EMERGENCY GUIDELINES:

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In-hospital Resuscitation

Collapsed / sick patient

Shout for HELP & assess patient

Signs of life?

No

Call resuscitation team

CPR 30:2
with oxygen and airway adjuncts

Apply pads/monitor
Attempt defibrillation if appropriate

Advanced Life Support when resuscitation team arrives

Yes

Assess ABCDE
Recognise & treat
Oxygen, monitoring, IV access

Call resuscitation team if appropriate

Handover to resuscitation team

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Basic Life Support with the use of an Automated External Defibrillator (AED)

Check response

- Shake gently
- Ask loudly: "Are you all right?"

If unresponsive

- Open airway & check for breathing

If unresponsive and not breathing normally

- **Call 112, send someone to get an AED**

If breathing normally

Turn into recovery position
- Call 112
- Continue to assess that breathing remains normal

Start chest compressions immediately

- Place your hands in the centre of the chest
- Deliver 30 chest compressions:
  - Press firmly at least 5 cm but no more than 6 cm deep
  - Press at a rate of at least 100/min but no more than 120/min
- If trained and able combine chest compressions with ventillations otherwise continue with compression only CPR
  - Seal your lips around the mouth
  - Blow steadily until the chest rises
  - Give next breath when the chest falls
- Continue CPR 30 compressions to 2 ventilations

As soon as AED arrives Switch on the AED & attach pads

- Follow the spoken/visual directions
- Attach one pad below the left armpit
- Attach the other pad below the right collar bone, next to the breastbone
- If more than one rescuer: do not interrupt CPR

If shock is indicated

- Stand clear and deliver shock
- Continue CPR

Follow AED instructions

Continue CPR unless you are certain the victim has recovered and starts to breathe normally.

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Advanced Life Support

Unresponsive and not breathing normally?

↔ Call Resuscitation Team

CPR 30:2
Attach defibrillator/monitor
Minimise interruptions

Assess rhythm

Shockable (VF/Pulseless VT)

1 Shock
Minimise interruptions

Immediately resume CPR for 2 min
Minimise interruptions

Return of spontaneous circulation

IMMEDIATE POST CARDIAC ARREST TREATMENT

- Use ABCDE approach
- Aim for SaO_2 of 94-98 %
- Aim for normal $PaCO_2$
- 12 Lead ECG
- Treat precipitating cause
- Targeted temperature management

Non-shockable (PEA/Asystole)

Immediately resume CPR for 2 min
Minimise interruptions

DURING CPR

- Ensure high quality chest compressions
- Minimise interruptions to compressions
- Give oxygen
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Vascular access (intravenous or intraosseous)
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks

TREAT REVERSIBLE CAUSES

Hypoxia	Thrombosis – coronary or pulmonary
Hypovolaemia	Tension pneumothorax
Hypo-/hyperkalaemia/metabolic	Tamponade – cardiac
Hypothermia/hyperthermia	Toxins

CONSIDER

- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR

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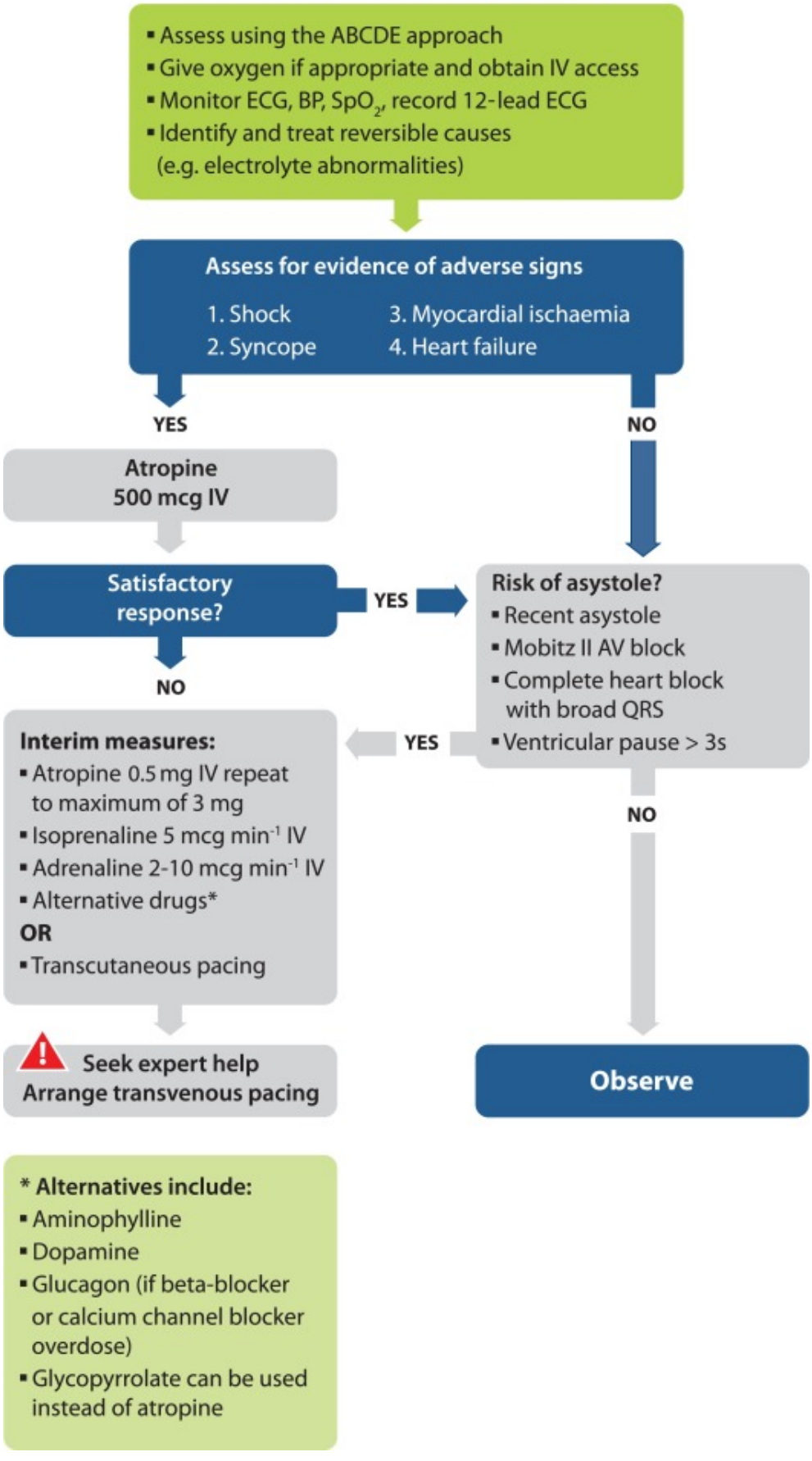
Bradycardia Algorithm



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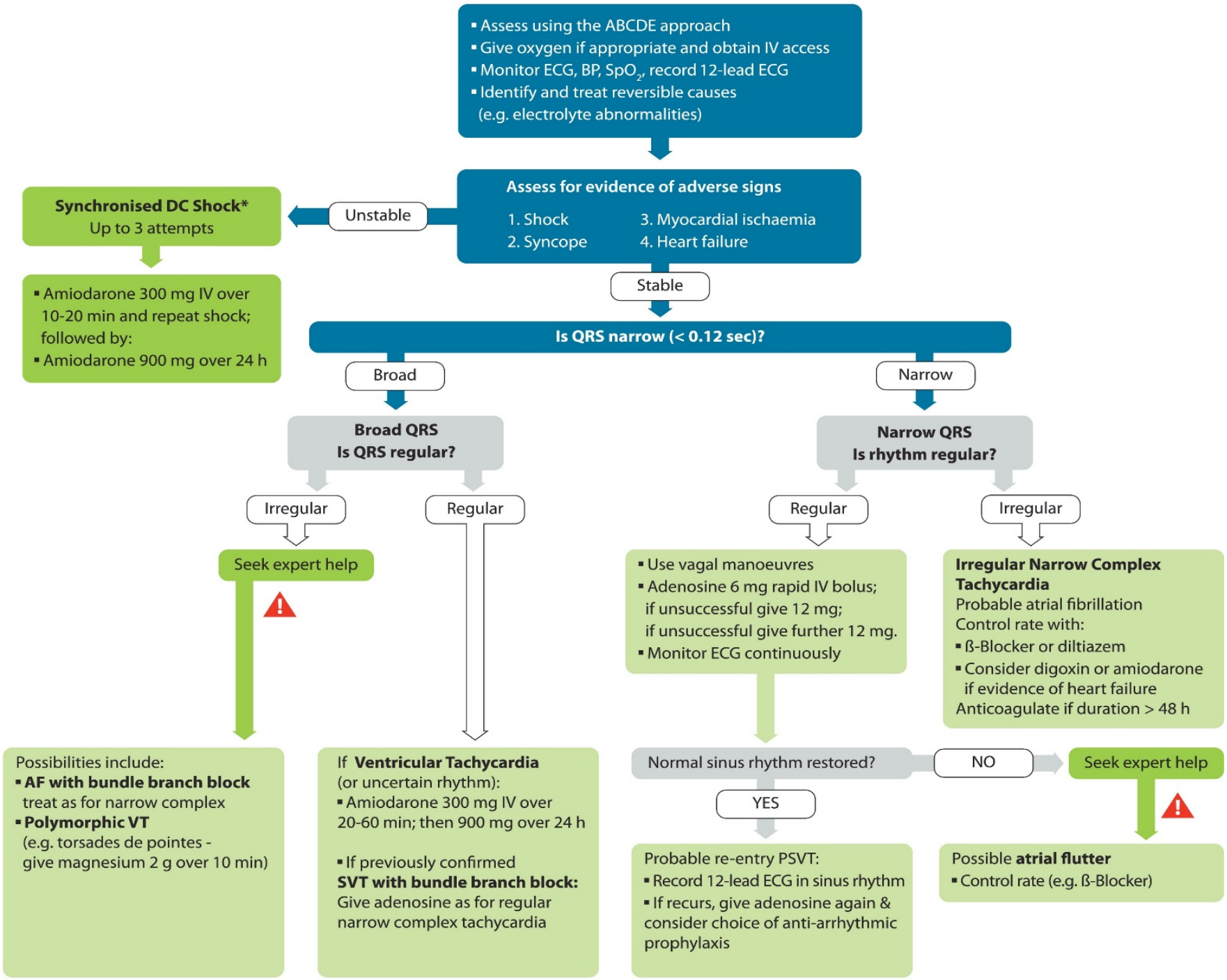
Tachycardia Algorithm (with pulse)



