

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**

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Adapted from various sources including:

- Guidelines: ANZAAG, AAGBI, NZRC, Starship Protocols
- 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

Instructions for Use

- Use the **index** and **coloured tabs** to find quick reference pages to assist in a crisis.
- The **handbook is in 2 parts**:
 - The front book: How to treat known **Emergencies**
 - The back book: How to **Diagnose** Problems
- **Routine/obvious tasks** (eg call for help, turn oxygen to 100%) are assumed & thus **not** repeated on every sheet for clarity
- For simplicity & to avoid calculation errors in an emergency, **drug doses** are given for a **70Kg adult**. Paeds doses are clearly marked with 🧒 (where appropriate).

- Emergency/Doing tasks

- Thinking tasks, diagnostic or further information

- Doses, equipment or calculation information

- There is an adult & paediatric drug formulary at the back
- Cards are arranged into coloured boxes:
- 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. CICO - Supraglottic

2e. CICO - Infraglottic

3e. LARYNGOSPASM

4e. BRONCHOSPASM

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15e. LOCAL ANAESTHETIC TOXICITY

16e. MALIGNANT HYPERTHERMIA

17e. HYPERKALAEMIA

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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. CICO - Supraglottic Rescue

Contents
Emerg | Diag

Main priority = Oxygenation with stable SpO₂ >90%

- Pre-oxygenate all patients
- Consider **passive apnoeic oxygenation** with nasal cannula during RSI
- Remove cricoid early

If failure of first supraglottic airway plan:

- Get difficult intubation trolley
- An extra anaesthetic assistant to prepare equipment is very useful
- Use 'vortex' approach -
 - **No more than 3 attempts** at each **rescue technique**. **Move quickly**, in any **order**, between rescue techniques watching SpO₂/EtCO₂:

Bag/Mask	LMA	ETT
Dentures in	Change type	Dentures out
Optimise position	Change size	Best: person, position, blade eg video laryngoscope
2 hands + assistant	Cuff inflation/deflation	BURP
OPA/NPA	Place with laryngoscope	Bougie - only 1 blind attempt
+/- Muscle relaxation	+/- Muscle relaxation	+/- Muscle relaxation

- If success with LMA:** consider converting to ETT with fibre optic scope
- Before giving muscle relaxation consider possibility of **waking patient:**
sugammadex 1.2g, naloxone 400mcg
- As each rescue attempt **fails**, **escalate** & start to **prepare** for infraglottic **rescue**:
 - **Ready:** Get CICO kit from side of anaesthetic machine
 - **Set:** Open equipment packaging & palpate cricothyroid landmarks

If SpO₂ rapidly falling or persistently low (<90%) despite **3** different **techniques**:

- Call out loud - **'We are in a Can't Intubate, Can't Oxygenate Scenario'**
- Do not delay**, start infraglottic rescue. See **tab 2e**

- **sugammadex** = immediately post roc/vec = 1.2g or 6 x 200mg vials (👉 16mg/kg)
- **naloxone** = 400mcg bolus (👉 10mcg/kg)

Main priority = **Oxygenation with stable SpO₂ >90%**

- Dedicated team** continuing to attempt **oxygenation supraglottically**
- Pull patient up bed so head extends over pillow
- 3 options for infraglottic rescue (decide on your preferred 1st method):

1. Scalpel bougie (*palpable neck anatomy*):

- = A **bloody, semi-blind** technique. Prepare gauze/swabs & suction
- 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

2. 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 from peak response
 - **2nd breath**: 1.5 secs (250mls) & **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

3. Scalpel, Finger, Cannula/Scalpel (*non-palpable anatomy*):

- = A **very bloody, blind** technique. Prepare gauze/swabs & suction
- Method:
 - Vertical **midline 6cm** incision through skin & subcutaneous tissue
 - Use both hands to **blunt** dissect down to airway & **secure** cartilage
 - Insert cannula or scalpel through cricothyroid membrane
 - Follow step 1 or 2 as above to oxygenate patient

- Choice of 1st method is operator's personal preference. Decide on your preferred method & practise it - mentally or in a simulation
- If 1st method is unsuccessful move to alternative method immediately
- If no palpable anatomy: scalpel finger method is recommended

Main Priority: Break laryngospasm & maintain SpO₂

- Ask surgeon to stop
- Delegate & prepare for intubation - **Suxamethonium** & **ETT**
- Manual procedures:**
 - Remove LMA & clear the airway
 - Consider OP/NP airway
 - **Jaw thrust & CPAP 30cmH₂O** - **do not** give +ve pressure breath
 - Apply bilateral, painful, inward pressure to **Larson's point** (immediately behind lobule of ear)
 - If paed: Consider gentle chest compressions (may be more effective than other manual procedures)
- If **SpO₂ stable & >92%** try pharmacological 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%** proceed to intubation without delay:
 - Adult: **Suxamethonium 100mg**
 - Paeds: **Suxamethonium IV: 2mg/kg; IM 4mg/kg**
- Consider **atropine 600mcg** (👉 20mcg/kg) for bradycardia
- Consider stomach decompression after event

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

Drug & Equipment dosing

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

Main Priority: SpO₂ >95% with Peak Airway Pressures <50cmH₂O

- Inform surgeon. Minimise surgical stimulation
- Check:**
 - Airway position
 - EtCO₂ trace
 - 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 - 250mcg** slow bolus (👉 below). Repeat at 10mins if needed
 - **IV adrenaline - 0.1 - 0.5ml of 1:10,000** (👉 0.01-0.05ml/kg 1:10,000)
- Optimise ventilator** settings: long expiratory phase, low PEEP, small tidal volumes, intermittent disconnection
- Other **bolus drug adjuncts** (listed in priority order): **hydrocortisone, magnesium, ketamine, aminophylline**
- If no improvement** use **infusions** of **salbutamol, aminophylline, adrenaline**
- Place arterial line. Take serial ABG's

- Always **consider other causes** of high airway pressure other than primary bronchospasm see **tab 25d** . Most common include:
 - anaphylaxis
 - tube position
 - pneumothorax
 - laryngospasm (on LMA)
 - chest wall rigidity
 - LV failure
- **Permissive hypercapnia** may be required in order to ↓ airway pressures
- Assess response by ↓ airway pressures, ABG's, and improving EtCO₂ trace

