C&C Anaesthetic Crisis Handbook

Treating known EMERGENCIES

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)
(C&C version localised by Hannah Janssens & Eilidh Menzies)

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

Flip end over end for
DIAGNOSING Problems
Including:
Adult & Paediatric Drug Formulary

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 **70 kg 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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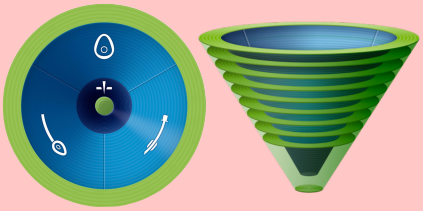
1e. AIRWAY MANAGEMENT - Vortex

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** (See Dr Chrimes vortexapproach.org)



If failure of first airway plan:

- ☐ Get difficult intubation trolley and extra help
- ☐ The goal is to **restore oxygenation** & reach the **green zone** (= $EtCO_2$ & safe SpO_2)
  (safe SpO_2 = SpO_2 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:

	Bag/Mask	SGA	ETT
	Dentures in	Pull tongue forward	Dentures out
	2 hands Vice grip	Twist to insert	Laryngeal manipulation Remove cricoid
	Cuff inflation/deflation	Cuff inflation/deflation	Lift epiglottis
	OPA NPA	Insert with laryngoscope/bougie	Bougie/Stylet
	Change size	Change size	Change ETT size
		Change type	Change blade Use video scope
	Suction foreign material		
	Muscle paralysis		

(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
  - **Go** = If not in the Green Zone after 3 lifeline best efforts:
    Optimise patient position & start **CICO Rescue** 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 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 -/- *(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
- ☐ Connect **Rapid O_2 device** to cannula & machine aux O_2 port (10L/min @ flowmeter):
  - **1st breath**: 6 secs (1000mls) - look for chest **rise & fall**
  - **Wait** 20 secs for **SpO_2 rise** or when SpO_2 starts to **drop** by 5% from **peak**
  - **2nd breath**: 3 secs (500mls) & **repeat only** after waiting as previous step
  - If **no ↑SpO_2** after **2nd breath** or **any doubt** then **abandon** technique
- ☐ Convert to size 5 airway using Seldinger cricothyrotomy catheter set *(on DI trolley)*

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

3e. LARYNGOSPASM

Main Priority: **Break laryngospasm & maintain SpO_2**

- ☐ Ask surgeon to stop
- ☐ Get **drugs** & **airway equipment**
- ☐ **Manual procedures**:
  - Remove LMA & clear the airway
  - Consider OP/NP airway
  - **Jaw thrust** & **CPAP** 30cmH_2O - **do not** give +ve pressure breath
  - Apply bilateral, painful, inward pressure to **Larson's point** (immediately behind lobule of ear)
  - If 👶: Consider gentle chest compressions (may be more effective than other manual procedures)
- ☐ If **SpO_2 stable & >92%** try low dose muscle 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 **SpO_2 dropping or <92%** give full dose muscle relaxation ASAP:
  - 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 (👶 tab 9e)

Drug & Equipment dosing

- Paediatric (uncuffed) ET Tube: preterm = 2.5; <1yr = 3.5 - 4; >1yr = (age/4)+4 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: **SpO_2 >95% with Peak Airway Pressures <40cmH_2O**