*Attempted electrical cardioversion on conscious patients is always undertaken under sedation or general anaesthesia

Hyperkalemia Management Guideline

Advisory, not mandatory

DEPARTMENT OF MEDICINE

SPTAR MATER DEI

NORMAL POTASSIUM (K+): 3.5 - 5.1 mmol/l

K^+ ≥5.5: TAKE ECG

1. EXAMINE: SYMPTOMS AND SIGNS

- Most are entirely asymptomatic
- Weakness – associated with bradycardia
- **ECG** – peaked T waves, widened QRS becoming sinusoidal, bradycardia, small P wave, ventricular fibrillation, other arrhythmias
- Hypotension, collapse (signs of adrenal failure)
- Fluid overload
- Cardiac arrest

2. IDENTIFY AND CORRECT COMMON CAUSES: MEDICATIONS

Drug treatment which can raise K+: Alter treatment chart if necessary

- K+ supplements
- K+ sparing diuretics
- Spironolactone
- NSAIDs
- ACE inhibitors
- Angiotensin Receptor Blockers
- Heparin (prolonged use ≥ 3days)
- Beta-blockers
- Digoxin toxicity
- Cyclosporin
- Tacrolimus
- Co-trimoxazole
- Ketoconazole
- Pentamidine

3. CHECK MOST RECENT RENAL STATUS

- Check renal function tests
- Check urine output
- If patient in renal failure or on dialysis, urgent dialysis may be necessary: Take ABGs/VBGs to check HCO_3

4. OTHER CAUSES

- If normal renal function – think in terms of:

- Haemolysed sample
- Haemolytic states
- Addison's
- Spurious result
- Recent blood transfusion
- Renal tubular acidosis type 4 (especially if diabetic)

- If spurious result suspected, repeat Se K+ immediately

This is a clinical practice guideline and clinical discretion may be used in its implementation

5. MANAGEMENT

K^+ **5.2-5.4** mmol/l	▪ No active correction ▪ Identify and correct cause ▪ Modify treatment if necessary ▪ Give dietary advice (see below)

	WITH **NO** ECG CHANGES	WITH **NEW** ECG CHANGES
K^+ **5.5-5.9** mmol/l	▪ Identify and correct cause ▪ Give Calcium Resonium 15g tds/qds orally with water	▪ As to the left **plus** ▪ Give 50mls of 50% dextrose + 10U Actrapid over 30 mins through large vein ▪ Give 10ml of 10% calcium gluconate IV over 10 mins ▪ *Repeat urea, creatinine & electrolytes in 4 hours*

K^+ **>6.0** ± ECG changes	▪ Identify and correct cause ▪ Give 10ml of 10% calcium gluconate IV over 10 mins (may need to be repeated every 20 mins – maximum 50ml) ▪ Give 50mls of 50% dextrose + 10U Actrapid over 30mins (may be repeated). Monitor HGT hourly ▪ Continue with dextrose 5% infusion 12 hourly rate ▪ Check ABGs/VBGs: correct acidosis if present with 50mls 8.4% sodium bicarbonate IV over 30 minutes ▪ Give Calcium Resonium as above ▪ *Repeat urea, creatinine & electrolytes after 4 hours*

Persistent hyperkalemia and / or Renal failure	▪ Refer to renal physician. ▪ Early/urgent dialysis (poor urine output, acidosis, rising creatinine, fluid overload, pericarditis)

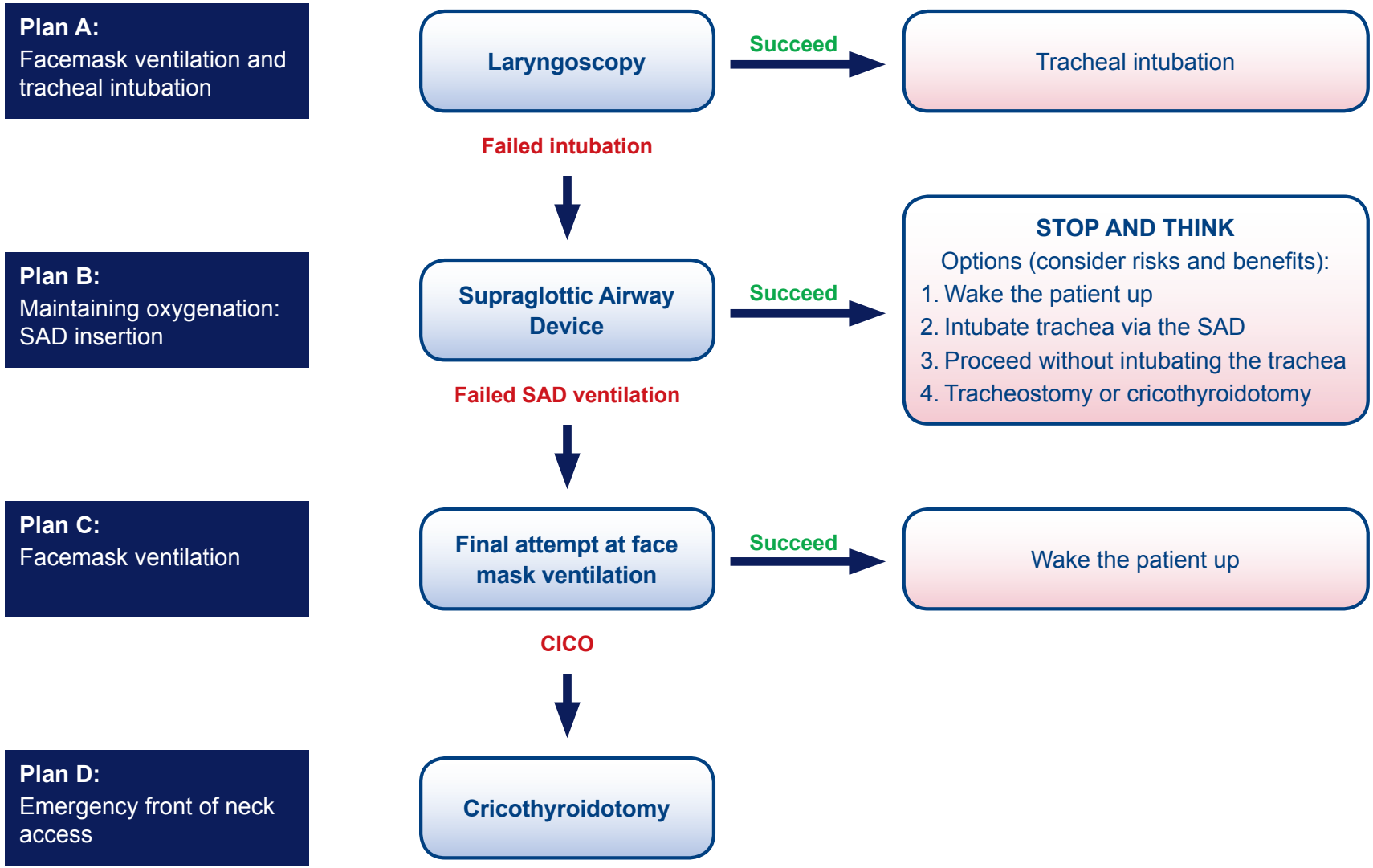
Important Notes

- Other Treatment Options:
  - Loop diuretics: Frusemide 20-40mg IV bolus
  - Beta agonist nebuliser: Salbutamol 2.5-5mg (0.5-1ml) in 3cc normal saline nebulised
- Dietary advice: foods which contain potassium: banana, dates, apricots, raisins, oranges and orange juice, spinach, tomatoes, Brussels sprouts, sweet corn, artichokes and salt substitutes which contain potassium

Further information may be found on the Intranet Annexes at http://cpg.mdh.gov.mt

DAS Difficult intubation guidelines – overview

2015



This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

Management of unanticipated difficult tracheal intubation in adults

2015

Plan A: Facemask ventilation and tracheal intubation

Optimise head and neck position
Preoxygenate
Adequate neuromuscular blockade
Direct / Video Laryngoscopy (maximum 3+1 attempts)
External laryngeal manipulation
Bougie
Remove cricoid pressure
Maintain oxygenation and anaesthesia

If in difficulty → call for help

Succeed → Confirm tracheal intubation with capnography

Declare failed intubation

Plan B: Maintaining oxygenation: SAD insertion

2nd generation device recommended
Change device or size (maximum 3 attempts)
Oxygenate and ventilate

Succeed →

STOP AND THINK

Options (consider risks and benefits):

1. Wake the patient up
2. Intubate trachea via the SAD
3. Proceed without intubating the trachea
4. Tracheostomy or cricothyroidotomy

Declare failed SAD ventilation

Plan C: Facemask ventilation

If facemask ventilation impossible, paralyse
Final attempt at facemask ventilation
Use 2 person technique and adjuncts

Succeed → Wake the patient up

Declare CICO

Plan D: Emergency front of neck access

Scalpel cricothyroidotomy

Post-operative care and follow up

- Formulate immediate airway management plan
- Monitor for complications
- Complete airway alert form
- Explain to the patient in person and in writing
- Send written report to GP and local database

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

Failed intubation, failed oxygenation in the paralysed, anaesthetised patient

CALL FOR HELP

Continue 100% O_2
Declare CICO

Plan D: Emergency front of neck access

Continue to give oxygen via upper airway
Ensure neuromuscular blockade
Position patient to extend neck

Scalpel cricothyroidotomy

Equipment:
1. Scalpel (number 10 blade)
2. Bougie
3. Tube (cuffed 6.0mm ID)

