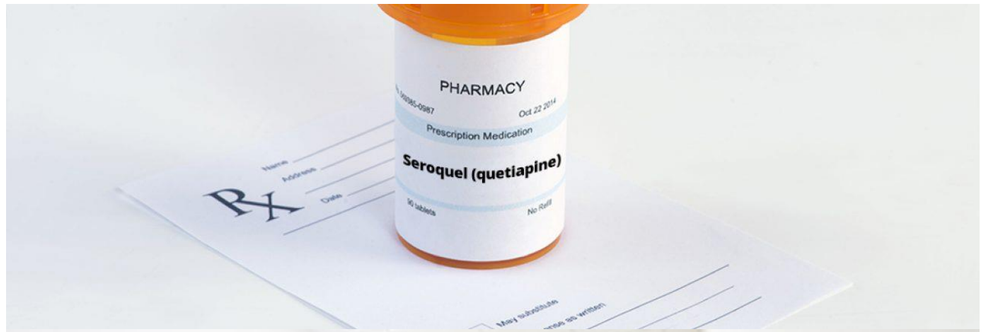
Oxygenation, Intubation and Ventilation

Lungs, Lines and Larynx Lecture 3

Case 1

- 23 year old male
- Quetiapine overdose
- GCS 6
- HR 120
- BP 110/70
- Sats 98%
- Resp 18

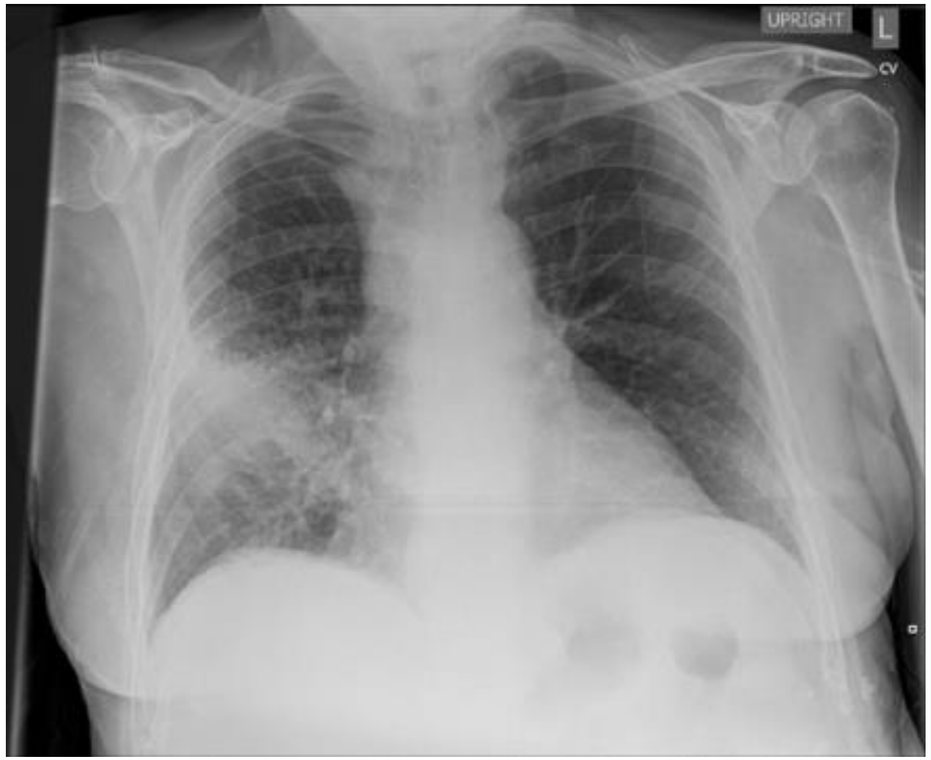


Case 2

- 24 year old female
- asthma attack
- VBG - pH 7.29, PO2 90, PCO2 49
- Resp 12
- HR 120
- Sats 95% on O2
- BP 110/70

Case 3

- 75 year old female
- Pneumonia
- HR 110
- BP 130/80
- Sats 89% NRM
- Resp 20

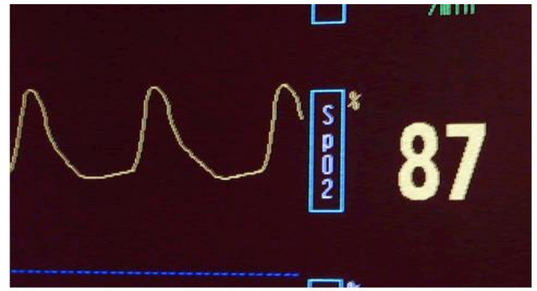


Case 4

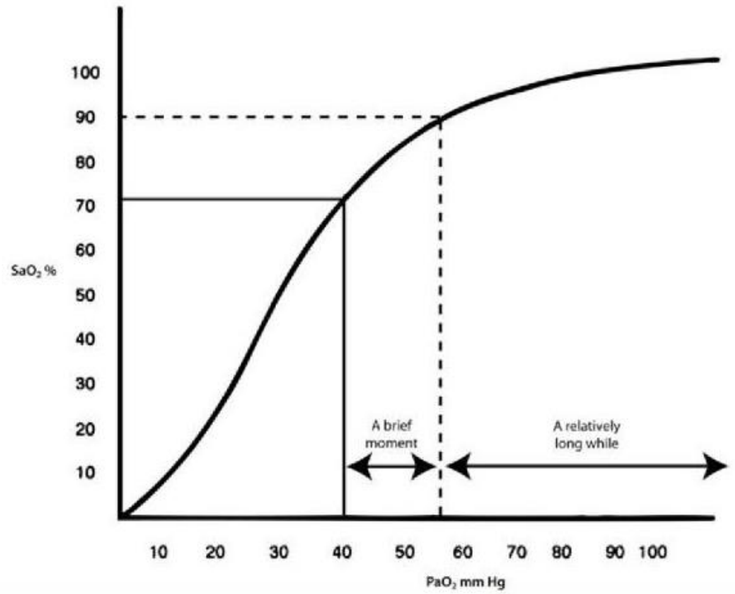
- 39 year old female
- Tricyclic overdose
- HR120
- GCS 9
- Broadening QRS complexes
- PH 7.19, HCO3 14, PCO2 45

- Each case will be managed differently……

Preoxygenation



- It is essential to optimize oxygen delivery to an acutely ill patient.
- If tracheal intubation is attempted with saturations below 90%, these patients can critically desaturate in seconds.
- Essentialy, preoxygenation replaces all the nitrogen in a patient's lung with oxygen
- Good preoxygenation extends the **safe apneoa time**
- Should be performed before all intubation and procedures requiring sedation



Passive Preoxygenation

(i.e. the spontaneously breathing patient)

- Low flow passive oxygen delivery devices (nasal cannulae, hudson face masks) entrain room air. Entrainment of room air defeats optimal oxygenation.

- NRFM at 15 liters delivers 60 – 90% and BVM at 15 liters delivers 100% O2 to a spontaneously breathing person.

- The best and most efficient way to pre-oxygenate a spontaneously breathing patient

VS

- Requires two hands to make a good seal
- Uncomfortable and frightening for awake/agitated patients
- Good effort of breathing requires to overcome valves and dead-space before getting to O2 reservoir

Apnoeic Oxygenation

- Providing the apnoeic patient oxygen by nasal cannula under a non-rebreather face mask with ***“flush rate”*** oxygen has been shown to significantly prolong the time to critical desaturation during rapid sequence intubation

- Nasal prongs are left on during the tracheal intubation attempts. This allows the continued benefits of apneic oxygenation while tracheal intubation techniques are performed.