- ☐ 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 (👶 <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 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 👶: 10mcg/kg over 2 min (single dose max 500mcg). Can repeat at 10min
- ***Magnesium:*** 5ml of 49.3% over 20mins (👶 0.1ml/kg of 49.3% (max 5ml) in 50ml saline over 20mins)
- ***Ketamine:*** [must be anaesthetised] 35-70mg IV. (👶 0.5-2mg/kg)
- ***Hydrocortisone:*** 200mg IV (👶 4mg/Kg)
- ***Aminophylline:*** bolus load: 400mg over 15mins. Infuse: 50mg in 50ml at 35ml/hr. (👶 Load: 10mg/kg (max 500mg) over 1hr diluted to 50ml with saline. Infusion varies by age: tab 36r
- ***Salbutamol Infusion:*** 5mg in 50ml saline. Infuse 0-10ml/hr. (👶 Infuse 5-10mcg/kg/min for 1 hour, then reduced to 1-2mcg/kg/min. <16kg: 3mg/kg made to 50ml with 5%dex. Then 1ml/hr = 1mcg/kg/min; >16kg: Use 20ml of 1mg/ml solution. Then ml/hr = 0.06 x kg x dose (mcg/kg/min).
  See Starship clinical guidelines for infusion chart)
- ***Adrenaline infusion:*** 5mg in 50ml saline. Infuse 0-20ml/hr. (👶 not recommended)

5e. ASPIRATION

5e

6e

Main Priority: **Minimise aspiration while maintaining 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 & 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 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

6e. ADULT CARDIAC ARREST - VF/VT

Main priority = **early defibrillation**

- ☐ Ask surgeons to stop (if appropriate)
- ☐ Start chest compressions at **100/min** and monitor $EtCO_2$ (ensure full chest recoil)
- ☐ Attach defibrillator. **Shock immediately** at 200J (or max setting)
- ☐ **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 check > **shock** > restart compressions
  - **Adrenaline 1mg** (10ml of 1:10,000) immediately after 2nd shock, then every 4mins
  - **Amiodarone 300mg** immediately after 3rd shock
  - If ECG shows a QRS complex go to 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 (if possible), urgent cardiology referral (?for PCI)
  - ABCDE's, ABG's, 12 lead ECG
  - Avoid: SpO_2 >99%, hyperglycaemia (>10mmol/l), hypercarbia, >37.5^0 for 72hrs

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 ß 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 (10ml of 1:10,000)
- ***Amiodarone*** IV: 300mg
- ***Magnesium*** IV: [Torsades]: 10mmol (5ml of 49.3%) over 2mins
- ***Calcium Chloride*** IV: [↑K or CCB overdose] 10ml 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] 7ml bolus (0.1ml/kg). Can rpt every 10mins (max 0.3ml/kg)
- ***Intralipid*** 20% IV: [LA toxicity] Bolus: 100ml (1.5ml/kg); Infusion 1000ml/hr (15ml/kg/hr) tab 15e
- ***Alteplase***: 50mg slow push. Can repeat at 15min (be prepared for prolonged CPR - up to 60 min)

7e. ADULT CARDIAC ARREST - Asystole/PEA

Main priority = good quality CPR

- ☐ Ask surgeons to stop all vagal stimuli
- ☐ Start chest compressions at **100/min** and monitor $EtCO_2$ (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** (10ml of 1:10,000) **immediately**, then every 4min
  - If ECG shows VF/VT go to tab 6e
- ☐ In asystole: if **p waves** present consider **pacing** 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 (if possible), urgent cardiology referral
  - ABCDE's, ABG's, 12 lead ECG
  - Avoid: SpO_2 >99%, hyperglycaemia (>10mmol/l), hypercarbia, >37.5^0 for 72hrs

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 ß 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**)*

- [↑K Rx:]
  - 10ml ***10% Ca chloride*** slow push
  - ***salbutamol***: 12puffs into circuit or 250mcg IV bolus
  - **10U *actrapid*** *in dextrose:* 50ml 50% dextrose (centrally); *or* 250ml 10% dextrose (peripherally), over 30min
- [Opiate toxicity] ***Naloxone*** = 400mcg
- [LA Toxicity]: ***Intralipid*** 20%: Bolus: 100ml (1.5ml/kg); Infusion 1000ml/hr (15ml/kg/hr) tab 15e
- [ß blocker OD]: - ***adrenaline infusion:*** 5mg in 50mls saline. Infuse via CVL 0-20ml/hr
  - ***isoprenaline***: Bolus = 200mcg amp into 20ml with saline & give 1ml boluses titrated. for infusion: tab 35r
  - ***high dose insulin***: Bolus= 50ml of 50% **dextrose** & 70u **actrapid**. Infusion= 100u **actrapid** in 50ml saline, run at 35ml/hr & **10% dex** run at 250ml/hr (monitor BSL & K every 15-30min)
- [Thrombosis] ***Alteplase***: 50mg slow push. Can repeat at 15min (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% O_2, stop anaesthetic** agents, give **2 breaths**
- ☐ Start chest compressions at **120/min** and monitor $EtCO_2$ (ensure full chest recoil)
- ☐ If **holding** a **mask/LMA:** use ratio of **15** compressions : **2** breaths
- ☐ If **ETT patent** & **secure:** ventilate at **15 breath/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 **10mcg/kg 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 ß 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

