For every crisis:

- **Verbalise** the problem. Say out loud....
  
  ‘This is a CRISIS’

- Call for **HELP** early

- **Set oxygen to 100%** (except where stated otherwise)

- Identify a ‘**hands off**’ Team Coordinator

- **Delegate duties to specific** team members

- Use **closed loop**, quiet & efficient **communication**

- Use the **indexed pages & coloured boxes** in this manual to **assist you**
Instructions for Use

• Use the **index** and **coloured tabs** to find quick reference pages to assist in a crisis.

• The **handbook is in 2 parts:**
  - The front book: How to treat known **Emergencies**
  - The back book: How to **Diagnose** Problems

• **Routine/obvious tasks** (eg call for help, turn oxygen to 100%) are assumed & thus **not** repeated on every sheet for clarity

• For simplicity & to avoid calculation errors in an emergency, **drug doses** are given for a **70Kg adult**. Paeds doses are clearly marked with 😊 (where appropriate).

• There is an adult & paediatric drug formulary at the back

• Cards are arranged into coloured boxes:
  - Emergency/Doing tasks
  - Thinking tasks, diagnostic or further information
  - Doses, equipment or calculation information

• Work through emergency/doing boxes in a linear fashion. Decision making steps are **highlighted** for clarity.

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Using an aid such as this efficiently, in a crisis, is a **learned** skill. You must take time to become **familiar** with this manual and **practise** using it.

It is recommended that a ‘**reader**’, with no other tasks, **read these cards out loud** to the team leader during the crisis.
| 1e. | AIRWAY MANAGEMENT - Vortex |
| 2e. | CICO RESCUE |
| 3e. | LARYNGOSPASM |
| 4e. | BRONCHOSPASM |
| 5e. | ASPIRATION |
| 6e. | ADULT CARDIAC ARREST - VF or VT |
| 7e. | ADULT CARDIAC ARREST - Asystole or PEA |
| 8e. | PAEDIATRIC CARDIAC ARREST |
| 9e. | PAEDIATRIC EMERGENCY CALCULATIONS |
| 10e. | ANAPHYLAXIS |
| 11e. | INTRA-OPERATIVE MYOCARDIAL ISCHAEMIA |
| 12e. | SEVERE HAEMORRHAGE |
| 13e. | AIR/GAS EMBOLISM |
| 14e. | HAEMOLYTIC TRANSFUSION REACTION |
| 15e. | LOCAL ANAESTHETIC TOXICITY |
| 16e. | MALIGNANT HYPERTHERMIA |
| 17e. | HYPERKALAEMIA |
| 18e. | FIRE - Airway or Patient |
| 19e. | MATERNAL COLLAPSE |
| 20e. | NEONATAL LIFE SUPPORT |
| 21e. | TOTAL/HIGH SPINAL |
| 22e. | POST PARTUM HAEMORRHAGE |
| 23e. | PERI-PARTUM SEIZURE |
| 24e. | AMNIOTIC FLUID EMBOLISM |
1e. AIRWAY MANAGEMENT - Vortex

Main priority = **Oxygenation in the green zone**

- Always prepare a **safe** airway **strategy** - e.g. AFOI, call ENT surgeon etc.
- **Pre-oxygenate** all patients
- Consider **passive apnoeic oxygenation** with nasal cannula during RSI
- Remove cricoid early
- Address all airways with the **Vortex Approach**

**If failure of first airway plan:**

- Get difficult intubation trolley and extra help
- The goal is to **restore oxygenation** & reach the **green zone** (= EtCO₂ & safe SpO₂)
  (safe SpO₂ = SpO₂ where no harm will occur if that level persists for 15mins)
- Try the **lifelines** (BMV, SGA, ETT) in any order
- For each lifeline perform at least 1 **attempt**, but **not more** than 3
  (You may have a 4th attempt if a **game changer** becomes available e.g. new equipment, expert help etc.)

**Suggested optimisations include:**

<table>
<thead>
<tr>
<th>Bag/Mask</th>
<th>SGA</th>
<th>ETT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentures in</td>
<td>Change type</td>
<td>Dentures out</td>
</tr>
<tr>
<td>Optimise position</td>
<td>Change size</td>
<td>Best: person, position, blade eg video laryngoscope</td>
</tr>
<tr>
<td>2 hands + assistant</td>
<td>Cuff inflation/deflation</td>
<td>Bougie/Stylet</td>
</tr>
<tr>
<td>Vice grip</td>
<td>Twist to insert</td>
<td>Pickaxe grip</td>
</tr>
<tr>
<td>OPA/NPA</td>
<td>Insert with laryngoscope/bougie</td>
<td>BURP</td>
</tr>
<tr>
<td>Muscle paralysis</td>
<td>Muscle paralysis</td>
<td>Muscle paralysis</td>
</tr>
</tbody>
</table>

(A best effort at any lifeline must include full **muscle paralysis**)

**If in the green zone:** Develop a **strategy** for ongoing **safety** (some examples):

- **Maintain** = Consider waking patient: **sugammadex 1.2g, naloxone 400mcg**
- **Convert** = Place ETT using **fiberoptic scope** through SGA or **surgical** airway
- **Replace** = Leave green zone and **re-enter vortex**

**With an unsuccessful best effort** at any lifeline escalate the **CICO status**:

- **Ready** = Get CICO kit, designate proceduralist
- **Set** = Ready equipment & palpate landmarks

**If you have not reached** the **green zone** after 3 lifeline best efforts:

- **Call out** - ‘We are in a Can’t Intubate, Can’t Oxygenate Scenario (CICO)’
- **Do not delay**, start CICO rescue. See **tab 2e**

- **sugammadex** = immediately post roc/vec = 1.2g or 6 x 200mg vials (👶 16mg/kg)
- **naloxone** = 400mcg bolus (👶 10mcg/kg)
Main priority = Oxygenation with stable $\text{SpO}_2 > 90\%$

- Dedicated team continuing to attempt oxygenation supraglottically
- Pull patient up bed so head extends over pillow
- 3 options for CICO Rescue (decide & share with team early your intended technique):

1. Cannula Cricothyroidotomy \(\text{(palpable neck anatomy)}\):
   - CICO Pack: 14G cannula, 5ml syringe (with 2ml NSL), Rapid O\(_2\) (insufflation device)
   - Secure cricoid cartilage & aspirate as you advance the saline filled cannula
   - Success = free aspiration of air - never let go of cannula

2. Scalpel Bougie \(\text{(palpable neck anatomy)}\):
   - Prepare gauze/swabs & suction for blood

   - Method (with 10 blade scalpel):
     - Horizontal stab incision through cricothyroid membrane
     - Rotate scalpel to vertical (blade caudad) and pass bougie alongside blade
     - Remove scalpel, railroad size 6 ETT over bougie

3. Scalpel, Finger, Cannula/Scalpel \(\text{(non-palpable anatomy)}\):
   - Prepare gauze/swabs & suction - there may be a lot of blood

   - Method:
     - Vertical midline 8-10cm incision through skin & subcutaneous tissue
     - Use both hands to blunt dissect down to airway & secure cartilage
     - Insert cannula or scalpel through cricothyroid membrane or trachea
     - Follow step 1 or 2 as above to oxygenate patient

- Choice of 1st method is operator’s personal preference. Decide on your preferred method & practise it - mentally or in a simulation
- If 1st method is unsuccessful move to alternative method immediately
- If no palpable anatomy: scalpel finger method is recommended
Main Priority: Break laryngospasm & maintain \( \text{SpO}_2 \)

- Ask surgeon to stop
- Delegate & prepare for intubation - **Suxamethonium** & ETT

**Manual procedures:**
- Remove LMA & clear the airway
- Consider OP/NP airway
- **Jaw thrust** & CPAP 30cmH\( \text{2} \)O - **do not** give +ve pressure breath
- Apply bilateral, painful, inward pressure to **Larson’s point** (immediately behind lobe of ear)
- If 😞: Consider gentle chest compressions (may be more effective than other manual procedures)

**If \( \text{SpO}_2 \) stable & >92%** try pharmacological relaxation:
- **Propofol** - 20% of induction dose
- **Suxamethonium IV 35mg** (\\( 0.5\text{mg/kg} \))

**If \( \text{SpO}_2 \) dropping or <92%** proceed to intubation without delay:
- Adult: **Suxamethonium 100mg**
- Paeds: **Suxamethonium IV: 2mg/kg; IM 4mg/kg**

- Consider **atropine 600mcg** (\\( 20\text{mcg/kg} \)) for bradycardia

- Consider stomach decompression after event

**Contents**
- Emerg | Diag
4e. BRONCHOSPASM

Main Priority: $\text{SpO}_2 > 95\%$ with Peak Airway Pressures < 40cmH$_2$O

- Inform surgeon. Minimise surgical stimulation
- **Check:**
  - Airway position
  - EtCO$_2$ trace (severe bronchospasm can present with low or absent EtCO$_2$)
  - Airway pressures

- **Manually ventilate** - confirm high pressures and ensure adequate tidal volume
- **Deepen anaesthesia.** If using desflurane, switch to alternative

- **Emergency Drug** therapy:
  - Inhaled **salbutamol** 12 puffs via circuit ($<6$yr = 6 puffs; $>6$yr = 12 puffs)
  - Inhaled **ipratroium bromide** 6 puffs via circuit ($4$ puffs)
  - **IV salbutamol** - 100-250mcg slow bolus ([below]). Can repeat at 10mins
  - **IV adrenaline** - 0.1 - 0.5ml of 1:10,000 ($0.01-0.05$ml/kg 1:10,000)

- **Optimise ventilator** settings: pressure control mode, long expiratory phase, low respiratory rate, low PEEP, small tidal volumes, intermittent disconnection

- Other **bolus drug adjuncts:** magnesium, ketamine, hydrocortisone, aminophylline

- **If no improvement** use infusions of salbutamol, adrenaline, aminophylline

- Place arterial line. Take serial ABG’s

- Always **consider other causes** of high airway pressure other than primary bronchospasm see tab 25d. Most common include:
  - anaphylaxis
  - laryngospasm (on LMA)
  - tube position
  - chest wall rigidity
  - pneumothorax
  - acute pulmonary oedema

- **Permissive hypercapnia** may be required in order to ↓ airway pressures

- Assess response by ↓ airway pressures, ABG’s, and improving EtCO$_2$ trace

- **Salbutamol IV** slow bolus: ($<2$yrs = 5mcg/kg; 2-18yrs = 10mcg/kg (max 250mcg)

- **Salbutamol Infusion:** 5mg in 50ml saline. Infuse 0-10ml/hr. (50mls of neat salbutamol. Infuse 5-10mcg/kg/min for 1 hour, then reduced to 1-2mcg/kg/min)

- **Adrenaline infusion:** 5mg in 50mls saline. Infuse 0-20mls/hr. (not recommended)

- **Hydrocortisone:** 200mg IV (4mg/Kg)

- **Aminophylline:** bolus load: 400mg over 15mins. Infuse: 50mg in 50ml at 35ml/hr. (Load: 10mg/kg over 1hr diluted to 1mg/ml (max 500mg). Infusion varies by age: see tab 36b)

- **Magnesium:** 10mmol (5mls of 49.3%) over 20mins ($0.1$ml/kg of 49.3% (max 5mls) over 20mins)

- **Ketamine:** [must be anaesthetised] 35-70mg IV. ($0.5-1$mg/kg)
Main Priority: Minimise aspiration while maintaining $\text{SpO}_2$

- Call for help from surgical team members immediately
- If practical, move patient to head down, left lateral position asap
- Remove LMA/OP airway & suction pharynx
- **If time & $\text{SpO}_2$ stable >97%:**
  - Cricoid pressure (if not actively vomiting)
  - **Suxamethonium IV 100mg** (IV 2mg/kg; IM 4mg/kg)
  - Intubate
  - Suction through ETT with largest possible suction catheter
  - Only then, ventilate with 100% $O_2$
- **If $\text{SpO}_2$ dropping or <90%:**
  - Do not delay oxygenation regardless of particulates in pharynx/bronchial tree:
    - Bag mask ventilation with 100% $O_2$ or
    - Manual breaths via ETT with 100% $O_2$
- Consider bronchoscopy
- Consider abandoning surgery
- Pass NG tube at earliest convenience