Laryngeal handshake to identify cricothyroid membrane

Palpable cricothyroid membrane

Transverse stab incision through cricothyroid membrane
Turn blade through 90° (sharp edge caudally)
Slide coude tip of bougie along blade into trachea
Railroad lubricated 6.0mm cuffed tracheal tube into trachea
Ventilate, inflate cuff and confirm position with capnography
Secure tube

Impalpable cricothyroid membrane

Make an 8-10cm vertical skin incision, caudad to cephalad
Use blunt dissection with fingers of both hands to separate tissues
Identify and stabilise the larynx
Proceed with technique for palpable cricothyroid membrane as above

Post-operative care and follow up

- Postpone surgery unless immediately life threatening
- Urgent surgical review of cricothyroidotomy site
- Document and follow up as in main flow chart

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

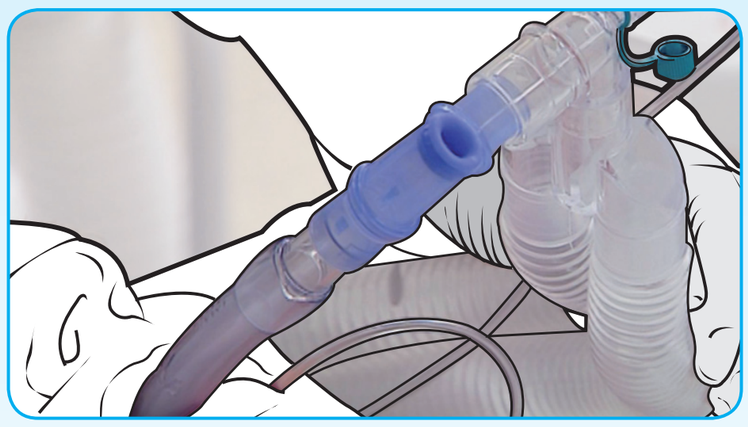
Fibreoptic guided tracheal intubation through supraglottic airway Device (SAD) using Aintree intubation catheter

Please ensure the SAD is in place; give 100% oxygen;
confirm adequate sedation/anaesthesia, ventilation & paralysis

Aintree catheter

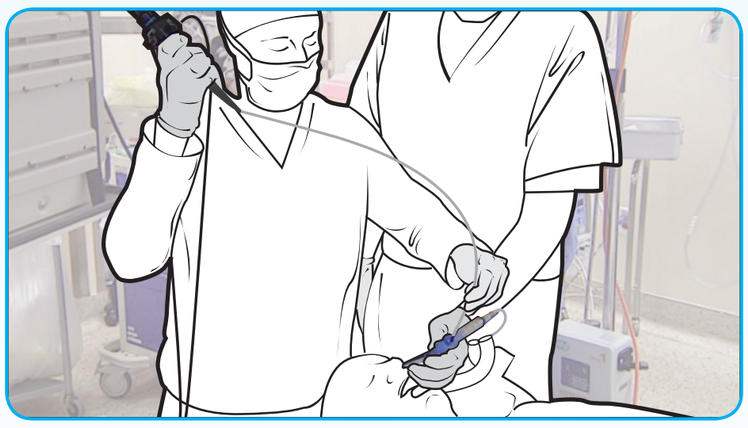
- 56cm long hollow catheter
- 6.5mm outer diameter; 4.7mm inner diameter
- Easily preloaded onto an appropriately sized intubating fibrescope (maximum insertion cord diameter - 4.2mm)
- Flexible enough for loading over fibrescope
- Stiff enough to facilitate railroading of tracheal tube
- Comes with 2 rapifit adaptors (please refer to manufacturer's guidelines)
- Used for SAD assisted orotracheal fibreoptic intubation

1



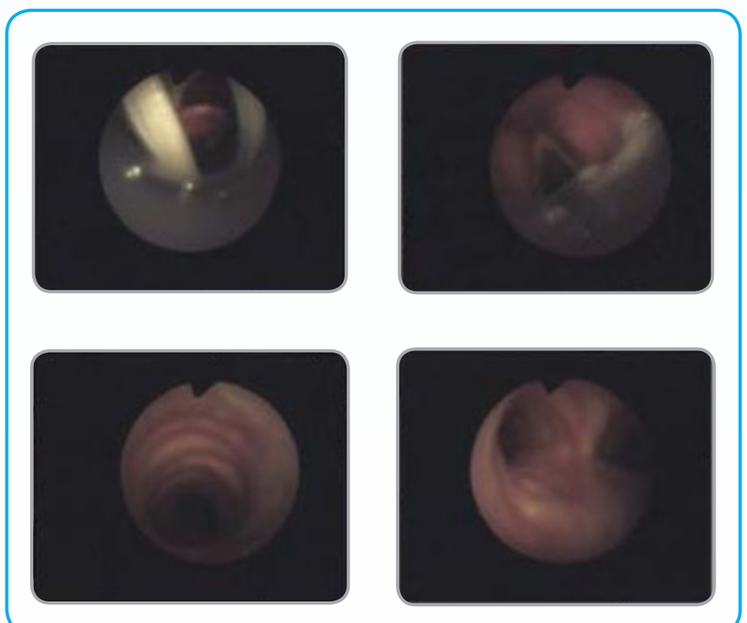
Having prepared the fibrescope (FS) and camera system, lubricate the outer surfaces of both the Aintree Intubation Catheter (AIC) and FS. Preload AIC onto FS and secure with tape. Attach a 15mm bronchoscopic swivel connector (with port) to SAD and attach the anaesthetic circuit to the swivel connector. Confirm adequate anaesthesia, muscle relaxation and assisted ventilation.

2



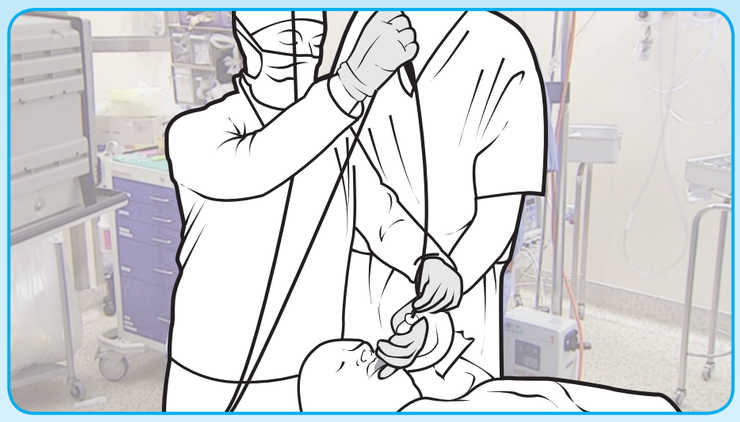
The SAD should be immobilised by an assistant. Introduce FS with loaded AIC through top port of swivel connector into the SAD lumen.

3



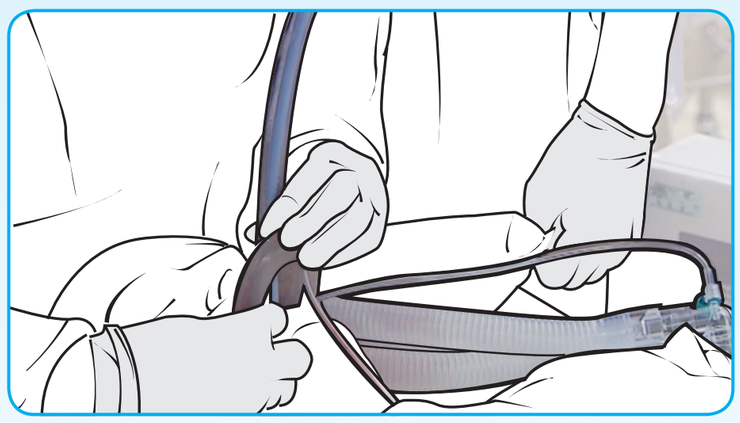
Sequentially visualise SAD aperture bars (if present), glottis, tracheal rings and finally carina as the FS passes caudally. **Never advance beyond carina.**

4



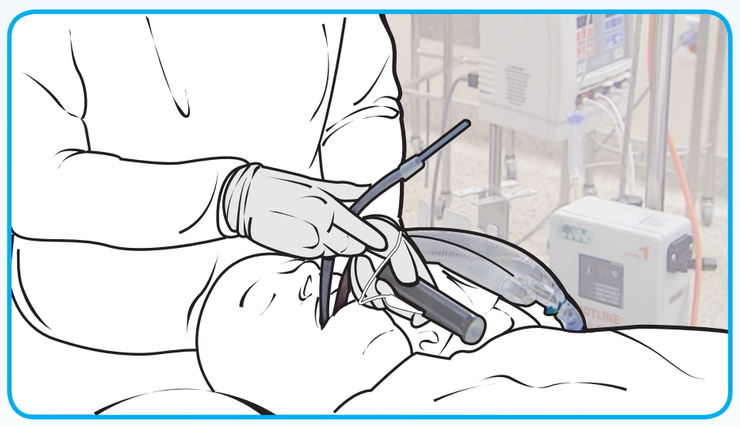
Note depth of AIC. With assistant immobilising SAD and the operator maintaining the position of AIC, the FS alone is withdrawn after removal of securing tape.

5



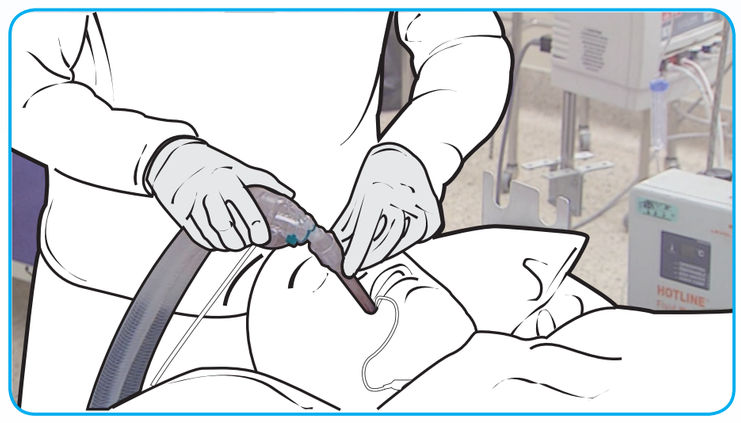
Briefly disconnect SAD (along with swivel connector) from anaesthetic circuit, deflate cuff (if present) and start withdrawing SAD (along with swivel connector), applying counter pressure on AIC to prevent movement. Once the SAD cuff becomes visible, grasp AIC in the mouth and fully remove SAD with the swivel connector. The process should be done with care. Again note the depth of AIC at the lips, ensuring that it **never exceeds 26cm**.