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

2 months or 5 kg	
Normal HR	100-160
Energy (J)	20
ETT Size (mm)	3.5
ETT(oral) Length (cm)	10
ETT(nasal) Length (cm)	12
LMA Size	1.5
Fluid bolus (ml)	100
Adrenaline (1:10,000)	0.5ml
Amiodarone (mg)	25
10% Glucose (ml)	10
Sux - IV (mg)	10
Sux - IM (mg)	20
Atropine (mcg)	100

6 months or 7 kg	
Normal HR	100-160
Energy (J)	28
ETT Size (mm)	3.5-4
ETT (oral) Length (cm)	10.5
ETT(nasal) Length (cm)	12
LMA Size	1.5
Fluid bolus (ml)	140
Adrenaline (1:10,000)	0.7ml
Amiodarone (mg)	35
10% Glucose (ml)	14
Sux - IV (mg)	14
Sux - IM (mg)	28
Atropine (mcg)	140

1yr or 10 kg	
Normal HR	90-140
Energy (J)	40
ETT Size (mm)	4
ETT (oral) Length (cm)	11
ETT(nasal) Length (cm)	14
LMA Size	2
Fluid bolus (ml)	200
Adrenaline (1:10,000)	1ml
Amiodarone (mg)	50
10% Glucose (ml)	20
Sux - IV (mg)	20
Sux - IM (mg)	40
Atropine (mcg)	200

3yr or 14kg	
Normal HR	90-140
Energy (J)	55
ETT Size (mm)	4.5
ETT (oral) Length (cm)	13
ETT(nasal) Length (cm)	16
LMA Size	2
Fluid bolus (ml)	280
Adrenaline (1:10,000)	1.4ml
Amiodarone (mg)	70
10% Glucose (ml)	30
Sux - IV (mg)	30
Sux - IM (mg)	55
Atropine (mcg)	280

5yr or 18kg	
Normal HR	80-130
Energy (J)	70
ETT Size (mm)	5.5
ETT (oral) Length (cm)	15
ETT(nasal) Length (cm)	19
LMA Size	2
Fluid bolus (ml)	360
Adrenaline (1:10,000)	1.8ml
Amiodarone (mg)	90
10% Glucose (ml)	35
Sux - IV (mg)	35
Sux - IM (mg)	72
Atropine (mcg)	360

10yr or 37kg	
Normal HR	80-130
Energy (J)	150
ETT Size (mm)	6.5
ETT (oral) Length (cm)	17
ETT(nasal) Length (cm)	21
LMA Size	3
Fluid bolus (ml)	740
Adrenaline (1:10,000)	3.7ml
Amiodarone (mg)	185
10% Glucose (ml)	75
Sux - IV (mg)	75
Sux - IM (mg)	150
Atropine (mcg)	600

10e. ANAPHYLAXIS

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)
- ☐ 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:

