Anaesthetic Crisis Handbook

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

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
• Emergencies in Anaesthesia. Oxford Handbook
• 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.
| 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 |
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)
- 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)
2e. CICO Rescue

Main priority = Oxygenation with stable SpO₂ > 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 (palpable neck anatomy):
   - CICO Pack: 14G cannula, 5ml syringe (with 2ml NSL), Rapid O₂ (insufflation device)
   - Secure cricoid cartilage & aspirate as you advance the saline filled cannula
   - Success = free aspiration of air - never let go of cannula

- Connect Rapid O₂ device to cannula & machine aux O₂ port (10L/min @ flowmeter):
  - 1st breath: 6 secs (1000mls) - look for chest rise & fall
  - Wait 20 secs for SpO₂ rise or when SpO₂ starts to drop by 5% from peak
  - 2nd breath: 3 secs (600mls) & repeat only after waiting as previous step
  - If no ↑SpO₂ after 2nd breath or any doubt then abandon technique

- Convert to Melker size 5 airway using Seldinger technique

2. Scalpel Bougie (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 (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 SpO₂**

- Ask surgeon to stop
- Delegate & prepare for intubation - Suxamethonium & ETT
- Manual procedures:
  - Remove LMA & clear the airway
  - Consider OP/NP airway
  - Jaw thrust & CPAP 30cmH₂O - 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 SpO₂ stable & >92% try pharmacological relaxation:
  (note paeds-obese/acutely unwell desaturate very quickly - consider going straight to intubation)
  - Propofol - 20% of induction dose
  - Suxamethonium IV 35mg (0.5mg/kg)

- If SpO₂ dropping or <92% proceed to intubation without delay:
  - Adult: Suxamethonium 100mg
  - Paeds: Suxamethonium IV: 2mg/kg; IM 4mg/kg

- Consider atropine 600mcg (20mcg/kg) for bradycardia
- Consider stomach decompression after event

- Laryngospasm will break with sufficient time & hypoxia but may be preceded by bradycardia, cardiac arrest, aspiration, pulmonary oedema
- Hypoxia may occur rapidly in paeds, obese +/- acutely unwell patients
- Pre-prepare IV & IM doses of suxamethonium in such cases (see tab 9e)

**Drug & Equipment dosing**
- Paediatric (uncuffed) ET Tube: preterm = 2.5; <1yr = 3.5 - 4; >1yr = (age/4)+4 (see tab 9e)
- Propofol: 20% induction dose
- Suxamethonium:
  - relaxation = 0.5mg/kg IV
  - intubation:
    - adult: induction dose or 100mg
    - paed: IV 2mg/kg; IM 4mg/kg
4e. BRONCHOSPASM

Main Priority: SpO₂ >95% with Peak Airway Pressures <40cmH₂O

☐ Inform surgeon. Minimise surgical stimulation

☐ Check:
  - Airway position
  - EtCO₂ trace (severe bronchospasm can present with low or absent EtCO₂)
  - 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 (👶 <6yr = 6puffs; >6yr = 12puffs)
  - Inhaled ipratromium 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 (0.01-0.05ml/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 EtCO₂ trace

- Salbutamol IV slow bolus (👶): <2yrs = 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 36f)
- Magnesium: 10mmol (5mls of 49.3%) over 20mins (0.1ml/kg of 49.3% (max 5mls) over 20mins)
- Ketamine: [must be anaesthetised] 35-70mg IV. (0.5-1mg/kg)
**5e. ASPIRATION**

**Main Priority: Minimise aspiration while maintaining SpO₂**

- 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 & SpO₂ 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% O₂

**If SpO₂ dropping or <90%:**
- Do not delay oxygenation regardless of particulates in pharynx/bronchial tree:
  - Bag mask ventilation with 100% O₂ or
  - Manual breaths via ETT with 100% O₂

- 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 °C)
  - 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 ET\(\text{CO}_2\) (ensure full chest recoil)
- Attach defibrillator
- **100% O\(_2\)**, 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 \(\text{tab 6e}\)
- In asystole: if **p waves** present consider pacing (see \(\text{tab 30d}\))
- 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 \(\text{\degree C}\))
  - Avoid: \(\text{SpO}_2\) >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 \(\beta\) blocker, other drug errors
- Thrombosis - cardiac or pulmonary
- Pregnant - manual uterine displacement & start preparations for delivering baby by 5mins - see (\(\text{tab 19e}\))