- Monitor patient for 2 hours post event in PACU: If they are asymptomatic, have normal vital signs and a normal CXR, then they are unlikely to require ICU
- **Steroids & antibiotics** are not routinely used medications in aspiration

- **Suxamethonium**: IV 2mg/kg; IM 4mg/kg
Main priority = early defibrillation

- Ask surgeons to stop (if appropriate)
- Start chest compressions at 100/min and monitor EtCO₂ (ensure full chest recoil)
- Attach defibrillator. Shock immediately at 200J (or max setting)
- 100% O₂, stop anaesthetic agents
- If holding a mask/LMA: use ratio of 30 compressions : 2 breaths
- If ETT patent & secure: ventilate at 10 breaths/min & do not pause CPR
- Follow 2 min cycles:
  - Charge defib > Rhythm check > shock > restart compressions
  - Adrenaline 1mg (10mls of 1:10,000) immediately after 2nd shock, then every 4mins
  - Amiodarone 300mg immediately after 3rd shock
  - If ECG shows a QRS complex goto tab 7e

- Read out & consider reversible causes (see below)
- Fetch ultrasound to help r/o causes (if skilled)
- If ROSC consider post resuscitation care:
  - Abandon surgery, urgent cardiology referral (?for PCI)
  - ABCDE's, ABG's, 12 lead ECG, therapeutic normothermia (cool if >36 ºC)
  - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia

Reversible Causes:
- Hypoxia
- Hypovolaemia or Haemorrhage
- Hypo/hyper-thermia
- Electrolyte/Metabolic Disturbance:
  - ↑↓K, ↑↓Mg, ↓BSL, ↓pH, ↑↓Ca
- Tension Pneumothorax
- Tamponade - cardiac
- Anaphylaxis & Toxins - opioids, local anaesthetics, Ca channel or β blocker, other drug errors
- Thrombosis - cardiac or pulmonary
- Pregnant - manual uterine displacement & start preparations for delivering baby by 5mins (tab 19e)

(Follow all drugs with 20ml flush)
- Adrenaline IV: 1mg (10mls of 1:10,000)
- Amiodarone IV: 300mg
- Magnesium IV: [Torsades]: 10mmol (5ml of 49.3%) over 2mins
- Calcium Chloride IV: [↑K or CCB overdose] 10mls of 10%
- Sodium bicarbonate 8.4% IV: [↑K or TCA OD or ↓pH] 50ml slow push. Can repeat every 2mins until pH 7.45-7.55
- 1% lignocaine IV: [if amiodarone not available] 7mls bolus (0.1ml/kg). Can rpt every 10mins (max 0.3mls/kg)
- Intralipid 20% IV: [LA toxicity] Bolus: 100ml (1.5ml/kg); Infusion 1000mls/hr (15ml/kg/hr) - see tab 15e
- Alteplase: 100mg in 20mls saline. Infuse at 80ml/hr (be prepared for prolonged CPR - upto 60mins)
Main priority = good quality CPR

- Ask surgeons to stop all vagal stimuli
- Start chest compressions at 100/min and monitor EtCO₂ (ensure full chest recoil)
- Attach defibrillator
- 100% O₂, stop anaesthetic agents
- If holding a mask/LMA: use ratio of 30 compressions : 2 breaths
- If ETT patent & secure: ventilate at 10 breaths/min & do not pause CPR
- Follow 2 min cycles:
  - Charge defib > rhythm & pulse check > restart compressions
  - Give adrenaline 1mg (10mls of 1:10,000) immediately, then every 4mins
  - If ECG shows VF/VT goto [tab 6e]

- In asystole: if p waves present consider pacing (see [tab 30d])
- Read out & consider reversible causes (see below)
- Fetch ultrasound to help r/o causes (if skilled)
- If ROSC consider post resuscitation care:
  - abandon surgery, urgent cardiology referral
  - ABCDE’s, ABG’s, 12 lead ECG, therapeutic normothermia (cool if >36 ºC)
  - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia

Reversible Causes:
- Hypoxia
- Hypovolaemia/Haemorrhage
- Hypo/hyper-thermia
- Electrolyte/Metabolic Disturbance: ↑↓K, ↑↓Mg, ↓BSL, ↓pH, ↑↓Ca
- Tension Pneumothorax
- Tamponade - cardiac
- Anaphylaxis & Toxins - opioids, local anaesthetics, Ca channel or β blocker, other drug errors
- Thrombosis - cardiac or pulmonary
- Pregnant - manual uterine displacement & start preparations for delivering baby by 5mins - see [tab 19e]

(Follow all drugs with 20ml flush)
- [1K Rx]:
  - 10mls 10% Ca chloride slow push
  - salbutamol: 12puffs into circuit or 250mcg IV bolus
  - 10u actrapid in 250ml 10% dextrose @500ml/hr
  - [Opiate toxicity] Naloxone = 400mcg
  - [LA Toxicity]: Intralipid 20%: Bolus: 100ml (1.5ml/kg), Infusion 1000mls/hr (15ml/kg/hr) – see [tab 35r]
- [β blocker OD]: - adrenaline infusion: 5mg in 50mls saline. Infuse via CVL 0-20ml/hr
  - isoprenaline: Bolus = 200mcg amp into 20mls with saline & give 1ml boluses titrated. For infusion see [tab 35r]
  - high dose insulin: Bolus= 50ml of 50% dextrose & 70u actrapid. Infusion= 100u actrapid in 50mls saline, run at 35ml/hr & 10% dex run at 250mls/hr (monitor BSL & K every 15-30min)
- [Thrombosis] Alteplase: 100mg in 20mls saline. Infuse at 80ml/hr (be prepared for prolonged CPR - upto 60mins)
PAEDIATRIC CARDIAC ARREST

Main priority = Ensure adequate oxygenation & good CPR

- Ask surgeons to stop all vagal stimuli
- 100% O₂, stop anaesthetic agents, give 2 breaths
- Start chest compressions at 100/min and monitor EtCO₂ (ensure full chest recoil)
- If holding a mask/LMA: use ratio of 15 compressions : 2 breaths
- If ETT patent & secure: ventilate at 15 breaths/min & do not pause CPR
- Attach defibrillator
- Ensure IV access. If none establish intraosseous access (do not delay)
- Follow 2 min cycles:
  - Charge defib 4J/kg > rhythm check +/- shock > restart compressions:
    - IfVF/VT = shock immediately then every cycle.
      - Give 10mcg/kg adrenaline straight after 2nd shock, then every 4 mins
      - Give 5mg/kg amiodarone straight after 3rd shock
    - If asystole/PEA = give adrenaline ASAP then every 4 mins
- Atropine 20mcg/kg is only used in vagal associated bradycardia
- Read out & consider reversible causes (see below)
- Fetch ultrasound to help rule out causes (if skilled)
- If ROSC consider post resuscitation care as tab 7e

Reversible Causes: (most common in bold)
- Hypoxia & Vagal Tone
- Hypovolaemia/Haemorrhage/Anaphylaxis
- Hypo/hyper-thermia
- Electrolyte/Metabolic Disturbance: ↑↓K, ↑↓Mg, ↓BSL, ↓pH, ↓↑Ca
- Tension Pneumothorax
- Tamponade - cardiac
- Anaphylaxis & Toxins - opioids, local anaesthetics, Ca channel or β blocker, other drug errors
- Thrombosis - cardiac or pulmonary

Paeds Calculations (Follow all drugs with 20ml flush)
- Weight: age <1yr = (months/2)+4; age 1-5 = (yrs x2)+8; age 6-12 = (yrs x3)+7
- Energy (J): 4*Kg; if using AED - use attenuated paeds pads for <8yrs old (if available)
- Tube (uncuffed): preterm (<1.5kg) = 2.5; preterm (1.5-3kg) = 3; <1yr = 3.5 - 4; >1yr = (age/4) + 4
- Fluid: 20ml/kg bolus
- Adrenaline: IV = 10mcg/kg (0.1ml/kg of 1:10,000); ETT = 100mcg/kg (0.1ml/kg of 1:1,000)
- Amiodarone: 5mg/kg
- Atropine: 20mcg/kg IV or IM
- Glucose: 2ml/kg of 10% dextrose
- Sux: IV: 2mg/kg; IM: 4mg/kg
- Calcium chloride 10%: 0.1-0.2ml/kg
- Naloxone: 10mcg/kg
- Follow all drugs with an appropriate large flush
- ETT sizes are uncuffed tubes. Consider dropping 0.5-1mm in size for cuffed tubes
- Calculations have been rounded where relevant & insignificant

<table>
<thead>
<tr>
<th>2 months or 5 kg</th>
<th>6 months or 7 kg</th>
<th>1yr or 10 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal HR</td>
<td>100-160</td>
<td>Normal HR</td>
</tr>
<tr>
<td>Energy (J)</td>
<td>20</td>
<td>Energy (J)</td>
</tr>
<tr>
<td>ETT Size (mm)</td>
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<td>ETT Size (mm)</td>
</tr>
<tr>
<td>ETT (oral) Length (cm)</td>
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<td>ETT (oral) Length (cm)</td>
</tr>
<tr>
<td>ETT (nasal) Length (cm)</td>
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<td>ETT (nasal) Length (cm)</td>
</tr>
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<td>LMA Size</td>
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<td>Fluid bolus (ml)</td>
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<tr>
<td>Adrenaline (1:10,000)</td>
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<td>Amiodarone (mg)</td>
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<td>10% Glucose (ml)</td>
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<tr>
<td>Sux - IV (mg)</td>
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<td>Sux - IV (mg)</td>
</tr>
<tr>
<td>Sux - IM (mg)</td>
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<td>5yr or 18kg</td>
<td>10yr or 37kg</td>
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</tr>
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<td>ETT (oral) Length (cm)</td>
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<td>ETT (nasal) Length (cm)</td>
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<td>ETT (nasal) Length (cm)</td>
</tr>
<tr>
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<td>10% Glucose (ml)</td>
<td>30</td>
<td>10% Glucose (ml)</td>
</tr>
<tr>
<td>Sux - IV (mg)</td>
<td>30</td>
<td>Sux - IV (mg)</td>
</tr>
<tr>
<td>Sux - IM (mg)</td>
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</tr>
<tr>
<td>Atropine (mcg)</td>
<td>280</td>
<td>Atropine (mcg)</td>
</tr>
</tbody>
</table>
Main priority = **Cease triggers, give adrenaline & IV fluid**

- Get **anaphylaxis box** (if you prefer: follow ANZAAG task cards)
- **Stop** or remove **causative agents** (e.g., drugs, blood products, latex products, chlorhexidine etc)
- Minimise volatile but maintain anaesthesia
- Consider early intubation (risk of airway oedema)
- Ensure large bore IV access. If none, consider intraosseous access
- **Treat based on grade of anaphylaxis** (see yellow box)

  - Give **IV adrenaline & fluids asap**
    - (If no IV give IM adrenaline 0.5ml 1:1,000  \(0.01\text{ml} / 1:1,000\), 6-12yrs = 0.3ml. Repeat every 5mins)
  - Repeat **adrenaline & fluid boluses every 1-2 minutes as required**:

<table>
<thead>
<tr>
<th>Grade 1 (Mild)</th>
<th>Grade 2 (Mod/severe)</th>
<th>Grade 3 (Life threatening)</th>
<th>Grade 4 (Cardiac arrest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Adrenaline</td>
<td>10mcg (0.1ml 1:10,000)</td>
<td>100mcg (1ml 1:10,000)</td>
<td>1mg (10ml 1:10,000)</td>
</tr>
<tr>
<td>Fluid Bolus</td>
<td>(0.01ml/kg 1:10,000)</td>
<td>(0.05ml/kg 1:10,000)</td>
<td>(0.1ml/kg 1:10,000)</td>
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<tr>
<td>Legs</td>
<td>Not required</td>
<td>Rapid 1 litre</td>
<td>Rapid 1-2 litres</td>
</tr>
<tr>
<td></td>
<td>10ml/kg</td>
<td>10-20ml/kg</td>
<td>20ml/kg</td>
</tr>
</tbody>
</table>

