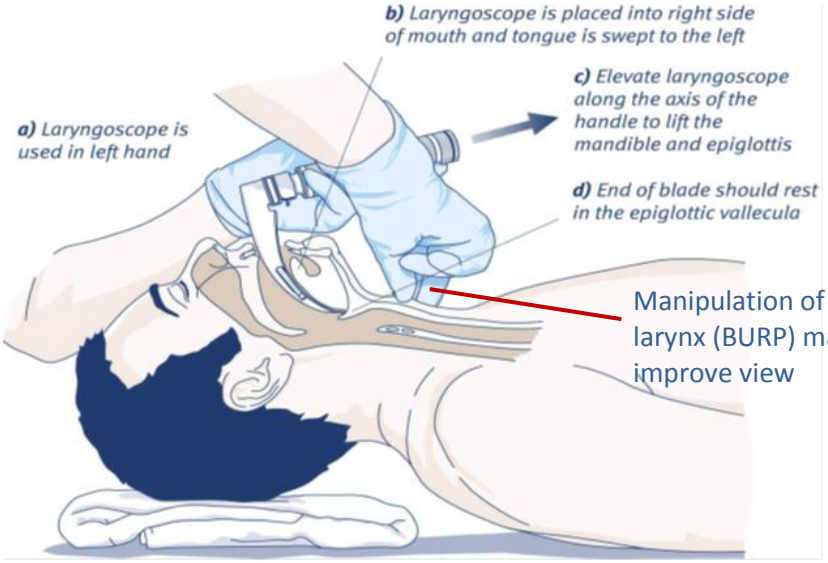
- **Intubation (cont.)**

3. Laryngoscopy – the gaol is to visualise the vocal cords

- Lift the tongue by lifting the laryngoscopy along the long axis of the handle (don't lever the handle backwards and forwards!). This lifts the epiglottis revealing the glottis



- If the epiglottis is obscuring the view of the glottis then either advancing the blade a little further or manipulating the larynx externally, Backwards – Upwards – Rightwards - Pressure (BURP), may improve the view



!! The reason BURP is required in this illustration may be because the head is too low and extended (tilted back). Firstly, change the position → lift the head so the face is parallel to the ceiling and the external auditory meatus is level with the sternal notch

- An assisting may improve view through the lips by retracting the corner of the mouth to the side

- **<u>Intubation (cont.)</u>**
  4. Insert the ETT
  - 'Hold-up' of the ETT at the arytenoids
    - Rotate the tube anticlockwise 90° to change the orientation of the bevel
    - Adjust the curve of the stylet – straight-to-cuff, 30 degree bend at the proximal cuff
    - Use an intubating catheter ('bougie')
    - Use a smaller tube

  - Using the 'Bougie'
    - For Grade 3 and 4 views, increase the anterior curve or the distal catheter
    - The proximal catheter needs lubricant to allow railroading of the ETT
    - Avoid getting lubricant on the distal half of the bougie when preparing for the ETT
    - ETT may be railroaded before or after the insertion of the catheter into the trachea
    - Advance the catheter with the tip pointing anteriorly
    - In restricted views, the idea is to have the tip of the catheter move along the posterior surface of the epiglottis, through the cords and into the trachea
    - Confirmation of correct position may be indicated by seeing the tip pass through the cords, feeling the tip bump over tracheal rings or fingers externally on the larynx feeling the catheter bump over tracheal rings
    - If there is resistance to the catheter tip passing through the cords, rotate the catheter clockwise or anticlockwise
    - Keep the laryngoscope held in position while passing the ETT
    - The operator or the assistant may advance the ETT into the trachea while the other holds the catheter firmly in position
    - If there is resistance to ETT advancement then rotate the tube 90° <u>anticlockwise</u> (places the bevel facing posteriorly) and try again
    - Some operators use the 'grips' below to allow accurate control over the rotation of the tip;

'Shake Grip'

The 'Kiwi Grip'

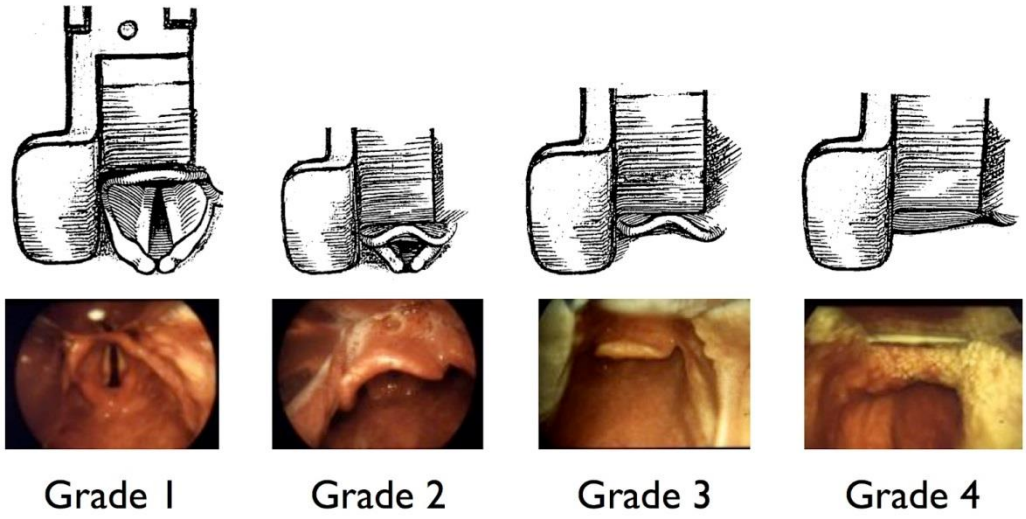
The 'D Grip'

