Paediatric Anaesthetic Crisis Handbook

NZ Generic Edition

v4 2026 Adam Hollingworth

FOR EVERY CRISIS

- **Verbalise** the problem. Say out loud: "**This is a CRISIS**"
- Call for **help** early
- State the child's **estimated weight** out loud
- Set **oxygen to 100%**
- Assign someone to **calculate & check doses**. Read back every **mg**, **mcg, ml**
- Establish an **effective team**:
  - Identify a "hands-off" **team co-ordinator** & delegate duties
  - **Share the mental model** with frequent **recaps**
  - Use **closed-loop**, **concise** & **efficient** communication
  - Be a good **team member. Anticipate. Effectively speak up** if concerns/ideas

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%**
- First **frequency gamble** common causes, then use a **structured approach**
- Always **meticulously** & **actively prove / disprove** all possible causes

HOW TO USE

- Using this aid is a **learned skill.** You must be familiar with it's contents
- Practise using it in simulation
- Different use approaches are possible: 1) **Do -> Check**; 2) **Check -> Do**
- Use a **reader** to read tasks out loud
- Boxes:
  - **Red = emergency / doing tasks** (work linearly)
  - **Amber = thinking / diagnostics**
  - **Green = doses, equipment & calculations**
- Routine tasks (get help, 100% O_2) are assumed & not repeated on every page
- Weight unknown? Use **page 8 formulas** ➜E8 or a length based tape
- All doses assume ideal body weight
- ➜Page link represent links to other pages. Digital version = press/click to jump

www.AnaestheticCrisisHandbook.com

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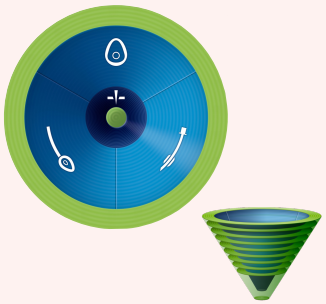
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AIRWAY MANAGEMENT - VORTEX

Main priority: Get to the Green Zone ($EtCO_2$ & safe SpO_2)

DO

- Prepare a safe strategy using a Vortex Approach – small children desaturate fast
- Pre-oxygenate all children: mask ○ **nasal cannula** ○ O_2 connector near face
- Use airway **lifelines** in any order (**BMV**, **SGA**, **ETT**) to reach the **Green Zone**
- Lifelines: at least 1 **Attempt** – not more than 3 (game-changer +1 e.g. expert help, new equipment)
- A **Best Effort** at any **lifeline** must include full **muscle paralysis**
- If in the Green Zone – develop a strategy for ongoing safety:
  - Maintain & **wake** – **sugammadex 16mg/kg**, **naloxone 10mcg/kg** (max 400mcg)
  - **Convert** = ETT via bronchoscope through SGA or surgical airway
  - **Replace** = Remove device & re-enter Vortex
- If unsuccessful best effort at any lifeline – escalate CICO status:
  - Ready: Get Neck Rescue kit – designate proceduralist
  - Set: Ready equipment – palpate landmarks
  - Go: Optimise position – start Neck Rescue ➔E2



THINK - OPTIMISATIONS PER LIFETIME:

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

- Safe SpO_2 = a level at which no harm occurs if it persists for 15 min – in small children this margin is narrow – act early

DOSES & EQUIPMENT

- **ETT size:** cuffed = (age/4) + 3.5 ○ uncuffed = (age/4) + 4 ○ neonate 3.0-3.5 ○ preterm 2.5
- **ETT oral length** (cm)**:** (age/2) + 12
- **Low flow nasal cannula O_2**: infant 2 L/min ○ child 4 L/min ○ adolescent 8 L/min
- **High flow nasal cannula O_2**: ≤15kg = 2L/kg/min ○ 16-30kg = 35L/min
  31-50kg = 40L/min ○ ≥50kg = 50L/min

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NECK RESCUE

Main priority: Oxygenation via any infraglottic route. Declare out load "This is a CICO"

DO

- Dedicate team continues supraglottic oxygenation
- Call **airway surgeon/ENT**: best choice may be rigid bronchoscopy / surgical tracheostomy
- Position in full neck extension: shoulder roll / head over end of pillow
- **Full muscle relaxation**

CANNULA TECHNIQUE - PALPABLE ANATOMY

- **Stabilise larynx** – insert midline 16G on 5ml syringe with 3ml saline
- **Aspirate** as advance – success = free air
- **Stabilise cannula**
- Connect **Rapid-O_2** with **1L/yr/min**: **Insufflate** first breath until **chest rises** – then stop
- Wait 20sec for SpO_2 rise or when SpO_2 drops by 5%
- Then **repeat** subsequent breaths
- If success –
  - Wait for surgeon to convert cannula
  - Only use Melker Conversion Kit if **gas trapping** or **cannula blockage**
- If no SpO_2 rise after 2nd breath or any doubt – abandon attempt
- If cannula fails x2 – consider scalpel techniques, rigid brochoscopy, neck rescue

SCALPEL TECHNIQUE - PALPABLE or NON PALPABLE ANATOMY

- Prepare gauze & suction for blood
- Horizontal stab incision with 10 blade scalpel
- Rotate blade to vertical (sharp edge caudal) – pass bougie along outside of blade
- Remove scalpel and railroad size size 3.0-5.0 micro cuff ETT – confirm $EtCO_2$

SCALPEL FINGER TECHNIQUE - NON PALPABLE ANATOMY

- Vertical midline neck incision
- Blunt dissect with fingers to trachea/larynx
- Proceed as above to enter trachea/cricothyroid membrane

DOSES & EQUIPMENT

- Sizing guide:

	Infant (<10kg)	Small Child (1-8yr or 10-30kg)	Large Child (>8yr or >30kg)
Cannula	Cannula: 16G Melker: Size 3.5	Cannula: 16G Melker: Size 4	Cannula: 16G Melker: Size 4 or 5
Scalpel	Bougie: 5F ETT: 3 micro cuff	Bougie: 5F ETT: 4 micro cuff	Bougie: 10F ETT: 5 micro cuff

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LARYNGOSPASM

Main priority: Break spasm & maintain SpO_2. Act immediately

DO

- Ask surgeon to stop all stimulation.
- Manual procedures:
  - Remove LMA & clear/suction the airway
  - Consider **oro-pharyngeal airway**
  - **Jaw thrust** & **CPAP** 30 cmH_2O with 100% O_2
  - Bilateral hard inward pressure at **Larson's point** (behind ear lobule)
  - Consider **gentle chest compressions** in small children/infants
  - (Caution with positive-pressure breath – inflates stomach)
- If SpO_2 stable >92% – deepen:
  - **propofol 20% of induction dose**
  - ± **suxamethonium 0.5 mg/kg IV**
- If SpO_2 dropping or <92% – full relaxation ASAP:
  - **suxamethonium 2 mg/kg IV** or **4 mg/kg IM** (max 200mg)
  - Intubate
- If hypoxia & repeat sux dose – **atropine 20 mcg/kg IV** (min 100 mcg)
- If bradycardic <60/min with poor perfusion despite oxygenation – start CPR ➜E8
- Consider stomach decompression after the event

THINK

- Laryngospasm will eventually break with hypoxia — but in children it may first cause bradycardia, cardiac arrest, aspiration or negative-pressure pulmonary oedema
- Pre-prepare IV & IM suxamethonium ± atropine especially if high-risk case (URTI, airway surgery, reflux, ex-prem)
- Common triggers: light anaesthesia + airway manipulation, secretions/blood on cords, extubation

DOSES & EQUIPMENT

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Propofol**: 20% of induction dose (≈ 0.5–1 mg/kg)
- **Suxamethonium**:
  - relaxation 0.5 mg/kg IV
  - intubation 2 mg/kg IV or 4 mg/kg IM
- **Atropine**: 20 mcg/kg IV or IM (min 100 mcg, max 600 mcg)
- **ETT**: cuffed (age/4) + 3.5 ○ uncuffed (age/4) + 4 ○ preterm 2.5 ○ <1 yr 3.5–4