6



Using a laryngoscope, railroad the tracheal tube (ETT) over AIC ensuring a 'tip anterior' orientation.
Use a conventional ETT - minimum size is 7.0 and pre cut to appropriate length.

7



Reconnect circuit and re-establish anaesthesia and ventilation.
Confirm end-tidal CO_2. Consider FS confirmation of ETT position.

- **This is not an airway rescue technique**
- **It should be performed in a controlled stepwise process**
- **The process is designed to provide continued ventilation/oxygenation via the SAD and swivel connector until the SAD is removed and tracheal tube is railroaded in place**
- **Oxygen can be delivered via the AIC in situations where railroading of tracheal tube is prolonged; assisting ventilation via this route is often suboptimal (narrow diameter/lack of cuff) - Refer to manufacturer's guidelines for methods of oxygen delivery.**

Recommendations

1. **Consider a second anaesthetist in addition to a trained assistant.**
2. **Use a camera system for fibrescope.**

Caution

The aintree catheter is not recommended with the LMA Supreme.

Permission for use granted by Cook Medical Incorporated, Bloomington, Indiana.

Authors: Dr. Rajmohan Padmanabhan, Consultant Anaesthetist, NHS Lanarkshire
Dr. Barry McGuire, Consultant Anaesthetist, NHS Tayside

Illustrations produced by Andy Morris, Medical Illustration Department, NHS Lanarkshire. 26/01/2011

The AIC was invented in Liverpool, UK;
Reference: Anaesthesia,1996, volume 51, pages 1123-1126.

CTP.PADMAN.71823.W

Master algorithm – obstetric general anaesthesia and failed tracheal intubation

Algorithm 1
Safe obstetric general anaesthesia

Pre-induction planning and preparation
Team discussion

Rapid sequence induction
Consider facemask ventilation (P_{max} 20 cmH_2O)

Laryngoscopy
(maximum 2 intubation attempts; 3rd intubation attempt only by experienced colleague)

Success → Verify **successful** tracheal intubation and proceed
Plan extubation

Fail

Algorithm 2
Obstetric failed tracheal intubation

Declare failed intubation
Call for help
Maintain oxygenation
Supraglottic airway device (maximum 2 attempts) or facemask

Success → **Is it essential / safe to proceed with surgery immediately?***

Fail

Algorithm 3
Can't intubate, can't oxygenate

Declare CICO
Give 100% oxygen
Exclude laryngospasm – ensure neuromuscular blockade
Front-of-neck access

Is it essential / safe to proceed with surgery immediately?*
- **No** → **Wake§**
- **Yes** → **Proceed with surgery§**

*See Table 1, §See Table 2

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Table 1 – proceed with surgery?

	Factors to consider	WAKE			PROCEED
Before induction	**Maternal condition**	• No compromise	• Mild acute compromise	• Haemorrhage responsive to resuscitation	• Hypovolaemia requiring corrective surgery • Critical cardiac or respiratory compromise, cardiac arrest
	Fetal condition	• No compromise	• Compromise corrected with intrauterine resuscitation, pH < 7.2 but > 7.15	• Continuing fetal heart rate abnormality despite intrauterine resuscitation, pH < 7.15	• Sustained bradycardia • Fetal haemorrhage • Suspected uterine rupture
	Anaesthetist	• Novice	• Junior trainee	• Senior trainee	• Consultant / specialist
	Obesity	• Supermorbid	• Morbid	• Obese	• Normal
	Surgical factors	• Complex surgery or major haemorrhage anticipated	• Multiple uterine scars • Some surgical difficulties expected	• Single uterine scar	• No risk factors
	Aspiration risk	• Recent food	• No recent food • In labour • Opioids given • Antacids not given	• No recent food • In labour • Opioids not given • Antacids given	• Fasted • Not in labour • Antacids given
	Alternative anaesthesia • **regional** • **securing airway awake**	• No anticipated difficulty	• Predicted difficulty	• Relatively contraindicated	• Absolutely contraindicated or has failed • Surgery started
After failed intubation	**Airway device / ventilation**	• Difficult facemask ventilation • Front-of-neck	• Adequate facemask ventilation	• First generation supraglottic airway device	• Second generation supraglottic airway device
	Airway hazards	• Laryngeal oedema • Stridor	• Bleeding • Trauma	• Secretions	• None evident

Criteria to be used in the decision to wake or proceed following failed tracheal intubation. In any individual patient, some factors may suggest waking and others proceeding. The final decision will depend on the anaesthetist's clinical judgement.

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Newborn Life Support

(Antenatal counselling)
Team briefing and equipment check

Birth

Dry the baby
Maintain normal temperature
Start the clock or note the time

Assess (tone), breathing and heart rate

If gasping or not breathing:
Open the airway
Give 5 inflation breaths
Consider SpO_2 ± ECG monitoring

Re-assess
If no increase in heart rate
look for chest movement

If chest not moving:
Recheck head position
Consider 2-person airway control
and other airway manoeuvres
Repeat inflation breaths
SpO_2 monitoring ± ECG monitoring
Look for a response

If no increase in heart rate
look for chest movement

When the chest is moving:
If heart rate is not detectable
or very slow (< 60 min^{-1})
Start chest compressions
Coordinate compressions with PPV (3:1)

Reassess heart rate every 30 seconds
If heart rate is not detectable
or very slow (< 60 min^{-1})
consider venous access and drugs

Discuss with parents and debrief team

Maintain Temperature

60 s

Increase oxygen
(Guided by oximetry if available)

Acceptable pre-ductal SpO_2	
2 min	60 %
3 min	70 %
4 min	80 %
5 min	85 %
10 min	90 %

At All Times Ask: Do You Need Help?

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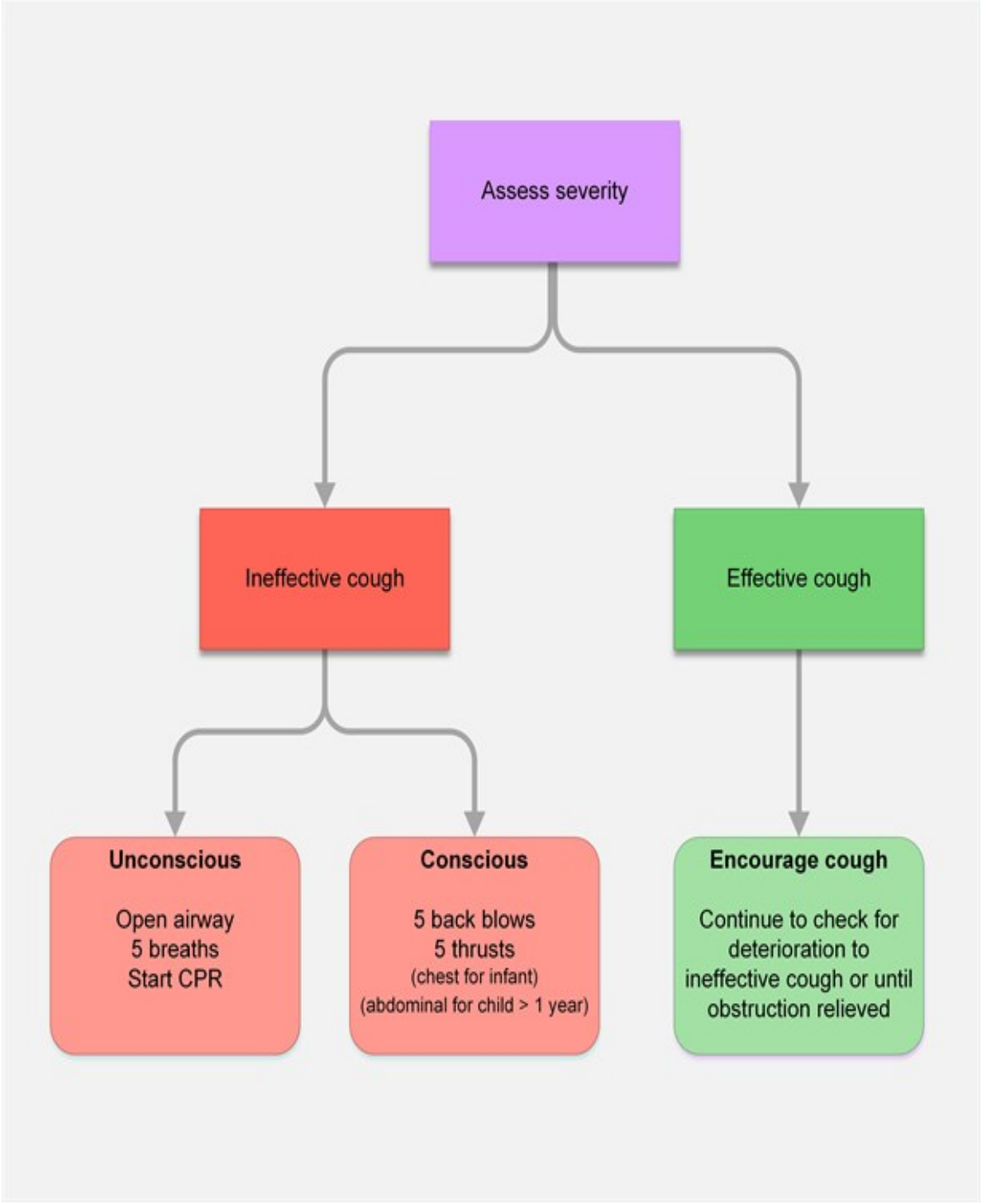
Paediatric choking algorithm



