

NZ Anaesthetic Crisis Handbook

Clickable links:

v3.3 Feb 2023

Treating known

EMERGENCIES

DIAGNOSING
Problems

ADULT DRUG
Formulary

TELEPHONE
Directory

PAEDS DRUG
Formulary

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 **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.

A

Airway

B

Breathing

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. MYOCARDIAL ISCHAEMIA - Intraoperative

12e. MASSIVE 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

C

Circulation

E

Everything else

O

Obstetrics

Contents

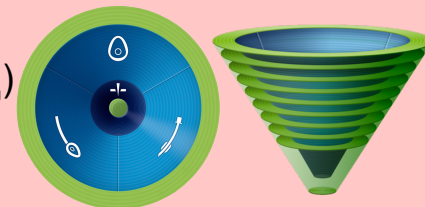
Diag

1e. AIRWAY MANAGEMENT - Vortex

Contents
Emerg | Diag









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** (= EtCO₂ & safe SpO₂)
(safe SpO₂ = SpO₂ where no harm will occur if that level persists for 15mins)
- Try the **lifelines** (BMV, SGA, ETT) in any order
- For each lifeline perform at least **1 attempt**, but **not more than 3**
(You may have a 4th attempt if a **game changer** becomes available e.g. new equipment, expert help etc.)
- Suggested optimisations include:

	Bag/Mask 	SGA 	ETT 
	Dentures in 2 hands Vice grip	Pull tongue forward Twist to insert	Dentures out 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 type	Change ETT size 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)

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 (500mls) & **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
- Get **drugs** & **airway equipment**
- 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 lobule of ear)
 - If 🧐: Consider gentle chest compressions (may be more effective than other manual procedures)
- If **SpO₂ stable & >92%** try low dose muscle relaxation:
 - (note paed/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%** 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 paed, 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

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 **tab 25d**
Most common include:
 - anaphylaxis
 - tube position
 - pneumothorax
 - laryngospasm (on LMA)
 - chest wall rigidity
 - 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 👤: 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

6e

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** (10ml 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
 - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia, >37.5° 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 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 (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 - upto 60 min)

Main priority = good quality CPR

- Ask surgeons to stop all vagal stimuli
- Start chest compressions at **100/min** and monitor EtCO₂ (ensure full chest recoil)
- Attach defibrillator**
- 100% O₂, stop anaesthetic agents**
- If holding a mask/LMA:** use ratio of **30** compressions : **2** breaths
- If ETT patent & secure:** ventilate at **10 breaths/min** & do **not** pause CPR
- Follow 2 min cycles:
 - Charge defib > **rhythm & pulse check** > restart compressions
 - **Give adrenaline 1mg** (10ml of 1:10,000) **immediately**, then every 4min
 - If ECG shows VF/VT goto **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, urgent cardiology referral
 - ABCDE's, ABG's, 12 lead ECG
 - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia, >37.5° 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 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)

- [↑K Rx:]
 - 10ml **10% Ca chloride** slow push
 - **salbutamol**: 12puffs into circuit or 250mcg IV bolus
 - 10u **actrapid** in 250ml 10% dextrose @500ml/hr
- [Opiate toxicity] **Naloxone** = 400mcg
- [LA Toxicity]: **Intralipid** 20%: Bolus: 100ml (1.5ml/kg); Infusion 1000ml/hr (15ml/kg/hr) **tab 15e**
- [β 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)

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 **120/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 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 **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 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		6 months or 7 kg		1yr or 10 kg	
Normal HR	100-160	Normal HR	100-160	Normal HR	90-140
Energy (J)	20	Energy (J)	28	Energy (J)	40
ETT Size (mm)	3.5	ETT Size (mm)	3.5-4	ETT Size (mm)	4
ETT (oral) Length (cm)	10	ETT (oral) Length (cm)	10.5	ETT (oral) Length (cm)	11
ETT (nasal) Length (cm)	12	ETT (nasal) Length (cm)	12	ETT (nasal) Length (cm)	14
LMA Size	1.5	LMA Size	1.5	LMA Size	2
Fluid bolus (ml)	100	Fluid bolus (ml)	140	Fluid bolus (ml)	200
Adrenaline (1:10,000)	0.5ml	Adrenaline (1:10,000)	0.7ml	Adrenaline (1:10,000)	1ml
Amiodarone (mg)	25	Amiodarone (mg)	35	Amiodarone (mg)	50
10% Glucose (ml)	10	10% Glucose (ml)	14	10% Glucose (ml)	20
Sux - IV (mg)	10	Sux - IV (mg)	14	Sux - IV (mg)	20
Sux - IM (mg)	20	Sux - IM (mg)	28	Sux - IM (mg)	40
Atropine (mcg)	100	Atropine (mcg)	140	Atropine (mcg)	200