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POST EXTUBATION STRIDOR / CROUP

Main priority: Reduce oedema before obstruction is complete

DO

- Sit the child up (or comfort with parent)
- Minimise distress – crying worsens obstruction
- Humidified 100% O_2
- **Nebulised adrenaline 0.5 ml/kg of 1:1,000** (max 5 ml) with O_2 – repeat every 10 min
- **Dexamethasone 0.6 mg/kg IV/IM** (max 12 mg)
- If obstruction progressing / SpO_2 falling – intubate:
  - Most experienced intubator
  - ENT on standby for rigid bronchoscopy
  - If severe: consider maintaining spontaneous breathing
  - Use ETT 0.5 – 1.0 mm smaller than predicted
- After nebulised adrenaline observe ≥2 h for rebound oedema before discharge from PACU

THINK

- Anaesthesia risk factors:
  - Tight ETT with no leak
  - Multiple/traumatic intubation attempts
  - Airway surgery/instrumentation
  - Head repositioning during surgery
- Patient risk factors:
  - Croup or recent URTI
  - Subglottic stenosis
  - Trisomy 21
  - Ex-prem
- Differentiate from: laryngospasm ➜E3 ○ foreign body ➜E5 ○ anaphylaxis ➜E10 residual paralysis
- The subglottis of an infant is ≈ 4–5 mm — 1 mm of oedema more than halves its area

DOSES & EQUIPMENT

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Prevention**:
  - Cuffed tube: always check pressure <20 cmH_2O
  - Uncuffed tube: check for an audible leak at 20–25 cmH_2O
- **Nebulised adrenaline**: 0.5 ml/kg of 1:1,000 (max 5 ml), repeat 10 min as needed
- **Dexamethasone**: 0.6 mg/kg IV/IM (max 12 mg)

INHALED FOREIGN BODY

Main priority: Create a team strategy for assessment & removal

DO - UNKNOWN FB

- **Assess** child while attempting to **avoid distress**
- **X-Ray** AP & lateral – neck, chest abdomen (if able)
- If ongoing coughing – 5 back blows → 5 chest thrusts → repeat
- If arrest – Start CPR ➜E8:
  - Laryngoscopy & intubation:
    - Laryngeal FB – use Magill forceps to remove. Failure → start neck rescue ➜E2
  - Flexible bronchoscopy via ETT:
    - FB blocking trachea seen: Last resort → push it into a bronchus, ventilate other lung
- If time for planned induction –
  - Create **strategy** with airway surgeon (rigid bronchoscopy?)
  - Consider **premed**: **midazolam 0.5mg/kg** (max 15mg) (if no concern about losing airway)
  - **Spontaneous breathing throughout** - IV or gas induction
  - **Glycopyrrolate IV 10mcg/kg** (max 200mcg)
  - Consider **TIVA maintenance**: **Propofol Ce 3-4mcg/ml** + **remifentanil 0.1-0.2mcg/kg/min**
  - **1% Lignocaine 4ml/kg** on flexible MAD – 50% to cords → 50% into trachea
  - **Oxygenation plan for surgery**:
    - **HFNO 2L/kg/min**
    - Nasal ETT – tip at uvula connected to circuit with nares tapped & mouth shut
    - 22mm connector on side of rigid bronchoscope
  - **Dexamethasone 0.3mg/kg** (max 12mg)
- At **Extubation**: Refer **PICU** if concern about significant trauma/swelling
- If postop stridor – ➜E4

DO - BUTTON BATTERY OR MAGNET

- If ≥1yr old and <12hr since ingestion – **Honey 2 teaspoon**. Repeat every 10min (max 6)
- **X-Ray** AP & lateral – neck, chest abdomen (if able)
- Remove ASAP

THINK

- Most inhaled FB are located in the bronchi rather than the larynx or trachea
- Children may present with symptoms days to weeks after FB inhalation
- Signs that a child may need immediate surgical intervention:
  - History of dangerous object inhaled: (*batteries, magnets or something sharp*)
  - Drooling
  - Hoarseness
  - Difficulty swallowing
  - Significant stridor
  - Tripodding
  - Cyanosis
  - Hypoxia
  - Drowsiness

BRONCHOSPASM

Main priority: Safe SpO_2 with airway pressure <40cmH_2O

DO

- Inform surgeon. Minimise surgical stimulation
- **Check**:
  - Airway position – tube kinked?
  - $EtCO_2$ trace – severe bronchospasm can present with **low or absent $EtCO_2$**
  - Airway pressures
  - PACU: Throat pack/swabs accounted for
- **Manually ventilate** – confirm high pressures & ensure adequate tidal volume
- **Deepen** anaesthesia
- **Emergency drugs**:
  - **Salbutamol via circuit** <6yr: **6 puff** ○ >6yr: **12 puff** . Repeat freely
  - **Ipratromium bromide via circuit 4 puff**
  - **IV salbutamol 10mcg/kg slow bolus over 2 min** (max 500mcg). Repeat at 10min
  - **IV adrenaline 0.01-0.05 ml/kg 1:10,000 (1-5mcg/kg)**. Titrate
- **Optimise ventilator**: Pressure control, long expiratory phase, low rate, low PEEP, small tidal volume, permit hypercapnia, intermittent disconnection (if breath stacking)
- **Adjunct bolus drugs**:
  - **Magnesium 49.3% 0.1 ml/kg** (max 5ml) into 50ml with saline over 20min (50 mg/kg,max 2g)
  - **Ketamine** (anaesthetised) **0.5-2mg/kg IV**
  - **Dexamethasone** (anaesthetised) **0.3-0.6mg/kg IV** (max 12mg)
  - **Aminophylline 10mg/kg** (max 500mg) over 1hr into 50ml with saline
- If no improvement –
  - Infusions of **salbutamol**, **aminophylline**
  - Arterial line & **serial ABGs**
  - Call **PICU**

THINK - ALWAYS CONSIDER OTHER CAUSES OF HIGH AIRWAY PRESSURE

- Anaphylaxis ➜E10
- Laryngospasm on SGA ➜E3
- ETT position (endobronchial/kinked)
- Chest wall rigidity (opioid)
- Pneumothorax
- Pulmonary oedema
- Gastric distension
- Retained throat pack

DOSES & EQUIPMENT

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Salbutamol infusion**: 5-10mcg/kg/min for 1 hr then 1-2mcg/kg/min ➜See Starship chart
  - <16kg: 3mg/kg made to 50ml with 5% dextrose. Then 1ml/hr (=1mcg/kg/min)
  - >16kg: Neat salbutamol (1mg/ml) into a 50ml syringe. Then rate (ml/hr) = 0.66 x kg x required dose (mcg/kg/min)
- **Aminophylline infusion**: Age & weight based infusions ➜R1
- **Adrenaline infusion**: 0.15 mg/kg in 50 ml with saline, 1–10 ml/hr (0.05–0.5 mcg/kg/min)

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ASPIRATION

Main priority: Minimise aspiration while maintaining SpO_2

DO

- Call for help from team members immediately
- If practical, move to **head-down**, **left lateral** position **ASAP**
- Remove SGA/OPA & suction the pharynx
- If time & SpO_2 stable –
  - Cricoid pressure (if not actively vomiting)
  - **Suxamethonium 2 mg/kg IV** (**IM 4 mg/kg** if no access)
  - **Intubate**
  - **Suction** down the ETT with the largest catheter before ventilating
  - Only then ventilate with 100% O_2
- If SpO_2 dropping or <90% – **do not delay oxygenation** regardless of particulates
  - Bag-mask with 100% O_2
  - Manual ETT breaths with 100% O_2
- Consider **bronchoscopy** (esp. if particulate aspiration or lobar collapse)
- Pass **NG/OG tube** – decompress and drain stomach
- Consider abandoning surgery
- CXR in PACU post op