  - If >3 **adrenaline** boluses start **adrenaline infusion**

- **Refractory management**:
  - bronchospasm (see tab 4 for other drug options)
    - **Salbutamol**: 12 puffs (\(<6\text{yrs} = 6\text{ puffs}\)  \(>6\text{yrs} = 12\text{ puffs}\)  \(\Rightarrow\)  IV bolus (see below)  \(\Rightarrow\)  infusion (see below)
  - hypotension:
    - **adrenaline infusion**  \(\Rightarrow\)  **repeat fluid bolus**  \(\Rightarrow\)  noradrenaline +/- vasopressin infusion

- Monitor treatment success: MAP, SpO₂, airway pressures, EtCO₂ waveform, ECHO
- Place arterial line - check ABG’s, FBC, U&Es, coags
- Consider abandoning surgery
- Once stabilised: **dexamethasone 12mg** (\(0.6\text{mg/kg}\))
- Collect **tryptase** (yellow tube) levels at time 1, 4, 24hrs

- **Grades of anaphylaxis**:

<table>
<thead>
<tr>
<th>Grade 1 = Mild</th>
<th>Grade 2 = Mod/severe</th>
<th>Grade 3 = Life threatening</th>
<th>Grade 4 = Cardiac arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucocutaneous signs</td>
<td>Mucocutaneous signs</td>
<td>+/- Mucocutaneous signs</td>
<td>Start IV, adrenaline &amp; CPR!</td>
</tr>
<tr>
<td>+/- Angiooedema</td>
<td>↓MAP, 1HR</td>
<td>Arrhythmias &amp; CVS collapse</td>
<td></td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>Severe bronchospasm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Adrenaline** or **Noradrenaline** infusion (do not need CVL to start): 5mg in 50mls saline. Infuse 1-20mls/hr (\(0.15\text{mg/kg} \text{made to 50mls with saline. Infuse 1-10mls/hr}\))
- **Salbutamol** IV bolus: 100-250mcg \(<2\text{yrs} = 5\text{mcg/kg}; 2-18\text{yrs} = 15\text{mcg/kg} \text{(max 250mcg)}\) infusion: 5mg in 50mls saline. Infuse 1-10ml/hr (\(5\text{mcg/kg/min for 1hr then 1-2mcg/kg/min}\))
- **Vasopressin** (do not need CVL to start): 20units in 20ml saline. Bolus 1ml. Infuse 1-4ml/hr (\(1\text{unit/kg} \text{made to 50mls with saline. Infuse 1-3ml/hr}\))
Main priority = ↓**Myocardial O\textsubscript{2} consumption** & ↑**myocardial O\textsubscript{2} supply**

- Titrate inspired O\textsubscript{2} to **normal** SpO\textsubscript{2} 97-99% (PaO\textsubscript{2} 80-100mmHg)
- Check **depth** of anaesthesia, ensure adequate **analgesia**

**Control heart rate** (target 60-80bpm):
- Minimise surgical stimulation (where appropriate)
- Drug strategies:
  - **Esmolol 20mg** boluses titrated to effect
  - **Metoprolol 2.5mg** boluses titrated to effect (max 15mg)

**Target MAP of 65-75mmHg:**
- If MAP <65mmHg:
  - Use **vasopressors or ephedrine** cautiously
  - If refractory ↓MAP consider:
    • Drugs: inotrope (eg **dobutamine**) or inodilators (eg **milrinone**)
    • Cardiothoracic referral for placement of Intra-Aortic Balloon Pump
- If MAP >75mmHg: use **GTN infusion**

- **Avoid hypovolaemia** - replace surgical losses & **transfuse** to Hb 80-90
- If **ongoing** signs of **ischaemia** commence **GTN infusion** regardless of MAP & support MAP with drugs/Intra-Aortic Balloon Pump as required
- Expedite end of surgery

**Other Intra-Op Tasks to consider:**
- Discuss anticoagulation with surgeon: heparin +/- aspirin, clopidogrel, enoxaparin
- ECHO to assess myocardial performance/volume status
- Further haemodynamic monitoring eg Cardiac Index Monitoring
- Take baseline Troponin, then at 3hrs or 6 hrs

**Post Op Tasks to consider:**
- 12 lead ECG and ongoing post-op telemetry
- Immediate cardiology referral - ?suitability for PCI

- **Vasopressors** - **Phenylepherine**: 50mcg bolus, **Metaraminol**: 0.5mg bolus
- **Ephedrine**: 6mg bolus. Titrate
- **Noradrenaline**: 5mg in 50ml saline. Infuse 0-20ml/hr preferably via CVL
- **Adrenaline**: 5mg in 50ml saline. Infuse 0-20ml/hr preferably via CVL
- **Dobutamine**: 250mg in 50ml saline. Infuse 0-10ml/hr (can infuse peripherally)
- **Milrinone**: 10mg in 50ml saline. Infuse at 5ml/hr or 10ml/hr only
- **GTN**: 50mg in 50ml saline. Infuse at 1-12ml/hr titrated to MAP & ECG changes
12e. SEVERE HAEMORRHAGE

Main priority = Volume replacement & good teamwork

- IV access: x2 16G cannula +/- Rapid Infusion Catheter (RIC)
- Ensure adequate surgical effort to control active bleeding (see yellow box)
- Contact blood bank - call for blood
- Set up rapid infusion device (+/- cell saver if available)
- Give 3 units O negative or group specific blood

If ongoing or severe bleeding:

- Activate massive transfusion protocol
- Request each box in turn and give products asap
- Assemble a team with clear roles (eg blood bank liaison, runner to collect boxes, blood checkers, people to hang blood etc.)

- Insert arterial line

- Use permissive hypotension: MAP 55-65mmHg until haemostasis established (except head injuries where MAP target = 80-90mmHg)

- Aggressively keep warm (>36°C): Warm fluids, warm theatre, forced air warmer

- Check bloods every 30mins: Coags (TEG if available), FBC, ABG, iCa²⁺

- Use treatment thresholds (in green box) to guide further blood product use

- Keep ionised Ca²⁺ >1mmol/L = give 10ml 10% calcium chloride

Other Tasks to consider:

- Stress to surgeon the need for haemostasis - compression, packing, direct pressure, arterial/aortic clamping
- If haemostasis achieved call blood bank to ‘stand down’ protocol

- Additional Treatment Thresholds & Doses:

  - Consider IV tranexamic acid with Box 2a - give 1g over 10mins. Then 1g over 8hrs
  - INR >1.5 or APTT >40 = give 4U FFP
  - Fibrinogen <1G/L = give 3U cryoprecipitate (in obstetrics aim for fibrinogen >2G/L)
  - Platelets <75 = give 1 adult pack of platelets
  - Factor VIIa in consultation with haematologist - 6mg (90mcg/kg)

- Blood product compatibility:

<table>
<thead>
<tr>
<th>Rbc's:</th>
<th>Patient (Recipient)</th>
<th>Compatible (Donor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in a crisis, Rh is not impt - see blood bank)</td>
<td>A</td>
<td>A, O</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>B, O</td>
</tr>
<tr>
<td></td>
<td>AB</td>
<td>A, B, AB, O</td>
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<td></td>
<td>O</td>
<td>O, AB, O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FFP: (at any time, Rh is not relevant)</th>
<th>Patient (Recipient)</th>
<th>Compatible (Donor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A, AB</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>B, AB</td>
<td></td>
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<tr>
<td>AB</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>O, A, B, AB</td>
<td></td>
</tr>
</tbody>
</table>

- Platelets/Cryo: in a crisis, ABC & Rh are not impt (see blood bank)
**13e. AIR/GAS EMBOLISM**

**Main priority = Restore cardio-respiratory stability**

- 100% oxygen
- Stop nitrous oxide
- Stop source of air/gas entry:
  - Surgical site - lower to below level of heart & flood with irrigation fluid
  - Entry point - search for e.g. open venous line
  - Neurosurgery case - consider intermittent jugular venous compression
- Place patient in head down, left tilt position
- Remove pneumoperitoneum (if in use)
- If CVL in place - aspirate line
- Consider chest compressions 100/min (even if not in arrest - known to break up volumes of air)
- Aim MAP >65mmHg:
  - Assess fluid responsiveness - 500ml bolus crystalloid (♀ = 20ml/kg)
  - Vasoactive medications eg noradrenaline, adrenaline, dobutamine
- Consider early TOE - (useful to r/o other causes of pulmonary embolism)
- Consider referral for hyperbaric oxygen therapy

**Signs of air/gas embolism:**

- **Respiratory:** ↓EtCO₂ (most sensitive), ↓SpO₂, pulmonary oedema, bronchospasm
- **CVS:** shock, tachycardia, ↑PA pressures, cardiovascular collapse

- Use of PEEP is controversial. May ↑risk of paradoxical air embolism through PFO (note PFO is present in 10-30% of population)

- **Hyperbaric O₂** - treatment up to 6hrs post event may improve outcome in paradoxical air embolism

**Adrenaline:**

- bolus = 10-100mcg (0.1-1ml of 1:10,000) - (♀ 0.01-0.05ml/kg of 1:10,000)
- Infusion = 5mg in 50mls saline. Infuse 0-20mls/hr (♀ see tab 36r)

**Noradrenaline infusion:** 5mg in 50mls saline. Infuse 0-20mls/hr

**Dobutamine infusion:** 250mg in 50ml saline. Infuse 0-10ml/hr (can infuse peripherally)
Main priority = Early recognition & full resuscitation of ABC’s

- Stop transfusion & flush line
- Recheck blood against patient
- Minimise volatile but maintain anaesthesia

Resuscitate based on ABC’s:
- Consider early intubation
- Treat bronchospasm if present - see tab 4e
- Address cardiovascular instability - aim MAP >65mmHg:
  - Assess fluid responsiveness: Leg elevation +/- 500ml fluid bolus (=*20ml/kg)
  - Start adrenaline infusion (recommended 1st line due to diagnostic similarity with anaphylaxis)
  - Maintain urine output (aim 1ml/kg/hr) - IV furosemide 35mg

- Place arterial line, CVL & urinary catheter (collect urine for analysis)
- Take bloods: U&E, FBC, Coags & sample for re-X match
- Watch for coagulopathy & consult haematologist - Treat early see tab 12e
- Consider IV methylprednisolone 250mg slow injection
- Collate all blood products & return to lab
- Contact ICU

Signs of haemolytic transfusion reaction (very similar to anaphylaxis):
- CVS: shock, tachycardia/arrhythmias, cardiac arrest
- Respiratory: Bronchospasm, wheezing, Cough/Stridor, Hypoxia, ↑airway pressure
- Misc: urticaria, oedema, bleeding from wound sites/membranes, dark coloured urine

- Consider differential eg anaphylaxis, cardiogenic shock, etc...