3yr or 14kg		5yr or 18kg		10yr or 37kg	
Normal HR	90-140	Normal HR	80-130	Normal HR	80-130
Energy (J)	55	Energy (J)	70	Energy (J)	150
ETT Size (mm)	4.5	ETT Size (mm)	5.5	ETT Size (mm)	6.5
ETT (oral) Length (cm)	13	ETT (oral) Length (cm)	15	ETT (oral) Length (cm)	17
ETT (nasal) Length (cm)	16	ETT (nasal) Length (cm)	19	ETT (nasal) Length (cm)	21
LMA Size	2	LMA Size	2	LMA Size	3
Fluid bolus (ml)	280	Fluid bolus (ml)	360	Fluid bolus (ml)	740
Adrenaline (1:10,000)	1.4ml	Adrenaline (1:10,000)	1.8ml	Adrenaline (1:10,000)	3.7ml
Amiodarone (mg)	70	Amiodarone (mg)	90	Amiodarone (mg)	185
10% Glucose (ml)	30	10% Glucose (ml)	35	10% Glucose (ml)	75
Sux - IV (mg)	30	Sux - IV (mg)	35	Sux - IV (mg)	75
Sux - IM (mg)	55	Sux - IM (mg)	72	Sux - IM (mg)	150
Atropine (mcg)	280	Atropine (mcg)	360	Atropine (mcg)	600

9e
10e

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]
Fluid Bolus	N/A	Rapid 1 litre ☹️ 20ml/kg]	Rapid 1-2 litres ☹️ 20ml/kg]	Rapid 2-3 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 infusion**

- Monitor treatment success: MAP, SpO₂, airway pressures, EtCO₂ waveform, ECHO
- Place arterial line
- Consider abandoning surgery
- 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**
- Collect **tryptase** (yellow tube) levels at time 1, 4, 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)

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
- Expedite end of surgery

Other Intra-Op Tasks to consider:

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

Post Op Tasks to consider:

- 12 lead ECG and ongoing post-op telemetry
- Immediate cardiology referral - ?suitability for PCI

- Vasopressors - **Phenylephrine**: 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

11e

12e

12e. MASSIVE HAEMORRHAGE

Contents
Emerg | Diag

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:** "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, iCa²⁺
- 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 ≤ 90 mmHg; - Positive eFAST; - HR ≥ 120 bpm
- Smaller centres should only give platelets if FBC = platelets $< 75 \times 10^9/L$
- 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** < 1.1 mmol/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)

Main priority = Restore cardio-respiratory stability

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

• Signs of air/gas embolism:

- **Respiratory:** ↓EtCO₂ (most sensitive), ↓SpO₂, pulmonary oedema, bronchospasm
- **CVS:** shock, tachycardia, ↑PA pressures, cardiovascular collapse
- Use of **PEEP** is controversial. May ↑risk of paradoxical air embolism through PFO (note PFO is present in 10-30% of population)
- **Hyperbaric O₂** - treatment up to 6hrs post event may improve outcome in paradoxical air embolism

• Adrenaline:

- bolus = 10-100mcg (0.1-1ml of 1:10,000) - (👉 0.01-0.05ml/kg of 1:10,000)
- Infusion = 5mg in 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)

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 **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

Contents
Emerg | Diag

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 **tab 29d**
(Consider **amiodarone 300mg** slow IV push. Avoid **lignocaine**, caution with **Bblockers**)
- ▶ 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
- ▶ 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)

- **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

15e

16e

16e. MALIGNANT HYPERTHERMIA

Contents
Emerg | Diag

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 10min 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:

Early	Developing	Late
↑ing EtCO ₂	↑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 2ml/kg of 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

15e

16e

17e. HYPERKALAEMIA

Contents
Emerg | Diag

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**
 - ▶ **100-250mcg IV salbutamol.** 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

🧐 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

17e

18e

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)
 - **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 **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
- 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 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**):

<ul style="list-style-type: none"> ▸ Hypoxia: aspiration, high spinal ▸ Hypovolaemia/hypotension: bleeding, high spinal ▸ Metabolic disorders: AKI from severe pre-eclampsia, ↓BSL ▸ Hypertension: intracranial haemorrhage, eclamptic seizure 	<ul style="list-style-type: none"> ▸ 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: 8ml in 12ml saline. Infuse at 120ml/hr
 - For maintenance & rescue doses **tab 23e**
- **Calcium chloride 10%** [MgSO₄ 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**)

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 (with EtCO₂):
 - Fine tuning of neutral head position with jaw thrust is vital
 - Room air initially. ↑O₂ every 30 secs if no improvement: 40%→60→80→100%
 - Give 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 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

- 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% ▸ 3min = 70-90% ▸ 5min = 80-90%
 - 2min = 65-85% ▸ 4min = 75-90% ▸ 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

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 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 **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: phenylephrine** 100mcg (👉 10mcg/kg); **metaraminol** 1mg (👉 10mcg/kg); **ephedrine** 9mg (👉 0.1mg/kg)
- **Adrenaline** - bolus: 0.1-0.5ml 1:10,000 (10-50mcg); infusion: 5mg in 50ml saline. Infuse at 0-20ml/hr (👉 infusion only: 0.15mg/kg (max 5mg) in 50ml saline. Infuse 0.5-10ml/hr)

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: 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)
 - **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**

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

Main Priority: Oxygenation, Magnesium & Treating Hypertension

- Call **777** & state “**obstetric emergency**”
- Call for **eclampsia box**
- Give **O₂** 15L/min via non-rebreathe facemask
- Apply monitoring: SpO₂, ECG, NIBP
- Start timer**: Measure length of seizure (eclamptic seizures normally self terminate)
- Maximise patient safety** while displacing gravid uterus (if antenatal):
 - Pillows & covered bed sides
 - Depending on staff safety: Lift uterus up & to left or place in **full left lateral**
- Prepare and give **Magnesium (49.3%) asap**:
 - **Loading dose**: 8ml with 12ml saline. Infuse at 120ml/hr
(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**: 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**: 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 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% 5ml IV** push