- **Salbutamol IV** slow bolus: 👉 <2yrs = 5mcg/kg; 2-18yrs = 15mcg/kg (max 250mcg)
- **Salbutamol Infusion:** 5mg in 50ml NSL. Infuse 0-10ml/hr. (👉 50mls of neat salbutamol. Infuse 5-10mcg/kg/min for 1 hour, then reduced to 1-2mcg/kg/min)
- **Adrenaline infusion:** 5mg in 50mls NSL. Infuse 0-20mls/hr. (👉 not recommended)
- **Hydrocortisone:** 200mg IV (👉 4mg/Kg)
- **Aminophylline:** bolus load: 400mg over 15mins. Infuse: 50mg in 50ml at 35ml/hr. (👉 Load: 10mg/kg over 1hr diluted to 1mg/ml (max 500mg). Infusion varies by age: see **tab 36r**)
- **Magnesium:** 10mmol (5mls of 49.3%) over 20mins (👉 0.1ml/kg of 49.3% (max 5mls) over 20mins)
- **Ketamine:** 35-70mg IV. (👉 0.5-1mg/kg)

5e. ASPIRATION

Contents
Emerg | Diag

5e

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

6e

- Call for help from surgical team members immediately
- Move patient** to head down, left lateral position **immediately**
- 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

- If patient is asymptomatic 2hrs after event with normal saturation & CXR: ICU referral is not indicated
- **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 (ensure full chest recoil)
- Attach defibrillator. **Shock immediately** at 200J (or max setting)
- Check & secure airway. Monitor EtCO₂ (with compressions)
- 100% O₂, **stop anaesthetic** agents. Ventilate at 10/min (ratio compression:breath=10:1)
- Follow 2 min cycles:
 - Charge defib > Rhythm check > **shock** > restart compressions
 - **Adrenaline 1mg** (10mls of 1:10,000) immediately after 2nd shock, then every 4mins
 - **Amiodarone 300mg** immediately after 3rd shock
 - If ECG shows QRS complex goto **tab 7e**
- Read out & consider reversible causes** (see below)
- Fetch ultrasound to help r/o causes (if skilled)
- If **ROSC** consider post resuscitation care:
 - Abandon surgery, urgent cardiology referral (?for PCI)
 - ABCDE's, ABG's, 12 lead ECG, therapeutic normothermia (cool if >36 °C)
 - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia

Reversible Causes:

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

(Follow all drugs with 20ml flush)

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

7e. ADULT CARDIAC ARREST - Asystole/PEA

Contents
Emerg | Diag

Main priority = good quality CPR

- Ask surgeons to stop all vagal stimuli
- Start chest compressions at 100/min (ensure full chest recoil)
- Attach defibrillator**
- Check & secure airway. Monitor EtCO₂ (with compressions)
- 100% O₂, **stop anaesthetic** agents. Ventilate RR 10/min (ratio compression:breath=10:1)
- Follow 2 min cycles:
 - Charge defib > **rhythm & pulse check** > restart compressions
 - **Give adrenaline 1mg** (10mls of 1:10,000) **immediately**, then every 4mins
 - If ECG shows VF/VT goto **tab 6e**
- In asystole: if **p waves** present consider **pacing** (see **tab 30d**)
- Read out & consider reversible causes** (see below)
- Fetch ultrasound to help r/o causes (if skilled)
- If ROSC** consider post resuscitation care:
 - abandon surgery, urgent cardiology referral
 - ABCDE's, ABG's, 12 lead ECG, therapeutic normothermia (cool if >36 °C)
 - Avoid: SpO₂ >99%, hyperglycaemia (>10mmol/l), hypercarbia

Reversible Causes:

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

(Follow all drugs with 20ml flush)

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

Main priority = Ensure patent airway & adequate oxygenation

- Ask surgeons to **stop all vagal stimuli**
- 100% O₂**, stop anaesthetic agents. Ventilate RR 15/min (compressions 15 : 2 breaths)
- Start chest compressions at 100/min (ensure full chest recoil)
- Check & secure airway**. Monitor EtCO₂ (with compressions)
- 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 r/o 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 = 2.5; <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	70-190	Normal HR	80-160	Normal HR	80-130
Energy (J)	20	Energy (J)	28	Energy (J)	40
ETT Size (mm)	3.5	ETT Size (mm)	4	ETT Size (mm)	4.5
ETT _(oral) Length (cm)	10.5	ETT Length (cm)	11.5	ETT Length (cm)	13.5
ETT _(nasal) Length (cm)	11.5	ETT _(nasal) Length (cm)	12.5	ETT _(nasal) Length (cm)	15.5
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)	0.5mls	Adrenaline (1:10,000)	0.7mls	Adrenaline (1:10,000)	1mls
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	80-120	Normal HR	75-115	Normal HR	60-100
Energy (J)	55	Energy (J)	70	Energy (J)	150
ETT Size (mm)	5	ETT Size (mm)	5.5	ETT Size (mm)	6.5
ETT Length (cm)	14.5	ETT Length (cm)	15.5	ETT Length (cm)	18
ETT _(nasal) Length (cm)	16.5	ETT _(nasal) Length (cm)	17.5	ETT _(nasal) Length (cm)	20
LMA Size	2	LMA Size	2	LMA Size	2.5
Fluid bolus (ml)	300	Fluid bolus (ml)	350	Fluid bolus (ml)	750
Adrenaline (1:10,000)	1.4mls	Adrenaline (1:10,000)	1.8mls	Adrenaline (1:10,000)	3.7mls
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)	75	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)
- Minimise volatile but maintain anaesthesia
- Consider early intubation (risk of airway oedema)
- Ensure large bore IV access. If none, consider intraosseous access
- Treat based on grade of anaphylaxis** (see yellow box)

▶ Give **IV adrenaline & fluids asap**

(If no IV give **IM adrenaline 0.5ml 1:1,000** 🤔 1:1,000: <6yrs = 0.15ml / 6-12yrs = 0.3ml) · Repeat every 5mins)

▶ Repeat **adrenaline** & fluid boluses every 1-2 minutes as required:

	Grade 1 (Mild)	Grade 2 (Mod/severe)	Grade 3 (Life threatening)	Grade 4 (Cardiac arrest)
IV Adrenaline	Not required	10mcg (0.1ml 1:10,000) 🤔 0.01ml/kg 1:10,000	100mcg (1ml 1:10,000) 🤔 0.05ml/kg 1:10,000	1mg (10ml 1:10,000) 🤔 0.1ml/kg 1:10,000
Fluid Bolus	Not required	Rapid 1 litre 🤔 10ml/kg	Rapid 1-2 litres 🤔 10-20ml/kg	Rapid 2-3 litres 🤔 20ml/kg
Legs	Not required	Elevate	Elevate	Elevate

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

Refractory management:

▶ **bronchospasm** (see **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** ⇒ **rpt IVF bolus** ⇒ **noradrenaline +/- vasopressin infusion**

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

• **Grades of anaphylaxis:**

Grade 1 = Mild	Grade 2 = Mod/severe	Grade 3 = Life threatening	Grade 4 = Cardiac arrest
Mucocutaneous signs	Mucocutaneous signs	+/- Mucocutaneous signs	Start IVF, adrenaline & CPR!
+/- Angiooedema	↓MAP, ↑HR	Arrhythmias & CVS collapse	
	Bronchospasm	Severe bronchospasm	

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

- **Adrenaline** or **Noradrenaline** infusion (do not need CVL to start) : 5mg in 50mls NSL. Infuse 1-20mls/hr 🤔 0.15mg/kg made to 50mls with saline. Infuse 1-20mls/hr
- **Salbutamol** IV bolus: 250mcg 🤔 <2yrs = 5mcg/kg; 2-18yrs = 15mcg/kg (max 250mcg)
infusion: 5mg in 50mls NSL. Infuse 1-10ml/hr 🤔 5mcg/kg/min for 1hr then 1-2mcg/kg/min
- **Vasopressin** (do not need CVL to start) : 20units in 20ml NSL. Bolus 1ml. Infuse 1-4ml/hr 🤔 1unit/kg made to 50mls with saline. Bolus 2mls. Infuse 1-3ml/hr

9e
10e

Main priority = ↓ Myocardial O₂ consumption & ↑ myocardial O₂ supply

- Titrate 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 NSL. Infuse 0-20ml/hr preferably via CVL
- **Adrenaline**: 5mg in 50ml NSL. Infuse 0-20ml/hr preferably via CVL
- **Dobutamine**: 250mg in 50ml NSL. Infuse 0-10ml/hr (can infuse peripherally)
- **Milrinone**: 10mg in 50ml NSL. Infuse at 5ml/hr or 10ml/hr only
- **GTN**: 50mg in 50ml NSL. Infuse at 1-12ml/hr titrated to MAP & ECG changes

11e

12e

12e. SEVERE HAEMORRHAGE

Contents
Emerg | Diag

Main priority = Volume replacement & good teamwork

- IV access:** x2 16G cannula +/- Rapid Infusion Catheter (RIC)
- Ensure adequate surgical effort to control active bleeding (see yellow box)
- Contact blood bank** - call for blood
- Set up rapid infusion device (+/- cell saver if available)
- Give 3 units** O negative or group specific blood
- If ongoing or severe bleeding:**
 - Activate **massive transfusion protocol**
 - Request each box in turn and give products asap
 - **Assemble a team with clear roles** (eg blood bank liaison, runner to collect boxes, blood checkers, people to hang blood etc..)
- Insert arterial line
- Use **permissive hypotension:** MAP 55-65mmHg until haemostasis established (except head injuries where MAP target = 80-90mmHg)
- Aggressively keep pt **warm** (>36°C): Warm fluids, warm theatre, forced air warmer
- Check bloods** every **30mins:** Coags (TEG if available), FBC, ABG, iCa²⁺
- Use treatment thresholds (in green box) to guide further blood product use
- Keep ionised Ca²⁺ >1mmol/L = give **10ml 10% calcium chloride**

11e
12e

Other Tasks to consider:

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

Additional Treatment Thresholds & Doses:

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

Blood product compatibility:

▸ **Rbc's:**
(in a crisis, Rh is not imp - 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 imp (see blood bank)

13e. AIR/GAS EMBOLISM

Contents
Emerg | Diag

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 lateral** position
- Remove **pneumoperitoneum** (if in use)
- If CVL in place - aspirate line
- Consider **chest compressions** 100/min (even if not in arrest - known to break up volumes of air)
- Aim **MAP >65mmHg** :
 - Assess fluid responsiveness - 500ml bolus crystalloid (😊 = 20ml/kg)
 - Vasoactive medications eg **noradrenaline, adrenaline, dobutamine**
- Consider early TOE - (useful to r/o other causes of pulmonary embolism)
- Consider referral for hyperbaric oxygen therapy

• Signs of air/gas embolism:

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

• Adrenaline:

- bolus = 10-100mcg (0.1-1ml of 1:10,000) - (😊 0.01-0.05ml/kg of 1:10,000)
- Infusion = 5mg in 50mls NSL. Infuse 0-20mls/hr (😊 see **tab 36r**)
- **Noradrenaline infusion:** 5mg in 50mls NSL. Infuse 0-20mls/hr
- **Dobutamine infusion:** 250mg in 50ml NSL. Infuse 0-10ml/hr (can infuse peripherally)

13e

14e

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

- Stop transfusion** & flush line
- Recheck blood against patient
- Minimise volatile but maintain anaesthesia
- Resuscitate based on ABC's:**
 - Consider early intubation
 - Treat bronchospasm if present- see **tab 4e**
 - Address cardiovascular instability - aim MAP >65mmHg:
 - Assess fluid responsiveness: Leg elevation +/- 500ml fluid bolus (👤 20ml/kg)
 - Start **adrenaline infusion** (recommended 1st line due to diagnostic similarity with anaphylaxis)
 - Maintain urine output (aim 1ml/kg/hr) - **IV furosemide 35mg**
- Place arterial line, CVL & urinary catheter (collect urine for analysis)
- Take bloods: U&E, FBC, Coags & sample for re-X match
- Watch for **coagulopathy** & consult haematologist - Treat early see **tab 12e**
- Consider **IV methylprednisolone 250mg** slow injection
- Collate all blood products** & return to lab
- Contact ICU