If relevant consult protocols for
- Anaphylaxis tab 10e
- Bronchospasm - tab 4e
- Severe Intraoperative haemorrhage - tab 12e

Adrenaline or Noradrenaline infusion: 5mg in 50mls saline. Infuse 0-20mls/hr

Salbutamol:
- bolus = 250mcg slow push (<=2yrs = 5mcg/kg; <=18yrs 15mcg/kg (max 250mcg)
- infusion = 5mg in 50mls saline. Infuse 0-10ml/hr (50mls of neat salbutamol. Infuse 5-10mcg/kg/min for 1 hour, then reduced to 1-2mcg/kg/min)
Main Priority: Good Quality CPR & early Intralipid

- **Stop** administration of LA and get LA Toxicity Box (if you prefer: follow AAGBI task cards)

- **If signs of cardiac output:**
  - Consider need for intubation
  - **Ventilate** if required - aim for EtCO₂ 30mmHg
  - Confirm IV access
  - Consider giving **IV 20% intralipid** early: bolus then infusion (see dosing below)
  - **If arrhythmia** use standard protocols - see tab 29d (Consider amiodarone 300mg slow IV push. Avoid lignocaine, caution with βblockers)
  - Support **MAP** with fluids & **vasopressors**
  - Treat **seizures:**
    - midazolam IV 2mg bolus. Repeat every min (max 10mg) (see green box)
    - If refractory: perform RSI

- **If cardiac arrest:**
  - Start CPR (see tab 6e or tab 7e) but note:
    - Use **reduced dose adrenaline** (70mcg/dose) (1mcg/kg) only after **intralipid**
    - Be prepared to continue for 60 mins
  - Give **20% IV intralipid** (see green box): 
    - **Bolus:** 100mls. Can repeat every 5 mins, maximum twice (if required)
    - **Infusion:** 1000ml/hr neat intralipid. Double rate @ 5mins if no improvement
    - Do not exceed max dose of 840mls
  - Mobilise cardiopulmonary bypass/ECMO team (if available)
  - Send ABG - keep pH >7.25: Give sodium bicarbonate **8.4% 50mls** (1ml/kg) (Can rpt every 2mins - must ensure adequate ventilation)

- **Signs** of LA toxicity:
  - **CNS:** Numb tongue, tinnitus, metallic taste, slurred speech, seizures, unconscious
  - **CVS:** ↓MAP, broad QRS, bradycardia deteriorating into PEA & asystole
  - Temporary pacing may be required for symptomatic bradycardias (see tab 30d)

**PAEDS Dosing** (see tab 8e or tab 36r for resus doses)

- **Midazolam**: IV 0.1mg/kg; IM 0.2mg/kg; buccal 0.5mg/kg. Can repeat at 5mins
- **Intralipid** 20%: bolus: 1.5ml/kg. Can rpt every 5mins x2. Infusion: 15ml/kg/hr. At 5mins can double rate if no improvement. Max cumulative dose = 12ml/kg
Main Priority: **Early Recognition, Removal of Triggers, Dantrolene**

- **Recognise problem** - if in doubt treat
- **Call for MH trolley** (if you prefer: distribute & follow MH task cards)
- **Delegate & organise help into teams**
- **Stop volatile & washout with 100% oxygen at 15 litres.** Switch to **TIVA**
- **Add charcoal filters to circuit. Change soda lime if easy** *(Do not waste time changing machine/circuit)*
- **Give **[IV dantrolene](#)** *(2.5mg/kg) & get more from on call pharmacist:*
  - 9 vials of 20mg. Reconstitute each vial into 60ml syringe with water
  - Repeat every 10mins until control achieved *(max total 35vials or 10mg/kg)*

- Increase **monitoring** if not already in place:
  - **Arterial line +/- CVL.** Take serial bloods: ABGs *(every 30min)*, Coags, CK
  - **Urinary catheter.** Aim for urine output >2ml/kg/hr
  - **Core temperature probe** eg rectal or bladder

**Treating complications:**

- **>38.5°C:** refrigerated IV fluids (& intraperitoneal if surgical access), surface ice, cold operating room
- **pH <7.2:** Ventilate EtCO₂ to 30cmH₂O *(+/- sodium bicarbonate)*
- **K⁺ >7 or ECG changes:** Give **IV calcium chloride, IV insulin-dextrose infusion, salbutamol puffs**
- **Arrhythmias:** Defibrillate. Consider **IV amiodarone +/- lignocaine +/- esmolol**
- **MAP <65mmHg:** start **noradrenaline** infusion

**Consider abandoning surgery & ICU referral**

- **Rapid diagnosis:** ABG = mixed respiratory & metabolic acidosis
- **Signs** suggesting possible MH:

<table>
<thead>
<tr>
<th></th>
<th>Early</th>
<th>Developing</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>EtCO₂ rising</td>
<td></td>
<td></td>
<td>Cola coloured urine</td>
</tr>
<tr>
<td>Masseter spasm</td>
<td></td>
<td>CVS instability</td>
<td>Coagulopathy, ↑↑CK</td>
</tr>
<tr>
<td>↑HR/arrhythmia</td>
<td></td>
<td></td>
<td>Cardiac arrest</td>
</tr>
</tbody>
</table>

- **[pH<7.2]: Sodium bicarbonate** 8.4% 50mls, rpt every 2mins
- **[K⁺ >7]: Calcium chloride** 10% 10mls IV *(0.2ml/kg)*; 10units of **actrapid** in 250mls 10% **dextrose** over 30mins *(0.1u/kg actrapid in 2ml/kg of dextrose over 30mins)*; 12puffs **salbutamol** into circuit *(2-6puffs)* rpt every 20mins
- **[arrhythmias] Amiodarone** 300mg slow IV push *(5mg/kg)*; 7mls **1% lignocaine** slow IV push *(0.1-0.2ml/kg)* *(Can rpt every 10 mins - max 0.3ml/kg)*; **Esmolol** 10mg increments
- **[↓MAP]: Noradrenaline** infusion: 5mg in 50mls saline. Infuse at 0-20mls/hr
Main Priority: Monitor ECG & Treat

- Consider haemolysis or faulty sample & need to re-check
- Stop any source of K+ infusion. Re-check recent drug calculations
- ↑Minute ventilation. Aim for EtCO₂ of 30mmHg
- If K+ >6.5mmol/L +/- marked ECG changes start drug therapy:
  - 10% calcium chloride 10ml slow bolus
  - Infuse quickly: 0.1ml of undiluted actrapid (10 units) in 250ml 10% dextrose
  - 6-12 puffs salbutamol into circuit. Repeat every 20mins
- If refractory high K+ consider:
  - 50mls 8.4% sodium bicarbonate (ensure adequate ventilation)
  - 20-40mg IV frusemide
  - Referral for dialysis
- Correct any reversible precipitating factors

**ECG signs** of hyperkalaemia:
- peaked T waves
- prolonged PR
- wide QRS
- loss of P waves
- ↓ R amplitude
- asystole

**Precipitating factors** to consider:
- trauma
- burns
- suxamethonium use in burns, spinal injury, neurological disease
- MH
- rhabdomyolysis
- acidosis
- acute renal failure
- organ re-perfusion eg following clamp/tourniquet
- haemolysis/massive transfusion
- medications

**Avoid:**
- further doses of suxamethonium
- respiratory acidosis

**PAEDS Doses**
- **Calcium chloride** 10% 0.2ml/kg slow bolus
- **Insulin/dextrose:**
  - Periph IV: Bolus 0.1u/kg actrapid in 5ml/kg of 10% dextrose
  - Central Line: Bolus 0.1u/kg actrapid in 2ml/kg of 50% dextrose
- **Salbutamol:** <5yrs: 6puffs every 20mins; >5yrs: 6-12puffs every 20mins
- **Sodium bicarbonate** 8.4%: 1ml/kg slow push. Can repeat every 2mins
- **Frusemide:** 1mg/kg IV bolus
**AIRWAY FIRE**

**Main priority = Disconnect circuit & flood with saline**

- **Stop ignition** source - laser or diathermy
- **Turn off oxygen & disconnect breathing circuit** from airway device
- **Extinguish fire:**
  - Flood fire with **saline: 50mls** into mouth, **10-20mls** down ETT (1ml/kg max 20mls)
  - **CO₂ extinguisher** (safe to use in airway)
- **Remove airway device & keep for inspection**
  (only consider leaving ETT in place if difficult intubation & very low risk of fire extending into ETT)
- **Remove any flammable material** in mouth - packs, gauze & sponges
- **Retrieve debris** with a Yankauer sucker or large bore suction catheter
- **Convert to TIVA anaesthetic**
- **Restart ventilation only when fire is fully extinguished** (wait 1-3min if SpO₂ allows):
  - Use bag mask ventilation initially but prepare for early intubation
  - Use **lowest possible oxygen** to maintain normal SpO₂
- **If unable to re-intubate**: perform **infracloctic technique** depending on urgency:
  - emergency: infraglottic technique (see tab 2e)
  - urgent: call ENT to perform tracheostomy
- **Terminate or expedite** end of surgery
- **Post crisis care:**
  - Perform **bronchoscopic exam** to assess mucosal airway damage
  - Do not extubate; refer to ICU

**PATIENT FIRE**

**Main priority = Recognise fire and extinguish**

- **Stop** any flow of **oxygen** or **nitrous** near/into to fire
- **Remove all drapes** and flammable material from patient
- **Extinguish fire with:**
  - **Saline, fire blanket** or **CO₂ extinguisher** (safe in wounds & electrical equipment)
  - **Do not** use alcohol liquids
  - **Do not** use any liquid on/around electrical equipment
- **If fire persists**: activate fire alarm, turn off gas supply to room, evacuate

- **To decrease risk of airway fire:**
  - Use lowest possible oxygen, avoid nitrous
  - Place saline in ETT & LMA cuffs
  - Pack wet throat pack around ETT’s
  - If LASER surgery: use LASER resistant ETT with methylene blue in proximal cuff, saline in distal cuff
- **To decrease risk of patient fire:**
  - Allow time for skin preps to fully dry
  - Use moistened sponges & gauzes near ignition sources
**Main Priority:** Good CPR, Diagnose Cause, Prepare for Delivery

- Review all infusions/medications recently administered
- **Activate MTP now.** Start volume resuscitation ASAP (See tab 12e)

- **If no cardiac output:**
  - Call 777 & declare ‘MET call + obstetric & neonatal emergency’
  - Start preparations to deliver baby now (peri-mortem Caesarean or instrumental)
  - Remove all foetal monitoring
  - Start CPR > apply defib > check rhythm > see tab 6e or tab 7e
  - Ensure IV access, if none consider IO access
  - Consider reversible causes & attempt diagnosis & treat asap (see yellow box)

- Note ‘maternal’ specific tasks during CPR:
  - **Lift uterus skyward & displace** to left
  - **Intubate early** & ventilate with EtCO₂ target of 30mmHg
  - Perform chest compressions higher on chest & push deeper
  - Patient >24 weeks: If no rapid ROSC then start immediate preparations to deliver baby within 5mins (peri-mortem Caesarean or instrumental)

- **Delivery of baby** is performed to improve maternal prognosis, not babies
  - Consider the reversible causes of collapse in pregnancy (Ts & Hs):
    - **Hypoxia:** aspiration, high spinal
    - **Hypovolaemia/hypotension:** bleeding, high spinal
    - **Metabolic disorders:** AKI from severe pre-eclampsia, ↓BSL
    - **Hypertension:** intracranial haemorrhage, eclamptic seizure
    - **Toxicity:** Anaphylaxis, ↑Mg²⁺, LA toxicity
    - **Thromboembolism:** VTE/PE, amniotic fluid or air embolism
    - **Tamponade:** cardiac 2nd to aortic dissection, trauma
    - **Tension Pneumothorax:** trauma

- **Magnesium** (49.3%) [eclampsia]:
  - loading infusion: 8mls with 12ml saline. Give via slow IV push over 5mins
  - For maintenance & rescue doses see tab 23e

- **Calcium chloride 10%** [MgSO₄ toxicity antidote]: 5mls slow push. (can repeat)

- **20% Intralipid** [LA toxicity]: (max total 12ml/kg)
  - bolus: 100mls (1.5ml/kg). Repeat (max twice) every 5 mins, if required
  - maintenance: 1000ml/hr (15ml/kg/hr). Double speed @5mins if no improvement

- **Alteplase** [Thrombosis]: 100mg in 20mls saline. Infuse at 80ml/hr (be prepared for prolonged CPR - upto 60mins)
  - [To reverse]: Stop infusion. Give 1g tranexamic acid. Discuss with haematologist (cryo +/- platelets)
Main Priority: **Dry baby, Oxygenate & Reassess every 30 secs**

- Pre-setup neopuff: Gas supply @10L, PEEP 5, PIP 30cmH₂O. Heater & suction
- In 1st minute: **Vigorously dry** baby & apply warm, dry towels
- Then work in **30 sec cycles**. Perform intervention then reassess at end of cycle:
  - **Tone** - UL & LL
  - **HR** - use SpO₂ probe or stethoscope (tap beats out +/- count beats for 3 secs, then x 20)
  - **RR** - Are they gasping or apnoeic?