D Grip - Proximal end of catheter through Murphy Eye of ETT

  - ETT 22cm at the teeth female, 24cm male
  - Attach BVM and ventilate while ETT cuff being inflated until there is no air leak
  - Confirmation of Tracheal Intubation
    - *Seeing ETT pass through cords*
    - *Capnography consistent with tracheal intubation ('Gold Standard')*
    - Chest rises with ventilation
    - Auscultate both axillae
    - Tube misting,
    - Maintains SaO_2
    - Chest x-ray
- Secure ETT with cotton ribbon tie
- Connect ventilator circuit (with airway filter)

CORMACK-LEHANE CLASSIFICATION

Grade 1: Full view of glottis
Grade 2: Partial view of glottis
Grade 3: Only epiglottis seen, none of glottis seen
Grade 4: Neither glottis nor epiglottis seen



3. Post Intubation

- Continue monitor ECG, BP, SpO_2 and Capnography
- Head and torso up 30^o
- Eye care – ointment and tape lids shut
- Oropharyngeal and airway suction via ETT as needed
- ETT cuff pressure 20 – 30 cm H_2O
- Long acting Paralysis – Vecuronium 0.1 mg/kg
- Sedation (and analgesia) infusion
  - Morphine 100 mg/Midazolam 50 mg 100 ml start at 5 ml/hr
  - Propofol 0.5 mg/kg bolus then 20 mcg/kg/min (= 50 mg/kg/hr = 5mls/kg/hr)
  - Ketamine 1 - 2 mg/kg bolus then 0.5 mg/kg/hr
- Ventilator – titrate RR to $EtCO_2$ and O_2 to FiO_2 (Don't just leave at 100%). Lower V_T better for lungs
- OG/NGT
- CXR – ETT & OG/NGT position, lung inflation, pneumothorax
- ABG & other Ix according to presentation
- IV fluids
- IDC
- Art Line
- CVC
- Temperature management
- Disposition
- Other clinically indicated medication, e.g.;
  - Antibiotics
  - Anticonvulsants
  - Tetanus prophylaxis
  - Activated Charcoal
  - DVT prophylaxis
- Family / NOK
- Documentation – procedures, drugs, infusions, fluid orders, clinical notes

Peri/Post Intubation Deterioration

- **Hypoxia**; Pre-existing respiratory failure, displaced/obstructed/mal-positioned (e.g. bronchial, oesophagus) ETT, bronchospasm, pneumothorax/haemothorax, pulmonary oedema, PE, shock, ventilator failure
  - If on ventilator, place patient back on BVM ventilation with high flow O_2 and get ventilator and circuit checked or changed (ventilator or connection failure?)
  - $EtCO_2$ irregular, abdominal movement (diaphragm), chewing on tube – not fully paralysed
  - Check length of ETT at teeth – accidental extubation, intubation of bronchus
  - Perform laryngoscopy (rule out oesophageal ETT placement)
  - Check chest expansion
  - Auscultate the axillae for absent breath sound or wheeze – bronchospasm, bronchial ETT, pneumothorax
  - Feel pressure on bag during inspiration – low (leak), high (obstruction, auto-PEEP)
  - Treat shock
  - Peripheral cyanosis or poor perfusion vs central cyanosis - ABG
  - Ultrasound the chest (pneumothorax/heart)
  - Get a CXR

  If the patient becomes hypoxic on intubation and there is doubt about the placement of the ETT, it may be safer to immediately pull the ETT out and BVM ventilate the patient.

- **Hypotension**; Hypovolaemia/shock, acidosis, RSI drug induced vasodilation and myocardial depression, auto-PEEP (gradual increase of pressure with each breath because of inadequate expiration), inadequate muscle relaxation (raised intrathoracic pressure), anaphylaxis, bradycardia, tension pneumothorax.
  Note: PPV and CPAP raise intrathoracic pressure and reduce venous return to the heart.
  - Check airway pressures not high from auto-PEEP – disconnect ventilator circuit from ETT and release airway pressure, adjust PEEP and ventilator settings
  - Ventilate with BVM
  - Hyperventilate if acidotic
  - Treat hypovolaemia and shock – IV fluids and pressors
  - ECG – myocardial ischaemia
  - Urticaria and other signs of anaphylaxis – adrenaline
  - Bradycardia – atropine
  - CXR/US re pneumothorax

- **Raised EtCO2** – hypoventilation (low respiratory rate), fever, malignant hyperthermia

- **Low EtCO2** – oesophageal intubation, over ventilated, reduced cardiac output (PE, hypovolaemia, cardiogenic shock), accidental extubation, air leak, hypothermia