- This increases ***“safe apneoa time”***

Flush rate

Active Preoxygenation

- If needed, for the patient demonstrating inadequate pre-oxygenation, assisted BMV may be performed, timed to deliver a positive-pressure breath with the patient's inspiratory effort.
- Ventilation provides 2 potential benefits during the onset phase of muscle relaxation: ventilation and increased oxygenation through alveolar distention and reduction in shunting.

- Ventilations should be delivered slowly (during 1 to 2 seconds), involve a low volume (6 to 7 mL/kg), and be administered at as low a rate as tolerable for the clinical circumstances (6 to 8 breaths/min).

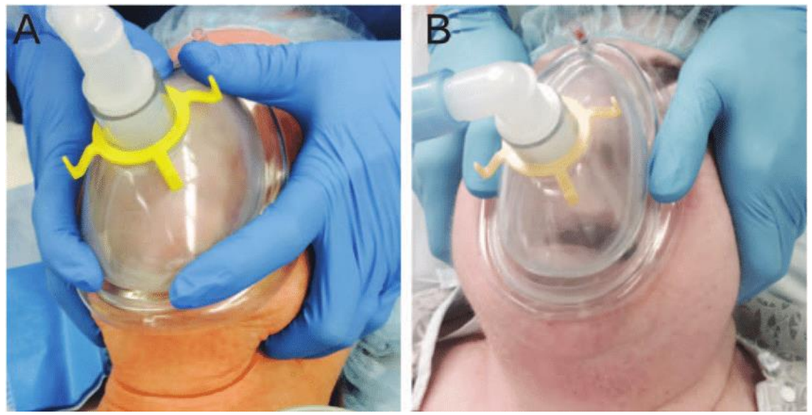
- Bag-valve-mask device inspiratory pressures greater than 25 cm H2 O can overwhelm the esophageal sphincter and put the patient at risk for regurgitation and aspiration. Gastric distention and resulting aspiration is unlikely at pressures below 25 cm H2O.

- If a bag-valve-mask device is used during the onset of muscular relaxation, a PEEP valve will provide sustained alveolar distention.

- PEEP also prevents absorption atelectasis caused by breathing high FiO2 gas level, increasing the efficacy of apneic oxygenation.

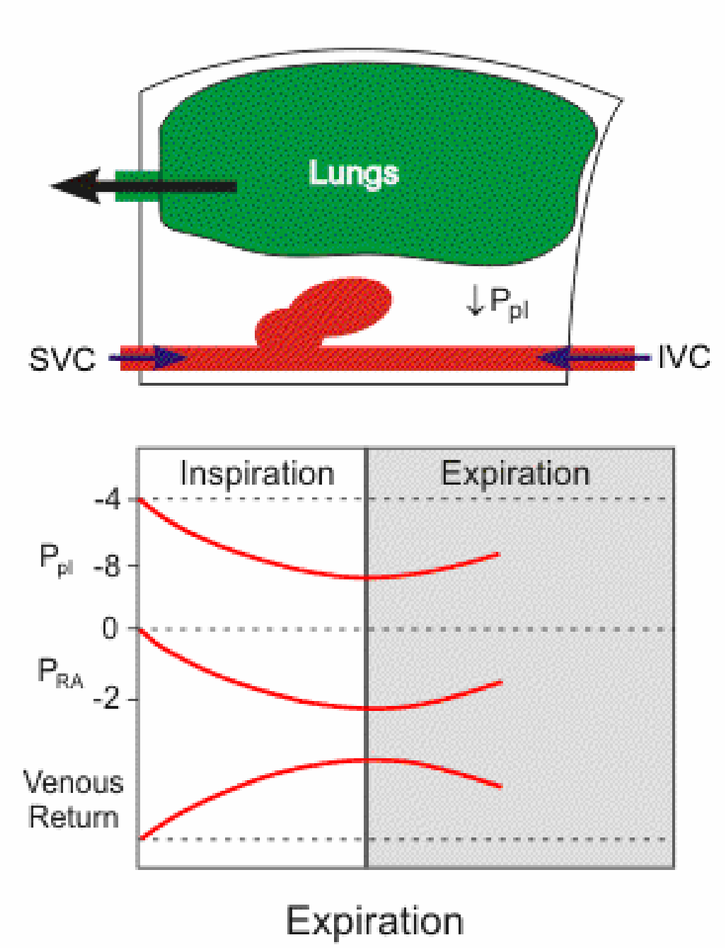
- Difficult mask ventilation is usually easily resolved by altering technique, including the early use of an oral airway combined with two person BMV.

- C/E Grip or “Thumbs Down”grip



- An adequate jaw thrust is the key to effective BMV and can be achieved using tow handed thumbs down grip

- A significant risk of positive-pressure ventilation in the critically ill patient involves decreased venous return and hypotension. This is especially significant in low flow states from any cause (hypotension), volume depletion, acute respiratory distress syndrome, and obstructive airway disease (with attendant risks of intrinsic PEEP).

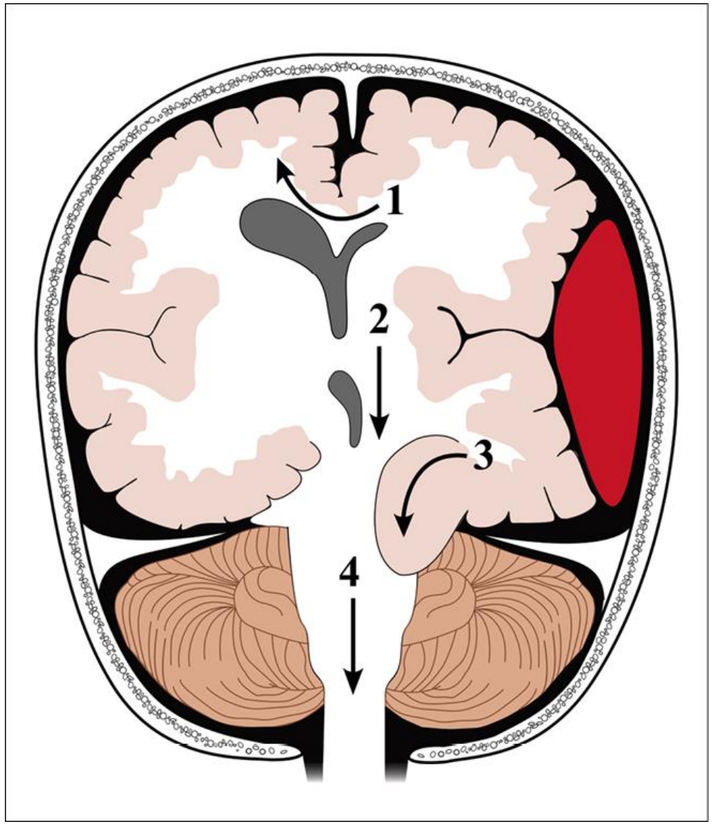


- Overventilation in such patients may precipitate hemodynamic collapse, and clinicians must be mindful of rate, volume, and speed of ventilation in these situations. Relative hypoventilation and resultant permissive hypercapnia may be required to avoid hemodynamic collapse.

- On average, $PaCO_2$ increases 8 to 16 mm Hg in the first minute of apnea and then approximately 3 mm Hg/minute subsequently. It is rare that this degree of $PaCO_2$ increase and pH decrease will be clinically significant.