(Follow all drugs with 20ml flush)

- [IK 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 \((1.5\text{ml/kg})\); Infusion 1000mls/hr \((15\text{ml/kg/hr})\) - see \(\text{tab 15e}\)
- [\(\beta\) 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 \(\text{tab 35r}\)
  - **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)
### 8e. 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:
    - If **VF/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 4mins

- **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 paed's 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
9e. PAEDIATRIC EMERGENCY CALCULATIONS

- 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>
<td>3.5</td>
<td>ETT Size (mm)</td>
</tr>
<tr>
<td>ETT (oral) Length (cm)</td>
<td>10</td>
<td>ETT (oral) Length (cm)</td>
</tr>
<tr>
<td>ETT (nasal) Length (cm)</td>
<td>12</td>
<td>ETT (nasal) Length (cm)</td>
</tr>
<tr>
<td>LMA Size</td>
<td>1.5</td>
<td>LMA Size</td>
</tr>
<tr>
<td>Fluid bolus (ml)</td>
<td>100</td>
<td>Fluid bolus (ml)</td>
</tr>
<tr>
<td>Adrenaline (1:10,000)</td>
<td>0.5mls</td>
<td>Adrenaline (1:10,000)</td>
</tr>
<tr>
<td>Amiodarone (mg)</td>
<td>25</td>
<td>Amiodarone (mg)</td>
</tr>
<tr>
<td>10% Glucose (ml)</td>
<td>10</td>
<td>10% Glucose (ml)</td>
</tr>
<tr>
<td>Sux - IV (mg)</td>
<td>10</td>
<td>Sux - IV (mg)</td>
</tr>
<tr>
<td>Sux - IM (mg)</td>
<td>20</td>
<td>Sux - IM (mg)</td>
</tr>
<tr>
<td>Atropine (mcg)</td>
<td>100</td>
<td>Atropine (mcg)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3yr or 14kg</th>
<th>5yr or 18kg</th>
<th>10yr or 37kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal HR</td>
<td>90-140</td>
<td>Normal HR</td>
</tr>
<tr>
<td>Energy (J)</td>
<td>55</td>
<td>Energy (J)</td>
</tr>
<tr>
<td>ETT Size (mm)</td>
<td>4.5</td>
<td>ETT Size (mm)</td>
</tr>
<tr>
<td>ETT (oral) Length (cm)</td>
<td>13</td>
<td>ETT (oral) Length (cm)</td>
</tr>
<tr>
<td>ETT (nasal) Length (cm)</td>
<td>16</td>
<td>ETT (nasal) Length (cm)</td>
</tr>
<tr>
<td>LMA Size</td>
<td>2</td>
<td>LMA Size</td>
</tr>
<tr>
<td>Fluid bolus (ml)</td>
<td>280</td>
<td>Fluid bolus (ml)</td>
</tr>
<tr>
<td>Adrenaline (1:10,000)</td>
<td>1.4mls</td>
<td>Adrenaline (1:10,000)</td>
</tr>
<tr>
<td>Amiodarone (mg)</td>
<td>70</td>
<td>Amiodarone (mg)</td>
</tr>
<tr>
<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>
<td>55</td>
<td>Sux - IM (mg)</td>
</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 (eg 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 (1:1,000; <6yrs = 0.15ml; 6-12yrs = 0.3ml). Repeat every 5mins)
- Repeat adrenaline & fluid boluses every 1-2 minutes as required:

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

If >3 adrenaline boluses start adrenaline infusion

- Refractory management:
  - bronchospasm (see tab 4 for other drug options)
    - Salbutamol: 12 puffs (emble s = 6 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 (\( \Rightarrow \) = 0.6mg/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 IVF, adrenaline &amp; CPR!</td>
</tr>
<tr>
<td>+/- Angioedema</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>

- Consider differential eg tension pneumothorax (tab 32d), auto-PEEP (tab 25d)

- Adrenaline or Noradrenaline infusion (do not need CVL to start): 5mg in 50mls saline. Infuse 1-20mls/hr
  (\( \Rightarrow \) 0.15mg/kg made to 50mls with saline. Infuse 1-10mls/hr)
- Salbutamol IV bolus: 100-250mcg (\( \Rightarrow \) <2yrs = 5mcg/kg; 2-18yrs = 15mcg/kg (max 250mcg) infusion: 5mg in 50mls saline. Infuse 1-10ml/hr \( \Rightarrow \) 5mcg/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
  (\( \Rightarrow \) 1unit/kg made to 50mls with saline. Infuse 1-3ml/hr)
Main priority = ↓Myocardial O₂ consumption & ↑myocardial O₂ supply