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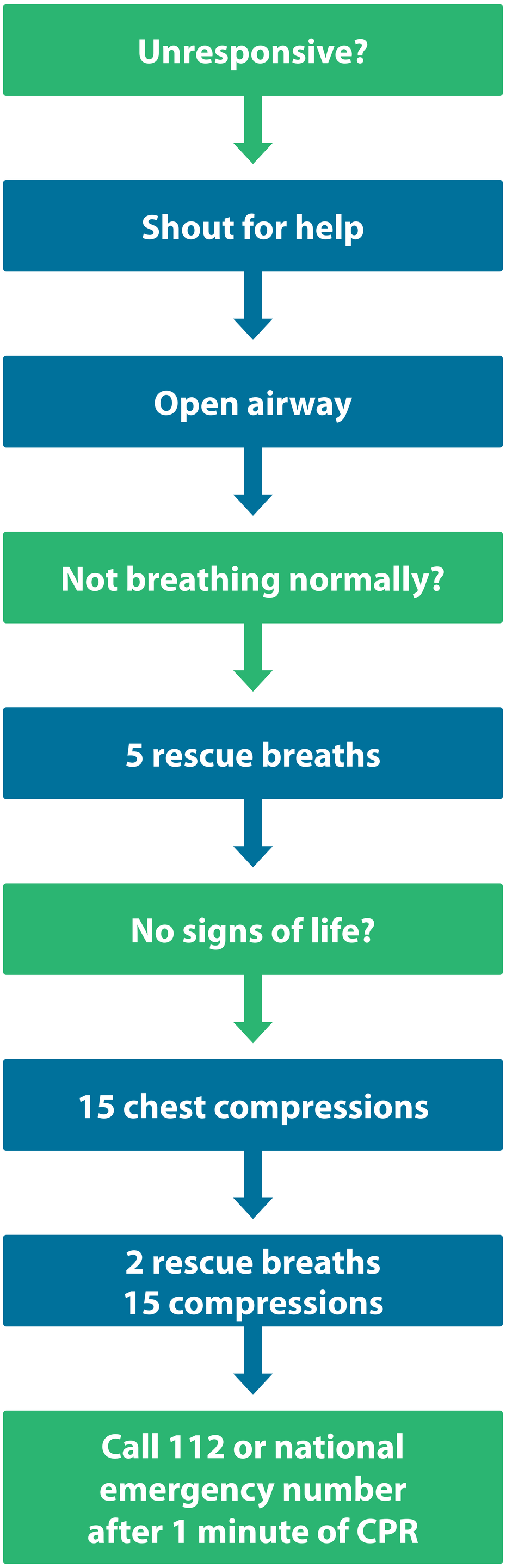
Paediatric Basic Life Support



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Paediatric Advanced Life Support

Unresponsive?
Not breathing or
only occasional gasps

↓

CPR (5 initial breaths then 15:2)
Attach defibrillator/monitor
Minimise interruptions

↔

Call Resuscitation Team
(1 min CPR first, if alone)

↓

Assess rhythm

Shockable (VF/Pulseless VT)

↓

1 Shock 4 J/Kg

↓

Immediately resume:
CPR for 2 min
Minimise interruptions
At 3rd cycle and 5th cycle consider amiodarone in shock-resistant VF/pVT

Return of spontaneous circulation

↓

IMMEDIATE POST CARDIAC ARREST TREATMENT

- Use ABCDE approach
- Controlled oxygenation and ventilation
- Investigations
- Treat precipitating cause
- Temperature control

Non-shockable (PEA/Asystole)

↓

Immediately resume:
CPR for 2 min
Minimise interruptions

DURING CPR

- Ensure high-quality CPR: rate, depth, recoil
- Plan actions before interrupting CPR
- Give oxygen
- Vascular access (intravenous, intraosseous)
- Give adrenaline every 3-5 min
- Consider advanced airway and capnography
- Continuous chest compressions when advanced airway in place
- Correct reversible causes

REVERSIBLE CAUSES

- **Hypoxia**
- **Hypovolaemia**
- Hyper/hypokalaemia, metabolic
- Hypothermia
- Thrombosis (coronary or pulmonary)
- Tension pneumothorax
- Tamponade (cardiac)
- Toxic/therapeutic disturbances

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Poster_PAEDS_PALS_Algorithm_ENG_V20150924.indd 1 5/10/15 08:39

Difficult mask ventilation (MV) – during routine induction of anaesthesia in a child aged 1 to 8 years

Difficult MV → **Give 100% oxygen** → **Call for help**

Step A Optimise head position

Check equipment

Depth of anaesthesia

Consider:
- Adjusting chin lift/jaw thrust
- Inserting shoulder roll if <2 years
- Neutral head position if >2 years
- Adjusting cricoid pressure if used
- Ventilating using two person bag mask technique

Consider changing:
- Circuit
- Mask
- Connectors

If equipment failure is suspected, change to self-inflating bag and isolate from anaesthetic machine promptly

Consider deepening anaesthesia

Use CPAP

Step B Insert oropharyngeal airway

Call for help again if not arrived

Assess for cause of difficult mask ventilation
- Light anaesthesia
- Laryngospasm
- Gastric distension – pass OG/NG tube

Maintain anaesthesia/CPAP

Deepen anaesthesia (Propofol first line)
- If relaxant given – intubate
- If intubation not successful, go to unanticipated difficult tracheal intubation algorithm

Step C Second-line: Insert SAD (e.g. LMA™)

- Insert SAD (e.g. LMA™) – **not > 3 attempts**
- Consider nasopharyngeal airway
- Release cricoid pressure

Good airway

Yes → **Continue**

No

SpO_2 >80% → Consider:
- SAD (e.g. LMA™) malposition/blockage
- Equipment malfunction
- Bronchospasm
- Pneumothorax

→ **Wake up patient**

SpO_2 <80% → Attempt intubation
- Consider paralysis

Succeed → **Proceed**

Fail → **Go to scenario cannot intubate cannot ventilate (CICV)**

SAD = supraglottic airway device

Unanticipated difficult tracheal intubation – during routine induction of anaesthesia in a child aged 1 to 8 years

Difficult direct laryngoscopy → **Give 100% oxygen and maintain anaesthesia** → **Call for help**

Step A Initial tracheal intubation plan when mask ventilation is satisfactory

Ensure: Oxygenation, anaesthesia, CPAP, management of gastric distension with OG/NG tube

Direct laryngoscopy – **not > 4 attempts**

Check:

- Neck flexion and head extension
- Laryngoscopy technique
- External laryngeal manipulation – remove or adjust
- Vocal cords open and immobile (adequate paralysis)

If poor view – consider bougie, straight blade laryngoscope* and/or smaller ETT

→ **Succeed** → Tracheal intubation → Verify ETT position

- Capnography
- Visual if possible
- Ausculation

If ETT too small consider using throat pack and tie to ETT

If in doubt, take ETT out

→ **Failed intubation with good oxygenation**

Step B Secondary tracheal intubation plan

Call for help again if not arrived

- Insert SAD (e.g. LMA™) – **not > 3 attempts**
- Oxygenate and ventilate
- Consider increasing size of SAD (e.g. LMA™) once if ventilation inadequate

→ **Succeed** →

- Consider modifying anaesthesia and surgery plan
- Assess safety of proceeding with surgery using a SAD (e.g. LMA™)

→ **Unsafe** → **Postpone surgery Wake up patient**

→ **Safe** → **Proceed with surgery**

→ **Safe** →

- **Consider 1 attempt at FOI via SAD (e.g. LMA™)**
- Verify intubation, leave SAD (e.g. LMA™) in place and proceed with surgery

→ **Succeed** → **Proceed with surgery**

→ **Failed intubation via SAD (e.g. LMA™)** → **Postpone surgery Wake up patient**

→ **Failed oxygenation e.g. SpO_2 <90% with FiO_2 1.0**

- Convert to face mask
- Optimise head position
- Oxygenate and ventilate
- Ventilate using two person bag mask technique, CPAP and oro/nasopharyngeal airway
- Manage gastric distension with OG/NG tube
- Reverse non-depolarisating relaxant

→ **Succeed** → **Postpone surgery Wake up patient**

→ **Failed ventilation and oxygenation** → **Go to scenario cannot intubate cannot ventilate (CICV)**

Following intubation attempts, consider • Trauma to the airway • Extubation in a controlled setting

*Consider using indirect larygoscope if experienced in their use

SAD = supraglottic airway device

Cannot intubate and cannot ventilate (CICV) in a paralysed anaesthetised child aged 1 to 8 years

Failed intubation inadequate ventilation → **Give 100% oxygen** → **Call for help**

Step A Continue to attempt oxygenation and ventilation

- FiO_2 1.0
- Optimise head position and chin lift/jaw thrust
- Insert oropharyngeal airway or SAD (e.g. LMA™)
- Ventilate using two person bag mask technique
- Manage gastric distension with an OG/NG tube

Step B Attempt wake up if maintaining SpO_2 >80%

If rocuronium or vecuronium used, consider suggamadex (16mg/kg) for full reversal

Prepare for rescue techniques in case child deteriorates

Step C Airway rescue techniques for CICV (SpO_2 <80% and falling) and/or heart rate decreasing

Call for help again if not arrived

Call for specialist ENT assistance

- **ENT available** → Consider:
  - Surgical tracheostomy
  - Rigid bronchoscopy + ventilate / jet ventilation (pressure limited)
- **ENT not available** → Percutaneous cannula cricothyroidotomy / transtracheal jet ventilation (pressure limited)
  - **Succeed** → Continue jet ventilation set to lowest delivery pressure until wake up or definitive airway established
  - **Fail** →
    - Perform surgical cricothyroidotomy / transtracheal and insertion of ETT / tracheostomy tube*
    - Consider passive O_2 insufflation while preparing

*Note: Cricothyroidotomy techniques can have serious complications and training is required – only use in life-threatening situations and convert to a definitive airway as soon as possible