THINK

- Monitor **2hr post event in PACU**:
  - Asymptomatic + normal vitals + normal CXR = unlikely to need PICU
- Steroids & antibiotics are not routine in aspiration
- Paeds risk factors:
  - Acute surgery with pain/opioids
  - Difficult bag-mask with gastric insufflation
  - Pyloric stenosis
  - Intussusception/obstruction

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PAEDIATRIC CARDIAC ARREST

Main priority: Oxygenation with good CPR. Always address hypoxia first

DO

- Ask surgeons to **stop all vagal stimuli**
- 100% O_2 – give **2 breaths**
- **Stop anaesthetic** agents
- Start **compressions** at **100–120**/min:
  - Lower half of sternum ○ ⅓ chest depth ○ ensure full recoil
  - Monitor **EtCO$_2$** – "**No trace, wrong place!**" (No capnography = remove/replace airway)
  - If Mask/SGA – **15 compressions : 2 breaths**
  - If ETT secure & patent – continuous compressions + **ventilate ~25/min (infant)** to **12/min (adolescent)**
- **IV Access** – if none, intraosseous immediately
- Attach **defibrillator** – 2 min cycles:
  - Charge defib **4 J/kg** → rhythm check ± shock → restart compressions
  - If VF / pulseless VT – shock 4 J/kg immediately, then every cycle.
    - **Adrenaline 10 mcg/kg (0.1ml 1:10,000)** (max 1mg) after 2nd shock then every 2nd cycle
    - **Amiodarone 5 mg/kg** (max 300mg) after 3rd shock
  - If Asystole / PEA – **adrenaline 10 mcg/kg** ASAP, then every 2nd cycle
- **Atropine 20 mcg/kg** only for vagally mediated bradycardia
- Read out & correct reversible causes (below)
- Ultrasound to rule out causes (if skilled)
- If ROSC – ABG, 12 lead ECG, call PICU

THINK - REVERSIBLE CAUSES (most common in bold)

- **Hypoxia**
- **Vagal tone**
- **Hypovoloaemia / haemorrhage**
- **Anaphylaxis**
- Hypo/hyper - thermia
- Hypo/hyper: K^+, Mg^{2+}, glucose, Ca^{2+}, pH
- Tension pneumothorax
- Tamponade - cardiac
- Toxins - Opioids, LA ➜E13, drug error
- Thrombosis - cardiac or pulmonary

DOSES - follow every drug with a flush

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Weight**: (kg): <1 yr = (months+9)/2 ○ 1–4 yr = (yrs+5)x2 ○ 5–14 yr = (yrs)x4
- **Adrenaline IV/IO**: 10 mcg/kg = 0.1 ml/kg of 1:10,000
- **Fluid/Crystalloid**: 20 ml/kg ○ (10 ml/kg neonate/cardiac)
- **10% dextrose**: 5 ml/kg
- **Calcium chloride 10%** [↑K^+, ↓Ca^{2+}, CCB OD]: 0.05 - 0.2 ml/kg (max 10ml)
- **Bicarbonate 8.4%** [↑K^+, TCA OD]: 1 ml/kg. Repeat every 2min
- **Naloxone**: 10 mcg/kg (max 400mcg)

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EMERGENCY CALCULATIONS

Example values

Neonate · 3.5 kg	
Normal HR	110–160
Energy (J)	15
ETT (uncuffed)	3.0–3.5
ETT oral (cm)	9
LMA size	1
Fluid (ml)	35*
Adr 1:10,000	0.35 ml
Amiodarone (mg)	18
Glucose 10% (ml)	7
Sux IV (mg)	7
Sux IM (mg)	14
Atropine (mcg)	100

2 mo · 5 kg	
Normal HR	100–160
Energy (J)	20
ETT (uncuffed)	3.5
ETT oral (cm)	10
LMA size	1.5
Fluid (ml)	100
Adr 1:10,000	0.5 ml
Amiodarone (mg)	25
Glucose 10% (ml)	10
Sux IV (mg)	10
Sux IM (mg)	20
Atropine (mcg)	100

6 mo · 7 kg	
Normal HR	100–160
Energy (J)	30
ETT (uncuffed)	3.5–4
ETT oral (cm)	10.5
LMA size	1.5
Fluid (ml)	140
Adr 1:10,000	0.7 ml
Amiodarone (mg)	35
Glucose 10% (ml)	14
Sux IV (mg)	14
Sux IM (mg)	28
Atropine (mcg)	140

1 yr · 10 kg	
Normal HR	90–140
Energy (J)	40
ETT (uncuffed)	4
ETT oral (cm)	11
LMA size	2
Fluid (ml)	200
Adr 1:10,000	1 ml
Amiodarone (mg)	50
Glucose 10% (ml)	20
Sux IV (mg)	20
Sux IM (mg)	40
Atropine (mcg)	200

3 yr · 14 kg	
Normal HR	90–140
Energy (J)	55
ETT (uncuffed)	4.5
ETT oral (cm)	13
LMA size	2
Fluid (ml)	280
Adr 1:10,000	1.4 ml
Amiodarone (mg)	70
Glucose 10% (ml)	30
Sux IV (mg)	30
Sux IM (mg)	55
Atropine (mcg)	280

5 yr · 18 kg	
Normal HR	80–130
Energy (J)	70
ETT (uncuffed)	5.0–5.5
ETT oral (cm)	15
LMA size	2.5
Fluid (ml)	360
Adr 1:10,000	1.8 ml
Amiodarone (mg)	90
Glucose 10% (ml)	35
Sux IV (mg)	35
Sux IM (mg)	72
Atropine (mcg)	360

7 yr · 28 kg	
Normal HR	80–130
Energy (J)	110
ETT (uncuffed)	5.5–6
ETT oral (cm)	16
LMA size	2.5
Fluid (ml)	560
Adr 1:10,000	2.8 ml
Amiodarone (mg)	140
Glucose 10% (ml)	55
Sux IV (mg)	55
Sux IM (mg)	110
Atropine (mcg)	560

10 yr · 37 kg	
Normal HR	80–130
Energy (J)	150
ETT (uncuffed)	6.5
ETT oral (cm)	17
LMA size	3
Fluid (ml)	740
Adr 1:10,000	3.7 ml
Amiodarone (mg)	185
Glucose 10% (ml)	75
Sux IV (mg)	75
Sux IM (mg)	150
Atropine (mcg)	600

THINK

- Alternatively use an automatic calculator ➜tinysaurus.co.nz
- ETT sizes are uncuffed – drop 0.5mm for cuffed tubes
- Follow all drugs with a flush
- If age/weight unknown – use a length based tape e.g. Broselow

CALCULATIONS

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Weight**: (kg): <1 yr = (months+9)/2 ○ 1–4 yr = (yrs+5)x2 ○ 5–14 yr = (yrs)x4
- **Energy**: 4J/kg (rounded)
- **ETT**: cuffed (age/4)+3.5 ○ uncuffed age(age/4)+4
- **Oral length**: (age/2)+12 cm
- **Fluid**: 20ml/kg (neonate/cardiac 10ml/kg)
- **Adrenaline**: 10 mcg/kg = 0.1 ml/kg of 1:10,000
- **Amiodarone**: 5mg/kg
- **Glucose/dextrose 10%**: 5ml/kg
- **Suxamethonium**: IV 2mg/kg ○ IM 4mg/kg
- **Atropine**: 20mcg/kg (min 100mcg, max 600mcg)

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ANAPHYLAXIS

Main priority: Cease triggers, adrenaline, IV fluid bolus

DO

- Get anaphylaxis box (or follow ANZAAG task cards)
- **Stop/remove causative agents** – drugs, blood products, latex, chlorhexidine
- Consider early intubation (risk of airway oedema). **"No trace = wrong place"**
- Ensure **good IV** access – if none, place IO ASAP
- **Elevate legs**. **Saline 20ml/kg**
- **IV adrenaline dilution** as per **grade ASAP (below)**
- Repeat **IV adrenaline** & **fluid** boluses every 1–2 min as required
- If no IV – give **IM adrenaline 1:1000** (1mg/ml) in lateral thigh. (Repeat every 5min):
  - **<6yr = 0.15ml (150mcg)** ○ **6-12yr = 0.3ml (300mcg)**
- If refractory (>3 boluses of adrenaline) –
  - **Adrenaline infusion**
  - Bronchospasm ➜E6
  - Hypotension: **adrenaline infusion**, repeat **saline**, **noradrenaline ± vasopressin infusion**
- **Monitor**: MAP, SpO_2, airway pressures, $EtCO_2$ waveform, arterial line
- Consider abandoning surgery
- Once stabilised:
  - **Dexamethasone 0.6 mg/kg** (max 12 mg)
  - Send tryptase – immediately, 1, 4 & 24 hr