- **Magnesium (49.3%)**:
 - Maintenance: add 16ml to 100ml saline. Infuse at 14.5ml/hr
 - Rescue (i.e. another seizure): 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)

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. 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 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:** 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:
 - 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

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	Coagulopathy
Neurological = Headaches, seizure, loss of consciousness	DIC
Fetus = Acute bradycardia	

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

NZ Anaesthetic Crisis Handbook

Clickable links:

v3.3 Feb 2023

DIAGNOSING Problems

Treating known
EMERGENCIES

ADULT DRUG
Formulary

TELEPHONE
Directory

PAEDS DRUG
Formulary

For every problem:

- Never normalise the abnormal
- **Verbalise** the problem. Say out loud....
 ‘We have a **problem**, I am **concerned**’
- Call for **help**
- **Set oxygen to 100%** (except where stated otherwise)
- Use indexed pages to facilitate diagnosis:
 - **Frequency gamble** common causes
 - Use a **structured approach** to consider all causes
- Seek to actively prove / disprove all possible causes

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

A

Airway

B

Breathing

25d. High Airway Pressure

26d. Low SpO₂

27d. High EtCO₂

28d. Low EtCO₂

29d. Tachycardia

30d. Bradycardia

31d. Hypertension

32d. Hypotension

C

Circulation

33d. Failure to wake

34r. TELEPHONE DIRECTORY

35r. ADULT DRUG FORMULARY

36r. PAEDS DRUG FORMULARY

E

Everything
else

**Contents
Emerg**

- Listen to chest.** Watch for bilateral chest rise & fall
- Switch to **bag** - manually ventilate to confirm high pressure
- Examine **EtCO₂ waveform** - ?bronchospasm ?kinked ETT
- Exclude **light anaesthesia** & inadequate **muscle relaxation**
- Perform a **systematic visual check**:
 - airway device (position or kinking) ⇒ filter ⇒ circuit ⇒ valves ⇒ ventilator
- Check **airway patent: suction full length** of ETT or **bronchoscopic exam**
- If suspect **autoPEEP** watch for persistent expiratory flow at end expiration. Try disconnecting circuit.
- If problem **not identified** :
 - **Exclude circuit**: replace circuit with Ambu-bag (if required convert to TIVA)
 - **Exclude filter**: replace or remove
 - **Exclude airway**: replace ETT. If using LMA convert to ETT
 - Not resolved = **patient problem**

• Consider timing of event eg CVL insertion, position change, surgical event

• **Possible causes** (most common in bold):

▸ **Circuit:**

- **ventilator settings**
- kinked tube
- valve failures
- obstructed filter
- O₂ flush failure

▸ **Airway:**

- **laryngospasm**
- **tube position**
- tube size
- blocked or kinked tube

▸ **Patient:**

- **chest wall rigidity**
- bronchospasm
- anaphylaxis
- pneumothorax
- pneumoperitoneum
- obesity
- alveolar problems/pathology:
 - oedema
 - infections
 - ARDS
 - contusion
- tracheal problems/pathology :
 - FB
 - secretions
 - tumour

- Check FiO₂ & turn to 100% O₂
- Check patient colour, peripheral temperature & **probe position**
- Switch to bag** to test circuit integrity & lung compliance
- Check the SpO₂ & EtCO₂ waveforms to aid systematic diagnosis:
 - ▶ **If EtCO₂ waveform abnormal or absent:**
 - Exclude: disconnected circuit, cardiac arrest, ↓cardiac output
 - Consider laryngospasm or bronchospasm (if LMA convert to ETT)
 - **Check airway** position & patency:
 - Visualise cords = rule out **oesophageal intubation**
 - Look inside mouth for kinks/gastric contents
 - Suction full length of ETT or bronchoscopic exam
 - Check ventilator mode & setting
 - Ventilate via Ambu-bag to exclude ventilator/circuit/probe problem
 - ▶ **If EtCO₂ waveform normal:** (∴ intact circuit integrity):
 - Check fresh gas flow / FiO₂
 - Exclude endobronchial ETT
 - Exclude pneumothorax: Neck veins, chest rise, auscultate or ultrasound
- Work through diagnostic checklist below to exclude all other causes

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

Quick check patient monitors: ?oxygenated & anaesthetised patient:

- **Anaesthetist's A** ^{Airway} EtCO₂ , **B** ^{SpO₂} Vent Settings , **C** ^{HR} MAP , **D** ^{Depth of} anaesthesia , **E** ^{Temp}

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

Frequency gamble:

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

Systematically work through all causes (see below)

- Consider timing of event eg drug administration, surgical event
- **Possible causes** (most common in bold):

↑ Production

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

↓ Elimination

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

□ Quick check patient monitors: ?oxygenated & anaesthetised patient:

- **Anaesthetist's** **A** Airway EtCO₂ , **B** SpO₂ Vent Settings , **C** HR MAP , **D** Depth of anaesthesia , **E** Temp