- If HR > 100, good tone, regular RR: give routine care
- If baby well except ↑ WOB: open airway & give 5 cmH₂O CPAP with room air
- If any of HR < 100, poor tone, gasping/apnoeic: start ventilating:
  - Fine tuning of neutral head position with jaw thrust is vital
  - Room air initially. ↑ O₂ every 30 secs if no improvement: 40% then 100%
  - Consider x5 inflation breaths of 2-3 sec: PIP 30cmH₂O
  - Once adequate **chest rise**: RR 40-60/min: PIP 15-20cmH₂O

- If HR < 60:
  - 100% O₂. Consider LMA or intubation (if skilled)
  - Start chest compressions @ 90/min (2 thumb technique with 2nd person for airway is preferred)
  - Use ratio = compressions 3 : 1 breath (half second compression pause to deliver breath)

- If Ongoing HR < 60:
  - Give **1:10,000 adrenaline** based on gestation
  - Umbilical **venous catheter** is preferred (1 vein, 2 arteries)

<table>
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<tr>
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<th>23-26 Weeks</th>
<th>27-37 Weeks</th>
<th>38-43 Weeks</th>
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</thead>
<tbody>
<tr>
<td>Umbilical Adrenaline</td>
<td>0.1 ml</td>
<td>0.25 ml</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>ETT Adrenaline</td>
<td>1ml/kg (100mcg/kg)</td>
<td>then 2ml normal saline flush</td>
<td></td>
</tr>
</tbody>
</table>

- Consider **umbilical saline bolus** 10ml/kg

- If preterm use lower inflation pressures: 28-32wks = 25/5; < 28wks = 20/5
- Significant meconium delivery: Only suction a flat baby prior to oxygenating
- Place NG to **decompress stomach** if difficulty ventilating
- Assistant can place SpO₂ probe on right arm at any point. **Targets:**
  - 1 min = 60-70%
  - 2 min = 65-85%
  - 3 min = 70-90%
  - 4 min = 75-90%
  - 5 min = 80-90%
  - 10 min = 85-90%

---

**Neonatal Drugs & Equipment**

- **Naloxone**: Full term = 200mcg IM (otherwise 10mcg/kg IM/IV)
- ETT: uncuffed size = [term] 3-3.5mm, [preterm] 2.5mm (have size above & below to hand); length 10cm
21e. TOTAL/HIGH SPINAL

Main Priority: Rapid management of ABC’s

- If on delivery suite: Call 777 & declare “obstetric & neonatal emergency”
- Review all infusions/medications & consider reversible causes (yellow box below)

If no cardiac output:

- Start CPR > apply defib > check rhythm - see tab 6e or tab 7e
- If obstetrics, follow ‘maternal’ specific tasks:
  - Lift uterus skyward & displace to left
  - Intubate early & ventilate with EtCO₂ target of 30mmHg
  - Perform chest compressions higher on chest & push deeper
  - Patient >24 weeks: If no rapid ROSC then start immediate preparations to deliver baby within 5mins (peri-mortem Caesarean or instrumental)

- Note ‘total spinal’ specific tasks:
  - Give adrenaline 1mg (10ml 1:10,000) (10mcg/kg) asap
  - Early rapid infusion of 2-3 litres of fluid (20ml/kg)

If respiratory arrest or distress or falling SpO₂:

- Elevate head of bed to 30 degrees
- Assist ventilation with 100% O₂ via BMV while preparing to RSI
- Consider induction with midazolam 5-10mg, alfentanil 1mg & sux 100mg

If cardiovascularly unstable (↓HR & ↓MAP):

- Elevate legs, rapidly infuse 2-3 litres fluid (20ml/kg)
- If obstetrics, lift uterus skyward & displace to left
- If HR <60 then give 600mcg atropine (20mcg/kg). Repeat if required (max adult 3mg)
- Give vasopressor (see below) depending on HR. Repeat as required.
- Refractory ↓MAP: use adrenaline boluses +/- infusion

- Diagnosis is clear if witnessed rapidly ascending block following neuraxial procedure
- If unwitnessed collapse consider other causes (if obstetrics see tab 19e):
  - Vasovagal
  - Haemorrhage (external or concealed) / tab 12e / tab 22e
  - LA Toxicity / Amniotic Fluid Embolism / tab 15e / tab 24e
  - Mg toxicity
  - IVC compression
  - Massive pulmonary embolus
  - Drug error

- Vasopressor: phenylephrine 100mcg (10mcg/kg); metaraminol 1mg (10mcg/kg);
  ephedrine 9mg (0.1mg/kg)
- Adrenaline - bolus: 0.1-0.5ml 1:10,000 (10-50mcg); infusion: 5mg in 50mls saline. Infuse at 0-20mls/hr (infusion only: 0.15mg/kg (max 5mg) in 50mls saline. Infuse 0.5-10ml/hr)
Main Priority: Prepare for Massive, Rapid Blood Loss

☐ x2 16G IV cannula - consider intraosseous access if needed
☐ Encourage surgical control of uterine tone & bleeding (see yellow box)
☐ Review with surgeon every 10mins: diagnosis & plan (see yellow box)
☐ Rapidly infuse crystalloid to match blood loss

☐ If ongoing severe blood loss:
   • Call blood bank & rapidly transfuse up to 3 units of blood
   • If required activate massive transfusion protocol (see tab 12e)
   • Note obstetric specific MTP actions:
     - If fibrinogen level <2 then give 3 units cryoprecipitate
     - Give 1g tranexamic acid slow push ASAP. Can repeat after 30mins

☐ If out of theatre: call 777 declare an “obstetric emergency”
☐ Use vasopressors to maintain a MAP >65mmHg
☐ Aggressively keep warm (>36°C): Warm fluids, warm theatre, forced air warmer
☐ Use oxytocics to address uterine atony:
   • Oxytocin IV 5 units slow push. Follow with infusion (see green box)
   • Ergometrine 500mcg IM (avoid if ↑MAP)
   • Carboprost 250mcg IM (avoid if asthmatic). Can repeat every 15mins (max 8 doses)
   • Misoprostol 1000mcg PR/vaginal

☐ Perform RSI to enable surgical control (spinal only if haemodynamically normal). Consider:
   • Induction: Ketamine 100mg (1-2mg/kg), suxamethonium 100mg
   • Maintenance: TIVA or volatile/nitrous
☐ Place arterial line +/- CVL

• Major causes of PPH:
  • Tone (75%)
  • Tissue/Retained placenta (15%)
  • Trauma/Laceration (5-10%)
  • Thrombosis/Coagulopathy
  • Splenic artery rupture (rare)

• Surgical control of bleeding can include:
  • Pre-theatre: Uterine massage, bimanual compression, aortal compression
  • Intra-op: BAKRI balloon, B Lynch suture, aortal compression, artery ligation, hysterectomy

• Oxytocin infusion: 40units in 250ml saline. Infuse at 62.5ml/hr
• Vasopressors: Metaraminol 1mg; phenylepherine 100mcg, Adrenaline: 10-100mcg & titrate
• Adrenaline/Noradrenaline Infusion: 5mg in 50mls saline. Infuse at 10-20ml/hr preferably via CVL
23e. PERI-PARTUM SEIZURE

Main Priority: Oxygenation, Magnesium & Treating Hypertension

☐ Call 777 & state “obstetric emergency”
☐ Call for eclampsia box
☐ Give O₂ 15L/min via non-rebreathe facemask
☐ Apply monitoring: SpO₂, ECG, NIBP
☐ **Start timer:** Measure length of seizure (eclamptic seizures normally self terminate)
☐ **Maximise patient safety** while displacing gravid uterus (if antenatal):
   - Pillows & covered bed sides
   - Depending on staff safety: Lift uterus up & to left or place in full left lateral

☐ Prepare and give **Magnesium (49.3%)** asap:
   - **Loading dose:** 8mls with 12mls saline. Give via slow IV push over 5mins
     (If no IV then give 10mls IM into each gluteal region (total 20mls))
   - Then **maintenance** infusion (see green box)
   - If repeat seizure give **rescue dose** (see green box)

☐ **If ongoing seizures or seizure lasting >10mins:** then escalate treatment in turn:
   - Give **Midazolam IV 2mg bolus**, repeat every minute (max 10mg)
     (If no IV then use high concentration 5mg/ml midazolam: **Nasal:** 2ml via atomiser or IM:** 2ml into deltoid)
   - Perform **RSI** & refer to ICU

☐ **Post seizure**:
   - Review A, B, C & check **blood sugar level**
   - Send **blood tests** (FBC, LFTs, U&Es, uric acid, coag screen, Mg, G&H)
   - Consider chance of **aspiration**: SpO₂, auscultate chest, perform chest XR (if needed)
   - If *bp >160/100mmHg* then consider one or both:
     - **Labetalol IV** (neat=5mg/ml): 4ml over 2mins. Repeat every 10 mins (max 3 doses)
     - **Hydralazine IV** (neat=1mg/ml): Give 5ml slow push. Repeat every 20min
   - **Restrict total fluid** input to 80mls/hr & monitor hourly urine with catheter

☐ **If antenatal:** Discuss with obstetric team: Plan for delivery of baby
☐ Consider **other causes** of seizure other than eclampsia: discuss with **neurologists**

- Check reflexes, sedation score & vitals: Initially every 30min, then hourly
- Serum magnesium levels are only needed if concurrent renal dysfunction:
  - Therapeutic Mg²⁺ level = 2-4mmol/L
  - Send yellow top 1 hour after start of maintenance dose. Repeat levels every 4 hrs if concern
- If concern over magnesium toxicity: Stop infusion & give **calcium chloride 10% 5mls** IV push

- **Magnesium (49.3%)**:
  - Maintenance: add 25mls (5 vials) to 100mls saline. Infuse at 10mls/hr for 24hrs
  - Rescue (i.e. another seizure): 4mls with 6mls saline. Give via slow IV push over 5mins
- **Labetalol** infusion: Make 200mg up to 200mls with saline. Infuse at 20ml/hr. Double rate 30mins (max 160ml/hr)
- **Hydralazine** infusion (neat=1mg/ml): Start infusion at 5ml/hr. Change rate every 30mins (max 18ml/hr)
24e. AMNIOTIC FLUID EMBOLISM

Main Priority: Recognition & Aggressive Resuscitation

- Get senior help or call 777 & declare an “obstetric +/- neonatal emergency”
- For all patients: Start treatment for haemorrhage & coagulopathy (see tab 12e):
  - Activate MTP now & if required give O negative blood until MTP boxes arrive
  - Call for & give empirically 3 units cryoprecipitate asap
  - Consider early tranexamic acid: 1g over 10min, then 1g over 8hrs
  - Send urgent blood tests including FBC, coagulation studies, TEG (if available)

- If no cardiac output: Start CPR & consider reversible causes - see tab 6e
  - If antenatal perform maternal specific CPR tasks:
    - Removal all foetal monitoring
    - Lift uterus skyward & displace to left
    - Intubate early & ventilate with EtCO₂ target of <30mmHg
    - Perform chest compressions higher on chest & push deeper
    - If no rapid ROSC then start immediate preparations to deliver baby within 5mins

- If signs of cardiac output: then start resuscitation:
  - Ensure patent airway. Consider early intubation
  - Address oxygenation: High flow oxygen, BiPAP, CPAP or high PEEP
  - Give blood & products as MTP. Use vasopressors or inotropes as required
  - Perform early ECHO (TTE or TOE: Any signs of right heart dysfunction or pulmonary hypertension?)

- Discuss with obstetricians:
  - If antenatal: urgent delivery of baby
  - Rule out sources of haemorrhage (eg placenta, uterine rupture or tone, trauma)
  - Possibility of hysterectomy if uncontrollable bleeding
- Refer to ICU early (drugs & monitoring for pulmonary hypertension may be required)

- Amniotic fluid embolism is rare, but life threatening. Always consider it in your differential
- The following features are suggestive of AFE:
  - sudden agitation e.g. non compliance, pulling out drips etc.
  - symptoms with no clear other explanation
  - peri-partum onset: during labour, delivery or within 30mins of baby delivery

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<td>Right heart strain</td>
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<td>Neurological =</td>
<td>DIC</td>
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<tr>
<td>Fetus =</td>
<td>Acute bradycardia</td>
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</tbody>
</table>

- [Bolus]: metaraminol 1mg; phenylephrine 100mcg, ephedrine 9mg, adrenaline 10-50mcg
- [Infusions]: noradrenaline/adrenaline infusion: 5mg in 50mls. infuse 0-20ml/hr
Anaesthetic Crisis Handbook

www.AnaestheticCrisisHandbook.com

By Adam Hollingworth
adamhollingworth@gmail.com

For Nichola. Thank you for your never-ending support and patience.