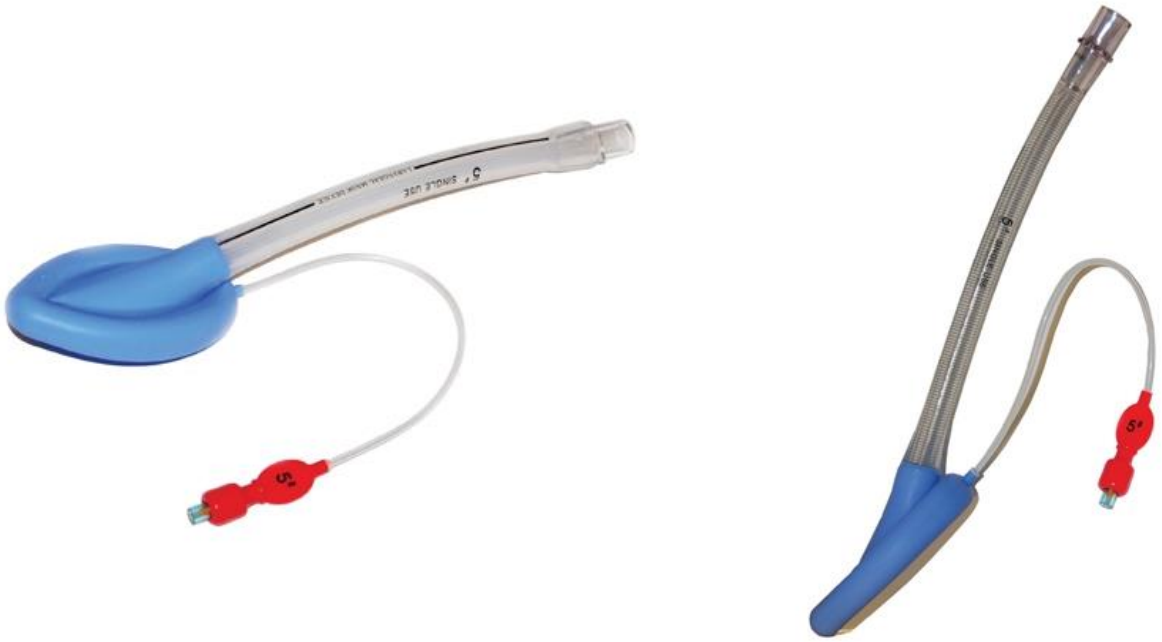
- **High Airway Pressure**; Excessive PEEP on ventilator, auto-PEEP – inadequate exhalation, airway circuit obstruction, migration of ETT into bronchus, aspiration, ETT/tracheal/bronchial obstruction, pneumothorax/haemothorax, lobar/lung collapse, pulmonary oedema, inadequate muscle relaxation, opiate/suxamethonium induced chest wall rigidity, malignant hyperthermia, obesity, external restriction of chest wall, gastric dilation, abdominal distention
  - Disconnect and allow full exhalation
  - Increase I:E ratio and reduce ventilation rate (permissive hypercapnia)
  - If on ventilator, place patient back on BVM ventilation with high flow O_2
  - If the cause is still not clear measure inspiratory pause pressure (approximates to alveolar pressure). If both airway and alveolar pressure are high the problem is due to poor compliance. If only the airway pressure is high the problem is one of high resistance

Supraglottic and Infraglottic Airways

Laryngeal Mask (LM)

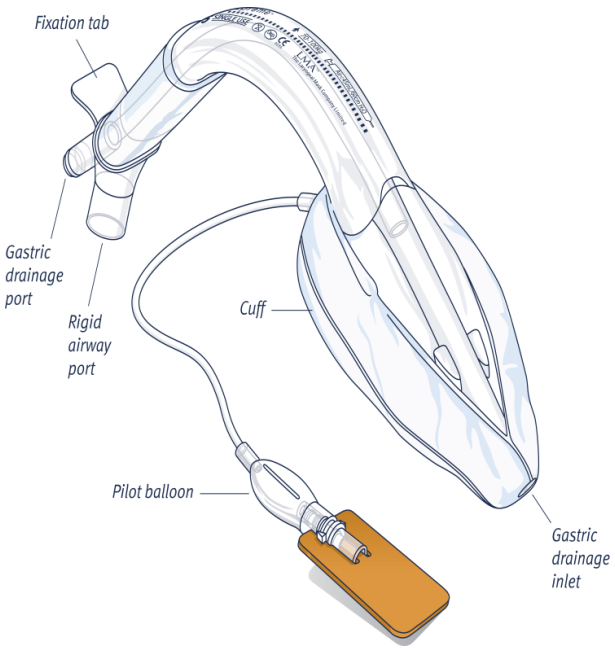
Note: LMA® is a registered brand name. Laryngeal Mask (LM) is the generic term

Insertion of the 'standard' (e.g. Pro-breathe™) LM;



1. The cuff is deflated or partially inflated according to preference
2. The mask is lightly lubricated
3. Patient is positioned as for intubation
4. Operator stands at the head of the stretcher, holding the LM
5. A further head tilt is performed with the operators non-dominant had on the patient's occiput and the patient's mouth opened fully
6. The tip of the mask inserted along the hard palate with the open side facing the tongue
7. The mask is further inserted, using the index finger to provide support for the tube
8. When the tip of the mask touches the back of the oropharynx, there is slight resistance
9. Further insertion pressure causes the mask to curve around into the pharynx, onto the larynx
10. When the tip is on the upper oesophageal sphincter, firm resistance will be felt
11. The cuff is inflated with 20 – 30 mls of air
12. The laryngeal mask is secured by a length of cloth tape
13. A 'bite block' (e.g. oral airway) may be inserted to reduce the risk of damage to the LMA if the patient's conscious state lightens

Insertion of the LM Supreme™;



LMA Supreme™ Insertion Technique

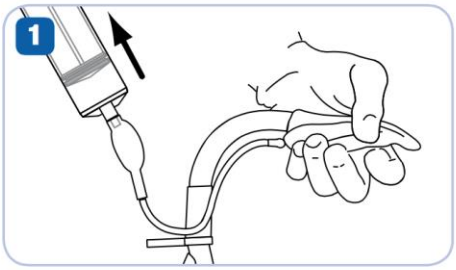


Figure 1: Fully deflate the mask for insertion. Attach a syringe. Compress the distal tip of the mask with thumb and index finger. Apply slight tension to the inflation line while removing all air until a vacuum is felt. Disconnect the syringe.