Cannula cricothyroidotomy

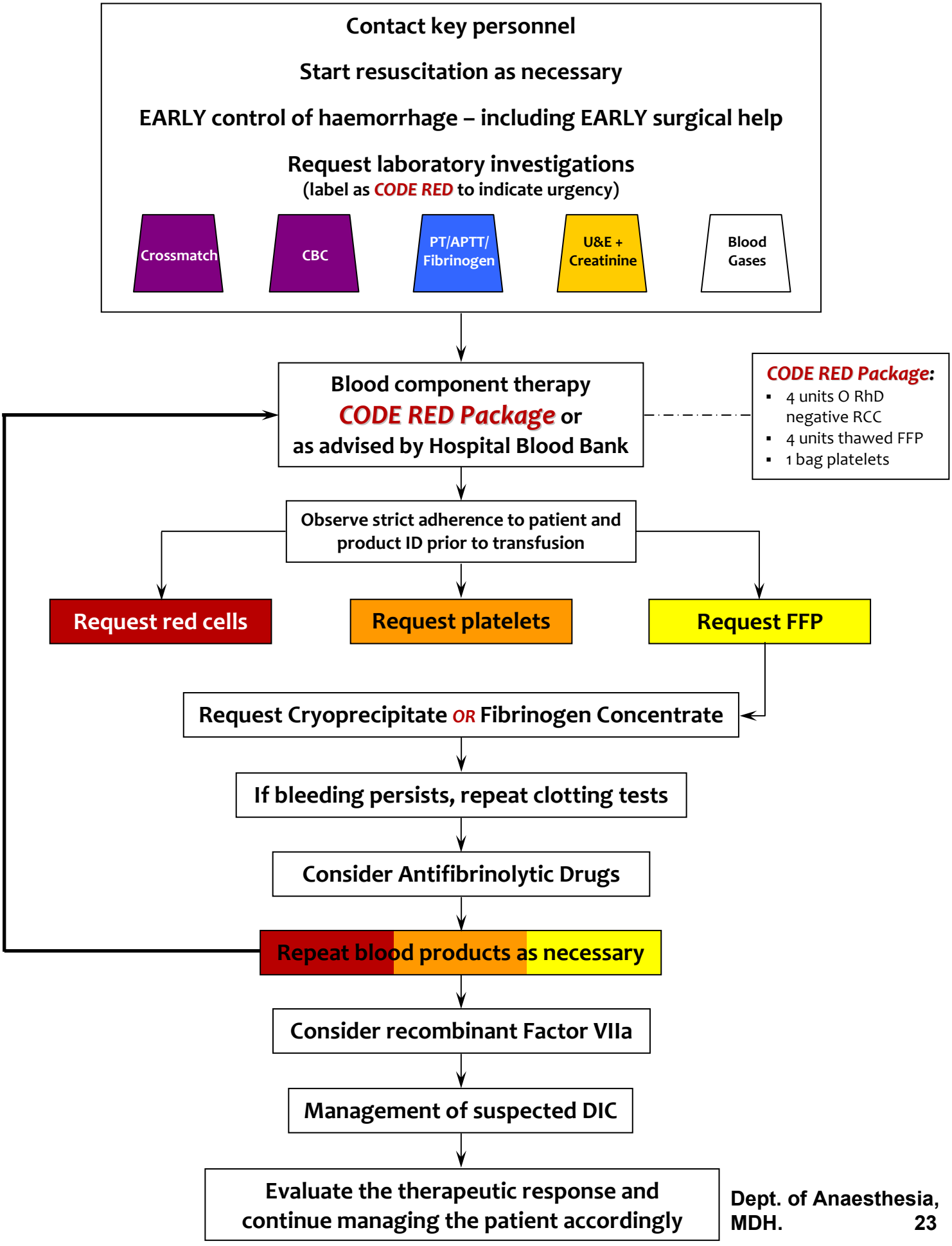
- Extend the neck (shoulder roll)
- Stabilise larynx with non-dominant hand
- Access the cricoithyroidotomy membrane with a dedicated 14/16 gauge cannula
- Aim in a caudad direction
- Confirm position by air aspiration using a syringe with saline
- Connect to either:
  - adjustable pressure limiting device, set to lowest delivery pressure

  or
  - 4Bar O_2 source with a flowmeter (match flow l/min to child's age) and Y connector
- Cautiously increase inflation pressure/flow rate to achieve adequate chest expansion Wait for full expiration before next inflation
- Maintain uper airway patency to aid expiration

SAD = supraglottic airway device

GUIDELINES TO THE MANAGEMENT OF MASSIVE HAEMORRHAGE

These guidelines are solely meant to provide guidance to doctors and do not in any way limit or substitute the clinical discretions afforded to the doctors making use of them.



GUIDELINES TO THE MANAGEMENT OF MASSIVE HAEMORRHAGE

These guidelines are solely meant to provide guidance to doctors and do not in any way limit or substitute the clinical discretions afforded to the doctors making use of them.

Contact key personnel:
- Consultant in charge, duty anaesthetist, Hospital Blood Bank

→ **Provide adequate ventilation and oxygenation**

→ **Control source of haemorrhage**, may include:
- Early surgical/obstetric intervention
- Upper GI tract procedures
- Interventional radiology

Restore circulating volume:
- Use ***CODE RED Package*** if necessary, liaise with senior laboratory staff
- Insert at least 2 wide-bore peripheral cannulae (14 G or larger)
- Give adequate volumes of warmed crystalloid/colloid/blood – *keep the patient warm at all times*
- Consider invasive monitoring (arterial or central venous pressure)
- Aim to maintain adequate BP and urine output >30 ml/hr in adults (or 0.5 ml/kg/hr)

Request laboratory investigations:
- Take samples at earliest opportunity as results may be affected by colloid infusion
- CBC, PT, APTT, Fibrinogen – repeat as necessary or after 1/3 blood volume replacement
- Crossmatch sample, biochemical profile, blood gases
- Repeat after blood component infusion

Start blood component therapy
(early transfusion of red cells required, anticipate coagulopathy)

Request suitable red cells:
- Aim for haemoglobin of around 8 g/dL
- Transfusion required before sample arrives at the HBB – use uncrossmatched O RhD negative blood; RhD positive acceptable if patient is male or post-menopausal female
- Transfusion required within 15 minutes – use group specific blood
- Transfusion required within 45 minutes – use fully compatible blood component
- The presence of alloantibodies will cause delay in the provision of fully crossmatched blood (HBB will advise)
- Ideally use blood warmer and/or rapid infusion device
- Consider blood salvage if available and appropriate (contraindicated if wound is heavily contaminated)

Request platelets:
- Standard dose = 1 platelet pack
- Available immediately
- Anticipate low platelet count after 1 x blood volume replacement (≈8 units RCC) – consider giving another pack of platelets
- Target platelet count:
  - > 100 x 10^9/L for multiple/CNS trauma
  - 75 x 10^9/L for other situations

Request FFP:
- Dose = 12-15 ml/kg body weight = 4-6 units for an adult
- Allow for 15 minutes thawing time
- Anticipate coagulation factor deficiency after blood loss of 1.5 x blood volume
- Aim for PT and APTT < 1.5 x mean control (higher volumes are correlated with increased surgical bleeding)

Request Cryoprecipitate:
- Dose = 1 pack/10 kg body weight
- Allow for 10 minutes thawing time
- To replace fibrinogen
- Aim for fibrinogen > 1.5 g/L

OR

Consider Antifibrinolytic Drugs:
- E.g. Tranexamic Acid: dose = 1 g IV over 10 minutes, then 1 g IV over 8 hours
- Obtained from pharmacy
- Recommended haematology consultation

OR

Fibrinogen Concentrate:
- Dose = aim for fibrinogen level >1.5 g/L
- Obtained from pharmacy
- To be considered when there are persistently low fibrinogen levels despite optimal FFP and cryo infusion
- Recommended haematology consultation

OBSERVE STRICT ADHERENCE TO PATIENT AND PRODUCT ID PRIOR TO TRANSFUSION

Recombinant Factor VIIa:
- Dose = 4.5 KIU/kg (90 µg/kg) initially, followed by 90 µg/kg in 2 hours if haemostasis is not achieved
- Obtained from the pharmacy
- To be considered if bleeding continues despite appropriate replacement therapy (off licence use)
- Recommended haematology consultation

Management of suspected DIC:
- Suspect DIC if patient continues to bleed
- DIC lab findings = increased PT/APTT/INR, decreased platelet/fibrinogen.
- Repeat blood component therapy as previously indicated
- Recommended haematological consultation

Evaluate the therapeutic response and continue managing the patient accordingly

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GUIDELINES TO ORDERING BLOOD PRODUCTS IN AN EMERGENCY

These guidelines are solely meant to provide guidance to doctors and do not in any way limit or substitute the clinical discretions afforded to the doctors making use of them.

If advanced warning of major trauma or outside emergency has been recorded, inform the Hospital Blood Bank (HBB)

→ ***'Code Red'*** emergency; Senior medical / anaesthetic staff to liaise with senior laboratory staff

Frequent unnecessary phone calls to the HBB cause delay in the provision of compatible blood

Blood sample:
- 3mL EDTA tube (violet top)
- Label by hand: patient surname, name and ID number
- Label with unique hospital identifier and gender if patient details are unavailable

Send request form with sample to HBB:
- Inform lab of urgency and specify the urgency on the request form
- The sample and request form should be transported manually – DO NOT use the vacuum tube system.

OBSERVE STRICT ADHERENCE TO PATIENT AND PRODUCT ID PRIOR TO TRANSFUSION

Platelets:
- Available immediately

Red cells:
- Transfusion required before sample arrives at the HBB – use un-crossmatched O RhD negative blood
- Transfusion required within 15 minutes – use group specific blood
- Transfusion required within 45 minutes – use fully compatible blood component
- The presence of alloantibodies will cause delay in the provision of fully crossmatched blood (HBB will advise)

FFP/Cryoprecipitate:
- Take 15 minutes to thaw out

Collection/transport of blood product(s):
- HBB to contact clinical area when product is ready for collection
- Units must be collected by trained and competent staff
- Store red cell units appropriately if they are not used immediately
- Platelets, FFP and Cryoprecipitate should be transfused immediately

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GUIDELINES TO THE MANAGEMENT OF MASSIVE BLOOD LOSS

Guideline No. PAT01Guide2012v01.0

These guidelines are solely meant to provide guidance to doctors and do not in any way limit or substitute the clinical discretions afforded to the doctors making use of them.