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 50mls NSL. Infuse 0-20mls/hr
- **Salbutamol:**
 - bolus = 250mcg slow push (👤 <2yrs = 5mcg/kg; <18yrs 15mcg/kg (max 250mcg)
 - infusion = 5mg in 50mls NSL. Infuse 0-10ml/hr (👤 50mls of neat salbutamol. Infuse 5-10mcg/kg/min for 1 hour, then reduced to 1-2mcg/kg/min)

15e. LOCAL ANAESTHETIC TOXICITY

Contents
Emerg | Diag

Main Priority: **Good Quality CPR & early Intralipid**

Stop administration of **LA** and get **LA Toxicity Box**

If signs of cardiac output:

- ▶ Consider need for **intubation**
- ▶ **Ventilate** if required - aim for EtCO₂ 30mmHg
- ▶ Confirm IV access
- ▶ Consider giving **IV 20% intralipid** early: bolus then infusion (see dosing below)
- ▶ If **arrhythmia** use standard protocols - see **tab 29d**
(Consider **amiodarone 300mg** slow IV push. Avoid **lignocaine**, caution with **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** (see **tab 6e** or **tab 7e**) but note:
 - Use **reduced dose adrenaline** (70mcg/dose) (👉 1mcg/kg) **only** after **intralipid**
 - Be prepared to continue for 60 mins
- ▶ Give **20% IV intralipid** (👉 see green box) :
 - **Bolus**: 100mls. Can repeat every 5 mins, maximum twice (if required)
 - **Infusion**: 1000ml/hr neat intralipid. Double rate @ 5mins if no improvement
 - Do not exceed max dose of 840mls
- ▶ Mobilise cardiopulmonary bypass/ECMO team (if available)
- ▶ Send **ABG** - keep pH >7.25: Give **sodium bicarbonate 8.4% 50mls** (👉 1ml/kg)
(Can rpt every 2mins - must ensure adequate ventilation)

• **Signs** of LA toxicity:

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

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

- **Midazolam**: IV 0.15mg/kg; IM 0.2mg/kg; buccal 0.5mg/kg. Can repeat at 5mins
- **Intralipid 20%**: bolus: 1.5ml/kg. Can rpt every 5mins x2. Infusion: 15ml/kg/hr. At 5mins can double rate if no improvement. Max cumulative dose = 12ml/kg

15e
16e

Main Priority: Early Recognition, Removal of Triggers, Dantrolene

- Recognise problem** - if in doubt treat
- Call for **MH trolley** (if you prefer: distribute & follow MH task cards)
- Delegate & organise help into teams
- Stop volatile** & washout with **100% oxygen at 15 litres**. Switch to **TIVA**
- Add charcoal filters to circuit. Change soda lime if easy (**Do not** waste time changing machine/circuit)
- Give **IV dantrolene** (🥺 2.5mg/kg) & **get more** from on call pharmacist:
 - 9 vials of 20mg. Reconstitute each vial into 60ml syringe with water
 - Repeat every 10mins until control achieved (max total 35vials or 10mg/kg)
- Increase **monitoring** if not already in place:
 - **Arterial line** +/- CVL. Take serial bloods: ABGs (every 30min), Coags, CK
 - **Urinary catheter**. Aim for urine output >2ml/kg/hr
 - **Core temperature probe** eg rectal or bladder
- Treat complications:**
 - **>38.5°C**: refrigerated IV fluids (& intraperitoneal if surgical access), surface ice, cold operating room
 - **pH <7.2**: Ventilate EtCO₂ to 30cmH₂O (+/- **sodium bicarbonate**)
 - **K⁺ >7** or **ECG changes**: Give **IV calcium chloride**, **IV insulin-dextrose infusion**, **salbutamol puffs**
 - **Arrhythmias**: Defibrillate. Consider **IV amiodarone** +/- **lignocaine** +/- **esmolol**
 - **MAP <65mmHg**: start **noradrenaline** infusion
- Consider abandoning surgery & ICU referral

• Rapid diagnosis: ABG = mixed respiratory & metabolic acidosis

• **Signs** suggesting possible MH:

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

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⁺ >7mmol/L +/- marked ECG changes** start drug therapy:
 - **10% calcium chloride 10ml slow bolus**
 - Infuse **10units of actrapid in 250ml 10% dextrose.** Run at 500ml/hr
 - **6-12 puffs salbutamol** into circuit. Rpt every 20mins
 - If refractory consider:
 - **50mls 8.4% sodium bicarbonate**
 - **20-40mg IV furosemide**
 - 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
- acidosis
- acute renal failure
- organ reperfusion eg following clamp/tourniquet
- haemolysis/massive transfusion
- medications

• Avoid:

- further doses of suxamethonium
- respiratory acidosis

PAEDS Doses

- **Calcium chloride** 10% 0.2ml/kg
- **Insulin/dextrose:** 0.1u/kg actrapid in 2ml/kg of dextrose over 30mins
- **Salbutamol:** <5yrs: 6puffs every 20mins; >5yrs: 6-12puffs every 20mins

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

PATIENT FIRE

Main priority = Recognise fire and extinguish

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

• To decrease risk of airway fire:

- Use lowest possible oxygen, avoid nitrous
- Place saline in ETT & LMA cuffs
- Pack wet throat pack around ETT's
- If LASER surgery: use LASER resistant ETT with methylene blue in proximal cuff, saline in distal cuff

• To decrease risk of patient fire:

- Allow time for skin preps to fully dry
- Use moistened sponges & gauzes near ignition sources

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

- Review all infusions/medications recently administered
- Activate MTP** now. Start volume resuscitation asap (See **tab 12e**)
- If no cardiac output:**
 - Call 777 & declare **'MET call + obstetric & neonatal emergency'**
 - Start **preparations** to deliver baby **now** (peri-mortem Caesarean or instrumental)
 - Remove all foetal monitoring
 - Start **CPR** > apply **defib** > check **rhythm** > see **tab 6e** or **tab 7e**
 - Ensure IV access, if none consider IO access (humerus preferable)
 - 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, eclampsia/seizures ▸ Thromboembolism: VTE/PE, amniotic fluid or air embolism ▸ Tamponade: cardiac 2nd to aortic dissection, trauma ▸ Tension PTX: trauma
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- **Magnesium** (49.3%) [eclampsia]:
 - loading infusion: 8mls in 100ml NSL. Infuse at 300ml/hr to complete
 - For maintenance & rescue doses see **tab 23e**
- **Calcium chloride 10%** [MgSO₄ toxicity antidote]: 5mls slow push. (can repeat)
- **20% Intralipid** [LA toxicity]: (max total 12ml/kg)
 - bolus: 100mls (1.5ml/kg). Repeat (max twice) every 5 mins, if required
 - maintenance: 1000ml/hr (15ml/kg/hr). Double speed @5mins if no improvement
- **Alteplase** [Thrombosis]: 100mg in 20mls NSL. Infuse at 80ml/hr (be prepared for prolonged CPR - upto 60mins)
[To reverse]: Stop infusion. Give **1g tranexamic acid**. Discuss with haematologist (**cryo +/- platelets**)