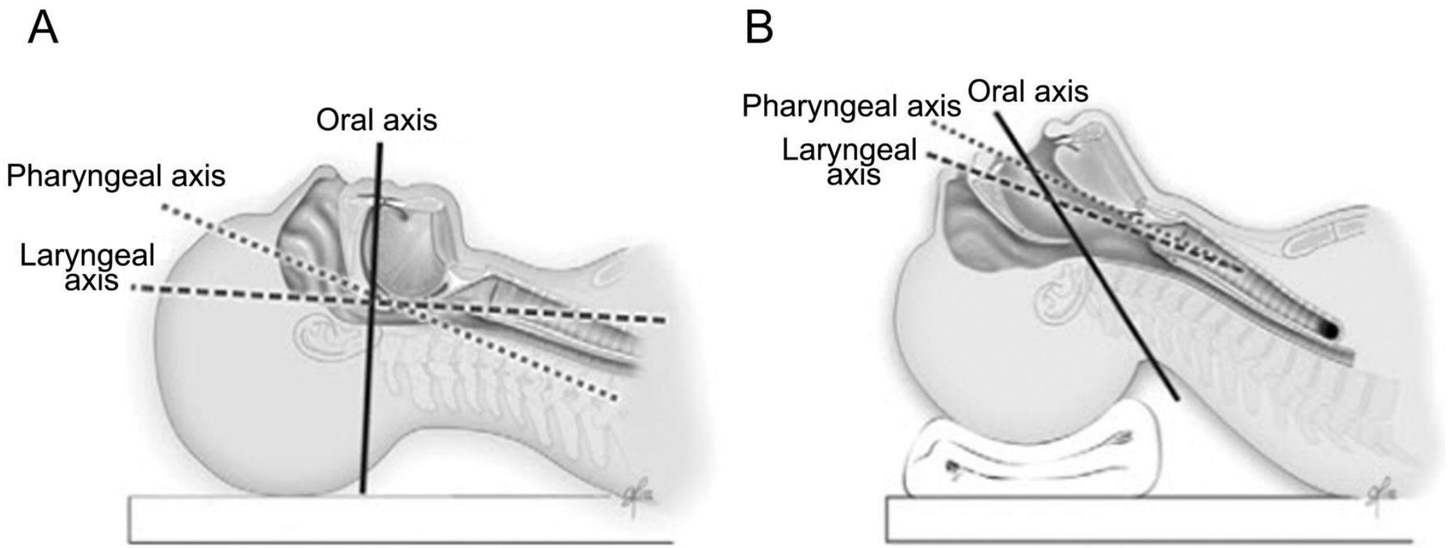
- An exception is a profound metabolic acidosis in which patients compensate for the acidosis through hyperpnea and tachypnea. Aggressive ventilation is needed for such patients because cardiovascular collapse with cessation of self-ventilation has been reported.

- A second exception is in situations of increased intracranial pressure, in which the carbon dioxide increase can lead to cerebral vasodilation, worsening intracranial pressure.



Intubation

Positioning with a pillow



Ramping patient

The aim is to get the tragus of the ear in line with the sternum

Trauma Patients

Patients in spinal precautions the bed can be tilted in order to achieve the same position

Positioning

The centre of the patient’s head should align with the laryngoscopist’s umbilicus.

The laryngoscopist’s elbow should be flexed and resting on their side during laryngoscopy.

The laryngoscope should be held near the base of the blade.

Open the mouth

Scissor technique to open mouth

Insert laryngoscope

The first target of laryngoscopy should be the epiglottis.

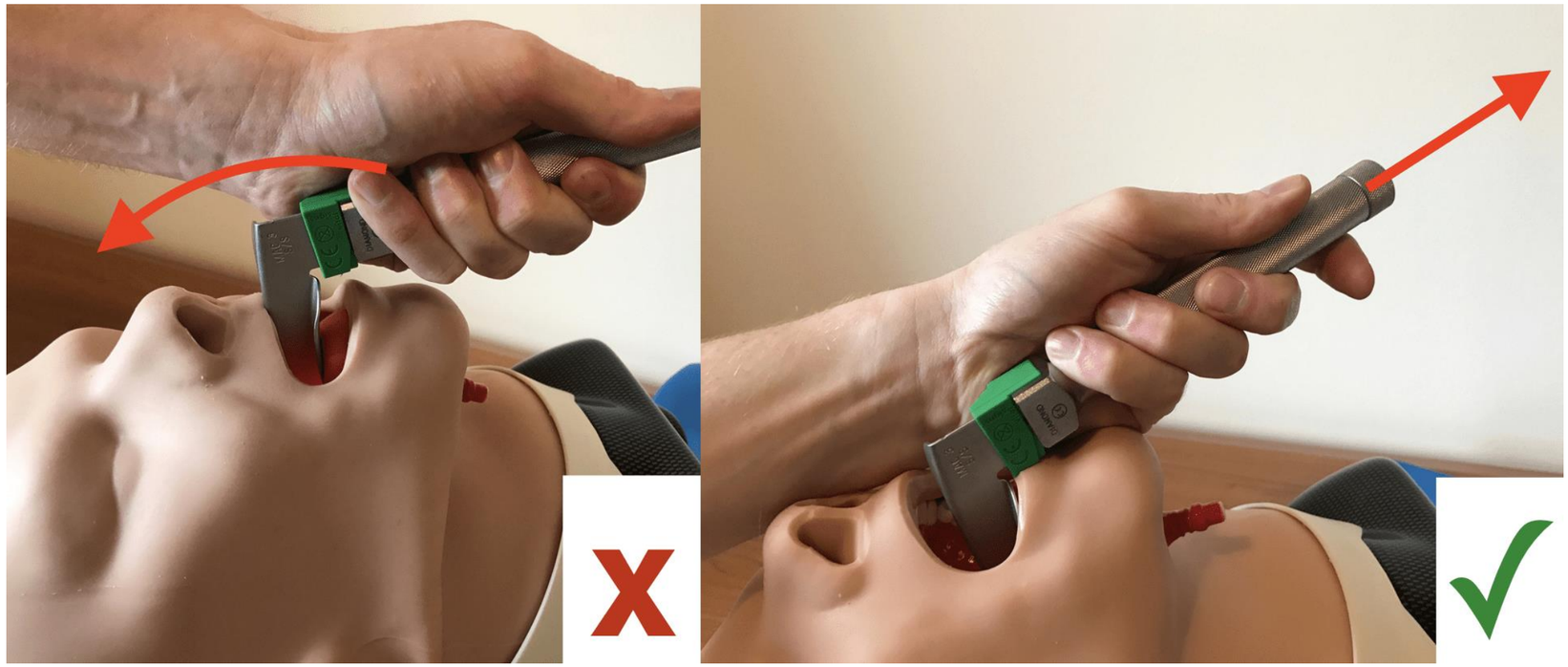
Gently inch down the center of the tongue until a sliver of epiglottis is seen.

Do not apply any force as this advance is made.