	Grade 1 (Mild)	Grade 2 (Mod/severe)	Grade 3 (Life threatening)	Grade 4 = CPR (PEA Cardiac arrest or adult SBP <50mmHg)
IV Adrenaline	N/A	**10-20mcg** (0.1-0.2ml 1:10,000) [👶 **Dilute 1mg in 50ml** =20mcg/ml **Give 0.1ml/kg** =2mcg/kg]	**50-100mcg** (0.5-1ml 1:10,000) [👶 **Dilute 1mg in 50ml** =20mcg/ml **Give 0.2-0.5ml/kg** =4-10mcg/kg]	**1mg** (10ml 1:10,000) [👶 **0.1ml/kg 1:10,000** = 10mcg/kg]
Fluid Bolus	N/A	Rapid 500ml [👶 20ml/kg]	Rapid 1 litre [👶 20ml/kg]	Rapid 2 litres [👶 20ml/kg]
Legs	N/A	Elevate	Elevate	Elevate

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

- ☐ **Refractory** management:
  - **bronchospasm** (tab 4 for other drug options)
    - **Salbutamol**: 12 puffs (👶 = <6yrs = 6 puffs, >6yrs = 12 puffs) ⟹ IV bolus (see below) ⟹ infusion (see below)
  - **hypotension:**
    - **adrenaline infusion ⟹ repeat fluid bolus ⟹ noradrenaline +/- vasopressin**

- ☐ Monitor treatment success: MAP, SpO_2, airway pressures, $EtCO_2$ waveform, ECHO
- ☐ Place arterial line
- ☐ Consider abandoning surgery (or expedite finish)
- ☐ **Once stabilised: dexamethasone 12mg** (👶 = 0.6mg/kg)

- **Grades of anaphylaxis:**

Grade 1 = Mild	Grade 2 = Mod/severe	Grade 3 = Life threatening	Grade 4 = Cardiac arrest
Mucocutaneous signs	Mucocutaneous signs	+/- Mucocutaneous signs	PEA cardiac arrest
+/- Angiooedema	↓MAP, ↑HR	Arrhythmias & CVS collapse	Adult SBP <50mmHg
	Bronchospasm	Severe bronchospasm	Absent $EtCO_2$

- **Consider differential** eg tension pneumothorax tab 32d, auto-PEEP tab 25d, oesophageal intubation
- Collect **tryptase** (yellow tube) levels *ASAP* and at time *1, 4 and 24hrs*

- ***Adrenaline*** or ***Noradrenaline*** infusion (do **not** need CVL to start)**:** 3mg in 50ml saline. Infuse 3-40ml/hr (👶 0.15mg/kg made to 50ml with saline. Infuse 1-40ml/hr)
- ***Salbutamol*** IV bolus: 100- 250mcg (👶 <2yrs = 5mcg/kg; 2-18yrs = 15mcg/kg (max 250mcg)
  infusion**:** 5mg in 50ml saline. Infuse 1-10ml/hr (👶 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 (👶 1unit/kg made to 50ml with saline. Bolus 2 ml. Infuse 1-3ml/hr)

9e
10e

11e. MYOCARDIAL ISCHAEMIA - Intraoperative

Main priority = ↓Myocardial O_2 consumption & ↑myocardial O_2 supply

- ☐ Titrate inspired O_2 to **normal** SpO_2 97-99% (PaO_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

11e
12e

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

- Vaso*pressors* - ***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. MASSIVE HAEMORRHAGE

Main priority = Volume replacement & good teamwork

- ☐ **IV access**: x2 16G cannula +/- Rapid Infusion Catheter (RIC) (👶 largest IV & remove extension)
- ☐ Talk to surgeon: All efforts to get **surgical control of bleeding**?
  (compression, packing, direct pressure, arterial/aortic clamping)
- ☐ Give **tranexamic Acid**: **1g** (standard & obstetric) or **2g** (trauma)
- ☐ **Call blood bank: 6961** "I am requesting (**Crimson, Standard** or **Obstetric**) **Stat Pack**"
- ☐ **If ongoing massive bleeding + shock**:
  - Call blood bank "I am **activating** (**Crimson, Standard** or **Obstetric**) **MHP**"
    (👶 follow Starship paediatric MHP protocol)
  - **Assemble a team with clear roles** (transfusion coordinator, MHP runner, blood checkers, people to hang blood etc..)
  - With all MHP packs, give **IV calcium chloride 10ml** via fast & different IV
- ☐ Set up rapid infusion device (+/- cell saver)
- ☐ 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, iCa^{2+}
- ☐ **Stand down MHP** once clinically stable. Change to targeted transfusion (see green box)