Second addition special thanks to Dr M Ku for your learned ideas and feedback.

Many other thanks to excellent colleagues who contributed to this manual. Without their suggestions, improvements, fact & error checking & so on, it wouldn’t have been possible.

This includes (but not limited to): CCDHB QA Committee, Dr D Borshoff, Dr J Cameron, Dr H Truong, Mr R Pryer, Mrs J Dennison, Dr D Mein, Dr N Chadderton, Dr L Kwan, Dr A Haq, Dr S McRitchie, Miss L Anderson, Dr D Heys, Miss D Hantom, Mr D Livesey, Dr J Dieterle, Dr V Singh, Dr P Tobin, Dr B Waldron, Dr J McKean, Miss K Chadwick-Smith & many more.

Disclaimer: Every effort has been taken to prevent errors/omissions/mistakes. However, this cannot be guaranteed. Graded assertiveness to query team leader decisions/management steps which are contrary to this manual are encouraged. However, clinical experience & acumen are vital in complex situations such as crises and may be more appropriate than this manual in certain situations.

Treating known
EMERGENCIES

Version 2.6 June 2018
For every problem:

- **Verbalise** the problem. Say out loud….
  
  ‘We have a **problem**, I am **concerned**’

- Call for **HELP** early

- **Set oxygen to 100%** (except where stated otherwise)

- Identify a ‘**hands off**’ Team Coordinator

- **Delegate duties** to **specific** team members

- Use **closed loop**, quiet & efficient **communication**

- Use the **indexed pages & coloured boxes** in this manual to **assist you**

---

**www.AnaestheticCrisisHandbook.com**

(Created by Adam Hollingworth with help from many people along the way)

Adapted from various sources including:

- Guidelines: ANZAAG, AAGBI, NZRC, Starship Protocols
- vortexapproach.org. Dr Chrimes & Dr Fritz
- Hutt Valley & CCDHB: Clinical protocols
- ESA Emergency Quick Reference Guide
- CCDHB Crisis Checklists. Dr A McKenzie
- Wellington ICU Drug Manual. Dr A Psirides & Dr P Young
- Various published peer reviewed papers
Instructions for Use

• Use the index and coloured tabs to find quick reference pages to assist in a crisis.

• The handbook is in 2 parts:
  ‣ The front book: How to treat known Emergencies
  ‣ The back book: How to Diagnose Problems

• Routine/obvious tasks (eg call for help, turn oxygen to 100%) are assumed & thus not repeated on every sheet for clarity

• For simplicity & to avoid calculation errors in an emergency, drug doses are given for a 70kg adult. Paeds doses are clearly marked with 😁 (where appropriate).

• There is an adult & paediatric drug formulary at the back

• Cards are arranged into coloured boxes:
  - Emergency/Doing tasks
  - Thinking tasks, diagnostic or further information
  - Doses, equipment or calculation information

• Work through emergency/doing boxes in a linear fashion. Decision making steps are highlighted for clarity.

Using an aid such as this efficiently, in a crisis, is a learned skill. You must take time to become familiar with this manual and practise using it.

It is recommended that a ‘reader’, with no other tasks, read these cards out loud to the team leader during the crisis.
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<td><strong>B</strong></td>
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<tr>
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<td>33d. Failure to wake</td>
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**E** Everything else

<p>| | | |</p>
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<td>34r. TELEPHONE DIRECTORY</td>
<td>35r. ADULT DRUG FORMULARY</td>
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<td>36r. PAEDS DRUG FORMULARY</td>
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Contents Emerg
Listen to chest. Watch for bilateral chest rise & fall
Switch to bag - manually ventilate to confirm high pressure
Examine EtCO₂ waveform - ?bronchospasm ?kinked ETT
Exclude light anaesthesia & inadequate muscle relaxation
Perform a systematic visual check:
  • airway device (inside & outside mouth) ⇒ filter ⇒ circuit ⇒ valves ⇒ ventilator
Check airway - the position & patency - suction full length of ETT
(Consider performing bronchoscopic exam)
If suspect autoPEEP watch for persistent expiratory flow at end expiration. Try disconnecting circuit.
If problem not identified need to exclude circuit > filter > airway > patient source:
  • Exclude circuit: replace circuit with Ambu-bag (if required convert to TIVA)
  • Exclude filter: replace or remove
  • Exclude airway: replace ETT. If using LMA convert to ETT
  • Not resolved = patient problem

Consider timing of event eg CVL insertion, position change, surgical event
Possible causes (most common in bold):
  • Circuit:
    - ventilator settings
    - kinked tube
    - valve failures
    - obstructed filter
    - O₂ flush failure
  • Airway:
    - laryngospasm
    - tube position
    - tube size
    - blocked or kinked tube
  • Patient:
    - chest wall rigidity
    - bronchospasm
    - anaphylaxis
    - pneumothorax
    - pneumoperitoneum
    - obesity
    - alveolar problems/pathology:
      • oedema
      • infections
      • ARDS
      • contusion
    - tracheal problems/pathology:
      • FB
      • secretions
      • tumour
26d. DESATURATION

☐ Check FiO₂ & turn to 100% O₂
☐ Check patient colour, peripheral temperature & probe position
☐ Switch to bag to test circuit integrity & lung compliance
☐ Check the SpO₂ & EtCO₂ waveforms to aid systematic diagnosis:

- **If EtCO₂ waveform abnormal or absent:**
  - Exclude: disconnected circuit, cardiac arrest, ↓ cardiac output
  - Consider laryngospasm or bronchospasm (if LMA convert to ETT)
  - **Check airway** position & patency:
    - Visualise cords = r/o oesophageal ETT
    - Suction full length of ETT (consider performing bronchoscopic exam)
    - Look inside mouth for kinks/gastric contents
  - Check ventilator mode & setting
  - Ventilate via Ambu-bag to exclude ventilator/circuit/probe problem

- **If EtCO₂ waveform normal:** (: intact circuit integrity):
  - Check fresh gas flow / FiO₂
  - Exclude endobronchial ETT
  - Inspect neck veins, chest rise & auscultate. Use ultrasound (if skilled)
  - Consider airway, lung/breathing, circulation causes (see yellow box)

☐ Work through diagnostic checklist below to exclude all other causes

- Consider timing of event eg position change, surgical event
- **Possible causes** (most common in bold):
  - **Airway:**
    - airway obstruction
    - laryngospasm
    - bronchospasm
    - endobronchial intubation
    - 1 lung ventilation
    - aspiration
  - **Lungs/Breathing:**
    - apnoea/hypoventilation
    - atelectasis
    - pneumothorax
    - sepsis/ARDS
    - pulmonary oedema
    - contusion
    - pneumonia
    - interstitial lung disease
  - **Ventilator/Circuit/Probe:**
    - probe displacement
    - inadequate reversal
    - mal: function/setting
    - auto-PEEP
    - low fresh gas flow
    - oxygen supply failure
    - circuit obstruction/ disconnection
  - **Circulation:**
    - cardiac arrest
    - cardiac failure
    - anaphylaxis
    - embolism: pulmonary, air, CO₂, cement
    - hypothermia/poor periph circulation
    - methaemoglobinaemia e.g. prilocaine
27d. HIGH EtCO₂

• Quick check patient monitors: Are oxygenated & anaesthetised patient:
  - Anaesthetist's A Airway EtCO₂, B SpO₂, Vent Settings, C HR, MAP, D Depth of anesthesia, E Temp

• This is generally not a crisis. Use the time to consider the causes

• Frequency gamble:
  - Check monitors & ventilator:
    - EtCO₂ waveform
    - Fresh Gas Flow - correct for circuit type, size of patient
    - Ventilator settings & mode - Resp rate, Tidal volume
  - Check soda lime? exhausted
  - Review:
    - Anaesthetic depth
    - Recent drug doses for errors

• Systematically work through all causes (see below)

• Consider timing of event e.g. drug administration, surgical event

• Possible causes (most common in bold):

  ↑Production
  - Endogenous:
    - sepsis/↑ temp
    - MH
    - thyroid storm
    - malignant neuroleptic syndrome
    - reperfusion
  - Exogenous:
    - CO₂ insufflation
    - bicarb administration

  ↓Elimination
  - Lungs:
    - hypoventilation
    - bronchospasm/asthma
    - COPD
  - Circuit/machine:
    - ↓ Fresh Gas Flow/re-breathing
    - incorrect vent settings
    - soda lime exhaustion
    - airway obstruction
    - ↑ dead space
    - valve malfunction

Contents
Emerg | Diag
Quick check patient monitors: ?oxygenated & anaesthetised patient:
- Anaesthetist’s A Airway EtCO₂, B SpO₂, C Vent Settings, D MAP, E Depth of anaesthesia, F Temp

If no EtCO₂ waveform diagnose immediately:
- Cardiac arrest - see tab 6e or tab 7e
- Incorrect ETT placement - if in doubt replace
- Severe bronchospasm - confirm airway & see tab 4e
- Check circuit & CO₂ sample line connections

If low EtCO₂ then first frequency gamble:
- Check sampling line - securely connected & patent
- Check MAP
- Examine patient:
  - Airway position & patency
  - Auscultate & ensure bilateral chest rise - (r/o laryngospasm/bronchospasm)
- Check ventilator:
  - Switched on & functioning
  - Correct settings: tidal volume, RR

If problem not identified work through causes systematically (see yellow box)

Consider timing of event e.g. post intubation, drug administration, surgical event

Possible causes (most common in bold):

NO EtCO₂:
- oesophageal intubation
- no ventilation, no airway
- cardiac arrest
- circuit/sampling line disconnection
- ventilator failure or not on
- apnoea

↓Production:
- hypothermia
- deep anaesthesia
- ↓ thyroid

↓Elimination:
- hyperventilation

↓Transport of CO₂ in blood:
- severe hypotension
- anaphylaxis
- cardiac arrest
- embolism - air or pulmonary
- tamponade/tension pneumothorax

↓CO₂ diffusion in lung:
- low tidal volumes/dead space
- laryngospasm
- severe bronchospasm
- ETT obstruction
- endobronchial intubation

Sampling dilution:
- high FGF
- sampler placed incorrectly
- dilution of sampling gas with air
- circuit disconnected
29d. TACHYCARDIA

- Check patient monitors: is the patient oxygenated & anaesthetised?:
  - Anaesthetist's A, B, C, D, E
- If there is diagnostic uncertainty & MAP <65 with HR >150 then give **synchronised DC shock** (see yellow box for joules)

- Differentiate sinus tachycardia & complex tachy-arrhythmia:
  - current surgical/pain stimulation
  - sinus rhythm?
  - QRS regularity?
  - QRS width?