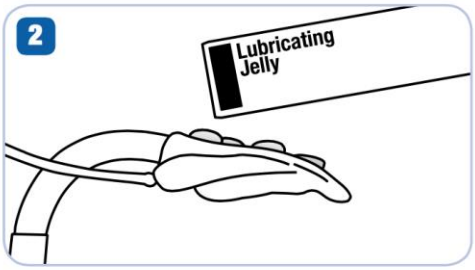


Figure 2: Generously lubricate the posterior surface of the cuff and airway tube.

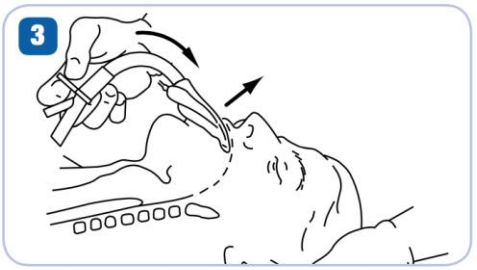


Figure 3: Place the patient's head in a neutral or slight "sniffing" position. Hold the LMA Supreme™ at the proximal end with the connector pointing downward to the chest and the tip of the distal end pointing toward the palate.

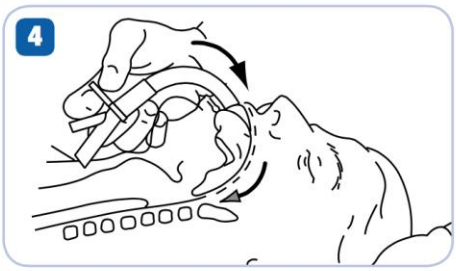


Figure 4: Press the tip of the mask against the hard palate. Maintaining pressure against the palate, continue to rotate the mask inwards in a circular motion following the curvature of the hard and soft palate.

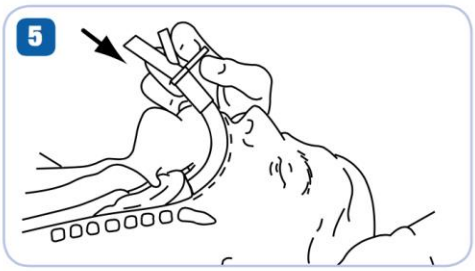


Figure 5: Continue until resistance is felt. The distal end of the mask should now be in contact with the upper esophageal sphincter. The device is now fully inserted.

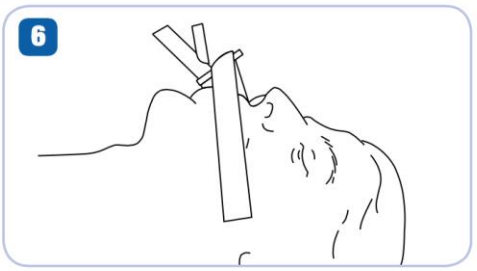
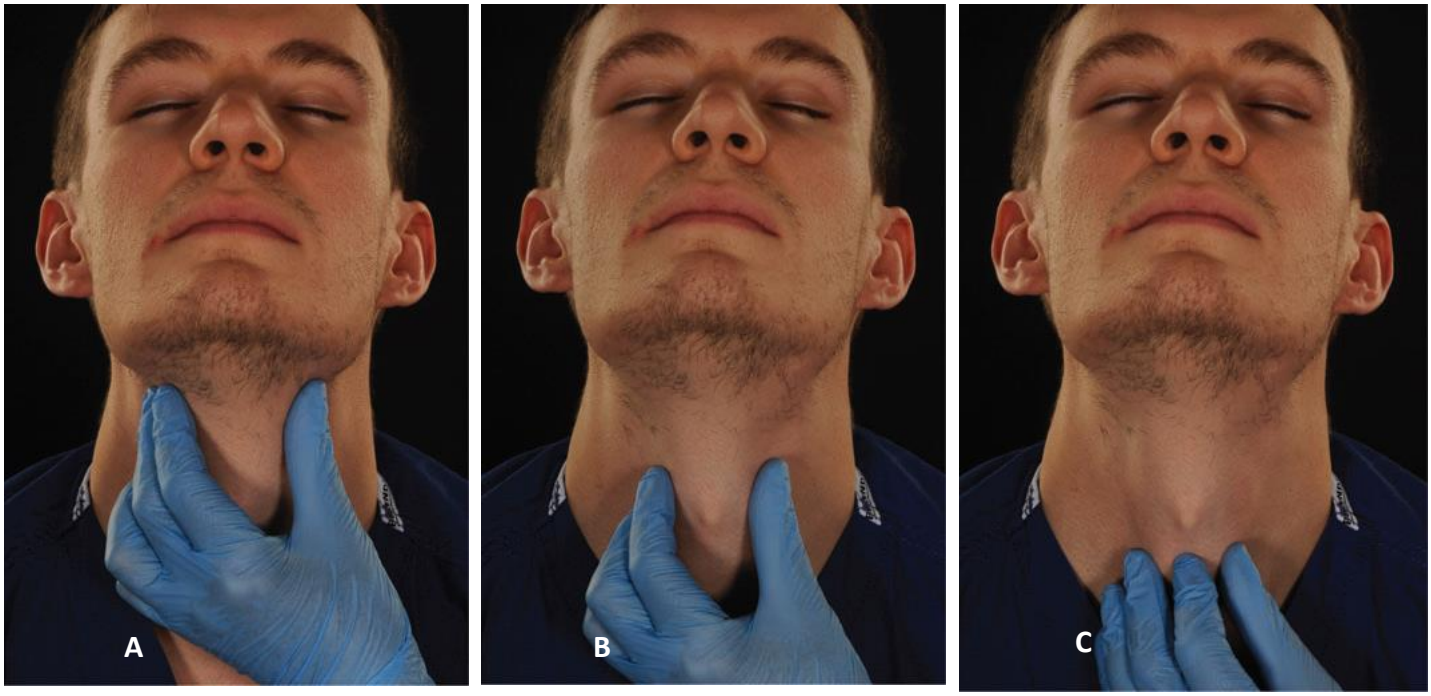