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

- Pre-setup **neopuff**: Gas supply @10L, PEEP 5, PIP 30cmH₂O. Heater & suction
- In 1st minute: **Vigorously dry** baby & apply warm, dry towels
- Then work in **30 sec cycles**. Perform intervention then reassess at end of cycle:
 - **Tone** - UL & LL
 - **HR** - use SpO₂ probe or stethoscope (tap beats out +/- count beats for 3secs, then x 20)
 - **RR** - Are they gasping or apnoeic?
- If HR >100, good tone, regular RR:** give routine care
- If baby well except ↑WOB:** give 5 cmH₂O CPAP with room air
- If any of HR <100, poor tone, gasping/apnoeic:** start ventilating:
 - Fine tuning of neutral head position with jaw thrust is vital
 - Room air initially. ↑O₂ every 30 secs if no improvement: 40% then 100%
 - consider x5 inflation breaths of 2-3 sec: PIP 30cmH₂O
 - Once adequate **chest rise**: RR 40-60/min: PIP 15-20cmH₂O
- If HR <60:**
 - 100% O₂. Consider LMA or intubation (if skilled)
 - Start chest compressions @ 90/min (2 thumb technique with 2nd person for airway is preferred)
 - Use ratio = **compressions 3 : 1 breath** (half second compression pause to deliver breath)
- If Ongoing HR <60:**
 - Give **1:10,000 adrenaline** based on gestation
 - Umbilical **venous catheter** is preferred (1 vein, 2 arteries)

	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) then 2ml normal saline flush		

 - 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 (see **tab 9e**)

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

21e. TOTAL/HIGH SPINAL

Contents
Emerg | Diag

Main Priority: Rapid management of ABC's

- If on delivery suite:** Call 777 & declare “**obstetric & neonatal emergency**”
- Review all infusions/medications & consider reversible causes (yellow box below)
- If no cardiac output:**
 - ▶ Start CPR > apply **defib** > check rhythm - see **tab 6e** or **tab 7e**
 - ▶ If obstetrics, follow ‘**maternal**’ **specific tasks**:
 - Lift uterus skyward & displace to left
 - **Intubate early** & ventilate with EtCO₂ target of 30mmHg
 - Perform chest **compressions higher** on chest & **push deeper**
 - Patient >24 weeks: If **no rapid ROSC** then start **immediate** preparations to **deliver baby** within 5mins (peri-mortem Caesarean or instrumental)
 - ▶ Note ‘**total spinal**’ **specific tasks**:
 - Give **adrenaline 1mg** (10ml 1:10,000) **asap**
 - Early rapid infusion of 2-3 litres of **fluid**
- 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
 - ▶ If obstetrics, **lift uterus** skyward & displace to left
 - ▶ If **HR <60** then give **600mcg atropine**. Repeat if required (max 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 see **tab 19e**):
 - ▶ Vasovagal
 - ▶ Haemorrhage (external or concealed) **tab 12e** / **tab 22e**
 - ▶ LA Toxicity **tab 15e**
 - ▶ Amniotic Fluid Embolism **tab 24e**
 - ▶ Mg toxicity
 - ▶ IVC compression
 - ▶ Massive pulmonary embolus
 - ▶ Drug error
- Vasopressor: **phenylephrine** 100mcg; **metaraminol** 1mg; **ephedrine** 9mg
- **Adrenaline** -
 - ▶ bolus: 0.1-0.5ml 1:10,000 (10-50mcg)
 - ▶ infusion: 5mg in 50mls NSL. Infuse at 0-20mls/hr

Main Priority: Prepare for Massive, Rapid Blood Loss

- x2 16G IV** cannula - consider intraosseous access if needed
- Encourage **surgical control** of uterine tone & bleeding (see yellow box)
- Rapidly infuse crystalloid to match blood loss
- If ongoing severe blood loss:**
 - Call blood bank & rapidly transfuse up to **3 units of blood**
 - If required activate **massive transfusion protocol** (see **tab 12e**)
 - Note **obstetric specific MTP** actions:
 - If fibrinogen level <2 then give **3 units cryoprecipitate**
 - Consider giving **tranexamic acid** early: **1g over 10mins**
- If out of theatre:** call **777** declare an “**obstetric emergency**”
- Use **vasopressors** to maintain a MAP >65mmHg
- Aggressively keep pt **warm** (>36°C): Warm fluids, warm theatre, forced air warmer
- Use **oxytocics** to address uterine atony:
 - **Oxytocin IV 5 units slow push.** Follow with **infusion**
 - **Ergometrine 500mcg IM** (avoid if ↑MAP)
 - **Carboprost 250mcg IM/IU** (avoid if asthmatic). Repeat every 15mins (max 8 doses)
 - **Misoprostol 400-1000mcg PR/vaginal**
- Perform **RSI** to enable surgical control (**spinal** only if haemodynamically **normal**). Consider:
 - Induction: **Ketamine 100mg** (1-2mg/kg), **suxamethonium 100mg**
 - Maintenance: **TIVA** or **volatile/nitrous**
- Place arterial line +/- CVL
- Review with surgeon every 10mins: diagnosis & plan (see yellow box)

Major causes of PPH:

- Tone (75%)
- Tissue/Retained placenta (15%)
- Trauma/Laceration (5-10%)
- Thrombosis/Coagulopathy

Surgical control of bleeding can include:

- Pre-theatre: Uterine massage, bimanual compression, aortal compression
- Intra-op: BAKRI balloon, B Lynch suture, aortal compression, artery ligation, hysterectomy