Grade	Features	IV Adrenaline (20mcg/ml dilution) (Dilute 1mg into 50ml with saline)
1 - Mild	Mucocutaneous only ± angiooedema	**N/A -** Observe & remove trigger
2 - Moderate	↓MAP. ↑HR, bronchospasm	**0.1ml/kg** of dilution (2mcg/kg)
3 - Life threatening	CVS collapse, arrhythmia, severe bronchospasm	**0.2-0.5ml/kg** of dilution (4-10mcg/kg)
4 - Arrest	PEA/absent $EtCO_2$	**0.1ml/kg of 1:10,000** (10mcg/kg) + **CPR**

THINK - DIFFERENTIAL DIAGNOSIS

- Tension pneumothorax
- Auto-PEEP
- Air embolism (especially neonates)
- Transfusion reaction

DOSES - CVC not needed to start vasopressors

- **Adrenaline / noradrenaline infusion**: 0.15 mg/kg made to 50 ml with saline; Infuse 1–20 ml/hr (0.05–1 mcg/kg/min)
- **Vasopressin**: 1 unit/kg made to 50 ml with saline; bolus 2 ml, infuse 1–3 ml/hr

MASSIVE HAEMORRHAGE

Main priority: Volume replacement & good teamwork

DO

- **Largest possible IV** ×2 (remove extension sets) ○ **IO line(s)**
- Talk to **surgeon**: All efforts at surgical control? (compression, packing, direct pressure, clamping)
- **Tranexamic acid 15 mg/kg** (max 1g) in 20-50ml saline over 10min
- **Call blood bank**: "I am requesting a **Paediatric Stat Pack** – give gender, weight, NHI":
  - **<30kg** = transfuse **10ml/kg RBC** → reassess → repeat **10ml/kg RBC**
  - **>30kg** = transfuse **1unit RBC** → reassess → repeat **1 unit RBC**
- If ongoing massive bleeding + shock –
  - Call blood bank: "I am activating the **Paediatric MHP**: (follow ➜Starship Paediatric MHP)
  - Assemble **team** with clear roles: transfusion coordinator, runner, checkers, warmers
  - **Give packs** as shown below
- **Arterial line** early – lower MAP may be tolerated until bleeding slowed (unless brain injury)
- **Keep warm** >36 °C: warm fluids, warm theatre, forced-air warmer
- **Bloods every 30 min**: Coags/TEG, FBC, ABG/VBG (transfusion hyperkalaemia ➜E15)
- **Stand down** MHP once stable → targeted transfusion (below)

STARSHIP MHP PACKS

Pack	ALPHA 0-10kg	BRAVO 11-20kg	CHARLIE 21-45kg	ADULT STANDARD >45kg
1	**10ml/kg** of: RBC→FFP→RBC→Cryo	1RBC ○ 1FFP	2RBC ○ 2FFP	2RBC ○ 2FFP
2	**10ml/kg** of: RBC→FFP→RBC→PLT	1RBC ○ 1 FFP 1Cryo	2RBC ○ 1FFP 2 Cryo	4RBC ○ 4FFP 3Cryo
3	Continue repeating 1 → 2	1RBC ○ 1FFP 150ml PLT	2RBC ○ 2 FFP 1 PLT	4RBC ○ 4FFP 1 PLT
>>	With each pack: **0.45ml/kg Ca^{2+} gluconate 10%**	Alternate Pack 2 & 3	Alternate Pack 2 & 3	Alternate Pack 2 & 3
Ca^{2+}		With each pack give **0.3ml/kg Ca^{2+} gluconate 10%**		

- **Calcium** always in separate fast running IV
- Smaller centres should check platelets <75 before giving **platelets**

THINK

- Consider giving RBC if blood loss >15% of blood vol. (neonate=90 ml/kg, child=80ml/kg)
- Massive haemorrhage = ≥40ml/kg of blood loss or 50% of blood volume

TARGETED TRANSFUSION

- **RBC**: 20ml/kg – if Hb <80
- **FFP**: 20ml/kg – if PR >1.5 / APTT >40
- **Cryoprecipitate**: 5ml/kg – if Fibrinogen <1
- **Platelets**: 10ml/kg – if Platelets <75

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AIR / GAS EMBOLISM

Main priority: Restore cardio-respiratory stability & stop further air/gas entry

DO

- **100% O_2**
- **Stop nitrous oxide**
- **Stop the source** of gas entry:
  - **Search & de-air all lines / pressure bags**
  - Surgical site – lower below heart level & flood with irrigation fluid
  - **Neurosurgery** — consider intermittent jugular venous compression
- Remove pneumoperitoneum
- Head-down, left-lateral tilt – if CVC = aspirate it
- Consider **chest compressions** even without arrest – (helps break up large air locks)
- **Support circulation** –
  - **20 ml/kg crystalloid**
  - **Metaraminol bolus 10mcg/kg** (max 500mcg). Repeat
  - **Adrenaline**:
    - Bolus: **0.01–0.05 ml/kg of 1:10,000 (1–5 mcg/kg)**
    - Infusion: **0.15mg/kg (max 5mg)** in 50ml with saline. Infuse 1-20ml/hr
- If arrest – CPR ➜E8
- Consider **early echo** (rule out other embolism)
- Consider hyperbaric O_2 referral for paradoxical embolism – (benefit up to 6 h)

THINK

- Small children tolerate small volumes of air poorly – a few ml/kg can be fatal
- Signs:
  - **Respiratory**: ↓$EtCO_2$ (most sensitive), ↓SpO_2, pulmonary oedema, bronchospasm
  - **CVS**: shock, tachycardia, mill-wheel murmur, cardiovascular collapse
- **PFO** present in 10–30% (higher in infants):
  - ↑risk of paradoxical embolism (PEEP may increase this risk)

LOCAL ANAESTHETIC TOXICITY

Main priority: Early intralipid

DO

- **Stop LA** administration
- Get LA toxicity box (if you prefer follow AAGBI task cards)
- If signs of cardiac output –
  - Confirm **IV** access
  - Consider **intubation** – ventilate $EtCO_2$ to ≈30 mmHg
  - Consider **20% intralipid** (see below)
  - **Arrhythmias**: **Amiodarone 5 mg/kg slow IV.** (Avoid lignocaine; caution with β-blockers)
  - **Hypotension**: **IV fluid bolus 20 ml/kg → vasopressors**
  - **Seizure**:
    - **Midazolam 0.1 mg/kg IV** (IM or buccal below)
    - Repeat **midazolam** at 5 min
    - Ongoing seizure → RSI
- If cardiac arrest –
  - Start **CPR:** ➜E8
    - Use smaller dose of **adrenaline 0.01 ml/kg of 1:10,000 (1mcg/kg)**
    - Continue for 60min unless ROSC
  - **Intralipid 20% ASAP** (see below)
  - Mobilise cardiopulmonary bypass / ECMO team

20% INTRALIPID DOSING

- Escalate dosing if cardiovascular instability or not improving/deteriorating

	Immediately	+5min	+10min
Bolus	1.5ml/kg	Repeat 1.5ml/kg	Repeat 1.5ml/kg
Infusion	15ml/kg/hr	Double rate to 30ml/kg/hr	X
Maximum cumulative dose = 12ml/kg			