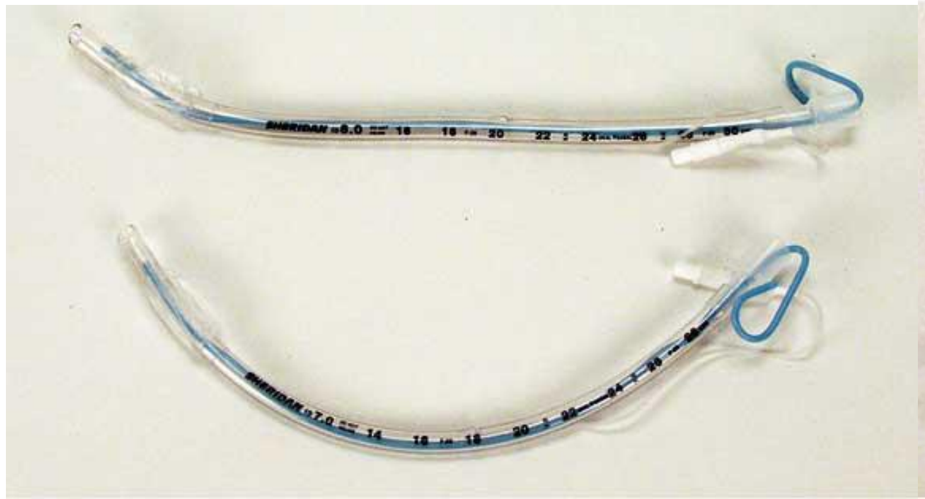
Use suction to clear secretions that pool in the posterior pharynx, obscuring the epiglottis

During direct laryngoscopy, attempts to lift the tongue before the hyoepiglottic ligament is engaged, often results in an inadequate view

Lift the tongue



Stylet the ETT?

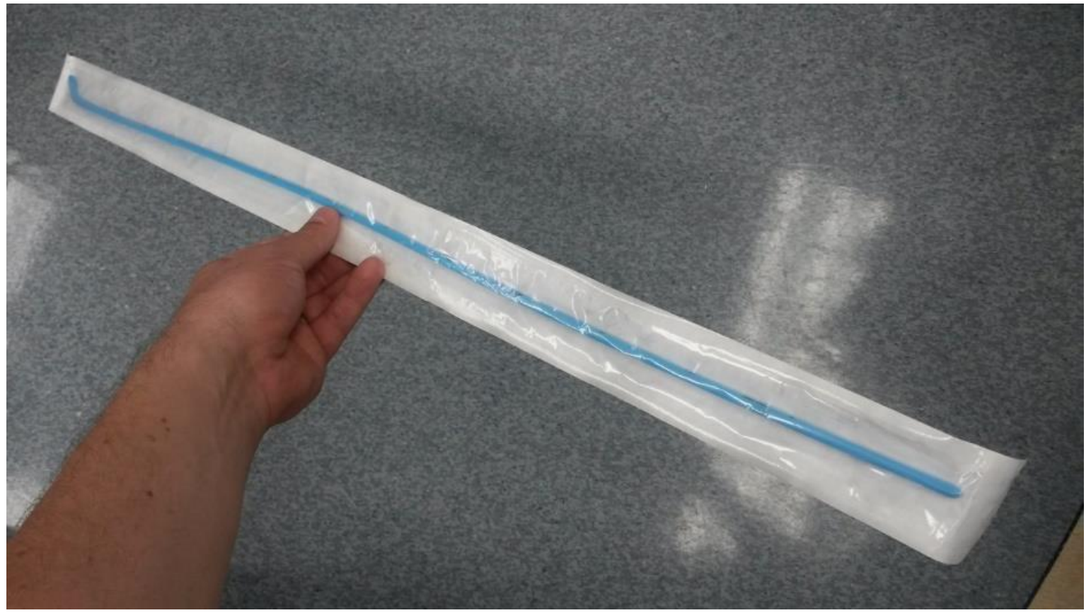


Bougie!

A bougie can be used on the first intubation attempt or when “best look” DL has failed to yield an adequate view of the glottis.

The ETT can be “railroaded" over the bougie when it is in the trachea.

If there is resistance to tube insertion, a clockwise (rightward) turn will lower the leading edge of the tube (disengaging it from the rings).



Video Laryngoscopy

Hyper-angulated Vs Mac

Hyper-angulated Stylet

=


CALVARY ACT
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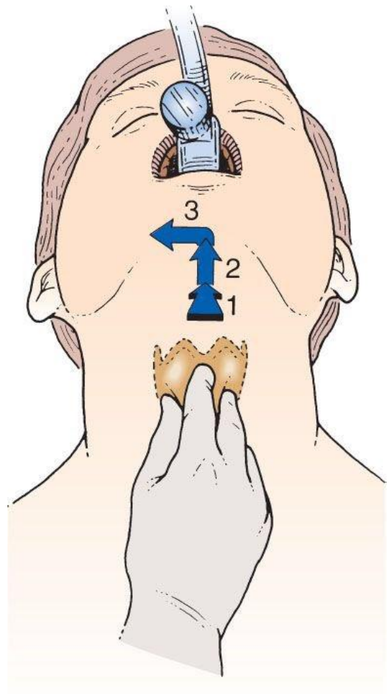
BURP Manoeuvre