11e
12e

- For code Crimson (trauma) use ABC score ≥2 as threshold for calling for stat pack:
  - 1 point for any of: - Penetrating mechanism; - SBP ≤90mmHg; - Positive eFAST; - HR ≥120bpm
- Smaller centres should only give platelets if FBC = platelets <75 x10^9/L
- Platelets: new infusion set preferred, but not essential
- Calcium chloride: Do not administer in same giving set as blood products
  Ensure peripheral IV patent working and crystalloid running quickly

- **Targeted Transfusion Thresholds & Doses:**
  - ***INR*** >1.5 or APTT >40 = 4U ***FFP*** (👶 20ml/kg)
  - ***Fibrinogen*** <2G/L = 3U ***cryoprecipitate*** (👶 5ml/kg)
  - ***Platelets*** <75 = 1 adult pack of platelets (👶 10ml/kg)
  - ***iCa*** <1.1mmol/l = 10ml calcium chloride (👶 0.1ml/kg)
  - ***Factor VIIa*** in consultation with haematologist - 6mg (90mcg/kg)
- Blood product compatibility:
  - Rbc's: (in a crisis, Rh is not impt - see blood bank)

Patient (Recipient)	Compatible (Donor)
A	A, O
B	B, O
AB	A, B, AB, O
O	O

  - FFP: (at any time, Rh is not relevant)

Patient (Recipient)	Compatible (Donor)
A	A, AB
B	B, AB
AB	AB
O	O, A, B, AB

  - Platelets/Cryo:
    - in a crisis, ABO & 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 appropriateness of bypass and a referral for ECMO

13e
14e

- **Signs of air/gas embolism:**
  - **Respiratory**: ↓$EtCO_2$ (most sensitive), ↓SpO_2, 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 O_2** - 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 50ml saline. Infuse 0-20ml/hr (👶 tab 36r)
- ***Noradrenaline infusion:*** 5mg in 50ml saline. Infuse 0-20ml/hr
- ***Dobutamine infusion:*** 250mg in 50ml saline. Infuse 0-10ml/hr (can infuse peripherally)

14e. HAEMOLYTIC TRANSFUSION REACTION

Main priority = **Early recognition** & **resuscitation of ABC's**

- ☐ **Stop transfusion,** discard giving set & flush line
- ☐ Recheck blood against patient
- ☐ Minimise volatile/TIVA but maintain anaesthesia
- ☐ **Resuscitate based on ABC's:**
  - Consider early intubation
  - Treat bronchospasm if present 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 tab 12e
- ☐ Consider **IV methylprednisolone 250mg** slow injection
- ☐ **Collate all blood products** & return to lab
- ☐ Contact ICU

13e
14e

- **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 50ml saline. Infuse 0-20ml/hr
- ***Salbutamol***:
  - bolus = 250mcg slow push (👶 <2yrs = 5mcg/kg; <18yrs 15mcg/kg (max 250mcg)
  - infusion = 5mg in 50ml saline. Infuse 0-10ml/hr (👶 50ml 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**:

- Confirm IV access
- Consider need for **intubation**
- **Ventilate** if required - aim for $EtCO_2$ 30mmHg
- Consider giving **IV 20% intralipid** early: bolus then infusion (see dosing below)
- If **arrhythmia** use standard protocols tab 29d
  (Consider **amiodarone 300mg** slow IV push. Avoid **lignocaine**, caution with **ß 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** (tab 6e or tab 7e). Be prepared to continue for 60 min.
- Give **20% IV intralipid** (👶 see green box):
  - **Bolus**: 100ml. Can repeat every 5 mins, maximum twice (if required)
  - **Infusion**: 1000ml/hr neat intralipid. Double rate @ 5 min if no improvement
  - Do not exceed max dose of 840ml (12ml/kg)
- Mobilise cardiopulmonary bypass/ECMO team (if available)
- Send **ABG** - keep pH >7.25: Give **sodium bicarbonate 8.4% 50ml** (👶 1ml/kg)
  (Can repeat every 2 min - must ensure adequate ventilation)