THINK

- **Arrhythmia** may be first sign in anaesthetised child:
  - CNS: Numb tongue, tinnitus, metallic taste, slurred speech, seizures, unconscious
  - CVS: ↓MAP, broad QRS, bradycardia → PEA/asystole

DOSES & MAXIMUMS

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Midazolam**: IV 0.1mg/kg ○ IM 0.2mg/kg ○ Buccal 0.5mg/kg (Can repeat doses at 5min)
- **Max LA doses** –
  - **Lignocaine** (1%=10mg/ml)**:** 4mg/kg (7mg/kg with adrenaline)
  - **Ropivacaine** (0.75%=7.5mg/ml)**:** 3mg/kg
  - **Bupivacaine** (0.5%=5mg/ml): 2mg/kg

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MALIGNANT HYPERTHERMIA

Main priority: Early recognition, remove triggers, dantrolene

DO

- If **MH considered → treat**
- Call for **MH trolley** (if you prefer – distribute & follow task cards)
- **Stop & wash out volatile** – 100% O_2 at 15L/min
- **TIVA**
- **Charcoal filters**
- Change soda lime – if easy (Do not waste time changing machine/circuit)
- **Hyperventilate** to normal $EtCO_2$ (2-3x minute ventilation)
- **Dantrolene 2.5mg/kg IV**:
  - Reconstitute each 20mg vial with 60ml water
  - Repeat every 10min until control (**max 10mg/kg**)
  - Mobilise more from pharmacy
- Increase monitoring –
  - **Arterial line** – Serial bloods: ABG (Q30min), coags, CK
  - **Urinary catheter** – aim output 2ml/kg/hr
  - **Core temperature** probe e.g. rectal/bladder
- If complications – treat:
  - **T >38.5 °C** – cooled **IV crystalloid 20 ml/kg**, surface ice, cold theatre (stop cooling at 38 °C)
  - **pH <7.2** – ventilate $EtCO_2$ to 30mmHg; **sodium bicarbonate 8.4% 1ml/kg rapid IV bolus**
  - **K^+ >6.5 / ECG changes** – ➜E15 **Calcium chloride**, **insulin/dextrose, salbutamol**
  - **Arrhythmias** – **Amiodarone 5 mg/kg slow push** (avoid calcium-channel blockers)
- Abandon/expedite surgery – refer PICU

THINK

- Rapid diagnosis: ABG = mixed respiratory & metabolic acidosis
- Possible signs:

Early	Developing	Late
↑O_2 consumption / ↑ $EtCO_2$	↑ Temp / Sweating	Cola coloured urine
Masseter spasm	CVS instability	Coagulopathy / ↑↑CK
↑ HR/arrhythmia	↓ pH / ↑ K	Cardiac arrest

- Refer family for MH testing later

DOSES

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Calcium chloride 10%**: 0.2ml/kg (max 10ml)
- **Insulin / dextrose**: 0.1unit/kg actrapid in dextrose over 30min (check BSL Q15min) plus:
  [Peripheral] 5 ml/kg 10% dextrose ○ [Central] 2ml/kg 50% dextrose
- **Salbutamol puffs**: <6yr: 6 puff ○ >6yr: 12 puff. Repeat every 20min
- **Salbutamol IV**: 5-10mcg/kg slow bolus over 2 min (max 500mcg). Repeat at 10min

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↑K⁺/HYPERKALAEMIA

Main priority: Protect heart, shift K⁺ intracellular, remove K⁺

DO

- Consider **faulty sample** – recheck, but treat if ECG changes
- **Stop any K⁺ source** (fluids, transfusion rate, avoid suxamethonium)
- Recheck recent drug calculations
- **Increase minute ventilation** – aim $EtCO_2$ ≈ 30 mmHg
- If K⁺ >6.5 mmol/L ± ECG changes –
  - **Calcium chloride 10% 0.2 ml/kg slow IV** (max 10 ml) – repeat if ECG worsens
  - Insulin/dextrose – **0.1unit/kg actrapid in dextrose over 30min** (check BSL Q15min):
    [Peripheral] 5 ml/kg 10% dextrose ○ **[Central] 2ml/kg 50% dextrose**
- If refractory ↑K+ –
  - **Salbutamol**:
    - Inhaled: **<5 yr 6 puffs**, **>5 yr 6–12 puffs**. Repeat Q20min
    - IV: **5-10 mcg/kg** over 2min. Can repeat every 10min
  - **Sodium bicarbonate 8.4% 1 ml/kg over 30min** (ensure adequate ventilation)
  - **Frusemide 1 mg/kg IV** (max 40mg)
  - Refer to **PICU** (discuss haemodialysis)

THINK

- **ECG:** Peaked T → Prolonged PR → Wide QRS → Loss of P → Sine wave → Asystole
- Paediatric precipitants:
  - Suxamethonium in undiagnosed myopathy (boys with DMD)
  - Burns
  - Spinal injury
  - Rapid/old blood transfusion
  - Tumour lysis
  - Renal failure
  - Malignant hyperthermia ➜E14
  - Acidosis
  - Reperfusion

FIRE – AIRWAY OR PATIENT

Main priority: Remove oxygen and extinguish fire

DO – AIRWAY FIRE

- **Stop ignition** source – laser or diathermy
- **Stop oxygen**
- **Disconnect** circuit from airway device
- **Extinguish**:
  - Flood with **saline**: **Mouth: 20–50ml** ○ **ETT: 1 ml/kg** (max 20 ml)
  - **CO_2 extinguisher** (safe in the airway)
- **Remove airway** device & keep (leave ETT only if difficult airway & very low risk of ETT fire)
- **Remove all material** from mouth – throat pack, gauze, sponges
- **Inspect oropharynx** with laryngoscope – Retrieve all debris
- **TIVA**
- If fire fully out – Restart oxygen/ventilation (wait 1–3 min if SpO_2 allows):
  - Bag mask first – prepare for early re-intubation with smaller ETT
  - Lowest possible FiO_2
- If unable to re-intubate – **infraglottic technique** depending on urgency:
  - Emergency – Neck rescue ➜E2
  - Urgent – Airway surgeon – tracheostomy
- **Terminate** or **expedite** end of surgery
- **Post crisis** –
  - Bronchoscopy to assess mucosal damage
  - PICU – Do not extubate

DO – PATIENT FIRE

- **Stop oxygen** flow near the fire
- **Remove** all material from patient – drapes, clothes, padding, stickers
- **Extinguish** fire:
  - **Saline**, fire blanket or **CO_2 extinguisher** (safe in open wounds/cavities)
  - Do not use alcohol liquids
  - Around electrical equipment use CO_2 extinguisher (avoid liquid)
- If fire persisting/spreading – Activate fire alarm ○ Turn off gas supply to room ○ Evacuate

THINK

- Paeds ENT/airway surgery (tonsillectomy, laser) is classic setting:
  - Follow strict protocol with high flow oxygen. No laser or electrocautery unless FiO_2 ≤0.35
  - Use lowest possible FiO_2 ○ Avoid nitrous ○ Wet packs around ETT
- Other precautions:
  - Laser resistant ETTs
  - Allow skin preps to fully dry before draping