Back

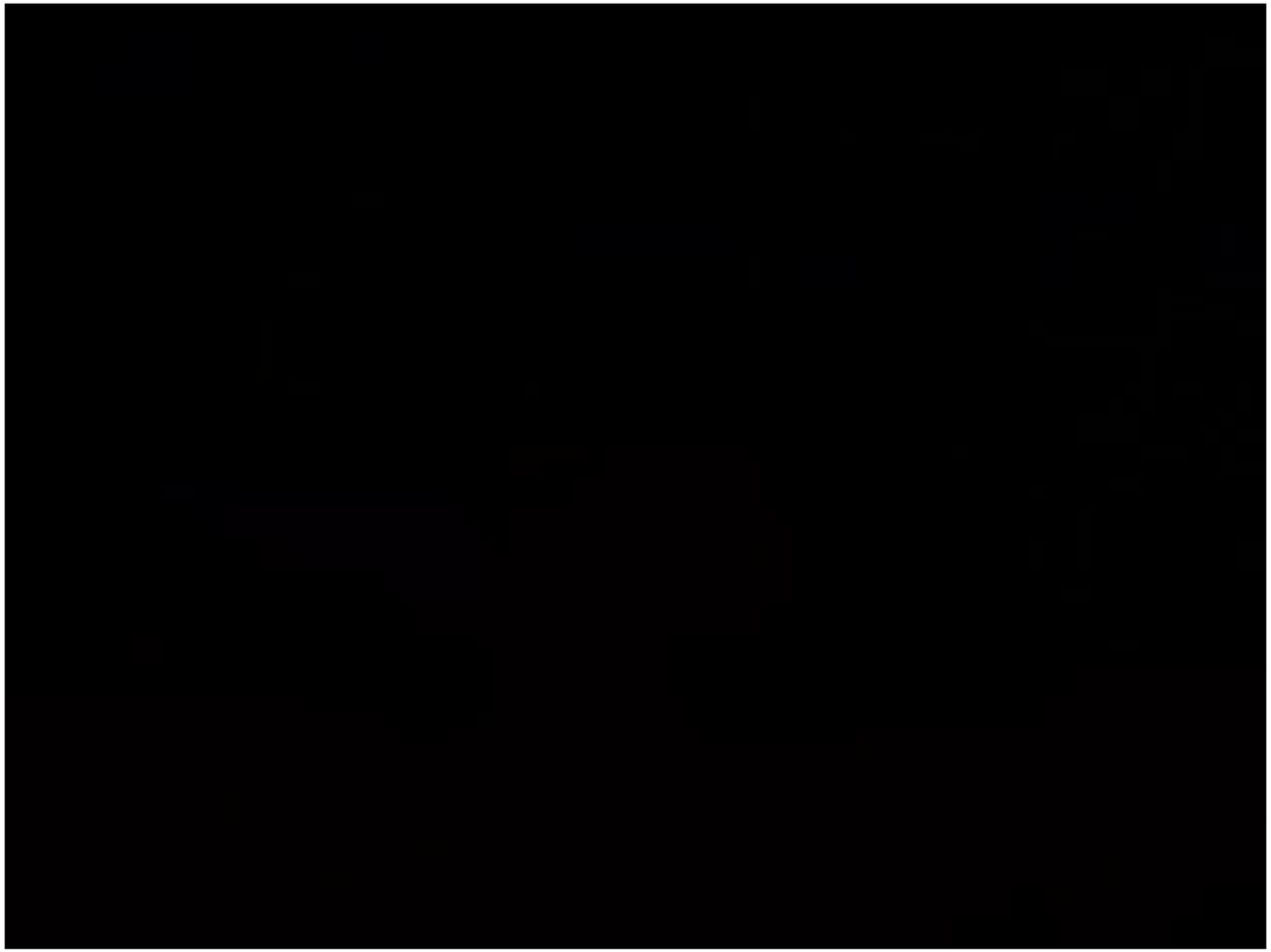
Up

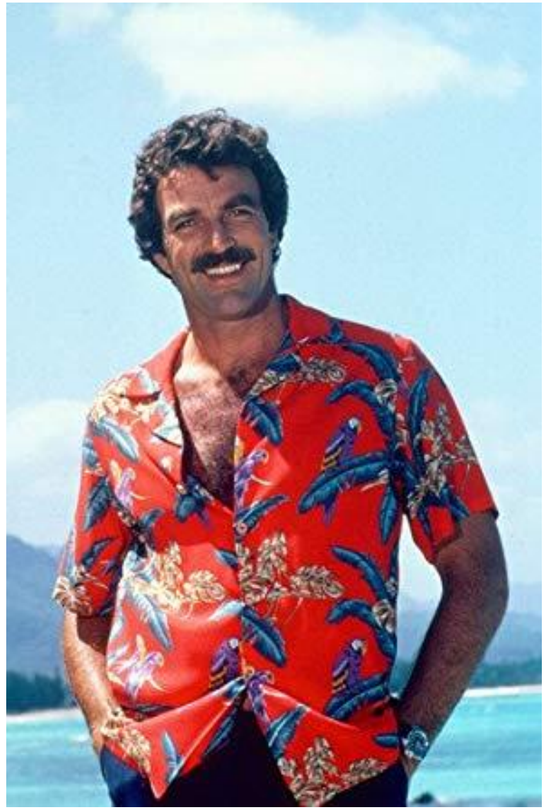
Right

Position



Bimanual Laryngoscopy

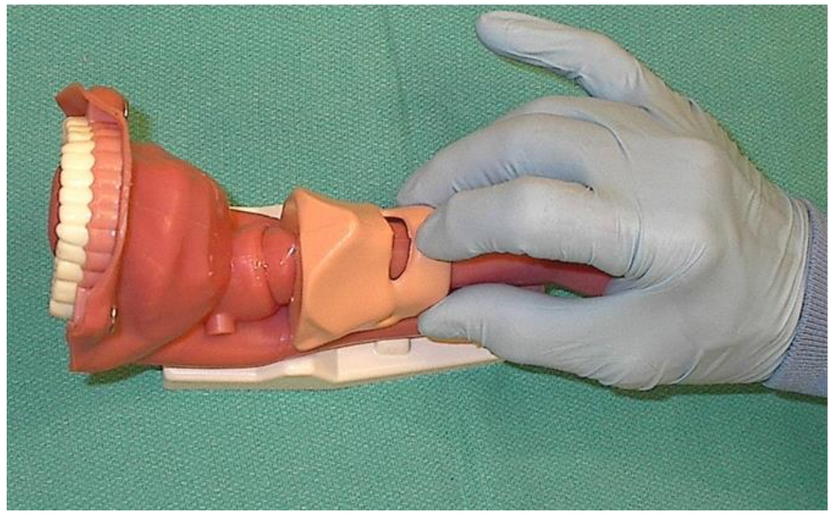




Sellick’s Manoeuver??

AKA Cricoid pressure –

has the potential to impair the view at laryngoscopy, trigger vomiting, cause obstruction to BMV, and impair extra-glottic device placement.



No longer Practiced!!!

RSI – RAPID SEQUENCE INDUCTION

- RSI is an airway management technique that induces immediate unresponsiveness (induction agent) and paralysis (neuromuscular blocking agent) as the fastest and most effective means of placing an endotracheal tube.

- Avoidance of bag-mask ventilation minimizes the inflation of air into the stomach, which might otherwise provoke regurgitation and aspiration.

Indications for RSI

“Indications” for RSI are rarely absolute, and the imperative to obtain a definitive airway will be determined by the acuity/urgency of the indication, balanced against patient (e.g. difficult anatomy/physiology) and provider (e.g. inexperience) factors.