- **Oxytocin** infusion: 40units in 1litre NSL. Infuse at 250ml/hr
- Vasopressors: **Metaraminol** 1mg; **phenylephrine** 100mcg, **Adrenaline**: 10-100mcg & titrate
- **Adrenaline/Noradrenaline** Infusion: 5mg in 50mls NSL. Infuse at 10-20ml/hr preferably via CVL

23e. PERI-PARTUM SEIZURE

Contents
Emerg | Diag

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**: IV 8mls in 100mls NSL. Infuse at 300mls/hr to completion.
(If no IV then give 10mls IM into each gluteal region (total 20mls))
 - Then **Maintenance** infusion (see green box)
 - If repeat seizure give **rescue dose** (see green box)
- If ongoing seizures or seizure lasting >10mins**: then escalate treatment:
 - 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 treatment with drugs:
 - **Labetalol IV** (neat=5mg/ml): 4ml over 2mins. Repeat every 10 mins (max 3 doses)
 - **Hydralazine IV** (neat=1mg/ml): Give 5ml over 10mins. Do not repeat within 30min
 - **Restrict total fluid** input to 80mls/hr & monitor hourly urine with catheter
- If antenatal**: Discuss with obstetric team: Plan for delivery of baby
- Consider **other causes** of seizure other than eclampsia: discuss with **neurologists**

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

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

23e

24e

Main Priority: Recognition & Aggressive Resuscitation

- Get senior help or call 777 & declare an “**obstetric +/- neonatal emergency**”
- For **all patients**: Start treatment for **haemorrhage & coagulopathy** (see **tab 12e**):
 - Activate **MTP** now & give **O negative blood** until MTP boxes arrive
 - Call for & give empirically **3 units cryoprecipitate asap**
 - Consider early **tranexamic acid: 1g over 10min**, then 1g over 8hrs
 - Send urgent blood tests including FBC, coagulation studies, TEG (if available)
- If no cardiac output**: Start CPR & consider reversible causes - see **tab 6e** / **tab 7e**
 - If **antenatal** perform maternal specific CPR tasks:
 - Removal all foetal monitoring
 - **Lift uterus** skyward & displace to left
 - **Intubate early** & ventilate with EtCO₂ target of 30mmHg
 - Perform chest **compressions higher** on chest & **push deeper**
 - If **no rapid ROSC** then start **immediate** preparations to **deliver baby** within 5mins
- If signs of cardiac output**: then start resuscitation:
 - Ensure patent airway. Consider **early intubation**
 - Address **oxygenation**: High flow oxygen, BiPAP, CPAP or high PEEP
 - Give **blood & products** as MTP. Use **vasopressors** or **inotropes** as required
 - Perform early **ECHO** (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 controllable bleeding
- Refer to ICU early

- 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 50mls. infuse 0-20ml/hr



Close book & flip end over end for

DIAGNOSING
Problems

Contents
Emerg | Diag

Anaesthetic Crisis Handbook

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

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Treating known

EMERGENCIES

Version 2: April 2017

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

Anaesthetic Crisis Handbook

DIAGNOSING Problems

For every problem:

- **Verbalise** the problem. Say out loud....
‘We have a **problem**, I am **concerned**’
- Call for **HELP** early
- **Set oxygen to 100%** (except where stated otherwise)
- Identify a ‘**hands off**’ **Team Coordinator**
- **Delegate duties** to **specific** team members
- Use **closed loop**, quiet & efficient **communication**
- Use the **indexed pages & coloured boxes** in this manual to **assist you**

Created by Adam Hollingworth

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Adapted from various sources including:

- Guidelines: ANZAAG, AAGBI, NZRC, Starship Protocols
- Hutt Valley & CC DHB: 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 Reviews Papers

Flip end over end for
Treating known
EMERGENCIES

Instructions for Use

- Use the **index** and **coloured tabs** to find quick reference pages to assist in a crisis.
- The **handbook is in 2 parts**:
 - The front book: How to treat known **Emergencies**
 - The back book: How to **Diagnose** Problems
- **Routine/obvious tasks** (eg call for help, turn oxygen to 100%) are assumed & thus **not** repeated on every sheet for clarity
- For simplicity & to avoid calculation errors in an emergency, drug doses are given for a 70Kg adult. Paeds doses are clearly marked where appropriate.
- There is an adult & paediatric drug formulary at the back
 - Emergency/Doing tasks
 - Thinking tasks, diagnostic or further information
 - Doses, equipment or calculation information
- Cards are arranged into coloured boxes:
- 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

25d. High Airway Pressure

26d. Desaturation

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**

25d. HIGH AIRWAY PRESSURE

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

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

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

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

- Cardiac arrest - see tab **tab 6e** or **tab 7e**
- Incorrect ETT placement - if in doubt replace
- Check circuit & CO₂ sample line connections

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

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

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

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

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

- **NO EtCO₂!!:**
 - **oesophageal intubation**
 - no ventilation, no airway
 - cardiac arrest
 - circuit/sampling line disconnection
 - ventilator failure or not on
 - apnoea
- **↓Production:**
 - hypothermia
 - deep anaesthesia
 - ↓thyroid
- **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** then give **synchronised DC shock**

Differentiate sinus tachycardia & complex tachy-arrhythmia:

- current surgical/pain stimulation
- QRS regularity?
- sinus rhythm?
- QRS width?

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

If **complex tachy-arrhythmia** treat based on **MAP**:

- MAP <65mmHg = **synchronised DC shock**
- MAP >65mmHg = manage by **regularity & QRS width**:

- **Regular:**

- **Narrow:** [SVT] vagal manoeuvres, **adenosine, β blocker**
- **Wide:**
 - [VT] **amiodarone**
 - [SVT with aberrancy] see narrow
 - [WPW] **amiodarone**

- **Irregular:**

- **Narrow:** [AF] **β blocker** or **amiodarone**
- **Wide:**
 - [torsades] **magnesium**
 - [AF with pre-excitation] **amiodarone**
 - [AF with aberrancy] see narrow

Send urgent ABG. Ensure high normal K⁺ & 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**
- electrolyte abnormalities
- cardiac tamponade
- sepsis
- thyroid storm
- MH

• Synchronised shock guides:

- AF/monomorphic VT: 100J ⇒ 150J ⇒ 200J
- SVT or flutter: 50J ⇒ 100J ⇒ 200J
- polymorphic VT or unstable: 200J