- Titrated inspired O₂ to normal SpO₂ 97-99% (PaO₂ 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

Expeditate 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

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

- **Vaspressors** - **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 pt **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:**

**Rbc's:**

<table>
<thead>
<tr>
<th>Patient (Recipient)</th>
<th>A</th>
<th>B</th>
<th>AB</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>A</td>
<td>B</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
<td></td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

**FFP:**

<table>
<thead>
<tr>
<th>Patient (Recipient)</th>
<th>A</th>
<th>AB</th>
<th>B</th>
<th>AB</th>
<th>O</th>
<th>A, AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td></td>
<td>B</td>
<td></td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>AB</td>
<td></td>
<td>AB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>O</td>
<td>A</td>
<td>B</td>
<td>AB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Platelets/Cryo:**

- in a crisis, ABO & Rh are not imp (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 ($\approx 20$ml/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) - ($\approx 0.01-0.05$ml/kg of 1:10,000)
  - Infusion = 5mg in 50mls saline. Infuse 0-20mls/hr ($\approx$ 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)
**14e. HAEMOLYTIC TRANSFUSION REACTION**

**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 [tab 10e](#), cardiogenic shock [tab 11e](#), 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)
15e. LOCAL ANAESTHETIC TOXICITY

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 β-blockers)
- 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

- Treat 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>tIng ETCO₂</td>
<td>tIng temp/sweating</td>
<td>Cola coloured urine</td>
<td></td>
</tr>
<tr>
<td>Masseter spasm</td>
<td>CVS instability</td>
<td>Coagulopathy, ↑↑CK</td>
<td></td>
</tr>
<tr>
<td>↑HR/arrhythmia</td>
<td>↑pH, ↑K</td>
<td>Cardiac arrest</td>
<td></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
**17e. HYPERKALAEMIA**

**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 (see green box):
  - 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 (see green box):
  - 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 infraglottic 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 8e 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)

- If Peri or Post Arrest:
  - Start standard peri-arrest care. Supporting ABC’s as appropriate (intubate early)
  - Consider reversible causes & attempt diagnosis & treat asap (see yellow box)
  - Ensure ongoing lifting of uterus skyward & displaced to left (if baby not delivered)

- 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 30secs**

- **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 3secs, 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>
<thead>
<tr>
<th>Umbilical Adrenaline</th>
<th>23-26 Weeks</th>
<th>27-37 Weeks</th>
<th>38-43 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ml/kg (100mcg/kg)</td>
<td>0.1 ml</td>
<td>0.25 ml</td>
<td>0.5 ml</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**:
  - 1min = 60-70%
  - 2min = 65-85%
  - 3min = 70-90%
  - 4min = 75-90%
  - 5min = 80-90%
  - 10min = 85-90%

**Neonatal Drugs & Equipment** (see tab 9e)
- **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 tab 15e
  - Amniotic Fluid Embolism tab 24e
  - Mg toxicity
  - IVC compression
  - Massive pulmonary embolus
  - Drug error

- Vasopressor: phentylephrine 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)
22e. POST PARTUM HAEMORRHAGE

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 pt 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
Main Priority: Oxygenation, Magnesium & Treating Hypertension

- Call 777 & state “obstetric emergency”
- Call for eclampsia box
- Give O₂ 15L/min via non-rebreath 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 / tab 7e
  - 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

<table>
<thead>
<tr>
<th>System &amp; Signs</th>
<th>Lab/Investigation Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>General = Restless, anxious, chest pain, vomiting</td>
<td>Pulmonary hypertension</td>
</tr>
<tr>
<td>Respiratory = Hypoxia, bronchospasm, pulmonary oedema, ARDS</td>
<td>Right heart strain</td>
</tr>
<tr>
<td>Cardiovascular = Hypotension, chest pain, cardiac arrest</td>
<td>Coagulopathy</td>
</tr>
<tr>
<td>Neurological = Headaches, seizure, loss of consciousness</td>
<td>DIC</td>
</tr>
<tr>
<td>Fetus = Acute bradycardia</td>
<td></td>
</tr>
</tbody>
</table>

- [Bolus]: metaraminol 1mg; phenylephrine 100mcg, epinephrine 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 Hanton, 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.

Version 2.6 June 2018