Figure 6*: Maintaining inward pressure, secure the mask into position by taping cheek to cheek across the fixation tab. This should be done prior to inflation. Inflate with the minimum amount of air needed to achieve an effective seal. The recommended intracuff pressure should not exceed 60 cm H_20.

Surgical Airway (Infraglottic)

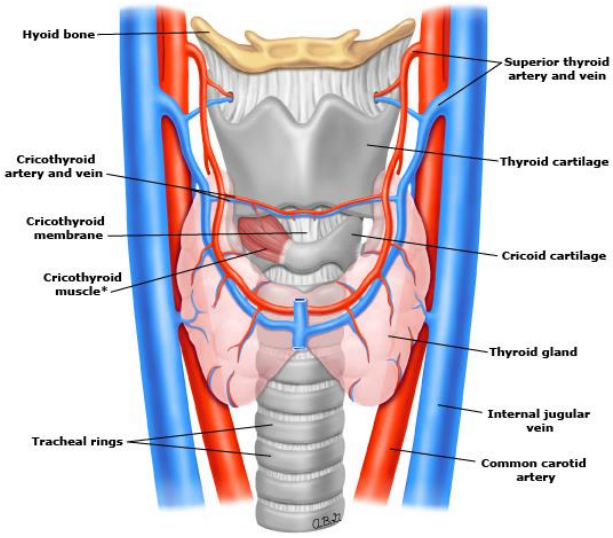


The laryngeal handshake – to identify the cricothyroid membrane;

(A) The index finger and thumb grasp the top of the larynx (the greater cornu of the hyoid bone) and roll it from side to side. The bony and cartilaginous cage of the larynx is a cone, which connects to the trachea.

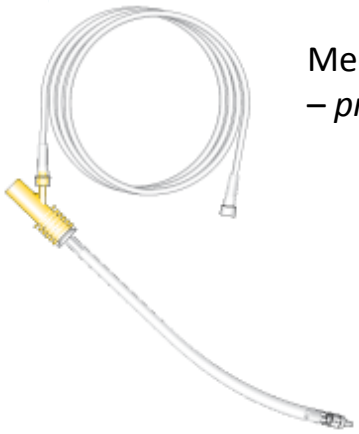
(B) The fingers and thumb slide down over the thyroid laminae.

(C) Middle finger and thumb rest on the cricoid cartilage, with the index finger palpating the cricothyroid membrane

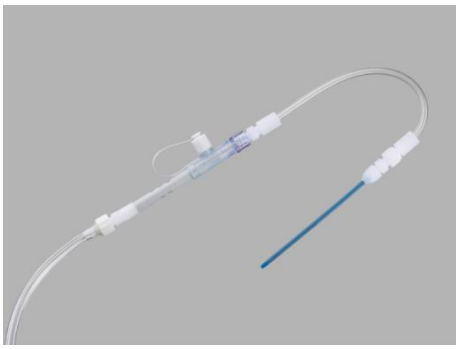


Cannula Percutaneous Cricothyroidotomy (Cricothyroid puncture)

Equipment; 14G (orange) luer-lock Insyte™ cannula, 5ml lock syringe, sterile saline, Meditech Rapid O2™ Oxygen Flow Modulator Device (Cook Enk™ Oxygen Flow Modulator Device may also be used) connected to O2 at 15 Lpm



Meditech Rapid O2
– preferred device



Cook Enk

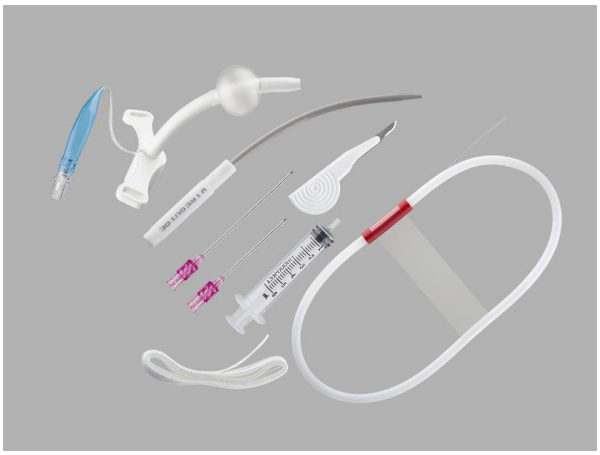
1. Right handed operator come from the patient's left side of the bed (reverse if left handed)
2. Extend the head and identify cricothyroid membrane and stabilise with left (non-dominant hand)
3. In right (dominant) hand hold 5-ml syringe filled with 2 ml sterile saline (to show air bubbles when aspirating from the airway) and fitted with 14G Insyte™ IV cannula.
4. Insert needle through skin at approximately 45° caudally (towards the feet)
5. 'Aspirate as you go' advancing into airway
6. Endpoint: free aspiration of air up full barrel of syringe
7. Stabilise cannula hub with non-dominant hand. Do not release cannula hub for remainder of procedure
8. Place dominant hand against patient and use to immobilise trochar
9. Advance cannula over needle into trachea with non-dominant hand and remove trochar
10. Repeat free aspiration of air with 3 ml syringe to ensure correct placement
11. Attach proximal end of **Meditech Rapid O2™** Oxygen Flow Modulator to wall O_2 at 15 Lpm (≈ 50 psi) and attach distal luer lock to the 14G cannula.
12. Occlude the hole in the yellow plastic part with thumb and for 4 seconds (= 1 litre of O_2 at a flow rate of 15 Lpm) – there should be visible expansion of the chest and/or abdomen to indicate lung inflation