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NEONATAL LIFE SUPPORT

Main priority: Dry, Oxygenate, Reassess every 30 seconds

DO

- **Set resuscitaire**: Gas 10 L/min ○ PEEP 5 ○ PIP 30 cmH_2O ○ Heater & suction on
- First minute: **Vigorously dry baby** with warm towels (preterm <32 wk: plastic bag, dry only head)
- Work in **30sec cycles** –
  - **Tone** – Upper and lower limbs
  - **Heart rate** – Stethoscope or SpO_2 on right wrist
  - **Breathing effort** – Chest expansion, breath sounds in axillae, ↑ing SpO_2/HR, $EtCO_2$
- If HR >100, good tone, regular breathing – routine care
- If only increased work of breathing – open airway, CPAP 5 cmH_2O in air
- If any of: HR <100 ○ poor tone ○ gasping/apnoea – facemask ventilate (with $EtCO_2$):
  - **Neutral head** position + **jaw thrust** + open mouth (small changes impactful)
  - Initial breaths use PIP 30 cmH_2O (premature 20-25 cmH_2O)
  - Titrate PIP down when able: Rate 40–60/min at PIP 15–20 cmH_2O
  - Start room air – ↑FiO_2 every 30sec if SpO_2/HR non-improving: 40% → 60 → 80 → 100%
- If poor chest expansion or HR still not >100 – Consider SGA or intubation (if skilled)
- If HR <60 –
  - **Chest compressions** – 2 thumbs, lower ⅓ of sternum, full recoil
  - **Ratios**: SGA/ETT = Continuous ○ Facemask = 3:1 ratio
- If ongoing CPR/HR <60 – Get **umbilical venous access** (1 bigger vein, 2 smaller arteries)
  - **IV adrenaline 0.1 to 0.3 mL/kg of 1:10,000**. Repeat every 3-5min
  - Consider **ETT adrenaline 0.5-1ml/kg of 1;10,000**
  - Consider **umbilical saline bolus 10ml/kg**

SpO_2 TARGETS

Time	Target	Time	Target	Time	Target
1 min	60-70%	3 min	70-90%	5 min	80-90%
2 min	65-85%	4 min	75-90%	10 min	85-90%

THINK

- If meconium delivery – Only suction a flat baby prior to oxygenating
- If difficulty ventilating – pass a suction catheter orally to decompress stomach

DOSES & MAXIMUMS

- **Adrenaline 1:10,000 [umbilical]**: term 0.5 ml ○ 27–37 wk 0.25 ml ○ 23–26 wk 0.1 ml
- **Naloxone**: 2-10mcg/kg IM/IV
- **Glucose/Dextrose 10%**: 5ml/kg IV
- **ETT**: Uncuffed with stylet: Term = 3.0-3.5mm ○ Preterm = 2.5mm
- **ETT length at lips**: Term = 8-9cm ○ Preterm = 5.5-7.5cm

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EMERGENCE DELIRIUM

Main priority: Keep child safe, exclude other causes before sedating

DO

- **Protect from injury** – pad/hold gently, guard IV lines, pad bed/cot sides, one calm voice
- Actively **exclude organic causes** first:
  - **Hypoxia** – check SpO_2, look & listen, cyanosis
  - **Pain** – surgical site, tourniquet, full bladder, tight cast, corneal abrasion
  - **Hypoglycaemia** – check BSL if any doubt
  - **Hyponatraemia** (e.g. irrigation absorption)
  - **Raised ICP**
- **Reduce stimulation** – dim lights, quiet, parent/caregiver to bedside
- If pain likely – choose:
  - **Fentanyl 1 mcg/kg IV titrated**
  - **Morphine 0.1mg/kg IV titrated**
  - **Fentanyl 1.5mcg/kg intranasal**. Repeat after 10min
- Most episodes self-terminate 5–15 min – observe until calm, settled & orientated
- If unsure of diagnosis – use PAED scale (below)
- If severe / prolonged & organic causes excluded – choose:
  - **Propofol 0.5-1 mg/kg IV** titrated – Be ready to support airway
  - **Dexmedetomidine 0.3–0.5 mcg/kg IV** over 10 min

THINK

- PAED scale – Add up total score: ≥10 = Likely ○ ≥13 = diagnostic

The child	Not at all	Just a little	Quite a bit	Very much	Extremely
Makes eye contact with parent/caregiver	4	3	2	1	0
Actions are purposeful	4	3	2	1	0
Is aware of their surroundings	4	3	2	1	0
Is restless	0	1	2	3	4
Is inconsolable	0	1	2	3	4

- Risk factors – Age 2-6yr, agitated at induction, sevoflurane, ENT & eye surgery, rapid wake up
- Prevention strategies:
  - IV induction + TIVA
  - TIVA switch after induction
  - 3mg/kg propofol over 3min @end
  - 1mg/kg propofol @end
  - Dexmedetomidine/clonidine @intraop
  - Ketamine @intraop/end
  - Fentanyl @intraop

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HIGH AIRWAY PRESSURE

FREQUENCY GAMBLE

- **Kinked tube or gag** – check tube/gag in mouth including ○ Use laryngoscope
- **Endobronchial tube** – check ETT length at lips ○ Listen in axilla
- **Bronchospasm** – listen bilaterally ○ Check $EtCO_2$ waveform
- **Gastric distension** – pass suction catheter orally into stomach

SYSTEM – ALVEOLI → MACHINE → DRUGS

- **Examine chest** – listen ○ watch for bilateral chest rise ○ lung ultrasound
- **Decompress stomach**
- **Check patency** of airway – suction catheter full length of ETT ○ bronchoscopy
- **Change airway** – replace ETT ○ SGA → ETT
- **Change filter**
- **Exclude circuit/machine** – swap to T piece/self inflating bag ± TIVA
- **Deepen anaesthesia**
- **Muscle paralysis**

THINK – CAUSES

- Consider timing of event e.g. CVAD insertion, position change, surgical event
- Patient –
  - Bronchospasm
  - Anaphylaxis
  - Gastric distension
  - Chest wall rigidity (opioid)
  - Pneumothorax
  - Pneumoperitoneum
  - Pulmonary oedema
  - Pulmonary contusion
- Airway –
  - Kinked tube
  - Laryngospasm
  - Tube position - endobronchial
  - Tube too small/blocked
  - Secretions
  - Tracheal foreign body/tumour
- Circuit –
  - Ventilator settings
  - Valve failure
  - Obstructed filter

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↓SpO_2/HYPOXIA

Children desaturate fast & deep – treat while you diagnose

FREQUENCY GAMBLE

- **Check probe position** – Change finger
- **Atelectasis** – Sustained inflation 20-30cmH2O ○ Add PEEP
- **Low FiO_2** or **low fresh gas flow** – Check settings
- **Endobronchial tube** – Check ETT length at lips ○ Listen in axilla
- **Laryngospasm** – Check $EtCO_2$

SYSTEM – USE $EtCO_2$ TRACE

- Hand ventilate & feel lung compliance (if high airway pressure ➜D1)
- If $EtCO_2$ waveform absent or abnormal –
  - Check airway position & patency
    - Exclude oesophageal – "No trace, wrong place"
    - Exclude kinks / blockages – suction full length ○ bronchoscopy
  - Consider: laryngospasm ➜E3 ○ bronchospasm ➜E6
  - Exclude: circuit disconnection ○ low cardiac output ○ cardiac arrest
- If $EtCO_2$ waveform normal –
  - Exclude endobronchial tube – check length at lips ○ listen in both axillae
  - Exclude pneumothorax – neck veins ○ chest rise ○ auscultate ○ ultrasound

THINK - HYPOXIC CHILDREN ARREST VIA BRADYCARDIA

- Airway –
  - Airway obstruction
  - Laryngospasm
  - Bronchospasm
  - Endobronchial intubation
  - Oesophageal intubation
  - Aspiration
- Ventilator/Circuit/Probe –
  - Probe displacement
  - Inadequate reversal
  - Malfunction/wrong settings
  - Auto-PEEP
  - Low fresh gas flow
  - Oxygen supply failure
  - Circuit obstruction/Disconnection
- Lungs/Breathing –
  - Apnoea/hypoventilation
  - Atelectasis
  - Pneumothorax
  - Pulmonary oedema - acute or negative pressure
  - Pneumonia
  - Contusion
- Circulation –
  - Low output / cardiac arrest
  - Congenital shunt (R→L)
  - Anaphylaxis
  - Embolism: pulmonary, air, CO_2, cement
  - Heart failure
  - Hypothermia/poor peripheral circulation
  - Methaemoglobinaemia e.g. prilocaine

↑CO_2/HYPERCAPNIA

FREQUENCY GAMBLE

- **Under ventilation** – check: mode ○ respiratory rate ○ tidal volume
- **Dead space** (neonates and infants) – smaller filter ○ decrease circuit length
- **Fresh gas flow** – if using a T piece
- **Soda lime exhausted**