• **Adenosine:** 6mg, then 12mg, then 12mg then consider other causes (👉 = 0.1mg/kg > 0.2mg/kg, 0.3mg/kg)

• β blocker: **Esmolol** 10mg titrated. **Metoprolol** 2.5mg boluses titrated (max 15mg)

• **Amiodarone:** 300mg slow IV push (👉 = 5mg/kg)

• **Magnesium:** [torsades] 10mmol (5ml of 49.3%) over 2mins. (Give slower for other causes)

☐ 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 listed in yellow box below):

- ▶ Frequency gamble common causes
- ▶ Systematically work through all causes

☐ If **MAP <65mmHg +/-** with evidence of ↓perfusion then consider:

- ▶ **Atropine 600mcg** (👤 = 20mcg/kg) OR **glycopyrrolate 200mcg** (👤 = 10mcg/kg)
- ▶ **Ephedrine 9mg** bolus titrated (👤 = 0.1 mg/kg)
- ▶ **Adrenaline** infusion (👤 = see green box)
- ▶ **Isoprenaline bolus**, followed by **infusion** (👤 = see green box)

☐ If **drug toxicity or overdose**:

- ▶ βblocker = as above + **high dose insulin** infusion, **Na bicarb** (if propranolol OD)
- ▶ Ca channel = as βblocker + **10mls 10% Ca chloride** slow push (can repeat)

☐ If **severe refractory bradycardia** try external temporary pacing:

- ▶ attach defib & ECG leads
- ▶ set to PACER mode
- ▶ select rate 60/min
- ▶ ↑mA of output until capture (normally 65-100mA required)
- ▶ set final mA 10mA above capture
- ▶ confirm pulse

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

• Consider timing of event eg drug administration, surgical event

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

▶ **Primary causes:**

- IHD
- AV block
- pacemaker malfunction
- cardiomyopathy
- sick sinus syndrome
- myocarditis
- pericarditis
- valvular heart disease
- pulmonary HTN
- **athlete**

▶ **Secondary causes:**

- electrolyte abnormality
- **drugs** eg error, overdose, anti-arrhythmics
- ↓thyroid
- ↓temperature
- **vagal stimulation**
- ↑ICP
- cardiac tamponade
- tension pneumothorax

▶ **Anaesthetic causes:**

- hypoxia
- **volatile**
- **suxamethonium**
- **opioids**
- anticholinesterases
- **vasopressors**
- auto-PEEP
- MH
- **high/total spinal**
- ↑↓K⁺

• For paediatric normal heart rates see **tab 9e**

• **Isoprenaline:** bolus: dilute 200mcg amp into 20mls then give 1ml boluses titrated (👤 = use infusion -see **tab 36r**). Infusion: dilute 1mg (5vials) into 50mls. Infuse at 0-60mls/hr

• **Adrenaline:** 5mg in 50mls NSL. Infuse at 0-20ml/hr (👤 see **tab 36r**)

• **Na bicarb 8.4%** [β blocker OD]: 50ml slow push. Can rpt every 2mins (target pH 7.45-7.55)

• **High dose insulin** [β blocker/CCB OD]: **Bolus= 50ml of 50% dextrose & 70u actrapid.**

Infusion= 100u actrapid in 50mls NSL, run at 35ml/hr and 10% dex run at 250mls/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**
 - hypoxia
 - hypercapnia
 - MH
 - **drugs** - consider error
 - 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:**
 - tourniquet
 - aortic clamping
 - carotid endarectomy
 - baroreceptor stimulation
 - **pneumoperitoneum**

- **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 rpt'ed every 5-15mins
- **α Agonists** = **clonidine**: 30mcg boluses titrated (max 150mcg)
- **vasodilators** = **GTN**: S/L spray or IV infusion: 50mg in 50ml NSL at 3ml/hr and titrate; **magnesium**: slow bolus 5mls of 49.3%, repeat if required

- 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** - see **tab 6e** or **tab 7e**
 - **MAP <65mmHg & concern** then consider:
 - Leg elevation
 - Rapid infusion of fluid +/- ready to transfuse blood (see **tab 12e**)
 - IV **vasopressors** or **inotropes**
- Consider **reversible causes**:
 - Frequency gamble on common causes
 - Systematically consider each cause in turn
- Consider:
 - ECHO (if skilled) to help differentiate causes
 - Other invasive monitoring to assist with diagnosis e.g. PPV 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** 1mg (😊 10mcg/kg); **phenylephrine** 100mcg, **ephedrine** 9mg (😊 0.1mg/kg), **adrenaline** 10-50mcg
- **noradrenaline/adrenaline** infusion: 5mg in 50mls. 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
- ▶ valproate toxicity