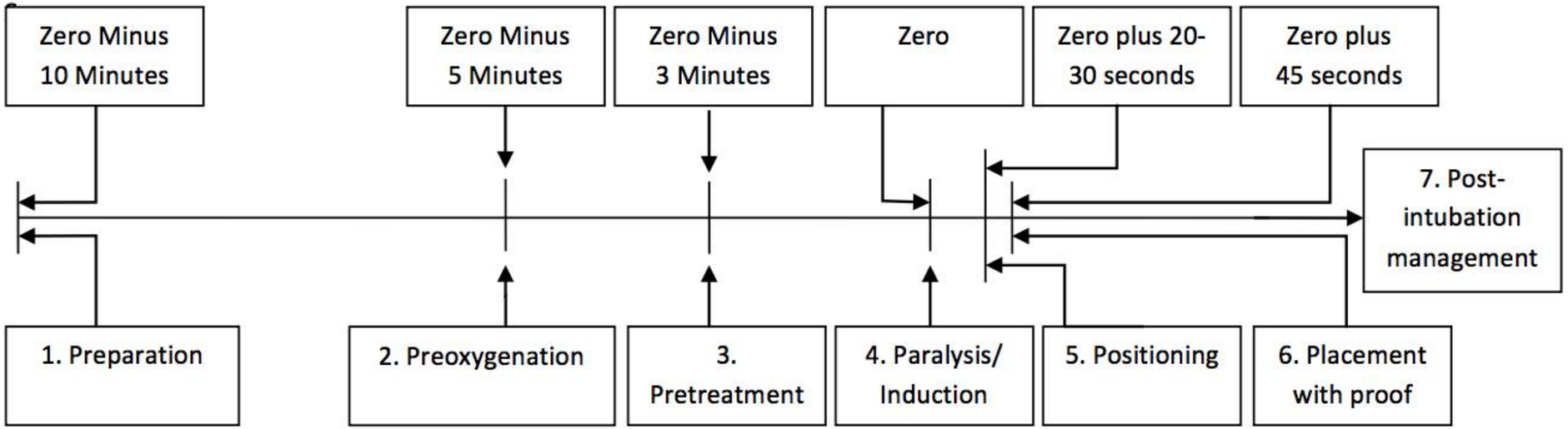
Urgency

Operator experience, Patient factors

RSI Team

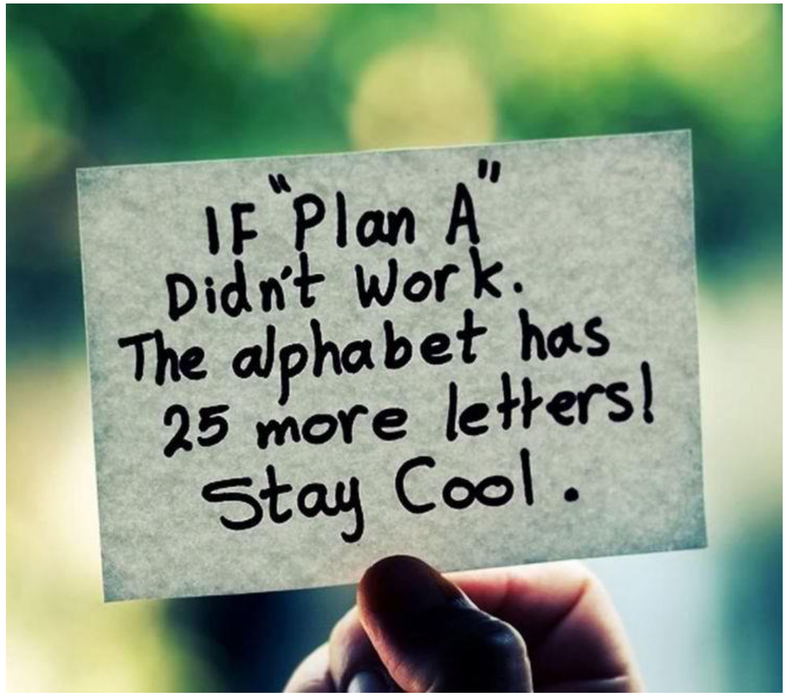
- There should be a minimum of 3 people: an airway proceduralist, an airway assistant and a drug administrator.
- Ideally the team leader should be free of the above roles, so they can devote their attention to monitoring the clinical situation.

Process of RSI



Preparation

- The goal is to maximise the chance of intubation on the first attempt.
- Failure to identify difficult intubation or ventilation is one of the main causes of failed airway management.
- Even in a normal looking airway, there must be a backup plan for unanticipated difficult airway management.
- The airway plan, including backup plans, need to be clearly articulated to the team.



Southern NSW Local Health District Airway Algorithm

PLAN A
Initial tracheal intubation plan

Most senior MO to perform
Maximum 2 attempts in 2 mins
Re-oxygenate if $SpO_2 < 90\%$
2 person BVM + OPA + NPA
Call for help if PLAN A fails

Direct laryngoscopy → SUCCESS → **Verify tracheal intubation with $EtCO_2$**

OR

PLAN B
Secondary tracheal intubation plan

Change technique / adjunct aids
Maximum 2 attempts in 2 mins
Re-oxygenate if $SpO_2 < 90\%$

Video laryngoscopy → SUCCESS → **Verify tracheal intubation with $EtCO_2$**

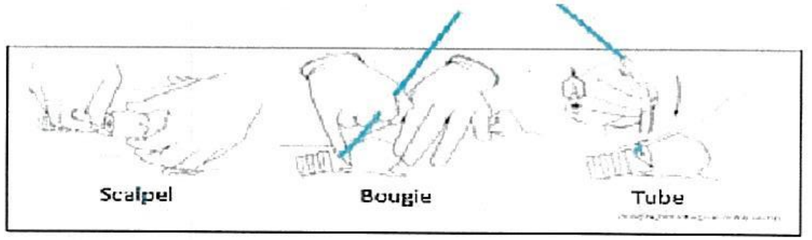
PLAN C
Maintenance of oxygenation / ventilation

Maximum 2 attempts in 2 mins
PLAN D if $SpO_2 < 75\%$

LMA → **Get HELP urgently**

PLAN D
Rescue techniques for "Can't Intubate, Can't Ventilate" situation

Cricothyroidotomy →



Aeromedical Retrieval:	Southcare Retrieval:	NETS:	Local Help:
1800 650 004	**1300 873 711**	**1300 362 500**	_____

Surgical Airway & Ventilation guidelines adapted from Emergency Care Institute Emergency Protocols
Contact with questions sherrileigh.bayliss@health.nsw.gov.au

Out of Theatre Intubation Checklist – SNSWLHD

Patient ID

Complete for all intubations as part of the patient record

Oxygenate early

Team

Team Leader to clarify roles:

- ❑ Airway Proceduralist
- ❑ Airway assistant
  - External laryngeal manipulation
- ❑ Drugs / circulation
- ❑ Scribe / monitoring
- ❑ Manual in-line stabilisation required? (trauma patients)

State airway plan:

- ❑ **Difficult airway likely?** (see airway algorithm) Yes No

Plan A

Plan B

Plan C

Plan D

Equipment

- ❑ Resus bag & mask with **end-tidal CO_2,** connect & zero
- ❑ Oro and nasopharyngeal airway & LMA available
- ❑ Prepare:
  - ❑ Suction
  - ❑ 2 ET tubes
  - ❑ 2 laryngoscopes
  - ❑ Bougie
  - ❑ Check video-laryngoscope (charged & working)
  - ❑ Oxylog or ventilator circuit (with HME & corrugated adaptor)
- ❑ **IVC x 2 patent** + pump set primed
- ❑ Allergies?
- ❑ Prepare relevant drugs (paralytic, sedation & vasopressors)

Prepare patient

- ❑ **Optimise patient position,** eg: 'ramping' for obese
  - Ear to sternal notch
- ❑ Apply manual in-line stabilisation if indicated
- ❑ Commence effective mask **pre-oxygenation + 15L nasal oxygen** (consider continuing NIV or using HFNC if available)
  - ➢ 3 mins via NRB mask or at least 8 breaths via BVM
- ❑ Haemodynamics

IV fluid bolus ☐
Blood products ☐
Vasopressor ☐

Patient Monitoring

$EtCO_2$ ☐
NiBP ☐
SpO_2 ☐
ECG ☐

Post intubation

<u>Verbally confirm</u> ETT placement:

- ❑ **$EtCO_2$ monitoring**
- ❑ Bilateral & symmetrical chest movement
- ❑ Bilateral air entry on auscultation
- ❑ Secure ETT – state length to teeth
- ❑ OGT / NGT (prior to CXR)
- ❑ Ventilator settings confirmed
- ❑ CXR to confirm position
- ❑ ABG attended
- ❑ Oxygenation maintained

Please complete QARS audit & fax a copy to 4827 3160

Health
Southern NSW
Local Health District

Intubation Record

Patient ID

Date:

Medication administered

Allergies / Adverse Drug Reactions:					
Medication	**Route**	**Dose**	**Prescriber** Signature + Print name	**Given by**	**Time given**

Intubator: _____

Position: _____

Mobile / pager no: _____

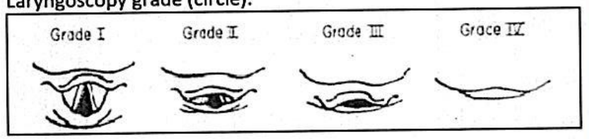
Signature: _____

Type of induction: Awake ☐ RSI ☐

Manual inline stabilisation used? Yes ☐ No ☐

Endotracheal tube: Size..... at ..... cm at teeth / gums

Laryngoscopy grade (circle):



For further assistance contact:

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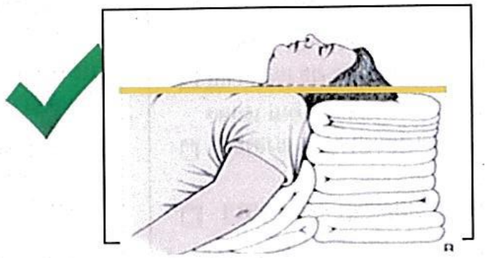