□ **If no EtCO₂ waveform** diagnose **immediately**:

- Incorrect ETT placement: "No Trace, Wrong Place". If in doubt, replace
- Severe bronchospasm - confirm airway **tab 4e**
- Check circuit & EtCO₂ sample line connections

□ **If low EtCO₂** then first **frequency gamble**:

- Cardiac or peri-arrest?: **tab 6e** or **tab 7e**
- Check sampling line - securely connected & patent
- Examine patient:
 - Airway position & patency
 - Auscultate & ensure bilateral chest rise - (r/o laryngospasm/bronchospasm)
- Check ventilator:
 - Switched on & functioning
 - Correct settings: tidal volume, RR

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

- Consider timing of event e.g. post intubation, drug administration, surgical event
- "No Trace, Wrong Place". Even in cardiac arrest without CPR; EtCO₂ should still be recordable
- If not an emergency or urgent, correlate EtCO₂ with ABG and PaCO₂
- **Possible causes** (most common in bold):

▸ **NO EtCO₂!!:**

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

▸ **↓Production:**

- hypothermia
- deep anaesthesia
- ↓thyroid

▸ **Sampling dilution:**

- high FGF
- sampler placed incorrectly
- dilution of sampling gas with air
- circuit disconnected

▸ **↑Elimination:**

- **hyperventilation**

▸ **↓Transport of CO₂ in blood:**

- **severe hypotension**
- anaphylaxis
- cardiac arrest
- embolism - air or pulmonary
- tamponade/tension pneumothorax

▸ **↓CO₂ diffusion in lung:**

- **low tidal volumes/dead space**
- **laryngospasm**
- **severe bronchospasm**
- ETT obstruction
- endobronchial intubation

29d. TACHYCARDIA

Contents
Emerg | Diag

- Check patient monitors: is the patient oxygenated & anaesthetised?:
 - ▶ **Anaesthetist's A** Airway EtCO₂, **B** SpO₂ Vent Settings, **C** HR MAP, **D** Depth of anaesthesia, **E** Temp
- If there is **diagnostic uncertainty & MAP <65 with HR >150** give **synchronised DC shock** (see yellow box for joules). Can repeat 3 times & give **amiodarone**
- Differentiate** sinus tachycardia & complex tachy-arrhythmia:
 - ▶ current surgical/pain stimulation
 - ▶ sinus rhythm?
 - ▶ QRS regularity?
 - ▶ QRS width?
- If **sinus tachycardia** consider causes (see yellow box below)
- If **complex tachy-arrhythmia** treat based on **MAP**:
 - ▶ MAP <65mmHg = **synchronised DC shock** (see yellow box for joules)
 - ▶ MAP >65mmHg = manage by **QRS width & regularity**:
 - **Broad:**
 - **Regular:**
 - ▶ [VT or WPW] **amiodarone**
 - ▶ [SVT with bundle block] *see narrow*
 - **Irregular:**
 - ▶ [AF with bundle block] *see narrow*
 - ▶ [torsades] **magnesium**
 - **Narrow:**
 - **Regular:**
 - ▶ [SVT]: vagal manoeuvres → **adenosine** → **β blocker**
 - **Irregular:**
 - ▶ [AF] **β blocker** or **amiodarone**
- Send urgent ABG. Ensure high normal K⁺ & Mg²⁺

- Consider timing of event eg drug administration, surgical event etc.
- **Possible causes of sinus tachycardia** (most common in bold):
 - ▶ **Primary causes:**
 - IHD
 - cardiomyopathy
 - sick sinus syndrome
 - accessory conduction pathways
 - myocarditis
 - pericarditis
 - valvular disease
 - congenital heart disease
 - ▶ **Secondary causes:**
 - **hypovolaemia**
 - **anaesthesia depth**
 - **drugs** - incl drug error
 - **pain**
 - anaphylaxis
 - electrolyte abnormalities
 - cardiac tamponade
 - sepsis
 - thyroid storm
 - MH
- Synchronised shock guides:
 - ▶ AF/monomorphic VT: 100J ⇒ 150J ⇒ 200J (☹️ 0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
 - ▶ SVT or flutter: 100J ⇒ 200J (☹️ 0.5J/kg ⇒ 1J/kg ⇒ 2J/kg)
 - ▶ polymorphic VT or unstable: 150J ⇒ 200J (☹️ 4J/kg)

- **Adenosine:** 6mg, then 12mg, then 18mg then consider other causes (☹️ = 0.1mg/kg > 0.2mg/kg, 0.3mg/kg)
- β blocker: **Esmolol** 10mg titrated. **Metoprolol** 2.5mg boluses titrated (max 15mg)
- **Amiodarone:** 300mg over 10min (☹️ = 5mg/kg)
- **Magnesium:** [torsades] 10mmol (5ml of 49.3%) over 2min (☹️ = 0.1ml/kg). (Give slower for other causes)