Definitions:

Massive blood loss is arbitrarily defined as:

- the loss of one blood volume within a 24-hour period[1],
- a 50% blood volume loss within 3 hours, or
- a rate of loss of 150 mL/minute. [2]

One blood volume in the normal adult is around 7% of the ideal body weight (approximately equivalent to 8 units of RCC) and 8-9% in children.

It is imperative to recognise major blood loss early and institute effective action promptly if shock and its consequences are to be prevented.

Indications for Massive Transfusion include but are not limited to:

- Administration of one estimated blood volume and continuing need for transfusion
- Massive blood loss with profound hemorrhagic/hypovolemic shock
- In trauma, surgical or obstetric emergency cases consider:
  - Prolonged PT (INR > 1.5), decreased fibrinogen levels (<1 g/dl) or platelet count (<100 x 10^9/L), accompanied by hemorrhage.

In extreme emergencies, a '***Code Red***' package is available. This includes:

- 4 units of O RhD negative RCC
- 4 units of thawed FFP
- 1 bag of platelets

This package may only be ordered by a consultant, resident specialist, HST or any other senior doctor entrusted with the care of the patient.

Therapeutic Goals:

- Maintenance of tissue perfusion and oxygenation by restoration of blood volume and haemoglobin
- Arrest of bleeding by:
  - Surgical or other intervention to treat any traumatic, surgical or obstetric source
  - Judicious use of blood component therapy to correct coagulopathy

Volume Resuscitation:

- Crystalloids and colloids should be used for volume replacement prior to the transfusion of blood components.

Investigations:

- When dealing with an evolving process it is important to check parameters frequently, (and after therapeutic intervention) to monitor the need for and the efficacy of component therapy.
- Sample tubes should be labelled by the patient's bedside after positive patient identification.

Blood Component Therapy:

- Transfusion giving sets, which should be changed at least 12-hourly during red cell infusion and prior to platelet infusion, include a microaggregate filter.

1. Red Cells:

- Red cells should NOT be used as volume expanders.
- Red cell transfusion is likely to be required when 30-40% blood volume is lost; over 40% blood volume is immediately life-threatening.
- Blood loss may be underestimated, particularly if concealed and in young fit individuals (such as in the obstetric setting).
- Replacement should be guided by clinical estimation of blood loss in conjunction with the patient's response to volume replacement.
- The haemoglobin level is a poor indicator of blood loss in the acute situation; thus, the decision to transfuse should be based on the patient's risk factors for complications of inadequate oxygenation. It is important to keep in mind that silent ischaemia may occur in the presence of stable vital signs.

2. Platelets:

- Empirical platelet transfusion may be required when platelet function is abnormal, as occurs after cardio-pulmonary by-pass, in patients with renal dysfunction or secondary to anti-platelet therapy.
- **NB:** 1 bag of platelets is equivalent to the commonly referred to '6 Units'.

3. Fresh Frozen Plasma (FFP) and Cryoprecipitate:

- Coagulation factor deficiency is the primary cause for coagulopathy in massive transfusion because of dilution of coagulation factors following volume replacement. Occasionally coagulopathy may also be caused by DIC.
- It is essential that PT, APTT and fibrinogen are monitored frequently.
- One should be aware that hypocalcaemia may be aggravated by the citrate in the blood component bags.

4. Cell Saver:

- The technique of blood salvage using a cell saver should be considered (especially in cases where the patient refuses transfusion with allogeneic blood products e.g. Jehovah's Witnesses).
- Its use is contraindicated if the wound is heavily contaminated.

Special transfusion requirements for special indications (e.g. components suitable for neonates, irradiated components for patients at risk of TA-GvHD) should be taken into account if time permits, but it may be necessary to make a pragmatic decision regarding the relative risks of delaying transfusion or giving components that are not of the appropriate specification.

Use of Pharmacological Agents to Reduce Bleeding:

1. *Antifibrinolytic Drugs (e.g. Tranexamic Acid):*

- Used to reverse established fibrinolysis in the setting of massive blood transfusion.
- A recent randomized placebo controlled trial showed that giving a loading dose of 1 g of Tranexamic Acid infused over 10 minutes within 8 hours of trauma, followed by an IV infusion of 1 g over 8 hours, significantly reduced mortality.

2. *Recombinant Factor VIIa (rVIIa) – Eptagog Alfa (activated):*

- Only licensed for use in haemophiliacs with inhibitors to treat active bleeding or as prophylaxis for surgery.
- Off license it may be used in various settings of massive blood transfusion (in adults, paediatric care, and even obstetrics (e.g. PPH). However, the SPC of the drug contains the following warning: when rVIIa is administered to patients outside approved indications, arterial thromboembolic events are common (≥ 1/100 to < 1/10). A higher risk of arterial thromboembolic adverse events (5.6% in patients treated with rVIIa versus 3.0% in placebo-treated patients) has been shown in a meta-analysis of pooled data from placebo-controlled trials conducted outside current approved indications in various clinical settings. Safety and efficacy of rVIIa have not been established outside the approved indications. Thromboembolic events may lead to cardiac arrest.
- It should be used where there is blood loss of >300 mL/hr, with no evidence of heparin or warfarin effect, where surgical control of bleeding is not possible and there has been adequate replacement of coagulation factors with FFP, cryoprecipitate and platelets, together with correction of acidosis.
- Rationale for use: it only induces coagulation in those sites where tissue factor is also present.
- The drug is expensive so it should be used judiciously.
- Use of rVIIa as a treatment of last resort in massive haemorrhage has been shown to be ineffective[5].

3. *Fibrinogen Concentrate:*

- Fibrinogen concentrate plays a role in achieving and maintaining haemostasis in patients suffering from acquired fibrinogen deficiency during massive bleeding, especially if used as an early intervention.

Disseminated Intravascular Coagulation (DIC):

- Very common in obstetric practice.
- Patients at particular risk are those with tissue damage due to hypoxia, hypovolaemia or hypothermia, and those with massive head injury or extensive muscle damage[6].
- D-dimer measurement may be useful in providing an early warning of DIC.

Risks of Transfusion:

1. *Wrong Blood Grouping:*

- Positive patient identification is of paramount importance as wrong blood grouping may at worst cause a fatal haemolytic reaction[7]. Evidence suggests that this error is common in emergency situations.

2. *Metabolic Consequences:*

- Ionised hypocalcaemia may result due to citrate toxicity, after a large volume of plasma is infused. This is corrected by 10 mL of Calcium Chloride injection (10% w/v) given via slow intravenous administration or 2.5 to 5.0 mmol Calcium Chloride (7.35% w/v) in divided doses over 10 minutes by slow intravenous injection.
- Hyperkalaemia may result due to high extracellular potassium concentration in stored red cell units. If the potassium concentration is >6 mmol/L it should be treated with glucose-insulin regimens together with bicarbonate to correct acidosis. (Refer to CPG on Hyperkalaemia).

3. *Hypothermia:*

- The patient must be kept warm at all times.
- Blood components should be adequately warmed; the use of rapid infusion and an in-line warming system is recommended.

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EUROPEAN RESUSCITATION COUNCIL

Anaphylaxis

Anaphylactic reaction?

↓

Assess using ABCDE approach

↓

Diagnosis - look for:

- Acute onset of illness
- Life-threatening Airway and/or Breathing and/or Circulation problems[1]
- And usually skin changes

↓

- **Call for help**
- Lie patient flat with raised legs (if breathing allows)

↓

Adrenaline[2]

↓

When skills and equipment available:

- Establish airway
- High flow oxygen
- IV fluid challenge[3]
- Chlorphenamine[4]
- Hydrocortisone[5]

Monitor:

- Pulse oximetry
- ECG
- Blood pressure

[1.] **Life-threatening problems:**
Airway: swelling, hoarseness, stridor
Breathing: rapid breathing, wheeze, fatigue, cyanosis, SpO_2 < 92%, confusion
Circulation: pale, clammy, low blood pressure, faintness, drowsy/coma

[2.] **Adrenaline** *(give IM unless experienced with IV adrenaline)*
IM doses of 1:1000 adrenaline (repeat after 5 min if no better)

Adult	500 mcg IM (0.5 mL)
Child more than 12 years	500 mcg IM (0.5 mL)
Child 6-12 years	300 mcg IM (0.3 mL)
Child less than 6 years	150 mcg IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: Adults 50 mcg; Children 1 mcg kg^{-1}

[3.] **IV fluid challenge (crystalloid):**

Adult	500 - 1000 mL
Child	20 mL kg^{-1}

Stop IV colloid if this might be the cause of anaphylaxis

	[4.] **Chlorphenamine** (IM or slow IV)	[5.] **Hydrocortisone** (IM or slow IV)
Adult or child more than 12 years	10 mg	200 mg
Child 6 - 12 years	5 mg	100 mg
Child 6 months to 6 years	2.5 mg	50 mg
Child less than 6 months	250 mcg kg^{-1}	25 mg

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THE ASSOCIATION OF ANAESTHETISTS

of Great Britain & Ireland

Management of a Patient with Suspected Anaphylaxis During Anaesthesia SAFETY DRILL

(Revised 2009)

Immediate management

- Use the ABC approach (Airway, Breathing, and Circulation). Team-working enables several tasks to be accomplished simultaneously.
- Remove all potential causative agents and maintain anaesthesia, if necessary, with an inhalational agent.
- CALL FOR HELP and note the time.
- Maintain the airway and administer oxygen 100%. Intubate the trachea if necessary and ventilate the lungs with oxygen.
- Elevate the patient's legs if there is hypotension.
- If appropriate, start cardiopulmonary resuscitation immediately according to Advanced Life Support Guidelines.
- Give adrenaline i.v.
    - Adult dose: 50 µg (0.5 ml of 1:10 000 solution).
    - Child dose: 1.0 $\mu g.kg^{-1}$ (0.1 $ml.kg^{-1}$ 1:100 000 solution).
- Several doses may be required if there is severe hypotension or bronchospasm. If several doses of adrenaline are required, consider starting an intravenous infusion of adrenaline.
- Give saline 0.9% or lactated Ringer's solution at a high rate via an intravenous cannula of an appropriate gauge (large volumes may be required).
    - Adult: 500 - 1 000 ml
    - Child: 20 $ml.kg^{-1}$
- Plan transfer of the patient to an appropriate Critical Care area.