Ear to sternal notch positioning for the obese

Adjuncts used:

Bougie ☐ McCoy blade ☐ Video laryngoscopy ☐ iLMA ☐

Other: _____

Notes (difficult intubation etc): _____

_____

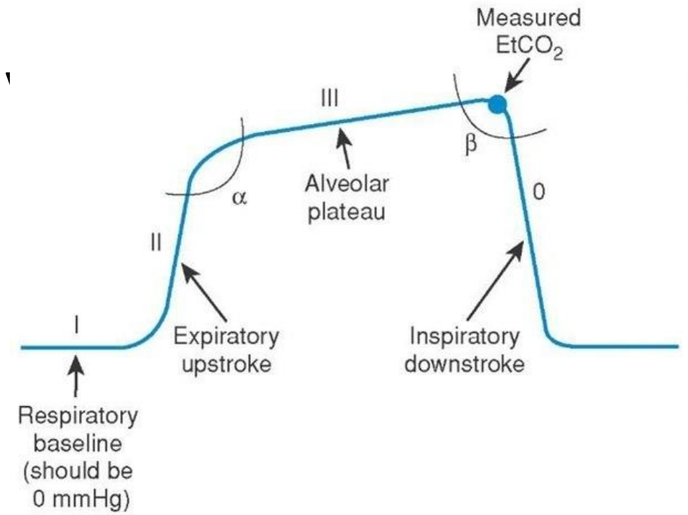
Please complete QARS audit & fax a copy to 4827 3100

Preparation

- **S**uction – at least one working suction, placed securely at head of bed
- **O**xygen – NRFM and BVM attached to 15 LPM of O2 with nasal prongs for apneic oxygenation
- **A**irways – 7.0 ETT for smaller females, 8.0 for larger males, 7.5 for most patients. Lubed stylet in tube, straight to cuff and bent 35 degrees from proximal end of cuff.
- **P**re-oxygenate the patient.
- **P**repare equipment = check laryngoscope light and have backups ready (bougie, VL, LMA, surgical cric kit)

Preparation for RSI

- **M**onitoring Equipment – cardiac monitor, sats, BP cuff opposite arm with IV
- **M**edications – induction agent, paralytic, ent bolused with crystalloid.
- **E**nd tidal CO2



Induction Agents

- Midazolam:
  - Dose: 0.3 mg/kg IV TBW
  - Onset 60 – 90 sec
  - Duration: 15 – 30 min
  - Use: not usually recommended for RSI
  - Drawbacks: respiratory depression, apnea, hypotension, paradoxical agitation, slow onset, variable response

Induction Agents

- Fentanyl
  - Short acting narcotic
  - 100mcg = 10mg morphine =75mg pethidine
  - 50-100mcg induction dose (less in elderly)
  - Cardiac depression if used with nitrous
  - May cause severe hypotension if used with beat or calcium channel blockers
  - Avoid with MAOIs

Induction Agents

- Ketamine:
  - Dose: 1-1.5 mg/kg IV (4 mg/kg IM)
  - Onset: 60 – 90 sec
  - Duration: 10 – 20 min
  - Especially in hemodynamically unstable, TBI, reactive airways disease (causes bronchodilation)
  - Caution in CV diseases (HTN, tachycardia), laryngospasm rarely, raised intraocular pressure.

Induction Agents

- Propofol:
  - Dose: 1.5 – 2.5 mg/kg TBW
  - ONSET: 15 – 45 secs
  - Duration: 5 – 10 min
  - Use: haemodynamically stable patients, reactive airways disease, status epilepticus
  - Drawbacks: hypotension, myocardial depression, reduced cerebral perfusion, pain on injection, variable response, very short acting.

Paralytic Agents

- Suxamethonium (succinylcholine):
  - Dose: 1.5 mg/kg IV and 4 mg/kg IM (in extremis)
  - Onset: 45 – 60 sec
  - Duration: 6 – 10 min
  - Use: widely used unless contraindicated
  - Drawbacks: hyperkalemia, malignant hyperthermia, bradycardia, fasciculations, elevated intra-ocular pressure.
  - N.B. Will not wear off fast enough to prevent harm in CICV situations

Paralytic Agents

- Rocuronium:
  - Dose: 1.2 mg/kg
  - Onset: 45 – 60 sec
  - Duration: 90 min
  - Use: rocuronium appears to have longer safe apnoea times than suxamethonium and has no significant contraindications.

Pretreatment

- Most patients in the ED requiring intubation will benefit from a bolus of IV crystalloid.

- Traditionally, pretreatment included drugs such as atropine, lignocaine, fentanyl and a defasciculating dose of NMB. There is little evidence that any of these are beneficial clinically and they should not be a routine part of clinical practice.

Confirmation of successful intubation

- The most reliable affirmation of intubation is seeing the ETT tip Pass between the vocal cords.

- All endotracheal intubations must be confirmed with quantitative wave-form capnography.

Delayed Sequence Induction

The concept of DIS is to use NIV to optimise the pre-oxygenation of the patient.

Ketamine is used as an induction agent whilst the patient continues on the NIV.

When everyone is read the paralytic agent is given, the head of the bed is dropped and the patient is promptly intubated

Ventilation

Mode of Ventilation

- Pressure Control Ventilation (PC SIMV+)
  - i.e. Set pressure / Monitor Volumes
- Volume Control Ventilation (SIMV)
  - i.e. Set Volume / Monitor Pressures

Adjustables on the Ventilator

- Mode - usually SIMV / sometimes PCV
- Tidal Volume (VT) (only in volume control)
- Respiratory (RR)
- FiO2
- PEEP
- P insp (only in pressure control mode)
- Pmax
- Slope/inspiratory flow rate –*Patient Comfort*

Ventilation Strategies

- Lung Protection Strategy
  - i.e. all patients that are not obstructive
- Obstructive Strategy
  - asthmatics

Lung Protection Strategy

- Mode - Usually SIMV
- VT – *6-8 ml/kg*
- RR – *16-18*
- Pmax (< or =40)
- FiO2 and PEEP – *use peep table for stats 88-95%*
- Pinsp (pressure control mode only start at 20)
- I:E Ratio - *1:1.5 (default)*
- Slope/inspiratory flow rate –*default*