- If sinus tachycardia consider causes (see yellow box below)

- If complex tachy-arrhythmia treat based on MAP:
  - MAP <65mmHg = *synchronised DC shock* (see yellow box for joules)
  - MAP >65mmHg = manage by regularity & QRS width:
    - **Regular:**
      - Narrow: [SVT] vagal manoeuvres, adenosine, β blocker
      - Wide: [VT] amiodarone
        - [SVT with aberrancy] see narrow
        - [WPW] amiodarone
    - **Irregular:**
      - Narrow: [AF] β blocker or amiodarone
      - Wide:
        - [torsades] magnesium
        - [AF with pre-excitation] amiodarone
        - [AF with aberrancy] see narrow

- Send urgent ABG. Ensure high normal K\(^+\) & Mg\(^{2+}\)

- Consider timing of event eg drug administration, surgical event etc.
- **Possible causes of sinus tachycardia** (most common in bold):
  - **Primary causes:**
    - IHD
    - cardiomyopathy
    - sick sinus syndrome
    - accessory conduction pathways
    - myocarditis
    - pericarditis
    - valvular disease
    - congenital heart disease
  - **Secondary causes:**
    - hypovolaemia
    - anaesthesia depth
    - drugs - incl drug error
    - pain
    - electrolyte abnormalities
    - cardiac tamponade
    - sepsis
    - thyroid storm
    - MH

- Synchronised shock guides:
  - AF/monomorphic VT: 100J ⇒ 150J ⇒ 200J (0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
  - SVT or flutter: 50J ⇒ 100J ⇒ 200J (0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
  - polymorphic VT or unstable: 200J (4J/kg)

- **Adenosine:** 6mg, then 12mg, then 12mg then consider other causes (0.1mg/kg>0.2mg/kg,0.3mg/kg)
- β blocker: **Esmolol** 10mg titrated. **Metoprolol** 2.5mg boluses titrated (max 15mg)
- **Amiodarone:** 300mg slow IV push (5mg/kg)
- **Magnesium:** [torsades] 10mmol (5ml of 49.3%) over 2mins (0.1ml/kg), (Give slower for other causes)
Quick check patient monitors: is the patient oxygenated & anaesthetised?:
- **Anaesthetist’s** A) Airway, B) ETCO₂, C) Blood Settings, D) HR, E) MAP, F) Depth of anaesthesia

If MAP >65mmHg you have time (see causes listed in yellow box below):
- Frequency gamble common causes
- Systematically work through all causes

If MAP <65mmHg +/- with evidence of ↓ perfusion then consider:
- **Atropine** 600mcg ( ⇒ 20mcg/kg) or **glycopyrrolate** 200mcg ( ⇒ 10mcg/kg)
- **Ephedrine** 9mg bolus titrated ( ⇒ 0.1 mg/kg)
- **Adrenaline** infusion ( ⇒ see green box)
- **Isoprenaline bolus**, followed by infusion ( ⇒ see green box)

If drug toxicity or overdose:
- β blocker = as above + **high dose insulin** infusion, **Na bicarb** (if propanolol OD)
- Ca channel = as β blocker + **10mls 10% Ca chloride** slow push (can repeat)

If severe refractory bradycardia try external temporary pacing:
- attach defib & ECG leads
- set to PACER mode
- select rate 60/min
- ↑ mA of output until capture (normally 65-100mA required)
- set final mA 10mA above capture
- confirm pulse

If PEA at any point start CPR - see tab 7e

- Consider timing of event eg drug administration, surgical event
- **Possible causes** (most common in **bold**):
  - **Primary causes:**
    - athlete
    - IHD
    - AV block
    - pacemaker malfunction
    - cardiomyopathy
    - sick sinus syndrome
    - myocarditis
    - pericarditis
    - valvular heart disease
    - pulmonary HTN
  - **Secondary causes:**
    - vagal stimulation
    - drugs eg error, overdose, anti-arrhythmics
    - electrolyte abnormality
    - ↓ thyroid
    - ↓ temperature
    - ↑ ICP
    - cardiac tamponade
    - tension pneumothorax
  - **Anaesthetic causes:**
    - vasopressors
    - volatile
    - suxamethonium
    - opioids
    - high/total spinal
    - anticholinesterases
    - hypoxia
    - auto-PEEP
    - MH
    - ↑↓K+

- **Isoprenaline** bolus: dilute 200mcg amp into 20mls then give 1ml boluses titrated ( ⇒ use infusion -see tab 36r). infusion: dilute 1mg (5vials) into 50mls. Infuse at 0-60mls/hr
- **Adrenaline**: 5mg in 50mls saline. Infuse at 0-20ml/hr ( ⇒ see tab 36r)
- **Na bicarb** 8.4% [β blocker OD]: 50ml slow push. Can rpt every 2mins (target pH 7.45-7.55)
- **High dose insulin** [β blocker/CCB OD]: Bolus= 50ml of 50% dextrose & 70u actrapid. Infusion= 100u actrapid in 50mls saline, run at 35ml/hr and 10% dex run at 250mls/hr (Monitor BSL & K every 30 mins.)
31d. HYPERTENSION

- Quick check patient monitors: is the patient oxygenated & anaesthetised?
  - Anaesthetist’s A Airway, B ETCO₂, C SpO₂, D Vent Settings, E MAP, F Depth of anaesthesia, G Temp

- Check accuracy of reading: check equipment (including transducer height)

- Frequency gamble on common causes:
  - Check for painful surgical activity - give analgesia
  - Check recent drug infusions & recent doses for drug error (incl LA with adrenaline)
  - Check tourniquet time
  - Consider bladder volume/fluids infused

- Systematically work through possible causes (see yellow box)

- Once all reversible causes have been addressed then consider IV antihypertensive agents (as green box below) to SBP target of ~160mmHg

- Consider timing of event eg drug administration, surgical event

- Possible causes (most common in bold):
  - Anaesthesia:
    - too light
    - pain
    - drugs - consider error
    - hypoxia
    - hypercapnia
    - MH
    - IV line - non-patient/tissued
    - A line transducer height
  - Patient related:
    - essential HTN
    - rebound HTN - B blocker stopped
    - full bladder
    - pre-eclampsia
    - renal disease
    - phaeochromocytoma (always give a blocker before β blocker)
    - thyroid storm
    - ↑ICP

  - Surgery:
    - pneumoperitoneum
    - tourniquet
    - aortic clamping
    - carotid endarterectomy
    - baroreceptor stimulation

- β Blocker = esmolol: 10mg boluses titrated; metoprolol: 2.5mg boluses titrated (max 15mg)
- α Blocker = labetalol (also β blocker): 5mg boluses titrated (max 100mg), phentolamine: 5-10mg IV repeated every 5-15mins
- α Agonists = clonidine: 30mcg boluses titrated (max 150mcg)
- vasodilators = GTN: S/L spray or IV infusion: 50mg in 50ml saline at 3ml/hr and titrate; magnesium: slow bolus 5mls of 49.3%, repeat if required
32d. HYPOTENSION

☐ Check patient monitors: is the patient oxygenated & anaesthetised?:
  - Anaesthetist’s A Airway B SpO2 C HR D Depth of anaesthesia E Temp

☐ Check accuracy of reading: check equipment (including transducer height)

☐ Assess severity: visualise patient, check ECG & EtCO2,SpO2 waveform:
  - **No cardiac output or critical MAP**: start CPR - see tab 6e or tab 7e
  - **MAP <65mmHg & concern** then consider:
    - Leg elevation
    - Rapid infusion of fluid +/- ready to transfuse blood (see tab 12e)
    - IV vasopressors or inotropes

☐ Consider reversible causes:
  - Frequency gamble on common causes
  - Systematically consider each cause in turn

☐ Consider:
  - ECHO (if skilled) to help differentiate causes
  - Other invasive monitoring to assist with diagnosis e.g. PPV SVV from arterial line, cardiac index monitoring

- Consider timing of event e.g. drug administration, surgical event, scope surgery (always suspect concealed haemorrhage)

- **Possible causes** (most common in bold):
  - **↓Preload:**
    - blood loss/hypovolaemia
    - ↑ intrathoracic pressure
    - ↓ VR - eg IVC compression, pt position, pneumoperitoneum
    - tamponade/tension pneumothorax
    - embolism
  - **↓Contractility:**
    - drugs incl. volatiles
    - IHD
    - cardiomyopathy
    - myocarditis
    - arrhythmia
    - valvular heart disease
  - **↓Afterload:**
    - drugs eg vasodilators incl anaesthetic agents, opioids, antiHTN drugs
    - neuraxial techniques
    - sepsis
    - tourniquet or clamp release
    - anaphylaxis
    - addisons crisis
    - ↓thyroid
  - **Equipment/human:**
    - artefact or failure
    - Invasive: wrong transducer height
    - NIBP: wrong cuff size
    - drug error

- ECHO: Consider LVEDV, LV function, gross valvular abnormality
- PPV SVV: >12% (only if: intubated, paralysed, Vt >8ml/kg, in sinus rhythm, norm abdo pressure) suggests hypovolaemia
- Normal CI = >2.6 L/min/m²

- Pressors: **metaraminol** 0.5mg (10mcg/kg), **phenylepherine** 100mcg, ephedrine 9mg (0.25mg/kg), adrenaline 10-50mcg
- noradrenaline/adrenaline infusion: 5mg in 50mls. infuse 0-20ml/hr
33d. FAILURE TO WAKE

☐ This is generally not a crisis. Use the time to consider the causes

☐ Airway: ensure patent unobstructed airway

☐ Breathing:
  - Ensure established respiratory pattern
  - Check SpO₂
  - Check EtCO₂ trace and value

☐ Cardiovascular: Ensure normal HR, MAP and ECG

☐ Drugs: Review all drugs given during anaesthetic:
  - Check muscle relaxation with nerve stimulator. Give reversal agent (see green box)
  - Consider timing and infusions of all agents
  - Consider drug errors
  - Consider drug interactions
  - Consider patient factors e.g. renal/hepatic failure, elderly

☐ Others:
  - Neurological:
  - check pupils
  - apply BIS for signs of seizure (frontal lobe seizure only)
  - consider need for CT
  - Metabolic: send an ABG - check PaO₂, PaCO₂, Na, glucose
  - Temperature: ensure >30°C

☐ Systematically work through all causes (see below)

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### Contents

Emerg | Diag

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- **Possible causes** (most common in bold):
  - **Drugs:**
    - analgesic agents e.g. opioids, α₂ agonists
    - anaesthetic agents e.g. volatile, propofol
    - muscle relaxants e.g. suxamethonium apnoea, inadequate reversal
    - sedative agents e.g. benzodiazepines, anticholinergics, antihistamines, antidopaminergics
    - magnesium toxicity
  - **Metabolic:**
    - ↑↓ blood sugar
    - ↑↓ sodium
    - ↑ urea
  - **Hypothermia**

- **Respiratory Failure:**
  - hypoxia or hypercapnia:
    - ↓ central drive e.g. stroke, COPD
    - lung disease e.g. PE, ARDS
    - muscle power e.g. obesity

- **Neurological:**
  - stroke - infarct, bleed or embolism
  - seizure (Non-convulsive status epileptics or post-ictal)
  - local anaesthetic toxicity

- **Other - Uncommon:**
  - central anticholinergic syndrome
  - dissociative coma
  - thyroid failure
  - toxicity of other CNS drugs

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- [rocuronium/vecuronium relaxant]: Sugammadex dose on TBW: PTC>2 = 4mg/kg (70kg=280mg); >T₂ = 2mg/kg (70kg=140mg)
- [all non-depolarising relaxants]: Neostigmine 2.5mg (50mcg/kg) & glycopyrrolate 500mcg (0.1mcg/kg). Rpt at 15min
- [suxamethonium apnoea]: No reversal option ➔ continue anaesthesia/refer to ICU
EMERGENCY OUT OF THEATRE
- MET Team

ANAESTHETICS & THEATRES
- Duty Anaesthetist
- Duty Technician
- Theatre Coordinator
- PACU Coordinator
- Perfusionist

OBSTETRICS
- Obstetric Doctor
- Delivery Technician
- Charge Midwife
- Paed/NICU Doctor

LABORATORY/X-RAY
- Blood bank
- Blood tests
- X-Ray Technician
- Duty Radiologist

REFERRALS
- ICU Doctor
- ICU Coordinator
- Haematology Doctor
- Surgical Doctor
- Paediatric Doctor
- Cardiology Doctor
### ADULT DRUG FORMULARY