Alternatively, attach **Cook Enk™** Oxygen Flow Modulator with wall O_2 at 15 Lpm to cannula and occlude the proximal holes with thumb and forefinger for 4 seconds (= 1 litre of O_2 at a flow rate of 15 Lpm)

13. Further breaths are given for 2 – 4 seconds (= 500 - 1000 mL), allowing enough time for expiration (chest/abdomen falling)
    Also described – Observe for a rise in O_2 sat and give further breaths when O_2 sat drops 5% from peak. This method of ventilation may reduce the risk of barotrauma. It may lead to hypercapnia but this is not an issue as long as O_2 sat is > 90%

Cook/Melker size 5.0 seldinger airway (Seldinger Percutaneous Cricothyroidotomy)

This technique is commonly used in ICU to convert an ETT to tracheostomy. It is more time consuming but may be preferred by operators who are skilled at this technique.

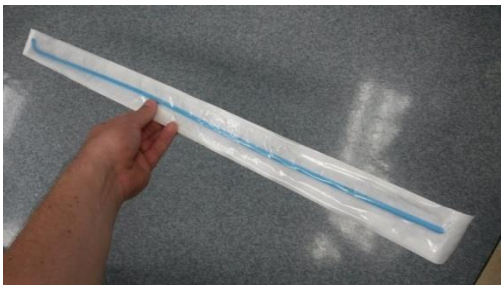


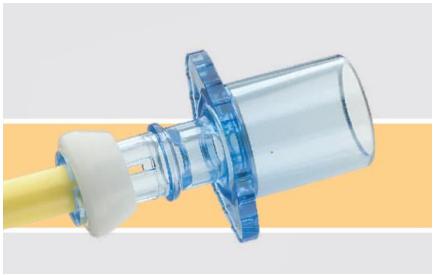
1. Right handed operator come from the patient's left side of the bed (reverse if left handed)
2. Extend the neck
3. Use the Laryngeal Handshake to identify the cricoid membrane with the left index finger
4. Stabilise the airway with your left hand
5. Insert the needle with syringe attached at 45^{o} to the skin over the cricoid membrane
6. Advance needle while aspirating until air is drawn into syringe
7. Holding the needle firmly, remove the syringe and advance the wire through needle 5 – 10cms into the trachea
8. Remove the needle
9. *Reoxygenate via cannula with jet ventilation*
10. Make a stab incision caudally with a scalpel where the needle enters the skin
11. Ensure the dilator is fully and completely seated inside the Melker 5.0 cuffed airway
12. Grip airway assembly device preventing the dilator moving back when it is advanced
13. Advance the Melker airway / dilator assembly device over the wire
14. Using moderate force and a slight screwing motion, through the skin into the trachea
15. Remove the wire and introducer
16. Inflate cuff
17. Attach self-inflating bag or circuit and ventilate
18. Secure the airway

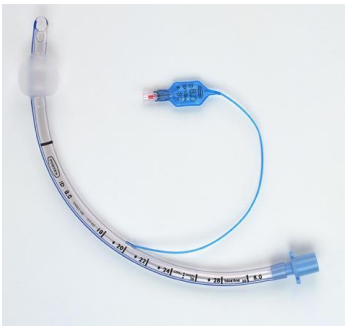
Surgical Cricothyroidotomy

A. Cricothyroid membrane palpable – *Scalpel Bougie Technique*;

Equipment; Scalpel size 10, **Cook Frova Intubating Introducer**, **15 ml Rapi-fit connector**, 6.0 ETT and a 5 or 10ml syringe.







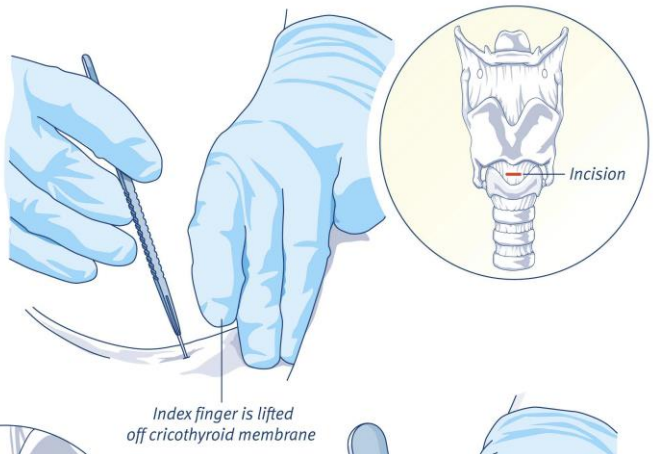
1. Continue attempts at rescue oxygenation via upper airway (assistant).
2. Right handed operator come from the patient's left side of the bed (reverse if left handed)
3. Use the Laryngeal Handshake to identify the cricoid membrane with the left index finger
4. (Can use trachea if easily palpable)
5. Stabilise the airway with your left hand
6. Hold the scalpel in your right hand, make a transverse stab incision through the skin and cricothyroid membrane with the cutting edge of the blade facing towards you