15e
16e

- **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 tab 30d

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

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

16e. MALIGNANT HYPERTHERMIA

Main Priority: **Early Recognition, Removal of Triggers, Dantrolene**

- ☐ **Recognise problem** (see yellow box) - 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 L/min**. 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), **source more** from on call pharmacist:
  - 9 vials of 20mg. Reconstitute each vial into 60ml syringe with sterile water
  - Repeat every 10min until control achieved (improving temp/CO2/pH, to a max 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 $EtCO_2$ to 30mmHg (+/- **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

15e
16e

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

Early	Developing	Late
↑ing EtCO2	↑ing temp/sweating	Cola coloured urine
Masseter spasm	CVS instability	Coagulopathy, ↑↑CK
↑HR/arrhythmia	↓pH, ↑K	Cardiac arrest

- [*pH<7.2*]: ***Sodium bicarbonate*** 8.4% 50ml (👶 1ml/kg), repeat every 2mins
- [*K^+ >7*]: ***Calcium chloride*** 10% 10ml IV (👶 0.2ml/kg); 10units of ***actrapid*** in 250ml ***10% dextrose*** over 30mins (👶 0.1u/kg actrapid in 5ml/kg of 10% dextrose over 30mins); 12puffs ***salbutamol*** into circuit (👶 2-6puffs) repeat every 20mins
- [*arrhythmias*] ***Amiodarone*** 300mg slow IV push (👶 5mg/kg); 7ml ***1% lignocaine*** slow IV push (👶 0.1-0.2ml/kg) (Can repeat every 10 mins - max 0.3ml/kg); ***Esmolol*** 10mg increments
- [*↓MAP*]: ***Noradrenaline*** infusion: 5mg in 50ml saline. Infuse at 0-20ml/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 $EtCO_2$ 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**
  - **100-250mcg IV salbutamol** (or 12puffs via circuit/5mg neb) Repeat every 20mins
- **If refractory high K^+ consider** (👶 see green box):
  - **50ml 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

17e
18e

👶 **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

18e. FIRE - AIRWAY OR PATIENT

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: 50ml** into mouth, **10-20ml** down ETT (👶 1ml/kg max 20ml)
  - **CO_2 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 SpO_2 allows):
  - Use bag mask ventilation initially but prepare for early intubation
  - Use **lowest possible oxygen** to maintain normal SpO_2
- ☐ **If unable to re-intubate:** perform **infraglottic technique** depending on urgency:
  - emergency: infraglottic technique 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

17e
18e

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 **CO_2 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

19e. MATERNAL COLLAPSE

Main Priority: **Good CPR, Diagnose Cause, Prepare for Delivery**

- ☐ Review all infusions/medications recently administered
- ☐ Consider haemorrhage (?concealed) tab 12e. Call blood bank for "Obstetric Stat Pack"
- ☐ If **no cardiac output:**
  - Call 777 & declare **'maternal cardiac arrest'**
  - Start **preparations** to deliver baby **now** (peri-mortem Caesarean or instrumental)
  - Remove all foetal monitoring
  - Start **CPR** > apply **defib** > check **rhythm** > 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 $EtCO_2$ 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, ↑Mg^{2+}, 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: 8ml in 12ml saline. Infuse at 120ml/hr
  - For maintenance & rescue doses tab 23e
- ***Calcium chloride 10%*** [$MgSO_4$ toxicity antidote]: 5ml slow push. (can repeat)
- ***20% Intralipid*** [LA toxicity]: (max total 12ml/kg)
  - bolus: 100ml (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]: Arrest = 50mg slow push. Can repeat at 15min (continue CPR for upto 60mins)
  Peri-Arrest = 20mg slow push. Then 80mg in 20ml saline. Infuse at 10ml/hr
  [To reverse]: Stop infusion. Give ***1g tranexamic acid***. Call haematologist (***cryo*** +/- ***platelets***)

