

C&C Anaesthetic Crisis Handbook

DIAGNOSING Problems

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

Adapted from various sources including:

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

Flip end over end for
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 **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

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

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

26d. LOW SpO₂

25d

26d

- 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
 - ▶ **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
 - pulmonary oedema - acute or negative pressure
 - sepsis/ARDS
 - contusion
 - pneumonia
 - interstitial lung disease
 - ▶ **Circulation:**
 - cardiac arrest
 - heart failure
 - anaphylaxis
 - embolism: pulmonary, air, CO₂, cement
 - hypothermia/poor peripheral circulation
 - methaemoglobinaemia e.g. prilocaine

27d. HIGH EtCO₂

27d

28d

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

28d. LOW EtCO₂

□ 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/low CO state**
- 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

27d

28d

29d. TACHYCARDIA

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
- ▶ 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** (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)

30d. BRADYCARDIA

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)

29d

30d

31d. HYPERTENSION

- 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

32d. HYPOTENSION

- 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

33d. FAILURE TO WAKE

- This is generally not a crisis. Use the time to consider the causes
- Airway:** ensure patent unobstructed airway
- Breathing:**
 - ▶ Ensure established respiratory pattern
 - ▶ Check SpO₂
 - ▶ Check EtCO₂ trace and value
- Cardiovascular:** Ensure normal HR, MAP and ECG
- Drugs:** Review **all drugs** given during anaesthetic:
 - ▶ Check muscle relaxation with nerve stimulator. Give **reversal agent** (see green box)
 - ▶ Consider timing and infusions of all agents
 - ▶ Consider drug errors
 - ▶ Consider drug interactions
 - ▶ Consider patient factors eg. 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 normothermia
- 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

34r. TELEPHONE DIRECTORY

EMERGENCY OUT OF THEATRE

- MET Team 777

ANAESTHETICS & THEATRES

- Duty Anaesthetist #6899 (021 199 8316)
- Duty Technician #6345 (027 443 3167)
- Theatre Coordinator 80496 (04 806 0496)
- PACU Coordinator 80726
- Perfusionist via switchboard, dial 0

OBSTETRICS

- Obstetric Anaesthetist #6885 (027 554 4632)
- Obstetric Registrar 021 199 8244
- Delivery Technician #6577 (027 231 0488)
- Charge Midwife 80845
- NICU Doctor 021 199 8286

LABORATORY/X-RAY

- Blood bank 6961
- Blood tests 6060
- X-Ray Technician 6699
- Duty Radiologist 8am- 5pm - #6903 Out of hours - #6135

REFERRALS

- ICU Doctor 80444 (021 199 8301)
- ICU Coordinator 80431
- Haematology Doctor via switchboard, dial 0
- Surgical Doctor #6936 (027 765 4339)
- Paediatric Doctor #6351 (021 199 8306)
- Cardiology Doctor via switchboard, dial 0

35r. ADULT DRUG FORMULARY

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 50ml saline. Infuse 0-20ml/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 slow push	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
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	200mcg into 20ml saline. Give 1ml boluses titrated	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 1000ml saline. Infuse 250ml/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

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 50ml saline. Infuse 0.5-10ml/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 0.5-4ml/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 0.5-10ml/hr
Phenylephrine	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	-	1 unit/kg in 50ml saline. Infuse 1-3ml/hr



Close book & flip end over end for

Treating known

EMERGENCIES

C&C 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, Dr S Treshina, Mr R Pryer, Mrs J Dennison, Dr D Mein, Dr N Chadderton, Dr L Kwan, Dr A Haq, Dr S McRitchie, Miss L Anderson, Dr D Heys, Miss D Hantom, Mr D Livesey, Dr J Dieterle, Dr V Singh, Dr P Tobin, Dr B Waldron, Dr J McKean, Miss K Chadwick-Smith & many more.

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.