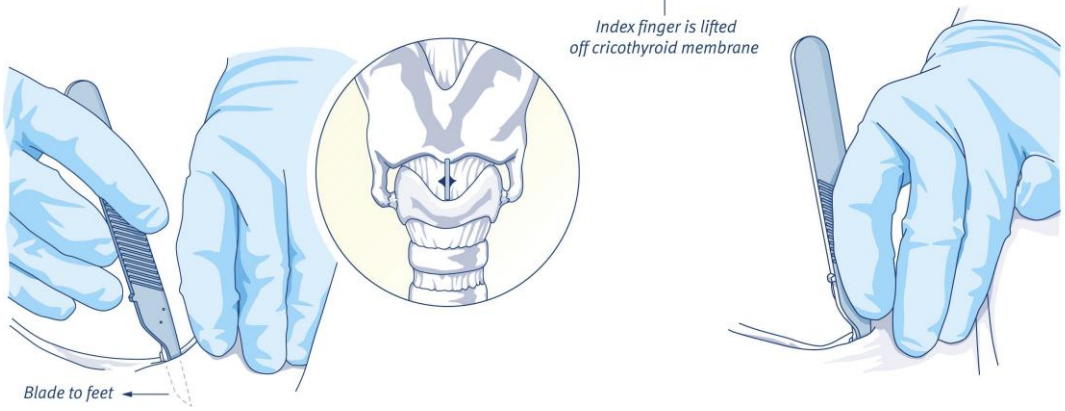
This is a vascular area and THERE WILL BE BLEEDING that may obscure the view. Holding the skin taught across the neck will help reduce this.

7. Keep the scalpel perpendicular to the skin and turn it through 90° so that the sharp edge points caudally (towards the feet)
8. Swap hands – keeping the scalpel steady, grasp it with your left hand.
9. Maintain gentle traction, pulling the scalpel towards you (laterally) with the left hand, keeping the scalpel handle vertical to the skin (not slanted).
10. Pick the bougie up with your right hand.
11. Hold the bougie parallel to the floor, with the tip pointing toward you and upper end away, at a right angle to the trachea
12. Slide the coudé tip of the bougie down the side of the scalpel blade into the trachea.
13. Rotate and align the bougie with the patient's trachea
14. Advance with gentle two finger pressure, up to 10–15 cm, often feeling a pop on entering the airway and should always feel the tip passing over tracheal rings.
15. Remove the scalpel
16. *Reoxygenate via bougie with BVM and 15 mm Rapi-Fit.*
17. Stabilize trachea and tension skin with left hand.
18. Railroad a lubricated size 6.0mmcuffed tracheal tube over the bougie.
19. Rotate continuously the tube over the bougie as it is advanced. Avoid excessive advancement and endobronchial intubation.
20. Remove the bougie.
21. Inflate the cuff and confirm ventilation with capnography.
22. Secure the tube

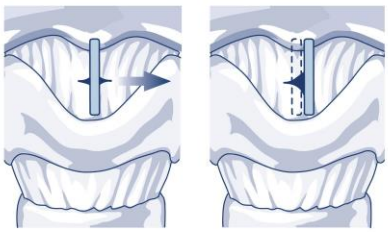
Surgical Cricothyroidotomy (cont.)

Make a transverse stab incision through the skin and cricothyroid membrane with the cutting edge of the blade facing towards you

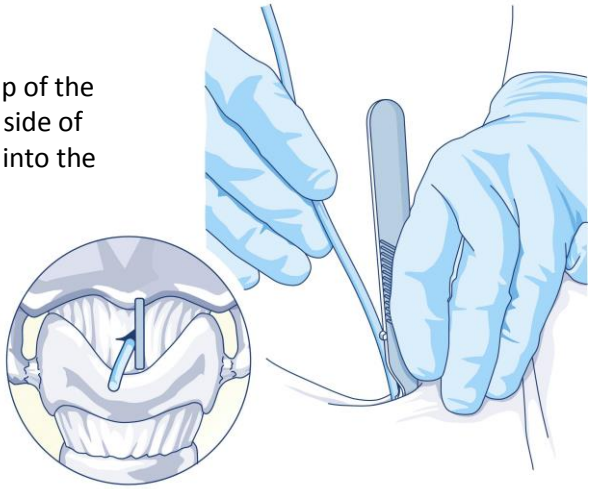




Turn it through 90° so that the sharp edge points caudally (towards the feet). Swap hands – keeping the scalpel steady. Maintain gentle traction, pulling the scalpel towards you