THINK – CAUSES

- Consider timing of event e.g. drug administration, surgical event

↑*Production*

- Endogenous –
  - Sepsis/↑temp
  - Malignant hyperthermia
  - Thyroid storm
  - Malignant neuroleptic syndrome
  - Reperfusion
- *Exogenous* –
  - CO_2 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

↓CO_2/HYPOCAPNIA

Complete loss of $EtCO_2$ requires quick and decisive action

FREQUENCY GAMBLE

- **Oesophageal intubation** – "no trace, wrong place". Replace ETT
- **Laryngospasm** – bolus IV propofol or muscle relaxant
- **Airway/circuit disconnection** – inform surgeon & check all connections
- **Severe bronchospasm** – confirm airway patent & location ○ listen to chest

SYSTEM – USE $EtCO_2$ TRACE

- Hand ventilate & feel lung compliance (if high airway pressure ➜D1)
- If no $EtCO_2$ –
  - **ETT**: Laryngoscopy - check tube through cords
  - **SGA**:
    - Check position – consider removing
    - Laryngospasm – consider regurgitation vs depth of anaesthesia
  - Check **circuit connections**: Airway device → filter → circuit
  - Check **CO_2 sampling line**: Filter → machine
  - Consider **replacing all equipment** (airway device, filter, circuit)
- If low EtCO2 – Cardiac or peri-arrest? ➜E8
  - **ETT**: Airway kinking/gag
  - **SGA**: Check position – consider removing
  - **Listen** to chest – bronchospasm ➜E6
  - **Check ventilator**: switched on ○ functioning ○ tidal volume ○ resp rate

THINK

- "No trace, wrong place". Even in cardiac arrest without CPR; $EtCO_2$ should still be recordable
- If not an emergency or urgent, correlate $EtCO_2$ with ABG and $PaCO_2$
- No $EtCO_2$ –
  - 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 fresh gas flow
  - Sampler placed incorrectly
  - Dilution of sampling gas with air
  - Circuit disconnected
- ↑Elimination –
  - Hyperventilation
- ↓Transport of CO_2 in blood –
  - Severe hypotension
  - Anaphylaxis
  - Cardiac arrest
  - Embolism - air or pulmonary
  - Tamponade/tension pneumothorax
- ↓CO_2 diffusion in lung –
  - Low tidal volumes/dead space
  - Laryngospasm
  - Severe bronchospasm
  - ETT obstruction
  - Endobronchial intubation

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↑HR/TACHYCARDIA

FREQUENCY GAMBLE

- **Pain** – **fentanyl 1-2mcg/kg**
- **Depth of anaesthesia** – check IV site (if TIVA) ○ Deepen

SYSTEM - SINUS vs COMPLEX BASED ON PERFUSION

- If sinus tachycardia –
  - Signs ≈ gradual onset ○ P waves ○ rate varies
  - Treat cause (see yellow box)
- If complex tachy-arrhythmia –
  - Signs ≈ sudden onset ○ fixed rate ○ absent P ○ variable QRS rate & width
  - Usually **SVT** – infant >220/min ○ child >180/min
  - Send **ABG** – correct K^+ & Mg^{2+} to high normal
- If SVT & perfusion adequate –
  - **Vagal manoeuvres** – [infant] ice cold water/bag to face ○ [older] valsalva
  - **Adenosine** – rapid IV flush:
    - **0.1mg/kg** (max 6mg) → **0.2mg/kg** (max 12mg) → **0.3mg/kg** (max 12mg)
- If poor perfusion / MAP low –
  - **Synchronised DC shock** (already anaesthetised) **0.5 J/kg → 1 J/kg → 2 J/kg**
  - **Refractory** – **amiodarone 5mg/kg** over 5-60min
- If pulseless –
  - Start **CPR** ➜E8
  - **Torsades** – **magnesium 49.3% 0.1ml/kg** (max5ml) in 50ml saline (50mg/kg) over 10min

THINK – CAUSES

- Consider timing of event eg drug administration, surgical event etc.
- Primary causes –
  - Congenital heart disease
  - Accessory conduction pathways
  - Myocarditis
  - Pericarditis
  - Congenital heart disease
- Secondary causes –
  - Anaesthesia depth
  - Drugs - including error
  - Pain
  - Hypovoloaemia
  - Anaphylaxis
  - Sepsis
  - Electrolyte abnormalities
  - Malignant hyperthermia
  - Cardiac tamponade

DOSES

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Esmolol**: 0.5mg/kg slow push. Repeat if required

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↓HR/BRADYCARDIA

Bradycardia is hypoxia until proven otherwise – oxygenate & ventilate FIRST

FREQUENCY GAMBLE

- **Hypoxia** – check airway, confirm ventilation
- **Vagal stimulation** – stop surgical traction (oculocardiac, peritoneal) ○ stop laryngoscopy
- **Drug error** – Too much: volatile ○ TIVA ○ opioids
- **High spinal/caudal**

DO

- If HR <60 with poor perfusion despite & confirmed oxygenation –
  - Start **CPR** ➔E8
  - **Prioritise oxygenation**
  - **Adrenaline 0.1ml/kg of 1:10,000 (10mcg/kg IV)**
- If vagally mediated –
  - **Remove/stop trigger**
  - **Atropine 20mcg/kg IV** (min 100mcg - max 1mg)
- If drug toxicity –
  - **ßblocker** – **high dose insulin infusion**
  - **Ca channel** – **high dose insulin** + **calcium chloride 0.05-0.2ml/kg** (max 10ml)
- If refractory –
  - **Adrenaline infusion**
  - External **pacing** – rare in children: D/W cardiology

THINK – CAUSES

- Hypoxia –
- Anaesthetic –
  - Volatile overdose
  - Propofol
  - Opioids
  - High spinal/caudal
  - ↑ICP (Cushing-with hypertension)
- Vagal –
  - Laryngoscopy, suction, oculocardiac, peritoneal, sux
- Drugs –
  - Anticholinesterases, ßblocker/CCB
  - Drug error
- Other –
  - ↑K^+
  - Hypothermia
  - Heart block (congenital, post cardiac surgery)

DOSES & NORMAL HEART RATES

- **Normal HR**: <1yr = 110-160 ○ 1-4yr = 90-140 ○ 5-11yr = 80-130 ○ 12+yr = 65-110
- **Glycopyrrolate**: 10mcg/kg (max 200mcg)
- **Ephedrine**: 0.1mg/kg (max 9mg/dose)
- **Adrenaline infusion**: 0.15 mg/kg made to 50 ml with saline.
  Infuse 1–20 ml/hr (0.05–1 mcg/kg/min)
- **High dose insulin**: Discuss with PICU/Starship

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↑BP/HYPERTENSION

FREQUENCY GAMBLE

- **Check equipment** – change/move NIBP cuff ○ transducer height / waveform
- **Pain** – **fentanyl 1-2mcg/kg**
- **Depth of anaesthesia** – check IV site (if TIVA) ○ deepen
- **Local anaesthesia with adrenaline** – check with surgeon
- **Bladder volume** – palpate ○ ultrasound

THINK – CAUSES

- Consider timing of event eg drug administration, surgical event etc.
- Anaesthesia –
  - Pain
  - Depth of anaesthesia
  - IV line tissued
  - Drugs - consider error
  - A line transducer height
  - Malignant hyperthermia
- Surgery –
  - Tourniquet
  - Baroreceptor stimulation
- Patient –
  - Full bladder
  - Renal disease
  - Phaeochromocytoma
  - ↑ICP

DOSES

Volume to give(ml)=weight calc'ed dose÷concentration(/ml)

- **Esmolol**: 0.5mg/kg slow push. Repeat if required
- **Labetalol**: 0.25-0.5mg/kg slow push. Repeat every 10min
- **Magnesium 49.3%**: 0.1ml/kg in 50ml (max 5ml) saline over 20min
- **Clonidine**: 1-5mcg/kg slow IV