20e. NEONATAL LIFE SUPPORT

Main Priority: **Dry baby, Oxygenate & Reassess every 30secs**

- ☐ Pre-setup **neopuff**: Gas supply @10L, PEEP 5, PIP 30cmH_2O. 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 SpO_2 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 cmH_2O CPAP with room air
- ☐ **If any** of **HR <100**, **poor tone**, **gasping/apnoeic:** start ventilating (with $EtCO_2$):
  - Fine tuning of neutral head position with jaw thrust is vital
  - Room air initially. ↑O_2 every 30 secs if no improvement: 40->60->80->100%
  - Give x5 inflation breaths of 2-3 sec: PIP 30cmH_2O
  - Once adequate **chest rise**: RR 40-60/min: PIP 15-20cmH_2O
- ☐ **If HR <60:**
  - 100% O_2. Consider LMA or intubation (if skilled)
  - Start chest compressions 100/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) 

	23-26 Weeks	27-37 Weeks	38-43 Weeks
Umbilical Adrenaline	0.1 ml	0.25 ml	0.5 ml
ETT Adrenaline	1ml/kg (100mcg/kg)		

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

19e
20e

- If **preterm** use lower inflation pressures: 28-32wks = 25/5; <28wks = 20/5
- Significant **meconium** delivery: Only suction a flat baby with no resp effort prior to oxygenating
- Place NG to **decompress stomach** if difficulty ventilating
- Assistant can place SpO_2 probe on right hand 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 tab 9e

- ***Naloxone***: Full term = 200mcg IM (otherwise 10mcg/kg IM/IV)
- ***ETT***: uncuffed size = [*term*] 3-3.5mm, [*preterm*] 2.5mm; length @lips [term] 9cm, [preterm] 7cm

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 tab 6e or tab 7e
- If obstetrics, follow '**maternal' specific tasks:**
  - Lift uterus skyward & displace to left
  - **Intubate early** & ventilate with $EtCO_2$ 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 asap** (10ml 1:10,000) (👶 10mcg/kg)
  - Early rapid infusion of 2-3 litres of **fluid** (👶 20ml/kg)

☐ If **respiratory arrest** or **distress** or **falling SpO_2**:

- Elevate head of bed to 30 degrees
- Assist ventilation with 100% O_2 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**

21e

22e

- Diagnosis is clear if witnessed rapidly ascending block following neuraxial procedure
- If unwitnessed collapse consider **other causes** (if obstetrics 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*: ***phenylepherine*** 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 50ml saline. Infuse at 0-20ml/hr (👶 infusion only: 0.15mg/kg (max 5mg) in 50ml 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 or RIC
- ☐ If **out of theatre**: call **777** declare an "**obstetric emergency**"
- ☐ Encourage **surgical control** of uterine tone & bleeding (see yellow box)
- ☐ Review with surgeon every 10mins: diagnosis & plan (see yellow box)
- ☐ If **massive bleeding + shock**: tab 12e
  - Call blood bank *6961*: State "I am requesting **Obstetric Stat Pack**)
  - Give **1g tranexamic acid** slow push
- ☐ If **ongoing** massive bleeding + shock:
  - Call blood bank: State "I am **activating Obstetric MHP**"
  - Repeat **1g tranexamic acid** slow push
  - Refer to generic MHP steps in tab 12e
    (Teamwork, Regular calcium, Rapid infusion device, A line, Permissive hypotension, Warming, Bloods Q30min)
- ☐ Use **oxytocics** to address uterine atony:
  - **Oxytocin IV 5 units slow push**
  - **Oxytocin infusion 40unit in 500ml saline**. Infuse at 125ml/hr
  - **Ergometrine 500mcg IM** (avoid if ↑MAP)
  - **Carboprost 250mcg IM** (avoid if asthmatic). Can repeat every 15mins (max 8 doses)
  - **Misprostol 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**