- [*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

33d
34r

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 12mg.	-
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	5mg in 50mls NSL. Infuse 0-20ml/hr
Alteplase	-	[PE in cardiac arrest] 100mg in 20mls NSL. Infuse at 80mls/hr
Aminophylline	400mg over 15mins	50mg in 50mls at 35ml/hr
Amiodarone	300mg slow push	900mg in 500ml D5W over 24hours
Ca²⁺ Chloride (10%)	5 - 10mls slow push	-
Clonidine	30mcg. Titrate (max 150mcg)	-
Dobutamine	-	250mg in 50ml NSL. Infuse 0-10ml/hr
Esmolol	10mg. Titrate	-
GTN	[tocolytic] 100-250mcg	50mg in 50ml NSL. Infuse 3-12ml/hr. Titrate to MAP/ECG
Hydrocortisone	200mg	-
Insulin (actrapid)	[βblocker or CCB OD] 50ml of 50% dextrose & 70u actrapid (1u/kg). Give as bolus.	[↑K] 10units in 250ml D5W @500ml/hr [βblocker or CCB OD] 100u actrapid in 50mls NSL, run at 35ml/hr and 10% dextrose run at 250mls/hr. check BSL & k /30min
Intralipid (20%)	100ml bolus (1.5ml/kg), Rpt ev 5min, max x2	1000ml/hr (15ml/kg/hr). Can double rate @5mins (max total dose = 12ml/kg)
Isoprenaline	200mcg into 20mls NSL. Give 1ml boluses titrated	1mg into 50mls NSL. Infuse at 0-60mls/hr
Ketamine	[induction] 70-140mg (1-2mg/kg) [bronchospasm] 35-70mg (0.5-1mg/kg)	-
Labetalol	5mg slow push. Titrate (max 100mg)	300mg in 60mls (neat). Infuse 0-30mls/hr
Lignocaine (1%) (1ml = 10mg)	[Arrhythmia] 7mls (0.1ml/kg). Can rpt ev 10mins (max 0.3ml/kg)	Neat 1% at 6-24ml/hr. (Total max in 1hr = 30mls ie 3mg/kg)
Magnesium (49.3%) (1ml = 2mmol = 0.5g)	[bronchospasm] 5mls over 20min [torsades] 5ml slow push [eclampsia] 8mls in 100ml NSL. Infuse @ 324ml/hr	[eclampsia]: Maintenance = 16mls in 100ml NSL. Infuse 14.5ml/hr for 8hrs Rescue (another seizure). 4mls in 6mls NSL. Infuse 120ml/hr
Metaraminol	0.5-1mg. Titrate	10mg in 20mls NSL. Infuse 0-40mls/hr
Metoprolol	2.5mg. Titrate (max 15mg)	-
Midazolam	[seizures] 2-7mg. Titrate	-
Milrinone	-	10mg in 50ml NSL. Infuse at 5ml or 10mls 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 50mls NSL. Infuse 0-20ml/hr
Oxytocin	[elective] 3units slow bolus (do not rpt) [emergency] 5units slow bolus (do not rpt)	40units in 1000ml NSL. Infuse 250ml/hr
Phentolamine	5-10mg. Repeat every 5-15 mins as req'd	-
Phenylephrine	100mcg bolus. Titrate	10mg in 100ml NSL (100mcg/ml). Infuse 0-40ml/hr
Salbutamol	250mcg slow push (Inhaled: 12 puffs via circuit)	5mg in 50ml NSL. Infuse 0-10ml/hr
Sodium Bicarb (8.4%)	50ml slow push. Can rpt every 2mins (target pH 7.45-7.55)	-
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 NSL. Infuse at 12.5ml/hr (8hrs)
Vasopressin	1unit slow push	20units in 20mls NSL. Infuse 1-4ml/hr

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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) [Other] 0.01-0.05ml/kg 1:10,000 (1-5mcg/kg) [IM dose] 0.01ml/kg of 1:1,000 (10mcg/kg)	[↓bp] 0..15mg/kg (max 5mg) in 50mls NSL. Infuse 0.5-10ml/hr
Aminophylline	10mg/kg over 1hr diluted to 1mg/ml (max 500mg)	1-9yrs: 55mg/kg into 50mls D5W. infuse 1ml/hr 10-15yrs & <35kg: 35mg into 50mls D5W. infuse 1ml/hr 10-15yrs & >35kg: neat drug in 50mls. infuse 0.028ml/kg/hr
Amiodarone	5mg/kg slow push (max 300mg)	-
Atropine	20mcg/kg	-
Ca²⁺ Chloride (10%)	0.2ml/kg (max 10mls) slow push	-
Dobutamine	-	15mg/kg in 50ml NSL. infuse 0.5-4ml/hr
Ephedrine	0.1mg/kg	-
Esmolol	500mcg/kg slow push. Titrate	-
Glycopyrrolate	10mcg/kg	-
Hydrocortisone	4mg/kg	-
Insulin (actrapid)	[βblocker or CCB OD] 25-50ml 50% dextrose then 1unit/kg insulin bolus	[↑K] 0.1unit/kg in 2ml/kg 10% dex over 30mins [βblocker or CCB OD] 0.5-2 unit/kg/hr infusion & 10% dextrose at 250ml/hr
Intralipid (20%)	1.5ml/kg bolus. Rpt ev 5min, max x2	15ml/kg/hr. Can double rate @5min (max total dose=12ml/kg)
Isoprenaline	-	300mcg/kg in 50mls NSL. Infuse at 1ml/hr (0.1mcg/kg/min) and titrate up.
Ketamine	[bronchospasm] 0.5-1mg/kg	-
Labetalol	0.25-0.5mg/kg slow push. rpt ev. 10min as req'ed	50mg/kg & NSL to make 50ml. Infuse 0-3ml/hr(0-3mg/kg/hr)
Lignocaine 1% (1ml=10mg)	[arrhythmia] 0.1-0.2ml/kg. Can rpt ev 10mins (max 0.3ml/kg)	-
Magnesium (49.3%) (1ml = 2mmol = 0.5g)	0.1ml/kg over 20mins	-
Metaraminol	10mcg/kg	-
Metoprolol	0.1mg over 5mins	-
Midazolam	[seizures] IV: 0.15mg/kg; IM 0.2mg/kg; buccal 0.5mg. Can rpt dose @ 5mins	-
Naloxone	[emergency] 10mcg/kg [titrate] 2mcg/kg (400mcg in 20mls give 0.1ml/kg)	300mcg to 30ml D5W & run at 0-1ml/hr (10mcg/kg/hr)
Noradrenaline	-	0.15mg/kg (max 5mg) in 50mls NSL. Infuse 0.5-20ml/hr
Phenylephrine	2-10mcg/kg. Titrate	10mg in 100mls NSL. Infuse 0-20mls/hr (1-5mcg/kg/min)
Salbutamol	IV: <2yr=5mcg/kg slow; <18yr=15mcg/kg (max 250) Inhaled: <5yr=6puffs; >5yrs 12puffs via circuit	Make neat salbutamol up to 50mls Infuse at 5-10mcg/kg/min for 1hr. Then 1-2mcg/kg/min
Sodium Bicarb (8.4%)	1ml/kg slow push. Can rpt 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 [laryngospasm] 0.5mg/kg	-
Tranexamic Acid	15mg/kg diluted in 20-50mls NSL over 10mins	2mg/kg/hr in 500ml NSL over 8hrs
Vasopressin	1unit/kg in 50mls NSL. Bolus 1-2mls	1unit/kg in 50mls NSL. Infuse 1-3mls/hr

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Close book & flip end over end for

Treating known

EMERGENCIES

Contents
Emerg | Diag

Anaesthetic Crisis Handbook

By Adam Hollingworth
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DIAGNOSING

Problems

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