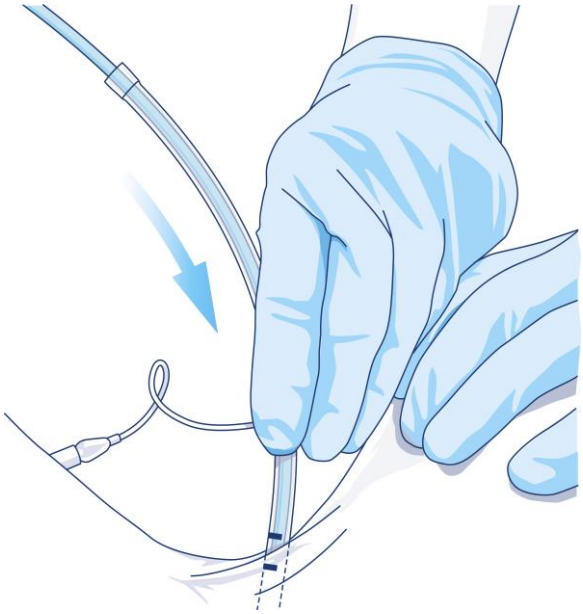
Slide the coudé tip of the bougie down the side of the scalpel blade into the trachea

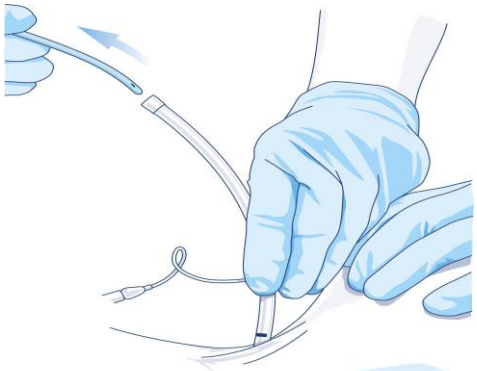


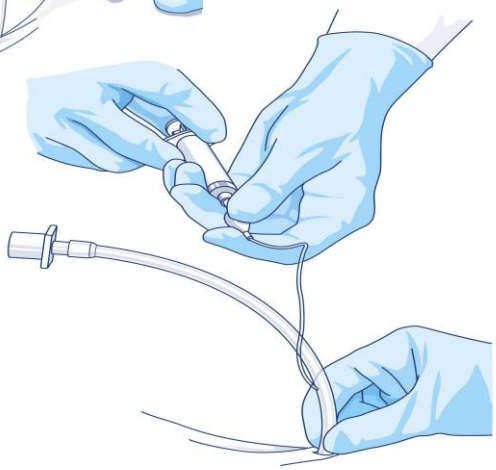
Advance with gentle two finger pressure, up to 10–15 cm

Surgical Cricothyroidotomy (cont.)

Railroad a lubricated size 6.0mmcuffed tracheal tube over the bougie







Rotate continuously the tube over the bougie as it is advanced.
Avoid excessive advancement and endobronchial intubation.
Remove the bougie

Surgical Cricothyroidotomy (cont.)

B. Cricothyroid membrane NOT palpable – Scalpel Finger Technique;

Equipment; Scalpel size 10, **Cook Frova Intubating Introducer**, **15 ml Rapi-fit connector**, 6.0 ETT and a 5 or 10ml syringe.

1. Continue attempts at rescue oxygenation via upper airway (assistant).
2. Right handed operator come from the patient's left side of the bed (reverse if left handed)
3. Attempt to identify the laryngeal anatomy using a laryngeal handshake.
4. If an ultrasound machine is immediately available and switched on, it may help to identify the midline and major blood vessels.
5. Tension skin using the left hand.
6. Make an 8–10 cm midline vertical skin incision, caudad to cephalad (foot to head).
7. Use blunt dissection with fingers of both hands to separate tissues and identify and stabilize the larynx with left hand.
8. Hold the scalpel in your right hand, make a transverse stab incision through the cricothyroid membrane with the cutting edge of the blade facing towards you
9. Continue from Point 7. **Scalpel Bougie Technique**

Intubating Doctor Checklist

Preparation

- ☐ PPE
- ☐ Pre-Oxygenate
  NRM / BVM (CO_2 monitor attached)
  NP 4 → 15 Lpm
- ☐ Assess for difficult airway
- ☐ ± Oral Airway / Nasal Airway
- ☐ ± Delayed Sequence Intubation
- ☐ ± Manual C-Spine immobilisation
- ☐ ± Laryngeal manipulation
- ☐ Position Patient (Ear canal = sternal notch)
- ☐ Yankour suckers (x 2)
- ☐ Which Laryngoscope and Blade size
- ☐ ETT size ± Stylet ± Silastic Bougie
- ☐ ± LMA size (Plan C)
- ☐ Ventilator Settings
- **Plan A – Initial intubation strategy**
- **Plan B – Alternative intubation strategy**
- **Plan C – Rescue oxygenation and ventilation plan**
- **Plan D – Can't intubate / Can't ventilate plan**
- ☐ Intubation Drugs
  - Sedation
  - Analgesia
  - Muscle Relaxant
  - Pressor
  - Atropine
- ☐ Post-intubation Drugs
  - As above + others as clinically indicated

Intubation

- ☐ Intubation begins with drugs being given
- ☐ Follow Plan – call out when Plan B, C or D needed
- ☐ View – Cormack-Lehane Classification
- ☐ Check ETT position
- ☐ Maintain grip on ETT till secured
- ☐ Connect to ventilator

Post-intubation

- ☐ Review vitals
- ☐ Review Ventilator settings and airway pressure
- ☐ NGT
- ☐ Patient's thorax up at 30^0
- ☐ Post-intubation drugs
- ☐ CXR
- ☐ Disposition plan
- ☐ Document procedure

Specific Clinical Issues

- Acidaemia
- Bronchospasm
- CAL
- Hypoxaemia
- Hypotension
- Obesity