29d

30d

- Quick check patient monitors: is the patient oxygenated & anaesthetised?:
 - ▶ **Anaesthetist's A** ^{Airway} EtCO₂ , **B** ^{SpO₂} Vent Settings , **C** ^{HR} MAP , **D** ^{Depth of} anaesthesia , **E** ^{Temp}
- If **MAP >65mmHg** you have time (see causes in yellow box)
- If **MAP <65mmHg +/-** with evidence of ↓perfusion then consider:
 - ▶ **Atropine 600mcg** upto **3mg** (👉 = 20mcg/kg)
 - ▶ **Glycopyrrolate 200mcg** upto **1mg** (👉 = 10mcg/kg)
 - ▶ **Ephedrine 9mg** bolus titrated (👉 = 0.1 mg/kg)
 - ▶ **Adrenaline** infusion (👉 **tab 36r**)
 - ▶ **Isoprenaline** infusion (👉 **tab 36r**)
 - ▶ **Dopamine** infusion (👉 **tab 36r**)
- If **drug toxicity or overdose**:
 - ▶ βblocker = as above + **high dose insulin** infusion, **Na bicarb** (if propanolol OD)
 - ▶ Ca channel = as βblocker + **10ml 10% Ca chloride** slow push (can repeat)
- If **severe refractory bradycardia** try external temporary pacing:
 - ▶ attach defib & ECG leads
 - ▶ set to PACER mode
 - ▶ select rate 60/min
 - ▶ ↑mA of output until capture (normally 65-100mA required)
 - ▶ set final mA 10mA above capture
 - ▶ confirm pulse
- If **PEA** at any point **start CPR** **tab 7e** **tab 8e**

- Consider timing of event eg drug administration, surgical event
- **Possible causes** (most common in **bold**):
 - ▶ **Primary causes:**
 - **athlete**
 - IHD
 - AV block
 - pacemaker malfunction
 - cardiomyopathy
 - sick sinus syndrome
 - myocarditis
 - pericarditis
 - valvular heart disease
 - pulmonary HTN
 - ▶ **Secondary causes:**
 - **vagal stimulation**
 - **drugs** eg error, overdose, anti-arrhythmics
 - electrolyte abnormality
 - ↓thyroid
 - ↓temperature
 - ↑ICP
 - cardiac tamponade
 - tension pneumothorax
 - ▶ **Anaesthetic causes:**
 - **vasopressors**
 - **volatile**
 - **suxamethonium**
 - **opioids**
 - **high/total spinal**
 - anticholinesterases
 - hypoxia
 - auto-PEEP
 - MH
 - ↑↓K⁺
- For paediatric normal heart rates: **tab 9e**

- **Isoprenaline:** Dilute 1mg (5vials) into 50ml. Infuse at 0-60ml/hr
- **Adrenaline:** 5mg in 50ml saline. Infuse at 0-20ml/hr
- **Dopamine:** 100mg in 50ml saline. Infuse at 0-20ml/hr
- **Na bicarb 8.4%** [β blocker OD]: 50ml slow push. Can repeat every 2min (target pH 7.45-7.55)
- **High dose insulin** [β blocker/CCB OD]: **Bolus= 50ml of 50% dextrose & 70u actrapid.**
Infusion= 100u actrapid in 50ml saline, run at 35ml/hr and 10% dex run at 250ml/hr
 (monitor BSL & K every 30mins)

- Quick check patient monitors: is the patient oxygenated & anaesthetised?:
 - **Anaesthetist's A** Airway EtCO₂, **B** SpO₂ Vent Settings, **C** HR MAP, **D** Depth of anaesthesia, **E** Temp
- Check accuracy** of reading: check equipment (including transducer height)
- Frequency gamble on **common** causes:
 - Check for painful surgical activity - give **analgesia**
 - Check recent drug infusions & recent doses **for drug error** (incl. LA with adrenaline)
 - Check **tourniquet** time
 - Consider **bladder** volume/fluids infused
- Systematically work** through possible causes (see yellow box)
- Once all reversible causes have been addressed then consider **IV antihypertensive agents** (as green box below) to **SBP** target of **~160mmHg**

- Consider timing of event eg drug administration, surgical event
- **Possible causes** (most common in bold):
 - **Anaesthesia:**
 - **too light**
 - **pain**
 - **drugs** - consider error
 - hypoxia
 - hypercapnia
 - MH
 - IV line - non-patent/tissued
 - A line transducer height
 - **Patient related:**
 - **essential HTN**
 - rebound HTN - B blocker stopped
 - full bladder
 - pre-eclampsia
 - renal disease
 - phaeochromocytoma (always give a blocker before β blocker)
 - thyroid storm
 - ↑ICP
 - **Surgery:**
 - **pneumoperitoneum**
 - tourniquet
 - aortic clamping
 - carotid endarectomy
 - baroreceptor stimulation

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

31d
32d

- Check patient monitors: is the patient oxygenated & anaesthetised?:
 - **Anaesthetist's A** ^{Airway} EtCO₂ , **B** ^{SpO₂} Vent Settings , **C** ^{HR} MAP , **D** ^{Depth of} anaesthesia , **E** ^{Temp}
- Check accuracy** of reading: check equipment (including transducer height)
- Assess **severity**: visualise patient, check ECG & EtCO₂/SpO₂ waveform:
 - **No cardiac output or critical MAP:** start **CPR:** **tab 6e** or **tab 7e**
 - **MAP <65mmHg & concern** then consider:
 - Leg elevation
 - Rapid infusion of fluid +/- ready to transfuse blood **tab 12e**
 - IV **vasopressors** or **inotropes**
- Consider **reversible causes**:
 - Frequency gamble on common causes
 - Systematically consider each cause in turn
- Consider:
 - ECHO (if skilled) to help differentiate causes
 - Other invasive monitoring to assist with diagnosis e.g. PPV SWV from arterial line, cardiac index monitoring