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↓BP/HYPOTENSION

Hypotension is a LATE sign of shock in children

FREQUENCY GAMBLE

- **Check equipment** – change/move NIBP cuff ○ transducer height / waveform
- **Hypovolaemia/vasodilation** – fluid bolus 10-20ml/kg
- **Depth of anaesthesia** – reduce volatile/propofol

DO

- **Assess severity** –
  - Monitors – ECG ○ EtCO2 ○ SpO_2 pleth
  - Exam – Colour of child ○ Capillary refill
- If cardiac or peri-arrest? – start CPR ➜E8
- If low or concerning BP –
  - Legs up ○ **fluid bolus 10-20ml/kg** ○ consider **blood 4-20ml/kg**
  - Vasopressor/inotrope: **ephedrine**, **metaraminol**, **phenylephrine**, **adrenaline**
- If refractory –
  - Suspect **concealed haemorrhage**
  - **ECHO**
  - Invasive monitoring

THINK – CAUSES

- Preload –
  - Hypovolaemia/bleeding
  - ↑Intrathoracic pressure
  - IVC compression
  - Tamponade
  - Tension pneumothorax
  - Embolism
- Contractility –
  - Drugs
  - Myocarditis
  - Congenital heart disease
  - Arrhythmia
- ↓Afterload –
  - Volatile/propofol
  - Opioids
  - Neuraxial (caudal/spinal)
  - Anaphylaxis
  - Sepsis
- Equipment/human –
  - Drug error - check dilutions
  - Artefact
  - Wrong cuff size
  - Transducer height/damping

DOSES & NORMAL HEART RATES

- **Ephedrine**: 0.25mg/kg IV bolus (max 9mg/dose)
- **Metaraminol**: [Bolus] 10mcg/kg IV. [Infusion] 0.15mg/kg in 50ml with saline. Infuse at 1-10ml/hr (0.05-0.5mcg/kg/min)
- **Phenylepherine**: [Bolus] 2-10mcg/kg IV. [Infusion] 10mg in 100ml saline. 0.5-2mcg/kg/min
- **Adrenaline / noradrenaline infusion**: 0.15 mg/kg made to 50 ml with saline; Infuse 1–20 ml/hr (0.05–1 mcg/kg/min)

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DRUG FORMULARY

Drug	Bolus	Infusion
Adenosine	0.1mg/kg→0.2mg/kg(max 6mg)→0.3mg/kg (max12mg)	-
Adrenaline (Sml: 1:1,000 = 1mg/ml) (Lrg: 1:10,000 = 100mcg/ml)	[Arrest IV] 0.1ml/kg 1:10,000 (10mcg/kg) [Neo arrest ETT] 0.5-1ml/kg 1:10,000 (50-100mcg/kg) [Hypotension] 0.01–0.05 ml/kg 1:10,000 (1–5 mcg/kg) [Anaphylaxis gd 2-3] Dilute 1mg in 50ml (20mcg/ml) Give 0.1-0.5ml/kg [IM dose] 0.01ml/kg of 1:1,000 (10mcg/kg) [Nebulised] 0.5 ml/kg of 1:1,000 (max 5 ml)	[↓bp] 0.15mg/kg (max 5mg) in 50ml saline. Infuse 1-20ml/hr (0.05–1 mcg/kg/min)
Aminophylline (25mg/ml)	10mg/kg (max 500mg) in 50ml saline over 1hr	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 (25mg/ml). infuse 0.028ml/kg/hr
Amiodarone	5mg/kg over 5-60min (max 300mg)	-
Atropine	20mcg/kg (min 100mcg, max 600mcg)	-
Ca^{2+} Chloride 10%	0.05 - 0.2ml/kg (max 10ml) slow push	-
Clonidine	1-5mcg/kg slow IV	-
Dantrolene	2.5mg/kg. Repeat every 10min (max 10mg/kg total)	-
Dexamethasone	[Airway/asthma] 0.3-0.6 mg/kg IV (max 12 mg)	-
Dextrose	[50% central] 2ml/kg; [10% peripheral] 5ml/kg	
Ephedrine	0.25mg/kg (max 9mg/dose)	-
Esmolol	0.5mg/kg slow push. Titrate	-
Frusemide	1mg/kg (max 40mg)	-
Glycopyrrolate	10mcg/kg (max 200mcg)	-
Hydrocortisone	[asthma] 4mg/kg (max 100mg)	-
Insulin (actrapid)	[↑K] Periph: 0.1u/kg in 5ml/kg 10% dex over 30min [↑K] CVL: 0.1u/kg in 2ml/kg 50% dex over 30min	-
Intralipid 20%	1.5ml/kg bolus. Repeat every 5min, max x2	15ml/kg/hr. Can double rate @5min (max total dose=12ml/kg)
Ketamine	[bronchospasm & anaesthetised] 0.5-2mg/kg	-
Labetalol	0.25-0.5mg/kg slow push. Repeat every 10min	50mg/kg & saline to make 50ml. Infuse 0-3ml/hr (0-3mg/kg/hr)
Magnesium 49.3% (1ml = 2mmol = 0.5g)	[asthma] 0.1ml/kg (max 5ml) in 50ml saline over 20mins [torsades] infuse over 10min	-
Metaraminol	10mcg/kg (max 0.5mg)	0.15mg/kg in 50ml with saline. Infuse 1-10ml/hr (0.05-0.5mcg/kg/min)
Metoprolol	0.1mg/kg over 5mins. Repeat every 5min (max 3)	-
Midazolam	[seizures] IV: 0.1mg/kg; IM 0.2mg/kg; buccal 0.5mg/kg. Can repeat doses @ 5min	-
Naloxone	[emergency] 10mcg/kg (max 400mcg) [titrate] 2mcg/kg (400mcg in 20ml give 0.1ml/kg)	300mcg/kg to 30ml 5% dex & run at 0-1ml/hr (10mcg/kg/hr)
Noradrenaline	-	0.15mg/kg (max 5mg) in 50ml saline. Infuse 1-20ml/hr
Oxygen-High flow	-	[≤15kg] 2L/kg/min [16-30kg] 35L/min [31-50kg] 40L/min [≥50kg] 50L/min
Phenylepherine	2-10mcg/kg. Titrate	10mg in 100ml saline (100mcg/ml). Infuse at 0.5-2mcg/kg/min
Salbutamol	Inhaled: <5yr=6puffs; >5yrs 12puffs via circuit IV: 5-10mcg/kg over 2 min (max 500mcg). Repeat at 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: 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%	[MH] 1ml/kg rapid IV bolus (target pH 7.45-7.55) [↑K] 1ml/kg over 30min (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 IV	-
Tranexamic Acid	15mg/kg diluted in 20-50ml saline over 10min (Max 1g)	2mg/kg/hr in 500ml saline for 8hrs
Vasopressin	-	1unit/kg in 50ml saline. Bolus 2ml. Infuse 1-3ml/hr

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TELEPHONE DIRECTORY

THEATRE

Duty Anaesthetist .....

Anaesthetic Assistant .....

Theatre Coordinator .....

PACU Coordinator .....

Airway Surgeon .....

HOSPITAL RESOURCES

Blood bank .....

Blood Tests .....

X-ray technician .....

Duty radiologist .....

Pharmacist .....

PAEDIATRICS

PET Call .....

Paediatric RMO .....

Paediatric SMO .....

PICU Doctor .....

NICU Doctor .....

Starship Anaesthesia .....

Starship PICU/Retrieval .....

Paediatric Anaesthetic Crisis Handbook ○ Version 4, 2026

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For Nichola

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Adapted from various sources including (but not limited to): ANZCOR/NZRC guidelines, APLS, ANZAAG, Starship guidelines, Royal Children's Hospital Melbourne guidelines, AAGBI LAST guidelines, Vortex Approach (N. Chrimes), CCHV clinical protocols, ESA Emergency quick reference guide, CCDHB Crisis checklists (A McKenzie), Emergencies in Anaesthesia, Oxford Handbook, Wellington ICU Drug Manual (A Psiridies & P Young), DrugDoses App (F Shann), Claude AI, Various peer reviewed papers.

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