Keep Saturations 88-95% using the PEEP Table

FiO2	.4	.4	.5	.5	.6	.7	.7	.7	.8	.9
PEEP	5	8	8	10	10	10	12	14	14	14

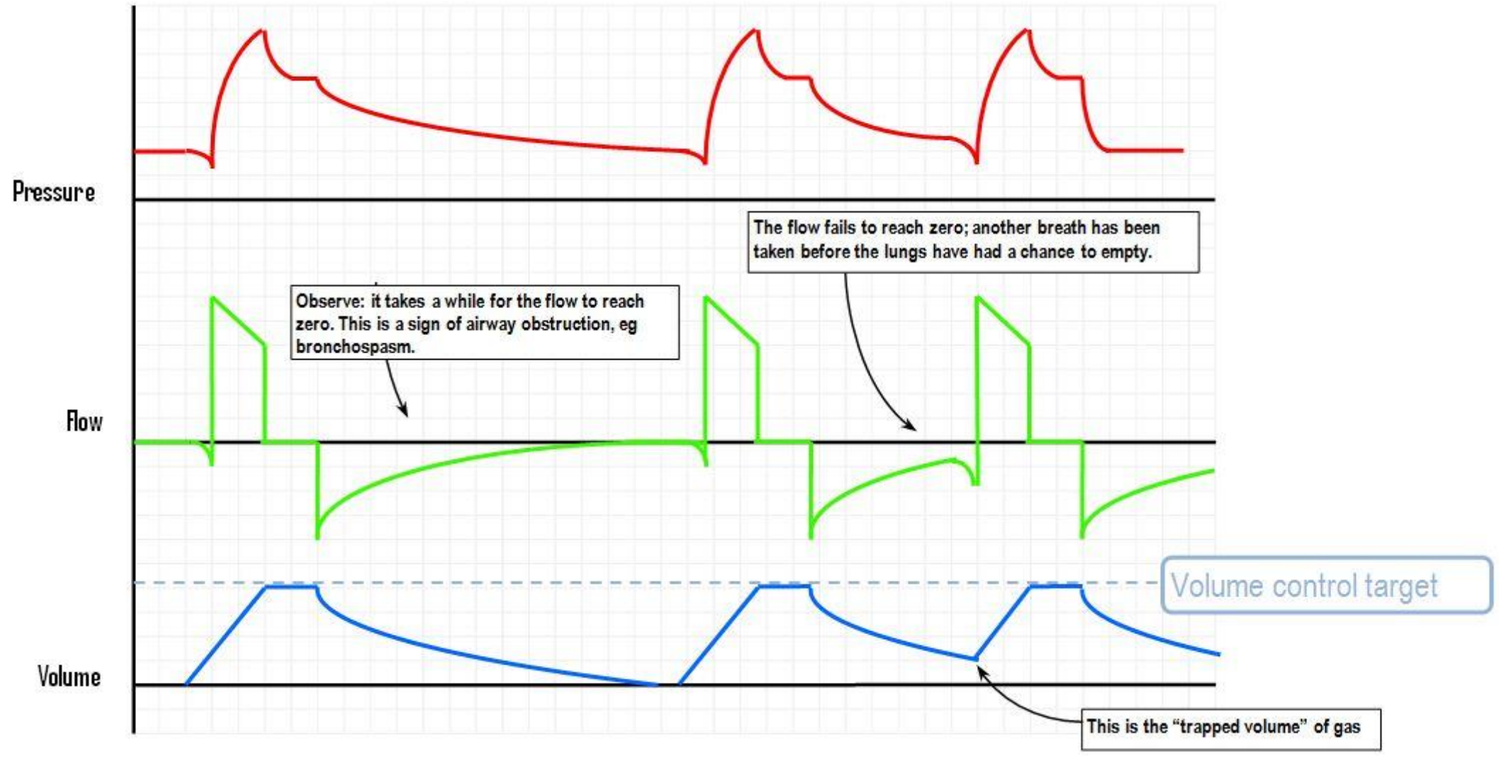
“the strategy helps keeps the alveoli just at the point where recruitment is maintained and avoids barotrauma”

Obstructive Strategy

- Mode - Usually SIMV
- VT – *6-8 ml/kg*
- RR – *6 - 10*
- Pmax (< or =40)
- FiO2 *to maintain sats of 88-95%*
- *Zero PEEP (“ZEEP”)*
- Pinsp (pressure control mode only start at 20)
- I:E Ratio – *1:4 or 1:5*
- Slope/inspiratory flow rate – *fast*

Gas Trapping

- Look for gas trapping / auto peep / breath stacking
- Watch flow waves
- Check plateau pressure (if <30 not likely)



- IF PATIENT IS CRASHING……
  - TAKE OFF THE VENTILATOR AND HAND BAG
  - CHECK TUBE
  - CHECK PATIENT

  …….then check ventilator

Back to our cases….

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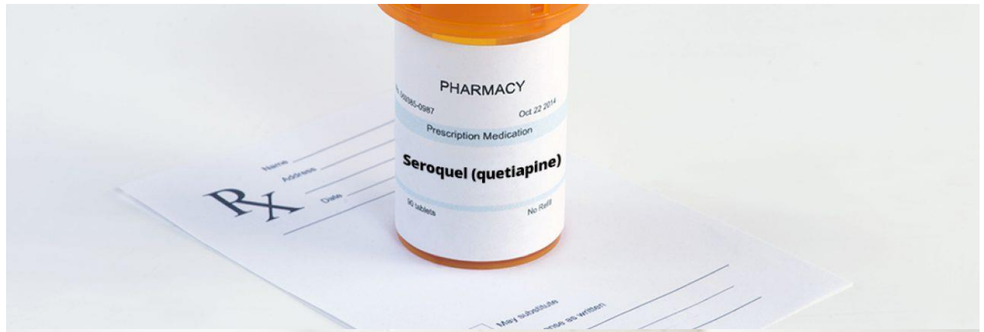
- Resp 18



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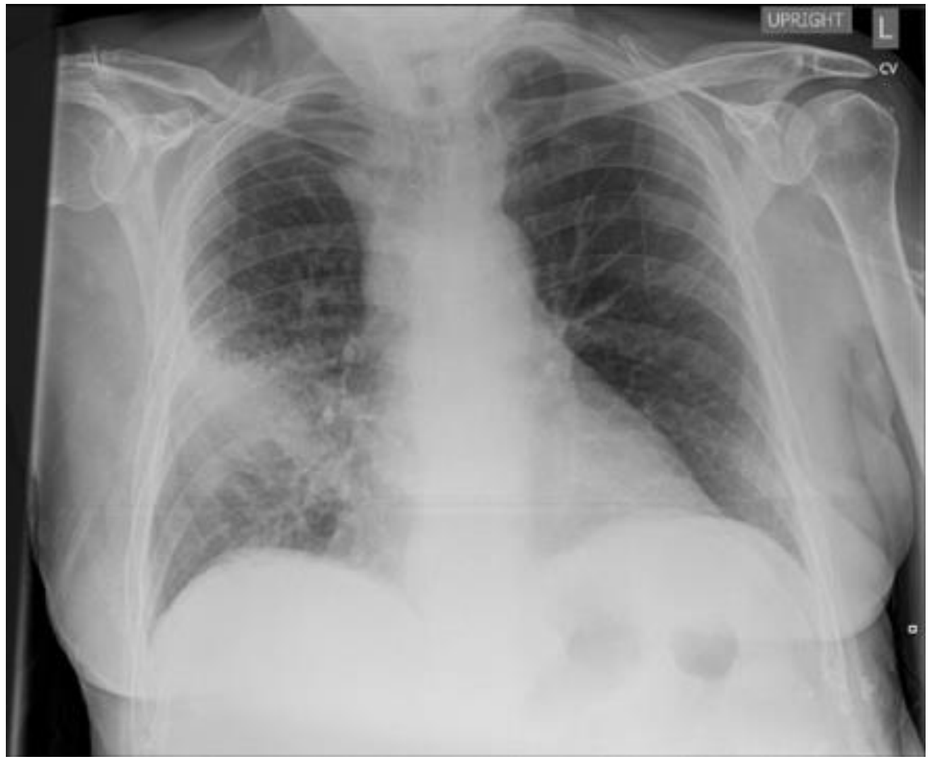
- Sats 89% NRM
- Resp 20



Case 4

- 39 year old female
- Tricyclic overdose
- HR120
- GCS 9
- Broadening QRS complexes
- PH 7.19, HCO3 14, PCO2 45

Questions?????