- Consider timing of event e.g. drug administration, surgical event, scope surgery (always suspect concealed haemorrhage)
- **Possible causes** (most common in bold):
 - **↓Preload:**
 - blood loss/**hypovolaemia**
 - **↑intrathoracic pressure**
 - ↓VR - eg IVC compression, pt position, pneumoperitoneum
 - tamponade/tension pneumothorax
 - embolism
 - **↓Contractility:**
 - **drugs** incl. **volatiles**
 - IHD
 - cardiomyopathy
 - myocarditis
 - arrhythmia
 - valvular heart disease
 - **↓Afterload:**
 - **drugs** eg vasodilators incl **anaesthetic agents, opioids**, antiHTN drugs
 - **neuraxial techniques**
 - sepsis
 - tourniquet or clamp release
 - anaphylaxis
 - addisons crisis
 - ↓thyroid
 - **Equipment/human:**
 - **artefact or failure**
 - Invasive: **wrong transducer height**
 - NIBP: wrong cuff size
 - drug error
- ECHO: Consider LVEDV, LV function, gross valvular abnormality
- PPV SWV: >12% (only if: intubated, paralysed, Vt >8ml/kg, in sinus rhythm, norm abdo pressure) suggests hypovolaemia
- Normal CI = >2.6 L/min/m²

- **Pressors:** **metaraminol** 0.5mg (👎 10mcg/kg); **phenylephrine** 100mcg, **ephedrine** 9mg (👎 0.25mg/kg), **adrenaline** 10-50mcg
- **noradrenaline/adrenaline** infusion: 5mg in 50ml. infuse 0-20ml/hr

- This is generally not a crisis. Use the time to consider the causes
- Airway:** ensure patent unobstructed airway
- Breathing:**
 - ▶ Ensure established respiratory pattern
 - ▶ Check SpO₂
 - ▶ Check EtCO₂ trace and value
- Cardiovascular:** Ensure normal HR, MAP and ECG
- Drugs:** Review **all drugs** given during anaesthetic:
 - ▶ Check muscle relaxation with nerve stimulator. Give **reversal agent** (see green box)
 - ▶ Consider timing and infusions of all agents
 - ▶ Consider drug errors
 - ▶ Consider drug interactions
 - ▶ Consider patient factors e.g. renal/hepatic failure, elderly
- Others:
 - ▶ **Neurological:**
 - check pupils
 - apply BIS for signs of seizure (frontal lobe seizure only)
 - consider need for CT
 - ▶ **Metabolic:** send an ABG - check PaO₂, PaCO₂, Na, glucose
 - ▶ **Temperature:** ensure >30°
- Systematically** work through all causes (see below)

• **Possible causes** (most common in bold):

Drugs:

- ▶ **analgesic agents** e.g. opioids, α₂ agonists
- ▶ **anaesthetic agents** e.g. volatile, propofol
- ▶ **muscle relaxants** e.g. suxamethonium apnoea, inadequate reversal
- ▶ sedative agents e.g. benzodiazepines, anticholinergics, antihistamines, antidopaminergics
- ▶ magnesium toxicity

Metabolic:

- ▶ ↑↓**blood sugar**
- ▶ ↑↓sodium
- ▶ ↑urea

Hypothermia

Respiratory Failure:

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

Neurological:

- ▶ **stroke** - infarct, bleed or embolism
- ▶ seizure (Non-convulsive status epilepticus or post-ictal)
- ▶ local anaesthetic toxicity

Other - Uncommon:

- ▶ central anticholinergic syndrome
- ▶ dissociative coma
- ▶ thyroid failure
- ▶ toxicity of other CNS drugs

- [*rocuronium/vecuronium relaxant*]: **Sugammadex** dose on TBW: PTC>2 = 4mg/kg (70kg=280mg); >T₂ = 2mg/kg (70kg=140mg)
- [*all non-depolarising relaxants*]: **Neostigmine** 2.5mg (👤 = 50mcg/kg) & **glycopyrrolate** 500mcg (👤 = 10mcg/kg). Rpt at 15min
- [*suxamethonium apnoea*]: No reversal option ⇒ continue anaesthesia/refer to ICU

EMERGENCY OUT OF THEATRE

- MET Team

ANAESTHETICS & THEATRES

- Duty Anaesthetist
- Duty Technician
- Theatre Coordinator
- PACU Coordinator
- Perfusionist

OBSTETRICS

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

LABORATORY/X-RAY

- Blood bank
- Blood tests
- X-Ray Technician
- Duty Radiologist

REFERRALS

- ICU Doctor
- ICU Coordinator
- Haematology Doctor.....
- Surgical Doctor
- Paediatric Doctor
- Cardiology Doctor