- 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

- Vasopressors: ***Metaraminol*** 1mg; ***phenylepherine*** 100mcg, ***Adrenaline***: 10-100mcg & titrate
- ***Adrenaline/Noradrenaline*** Infusion: 5mg in 50ml saline. Infuse at 10-20ml/hr preferably via CVC

23e. PERI-PARTUM SEIZURE

Main Priority: **Oxygenation, Magnesium & Treating Hypertension**

- ☐ Call **777** & state "**obstetric emergency**"
- ☐ Call for **eclampsia box**
- ☐ Give **O_2** 15L/min via non-rebreather facemask
- ☐ Apply monitoring: SpO_2, 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 (2.5g/5ml) asap**:
  - **Loading dose**: 8ml with 12ml saline. Slow push over 5mins.
    (If no IV then give 10ml IM into each gluteal region (total 20ml))
  - 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**: SpO_2, auscultate chest, perform chest XR (if needed)
  - If **bp >160/110mmHg** then consider one or both:
    - **Labetalol IV** (neat=5mg/ml): 2-4ml over 2min. Repeat every 10mins (max 3 doses)
    - **Hydralazine IV**: Dilute to 1mg/ml. Give 5ml slow push. Repeat every 20min
  - **Restrict total fluid** input to 80ml/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 Mg^{2+} 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% 5ml** IV push

23e
24e

- ***Magnesium*** (2.5g/5ml):
  - Maintenance: 1g/hr. Sdd 5 ampoules to 100ml saline. Infuse at 10ml/hr.
  - Rescue (i.e. another seizure): 2g bolus. Mix 4ml with 6ml saline. Give via slow IV push over 5mins
- ***Labetalol*** infusion: Add 100mg to saline to make 100ml. Infuse at 20ml/hr. Double rate every 30mins (max 160ml/hr)
- ***Hydralazine*** infusion: Dilute to 1mg/ml. Start infusion at 5ml/hr. Change rate by 1ml/hr every 20mins (max 20ml/hr)

24e. AMNIOTIC FLUID EMBOLISM

Main Priority: **Recognition & Aggressive Resuscitation**

- ☐ Get senior help or call 777 & declare an "**obstetric +/- neonatal emergency**"
- ☐ **For all:** Start treatment for **haemorrhage** & **coagulopathy** tab 12e :
  - Call blood bank *6961*. State:
    - "I am requesting **Obstetric Stat Pack**" ***and*** "I am activating **Obstetric MHP**"
  - Give **IV tranexamic acid 1g slow push**, repeat 30min later
  - Send urgent blood tests including FBC, coagulation studies, TEG (if available)
- ☐ **If no cardiac output:** Start CPR & consider reversible causes 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 $EtCO_2$ 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:** Start resuscitation:
  - Ensure patent airway. Consider **early intubation**
  - Address **oxygenation**: High flow oxygen, BiPAP, CPAP or high PEEP
  - Give **blood** & **products** as MHP. 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 (is ECMO a consideration? Does pulmonary hypertension need treatment?)

- Amniotic fluid embolism is rare, but life threatening. Always consider it in your differential
- **The following** features are suggestive of AFE:
  - hypotension, foetal distress
  - symptoms with no clear other explanation eg sudden agitation
  - peri-partum onset: during labour, delivery or within 30mins of baby delivery

System & Signs		Lab/Investigation Findings
General =	Restless, anxious, chest pain, vomiting	Pulmonary hypertension
Respiratory =	Hypoxia, bronchospasm, pulmonary oedema, ARDS	Right heart strain
Cardiovascular =	Hypotension, chest pain, cardiac arrest	Coaguloapthy
Neurological =	Headaches, seizure, loss of consciousness	DIC
Fetus =	Acute bradycardia	

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

Close book & flip end over end for

DIAGNOSING
Problems

Including:
Adult & Paediatric
Drug Formulary

C&C Anaesthetic Crisis Handbook

www.AnaestheticCrisisHandbook.com

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Treating known EMERGENCIES

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