<table>
<thead>
<tr>
<th>Drug</th>
<th>Bolus</th>
<th>Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenosine</strong></td>
<td>6mg, then 12mg, then 12mg.</td>
<td></td>
</tr>
<tr>
<td><strong>Adrenaline</strong></td>
<td>[Arrest] 10ml of 1:10,000 (1mg)</td>
<td>5mg in 50ml saline. Infuse 0-20ml/hr</td>
</tr>
<tr>
<td></td>
<td>[Other] 0.1ml - 1ml of 1:10,000 (1-100mcg).</td>
<td></td>
</tr>
<tr>
<td><strong>Alteplase</strong></td>
<td></td>
<td>[PE in cardiac arrest] 100mg in 20mls saline.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infuse at 80mls/hr</td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>400mg over 15mins</td>
<td>50mg in 50mls at 35ml/hr</td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>300mg slow push</td>
<td>900mg in 500ml D5W over 24hours</td>
</tr>
<tr>
<td><strong>Ca²⁺ Chloride (10%)</strong></td>
<td>10mls slow push</td>
<td></td>
</tr>
<tr>
<td><strong>Clonidine</strong></td>
<td>30mcg. Titrate (max 150mcg)</td>
<td></td>
</tr>
<tr>
<td><strong>Dobutamine</strong></td>
<td></td>
<td>250mg in 50ml saline. Infuse 0-10ml/hr</td>
</tr>
<tr>
<td><strong>Esmolol</strong></td>
<td>10mg. Titrate</td>
<td></td>
</tr>
<tr>
<td><strong>GTN</strong></td>
<td>[tocolytic] 100-250mcg</td>
<td>[ischaemia] 50mg in 50ml saline. Infuse 3-12ml/hr. Titrate to MAP/ECG</td>
</tr>
<tr>
<td><strong>Hydrocortisone</strong></td>
<td>200mg</td>
<td></td>
</tr>
<tr>
<td><strong>Insulin (actrapid)</strong></td>
<td>[β-blocker or CCB OD] 50ml of 50% dextrose &amp; 70u acratpid (1u/kg). Give as bolus.</td>
<td>[1K+] 10units in 250ml 10% dextrose. Infuse quickly [β-blocker or CCB OD] 100u acratpid in 50mls saline, run at 35ml/hr and 10% dextrose run at 250mls/hr. check BSL &amp; k:00min</td>
</tr>
<tr>
<td><strong>Intralipid (20%)</strong></td>
<td>100ml bolus (1.5ml/kg), Rpt ev 5min, max x2</td>
<td>1000ml/hr (15ml/kg/hr). Can double rate @5mins (max total dose = 12ml/kg)</td>
</tr>
<tr>
<td><strong>Isoprenaline</strong></td>
<td>200mcg into 20mls saline. Give 1ml boluses titrated</td>
<td></td>
</tr>
<tr>
<td><strong>Ketamine</strong></td>
<td>[induction] 70-140mg (1-2mg/kg)</td>
<td>1mg into 50mls saline. Infuse at 0-60mls/hr</td>
</tr>
<tr>
<td><strong>Labetalol</strong></td>
<td>5mg slow push. Titrate (max 100mg)</td>
<td>300mg in 60mls (neat). Infuse 0-30mls/hr</td>
</tr>
<tr>
<td><strong>Lignocaine (1%)</strong></td>
<td>[Arrhythmia] 7mls (0.1ml/kg). Can rpt ev 10mins (max 0.3ml/kg)</td>
<td>Neat 1% at 6-24ml/hr. (Total max in 1hr = 30mls ie 3mg/kg)</td>
</tr>
<tr>
<td><strong>Magnesium (49.3%)</strong></td>
<td>[bronchospasm] 5mls over 20min</td>
<td>[ eclampsia]: Maintenance = 25mls in 100ml saline. Infuse 10ml/hr for 24hrs Rescue (another seizure). 4mls in 6mls saline. Push over 5min</td>
</tr>
<tr>
<td></td>
<td>[torsades] 5ml slow push</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[eclampsia] 8mls in 12ml saline. Slow push over 5min</td>
<td></td>
</tr>
<tr>
<td><strong>Metaraminol</strong></td>
<td>0.5-1mg. Titrate</td>
<td>10mg in 20mls saline. Infuse 0-40mls/hr</td>
</tr>
<tr>
<td><strong>Metoprolol</strong></td>
<td>1-2.5mg. Titrate (max 15mg)</td>
<td></td>
</tr>
<tr>
<td><strong>Midazolam</strong></td>
<td>[seizures] 1-7mg. Titrate</td>
<td></td>
</tr>
<tr>
<td><strong>Milrinone</strong></td>
<td></td>
<td>10mg in 50ml saline. Infuse at 5ml/hr or 10ml/hr only</td>
</tr>
<tr>
<td><strong>Naloxone</strong></td>
<td>[emergency] 400mcg</td>
<td>Infusion with hourly rate = 2/3 of bolus dose required for initial clinical effect</td>
</tr>
<tr>
<td></td>
<td>[titration] 40mcg (max 800mcg)</td>
<td></td>
</tr>
<tr>
<td><strong>Noradrenaline</strong></td>
<td></td>
<td>5mg in 50mls saline. Infuse 0-20ml/hr</td>
</tr>
<tr>
<td><strong>Oxytocin</strong></td>
<td>[elective] 3units slow bolus (do not rpt)</td>
<td>40units in 1000ml saline. Infuse 250ml/hr</td>
</tr>
<tr>
<td></td>
<td>[emergency] 5units slow bolus (do not rpt)</td>
<td></td>
</tr>
<tr>
<td><strong>Phentolamine</strong></td>
<td>5-10mg. Repeat every 5-15 mins as req’ed</td>
<td></td>
</tr>
<tr>
<td><strong>Phenylephrine</strong></td>
<td>100mcg bolus. Titrate</td>
<td>10mg in 100ml saline (100mcg/ml). Infuse 0-40ml/hr</td>
</tr>
<tr>
<td><strong>Salbutamol</strong></td>
<td>250mcg slow push (Inhaled: 12 puffs via circuit)</td>
<td>5mg in 50ml saline. Infuse 0-10ml/hr</td>
</tr>
<tr>
<td><strong>Sodium Bicarb (8.4%)</strong></td>
<td>25-50ml slow push. Can rpt every 2mins (target pH 7.45-7.55)</td>
<td></td>
</tr>
<tr>
<td><strong>Sugammadex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[emergency post intubation] = 16mg/kg;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[PTC&gt;2] 4mg/kg; [&gt;T2]= 2mg/kg</td>
<td></td>
</tr>
<tr>
<td><strong>Suxamethonium</strong></td>
<td>[laryngospasm] 35mg (0.5mg/kg)</td>
<td></td>
</tr>
<tr>
<td><strong>Tranexamic Acid</strong></td>
<td>1g over 10mins (15mg/kg)</td>
<td>1g in 100ml saline. Infuse at 12.5ml/hr (8hrs)</td>
</tr>
<tr>
<td><strong>Vasopressin</strong></td>
<td>1 unit slow push</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20units in 20mls saline. Infuse 1-4ml/hr</td>
</tr>
<tr>
<td>Drug</td>
<td>Bolus</td>
<td>Infusion</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Adenosine</strong></td>
<td>0.1mg/kg, then 0.2mg/kg, then 0.3mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Adrenaline</strong></td>
<td>[Arrest IV] 0.1ml/kg 1:10,000 (1mcg/kg)</td>
<td>[↓bp] 0.15mg/kg (max 5mg) in 50mls saline. Infuse 0.5-10ml/hr</td>
</tr>
<tr>
<td>(1:1,000 = 1mg/ml)</td>
<td>[Arrest ETT] 0.1ml/kg of 1:1,000 (10mcg/kg)</td>
<td></td>
</tr>
<tr>
<td>(1:10,000 = 100mcg/ml)</td>
<td>[Other] 0.01-0.05ml/kg 1:10,000 (1-5mcg/kg)</td>
<td></td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>10mg/kg over 1hr diluted to 1mg/ml (max 500mg)</td>
<td>1-9 yrs: 55mg/kg into 50mls 5% dext. Infuse 1ml/hr 10-15yrs &amp; &lt;35kg: 35mg into 50mls 5% dext. Infuse 1ml/hr 10-15yrs &amp; &gt;35kg: neat drug. Infuse 0.028ml/kg/hr</td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>5mg/kg slow push (max 300mg)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Atropine</strong></td>
<td>20mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Ca&lt;sup&gt;2+&lt;/sup&gt; Chloride (10%)</strong></td>
<td>0.05 - 0.2ml/kg (max 10mls) slow push</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dobutamine</strong></td>
<td>-</td>
<td>15mg/kg in 50ml saline. Infuse 0.5-4ml/hr</td>
</tr>
<tr>
<td><strong>Ephedrine</strong></td>
<td>0.25mg/kg (max 9mg/dose)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Esmolol</strong></td>
<td>500mcg/kg slow push. Titrate</td>
<td>-</td>
</tr>
<tr>
<td><strong>Glycopyrrolate</strong></td>
<td>10mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Hydrocortisone</strong></td>
<td>[asthma] 4mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Insulin (actrapid)</strong></td>
<td>[1K] Periph IV: 0.1unit/kg in 5ml/kg 10% dex [1K] CVL: 0.1u/kg in 2ml/kg 50% dex</td>
<td>-</td>
</tr>
<tr>
<td><strong>Lignocaine 1%</strong></td>
<td>[1]ml/10mg</td>
<td>50mcg/kg &amp; saline to make 50ml. Infuse 0-3ml/hr(0-3mg/kg/hr)</td>
</tr>
<tr>
<td>(1ml = 2mmol = 0.5g)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Magnesium (49.3%)</strong></td>
<td>[asthma] 0.1ml/kg over 20mins</td>
<td>-</td>
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<td>(1ml = 2mmol = 0.5g)</td>
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<td><strong>Metaraminol</strong></td>
<td>10mcg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Metoprolol</strong></td>
<td>0.1mg over 5mins</td>
<td>-</td>
</tr>
<tr>
<td><strong>Midazolam</strong></td>
<td>[emergency] IV: 0.1mg/kg; IM 0.2mg/kg; buccal 0.5mg. Can repeat dose @ 5mins</td>
<td>-</td>
</tr>
<tr>
<td><strong>Naloxone</strong></td>
<td>[titrate] 2mcg/kg (400mcg in 20mls give 0.1ml/kg)</td>
<td>300mcg/kg to 30ml 5% dext &amp; run at 0-1ml/hr (10mcg/kg/hr)</td>
</tr>
<tr>
<td><strong>Noradrenaline</strong></td>
<td>0.15mg/kg (max 5mg) in 50mls saline. Infuse 0.5-10ml/hr</td>
<td>-</td>
</tr>
<tr>
<td><strong>Phenylepherine</strong></td>
<td>2-10mcg/kg. Titrate</td>
<td>10mg in 100ml saline. Infuse 0-20mls/hr (1-5mcg/kg/min)</td>
</tr>
<tr>
<td><strong>Salbutamol</strong></td>
<td>Inhaled: &lt;5yr=6puffs; &gt;5yrs 12puffs via circuit IV: &lt;1yr=5mcg/kg slow; &lt;18yr=10mcg/kg (max 250)</td>
<td>Make neat salbutamol up to 50mls Infuse at 5-10mcg/kg/min for 1hr. Then 1-2mcg/kg/min</td>
</tr>
<tr>
<td><strong>Sodium Bicarb (8.4%)</strong></td>
<td>1ml/kg over 5min. Can repeat every 2mins (target pH 7.45-7.55)</td>
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<td>-</td>
</tr>
<tr>
<td><strong>Suxamethonium</strong></td>
<td>[intubation] IV: 2mg/kg; IM 4mg/kg [laryngospasm] 0.5mg/kg</td>
<td>-</td>
</tr>
<tr>
<td><strong>Tranexamic Acid</strong></td>
<td>15mg/kg diluted in 20-50mls saline over 10mins</td>
<td>2mg/kg/hr in 500ml saline over 8hrs</td>
</tr>
<tr>
<td><strong>Vasopressin</strong></td>
<td>1unit/kg in 50mls saline. Infuse 1-3mls/hr</td>
<td>-</td>
</tr>
</tbody>
</table>
Anaesthetic Crisis Handbook

www.AnaestheticCrisisHandbook.com
By Adam Hollingworth
adamhollingworth@gmail.com

For Nichola. Thank you for your never-ending support and patience.

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Disclaimer: Every effort has been taken to prevent errors/omissions/mistakes. However, this cannot be guaranteed. Graded assertiveness to query team leader decisions/management steps which are contrary to this manual are encouraged. However, clinical experience & acumen are vital in complex situations such as crises and may be more appropriate than this manual in certain situations.