35r. ADULT DRUG FORMULARY

Contents
Emerg | Diag

Drug	Bolus	Infusion
Adenosine	6mg, then 12mg, then 18mg.	-
Adrenaline (1:1,000 = 1mg/ml) (1:10,000 = 100mcg/ml)	[Arrest] 10ml of 1:10,000 (1mg) [Other] 0.1ml - 1ml of 1:10,000 (10-100mcg). Titrate	[Central] 5mg in 50ml saline. Infuse 0-20ml/hr [Peripheral] 3mg in 50ml saline. Infuse 3-40ml/hr
Alteplase	[Cardiac arrest] 50mg slow push. Can rpt at 15min [Peri-arrest] 20mg slow push	[Peri-arrest] 80mg in 20ml saline. Infuse at 10ml/hr
Aminophylline	400mg over 15mins	50mg in 50ml at 35ml/hr
Amiodarone	300mg over 10mins	900mg in 500ml D5W over 24hours
Ca²⁺ Chloride (10%)	10ml slow push	-
Clonidine	30mcg. Titrate (max 150mcg)	-
Dobutamine	-	250mg in 50ml saline. Infuse 0-10ml/hr
Dopamine	-	100mg in 50ml saline. Infuse at 0-20ml/hr
Esmolol	10mg. Titrate	-
GTN	[tocolytic] 100-250mcg	[ischaemia] 50mg in 50ml saline. Infuse 3-12ml/hr. Titrate to MAP/ECG
Hydralazine	Dilute to 1mg/ml. Give 5ml slow push. Repeat every 20min (max 30ml)	Dilute to 1mg/ml. Start infusion at 5ml/hr. Change rate by 1ml/hr every 20mins (max 20ml/hr)
Hydrocortisone	200mg	-
Insulin (actrapid)	[βblocker or CCB OD] 50ml of 50% dextrose & 70u actrapid (1u/kg). Give as bolus.	[↑K ⁺] 10units in 250ml 10% dextrose. Infuse quickly [βblocker or CCB OD] 100u actrapid in 50ml saline, run at 35ml/hr and 10% dextrose run at 250ml/hr. check BSL & k /30min
Intralipid (20%)	100ml bolus (1.5ml/kg), Rpt every 5min, max x2	1000ml/hr (15ml/kg/hr). Can double rate @5mins (max total dose = 12ml/kg)
Isoprenaline	-	1mg into 50ml saline. Infuse at 0-60ml/hr
Ketamine	[induction] 70-140mg (1-2mg/kg) [bronchospasm] 35-70mg (0.5-1mg/kg)	-
Labetalol	5-20mg slow push. Titrate (max 100mg)	[eclampsia]: Add 100mg to saline to make 100ml volume. Infuse at 20ml/hr. Double rate every 30mins (max 160ml/hr)
Lignocaine (1%) (1ml = 10mg)	[Arrhythmia] 7ml (0.1ml/kg). Can rpt every 10mins (max 0.3ml/kg)	Neat 1% at 6-24ml/hr. (Total max in 1hr = 30ml ie 3mg/kg)
Magnesium (49.3%) (1ml = 2mmol = 0.5g)	[bronchospasm] 5mls over 20min [torsades] 5ml slow push [eclampsia] 8ml in 12ml saline. Infuse at 120ml/hr	[eclampsia]: Maintenance = add 16ml to 100ml saline. Infuse at 14.5ml/hr Rescue (another seizure). 4mls in 6ml saline. Push over 5min
Metaraminol	0.5-1mg. Titrate	10mg in 20ml saline. Infuse 0-40ml/hr
Metoprolol	1-2.5mg. Titrate (max 15mg)	-
Midazolam	[seizures] 1-7mg. Titrate	-
Milrinone	-	10mg in 50ml saline. Infuse at 5ml/hr or 10ml/hr only
Naloxone	[emergency] 400mcg [titration] 40mcg (max 800mcg)	Infusion with hourly rate = 2/3 of bolus dose required for initial clinical effect
Noradrenaline	-	5mg in 50ml saline. Infuse 0-20ml/hr
Oxytocin	[elective] 3units slow bolus (do not repeat) [emergency] 5units slow bolus (do not repeat)	40units in 500ml saline. Infuse 125ml/hr
Phentolamine	5-10mg. Repeat every 5-15 mins as required	-
Phenylephrine	100mcg bolus. Titrate	10mg in 100ml saline (100mcg/ml). Infuse 0-40ml/hr
Salbutamol	250mcg slow push (Inhaled: 12 puffs via circuit)	5mg in 50ml saline. Infuse 0-10ml/hr
Sodium Bicarb (8.4%) (target pH 7.45-7.55)	25-50ml slow push. Can repeat every 2mins	-
Sugammadex	[emergency post intubation] = 16mg/kg; [PTC>2] 4mg/kg; [>T ₂] = 2mg/kg	
Suxamethonium	[laryngospasm] 35mg (0.5mg/kg)	
Tranexamic Acid	1g over 10mins (15mg/kg)	1g in 100ml saline. Infuse at 12.5ml/hr (8hrs)
Vasopressin	1unit slow push	20units in 20ml saline. Infuse 1-4ml/hr

35r

36r

36r. PAEDIATRIC DRUG FORMULARY

Contents
Emerg | Diag

Drug	Bolus	Infusion
Adenosine	0.1mg/kg, then 0.2mg/kg, then 0.3mg/kg	-
Adrenaline (1:1,000 = 1mg/ml) (1:10,000 = 100mcg/ml)	[Arrest IV] 0.1ml/kg 1:10,000 (10mcg/kg) [Arrest ETT] 0.1ml/kg of 1:1,000 (100mcg/kg) [Anaphylaxis gd 2-3] Dilute 1mg in 50ml (20mcg/ml) Give 0.1-0.5ml/kg [IM dose] 0.01ml/kg of 1:1,000 (10mcg/kg)	[↓bp] 0.15mg/kg (max 5mg) in 50ml saline. Infuse 1-40ml/hr
Aminophylline (25mg/ml)	10mg/kg (max 500mg) over 1hr diluted to 50ml with saline	1-9yrs: 55mg/kg made to 50ml with 5% dex. infuse 1ml/hr 10-15yr & <35kg: 35mg made to 50ml with 5% dex. infuse 1ml/hr 10-15yr & >35kg: neat drug. infuse 0.028ml/kg/hr
Amiodarone	5mg/kg slow push (max 300mg)	-
Atropine	20mcg/kg	-
Ca²⁺ Chloride (10%)	0.05 - 0.2ml/kg (max 10ml) slow push	-
Dobutamine	-	15mg/kg in 50ml saline. Infuse at 0-4ml/hr
Dopamine	-	15mg/kg in 50ml saline. Infuse at 0-4ml/hr
Ephedrine	0.25mg/kg (max 9mg/dose)	-
Esmolol	500mcg/kg slow push. Titrate	-
Glycopyrrolate	10mcg/kg	-
Hydrocortisone	[asthma] 4mg/kg	-
Insulin (actrapid)	[↑K] Periph IV: 0.1unit/kg in 5ml/kg 10% dex [↑K] CVL: 0.1u/kg in 2ml/kg 50% dex	-
Intralipid (20%)	1.5ml/kg bolus. Repeat every 5min, max x2	15ml/kg/hr. Can double rate @5min (max total dose=12ml/kg)
Isoprenaline	-	300mcg/kg in 50ml saline. Infuse at 1ml/hr (0.1mcg/kg/min) and titrate up (max 10ml/hr)
Ketamine	[bronchospasm & anaesthetised] 0.5-2mg/kg	-
Labetalol	0.25-0.5mg/kg slow push. rpt ev. 10min as req'ed	50mg/kg & saline to make 50ml. Infuse 0-3ml/hr (0-3mg/kg/hr)
Lignocaine 1% (1ml=10mg)	[arrhythmia] 0.1ml/kg. Can rpt every 10mins (max 0.3ml/kg)	-
Magnesium (49.3%) (1ml = 2mmol = 0.5g)	[asthma] 0.1ml/kg (max 5ml) in 50ml saline over 20mins	-
Metaraminol	10mcg/kg	-
Metoprolol	0.1mg over 5mins	-
Midazolam	[seizures] IV: 0.1mg/kg; IM 0.2mg/kg; buccal 0.5mg/kg. Can repeat dose @ 5mins	-
Naloxone	[emergency] 10mcg/kg (max 400mcg) [titrate] 2mcg/kg (400mcg in 20ml give 0.1ml/kg)	300mcg/kg to 30ml 5% dex & run at 0-1ml/hr (10mcg/kg/hr)
Noradrenaline	-	0.15mg/kg (max 5mg) in 50ml saline. Infuse 1-40ml/hr
Phenylepherine	2-10mcg/kg. Titrate	10mg in 100ml saline. Infuse 0-20ml/hr (1-5mcg/kg/min)
Salbutamol	Inhaled: <5yr=6puffs; >5yrs 12puffs via circuit IV: 10mcg/kg over 2 min (max 500mcg). Rpt @ 10min	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
Sodium Bicarb (8.4%)	1ml/kg over 5min. Can repeat every 2mins (target pH 7.45-7.55)	-
Sugammadex	[emergency post intubation] = 16mg/kg; [PTC>2] 4mg/kg; [>T ₂] = 2mg/kg	-
Suxamethonium	[intubation] IV: 2mg/kg; IM 4mg/kg [non-emergency laryngospasm] 0.5mg/kg	-
Tranexamic Acid	15mg/kg diluted in 20-50ml saline over 10min. (Max 1g)	2mg/kg/hr in 500ml saline for 8hrs
Vasopressin	-	1unit/kg in 50ml saline. Bolus 2ml. Infuse 1-3ml/hr

35r

36r

Clickable links:

Treating known
EMERGENCIES

DIAGNOSING
Problems

ADULT DRUG
Formulary

PAEDS DRUG
Formulary

Anaesthetic Crisis Handbook

www.AnaestheticCrisisHandbook.com

By Adam Hollingworth
adamhollingworth@icloud.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 H Janssens, Dr J Cameron, Dr H Truong, Mr R Pryer, Mrs J Dennison, Dr D Mein, Dr N Chadderton, Dr S Treshina, Dr L Kwan, Dr A Haq, Dr S McRitchie, Miss L Anderson, Dr D Heys, Miss D Hantom, Mr D Livesey, Dr J Dieterle, Dr V Singh, Dr P Tobin, Dr B Waldron, Dr J McKean, Miss K Chadwick-Smith & many more.

DIAGNOSING
Problems

Version 3.3, Feb 2023

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 handbook in certain situations.