CONTINUED OVERLEAF

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Secondary management

• Give chlorphenamine i.v.	Adult:	10 mg
	Child 6 - 12 years:	5 mg
	Child 6 months - 6 years:	2.5 mg
	Child <6 months:	250 $\mu g.kg^{-1}$
• Give hydrocortisone i.v.	Adult:	200 mg
	Child 6 - 12 years:	100 mg
	Child 6 months - 6 years:	50 mg
	Child <6 months:	25 mg

- If the blood pressure does not recover despite an adrenaline infusion, consider the administration of an alternative i.v. vasopressor according to the training and experience of the anaesthetist, e.g. metaraminol.
- Treat persistent bronchospasm with an i.v. infusion of salbutamol. If a suitable breathing system connector is available, a metered-dose inhaler may be appropriate. Consider giving i.v. aminophylline or magnesium sulphate.

Investigation

- Take blood samples (5 - 10 ml clotted blood) for **mast cell tryptase**:
  - Initial sample as soon as feasible after resuscitation has started – do not delay resuscitation to take the sample.
  - Second sample at 1 - 2 h after the start of symptoms.
  - Third sample either at 24 h or in convalescence (for example in a follow-up allergy clinic). This is a measure of baseline tryptase levels as some individuals have a higher baseline level.
- Ensure that the samples are labelled with the time and date.
- Liaise with the hospital laboratory about analysis of samples.

Later investigations to identify the causative agent

The anaesthetist who gave the anaesthetic or the supervising consultant anaesthetist is responsible for ensuring that the reaction is investigated. The patient should be referred to a specialist Allergy or Immunology Centre (see www.aagbi.org for details). The patient, surgeon and general practitioner should be informed. Reactions should be notified to the AAGBI National Anaesthetic Anaphylaxis Database (see www.aagbi.org).

This guideline is not to be construed as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as knowledge advances. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in light of the clinical data presented and the diagnostic and treatment options available.

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AAGBI Safety Guideline

Management of Severe Local Anaesthetic Toxicity

1 Recognition

Signs of severe toxicity:

- Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions
- Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur
- Local anaesthetic (LA) toxicity may occur some time after an initial injection

2 Immediate management

- Stop injecting the LA
- Call for help
- Maintain the airway and, if necessary, secure it with a tracheal tube
- Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH in the presence of metabolic acidosis)
- Confirm or establish intravenous access
- Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses
- Assess cardiovascular status throughout
- Consider drawing blood for analysis, but do not delay definitive treatment to do this

3 Treatment

IN CIRCULATORY ARREST

- Start cardiopulmonary resuscitation (CPR) using standard protocols
- Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment
- Consider the use of cardiopulmonary bypass if available

GIVE INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)

- Continue CPR throughout treatment with lipid emulsion
- Recovery from LA-induced cardiac arrest may take >1 h
- Propofol is not a suitable substitute for lipid emulsion
- Lidocaine should not be used as an anti-arrhythmic therapy

WITHOUT CIRCULATORY ARREST

Use conventional therapies to treat:

- hypotension,
- bradycardia,
- tachyarrhythmia

CONSIDER INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)

- Propofol is not a suitable substitute for lipid emulsion
- Lidocaine should not be used as an anti-arrhythmic therapy

4 Follow-up

- Arrange safe transfer to a clinical area with appropriate equipment and suitable staff until sustained recovery is achieved
- Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days
- Report cases as follows:
  - in the United Kingdom to the National Patient Safety Agency (via **www.npsa.nhs.uk**)
  - in the Republic of Ireland to the Irish Medicines Board (via **www.imb.ie**)

If Lipid has been given, please also report its use to the international registry at **www.lipidregistry.org**. Details may also be posted at **www.lipidrescue.org**

Your nearest bag of Lipid Emulsion is kept CPR TROLLEY

This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.
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IMMEDIATELY

Give an initial intravenous bolus injection of 20% lipid emulsion

1.5 ml.kg^{-1} over 1 min

AND

Start an intravenous infusion of 20% lipid emulsion at **15 ml.kg^{-1}.h^{-1}**

AFTER 5 MIN

Give **a maximum of two** repeat boluses (same dose) if:

- cardiovascular stability has not been restored **or**
- an adequate circulation deteriorates

Leave **5 min** between boluses

A maximum of **three** boluses can be given (including the initial bolus)

AND

Continue infusion at same rate, but:

Double the rate to **30 ml.kg^{-1}.h^{-1}** at any time after 5 min, if:

- cardiovascular stability has not been restored or
- an adequate circulation deteriorates

Continue infusion until stable and adequate circulation restored or maximum dose of lipid emulsion given

Do not exceed a maximum cumulative dose of 12 ml.kg^{-1}

An approximate dose regimen for a 70-kg patient would be as follows:

IMMEDIATELY

Give an initial intravenous bolus injection of 20% lipid emulsion 100 ml over 1 min

AND

Start an intravenous infusion of 20% lipid emulsion at 1000 ml.h^{-1}

AFTER 5 MIN

Give a **maximum of two** repeat boluses of 100 ml

AND

Continue infusion at same rate but **double** rate to 2000 ml.h^{-1} if indicated at any time

Do not exceed a maximum cumulative dose of 840 ml

This AAGBI Safety Guideline was produced by a Working Party that comprised:
Grant Cave, Will Harrop-Griffiths (Chair), Martyn Harvey, Tim Meek, John Picard, Tim Short and Guy Weinberg.

This Safety Guideline is endorsed by the Australian and New Zealand College of Anaesthetists (ANZCA).

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AAGBI Safety Guideline

Management of Severe Local Anaesthetic Toxicity

ACCOMPANYING NOTES

1 Recognition

Local anaesthetic intoxication can present in many different ways, making it very difficult to recognise.

After injection of a bolus of local anaesthetic, toxicity may develop at any time in the following hour.

Techniques involving infusion of local anaesthetic through a catheter allow intoxication to develop at any time.

2 Immediate management

Some hospital laboratories have encountered difficulty analysing blood drawn during lipid emulsion therapy. If clinical circumstances allow, it may be prudent to draw blood for later analysis before lipid emulsion therapy begins.

3 Treatment

1000 ml of 20% lipid emulsion should be immediately available to all patients receiving potentially cardiotoxic doses of local anaesthetic.

20% lipid emulsion is readily available from most hospital pharmacies, which may also be able to help departments with timely replacement of bags nearing expiry.

Intralipid® 20% emulsion has been used in the majority of reported uses of lipid emulsion as an antidote. Alternative preparations have also been used in successful resuscitations.

Although some propofol preparations are provided in Intralipid®, e.g. Diprivan®, these are not a suitable alternative due to the significant cardiovascular depression caused by the propofol. This does not preclude the use of small, incremental doses of propofol to treat convulsions.

In extremely obese patients, doses of lipid emulsions should ideally be based on an estimate of lean body weight.

The interaction between lipid emulsion treatment and other cardioactive drugs used in resuscitation is unclear. Some evidence suggests high doses of vasopressors are harmful in resuscitation in local anaesthetic intoxication.

Conversely, some evidence suggests lipid emulsion therapy may be harmful in asphyxial cardiac arrest.

4 Follow-up

The immediate management of severe intoxication by LA is extremely demanding. In the aftermath, completion of forms on websites may seem unattractive. However, every case can help prevent another and improve treatment of the condition. Thus, reports to relevant registries are extremely important.

Pancreatitis has occasionally been associated with acute lipidaemia, and therefore should be excluded.

5 Education

Educational material and up-to-date lists of relevant publications are available at **www.lipidrescue.org**

This guideline will be updated regularly; the latest version can be found on **www.aagbi.org**

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Malignant Hyperthermia Crisis

AAGBI Safety Guideline

Successful management of malignant hyperthermia depends upon early diagnosis and treatment; onset can be within minutes of induction or may be insidious. The standard operating procedure below is intended to ease the burden of managing this rare but life threatening emergency.

1 Recognition

- Unexplained increase in $ETCO_2$ **AND**
- Unexplained tachycardia **AND**
- Unexplained increase in oxygen requirement (Previous uneventful anaesthesia does **not** rule out MH)
- Temperature changes are a late sign

2 Immediate management

- **STOP** all trigger agents
- **CALL FOR HELP.** Allocate specific tasks (action plan in MH kit)
- Install clean breathing system and **HYPERVENTILATE** with **100% O_2 high flow**
- Maintain anaesthesia with intravenous agent
- **ABANDON/FINISH** surgery as soon as possible
- Muscle relaxation with non-depolarising neuromuscular blocking drug

3 Monitoring & treatment

- Give **dantrolene**
- Initiate active **cooling** avoiding vasoconstriction
- **TREAT:**
  - **Hyperkalaemia:** calcium chloride, glucose/insulin, $NaHCO_3^-$
  - **Arrhythmias:** magnesium/amiodarone/metoprolol **AVOID** calcium channel blockers - interaction with dantrolene
  - **Metabolic acidosis:** hyperventilate, $NaHCO_3^-$
  - **Myoglobinaemia:** forced alkaline diuresis (mannitol/furosemide + $NaHCO_3^-$); may require renal replacement therapy later
  - **DIC:** FFP, cryoprecipitiate, platelets
- Check plasma CK as soon as able

DANTROLENE

2.5mg/kg immediate iv bolus.
Repeat 1mg/kg boluses as required to max 10mg/kg

For a 70kg adult

- **Initial bolus: 9 vials dantrolene** 20mg (each vial mixed with 60ml sterile water)
- Further boluses of 4 vials dantrolene 20mg repeated up to 7 times.

Continuous monitoring

Core & peripheral temperature
$ETCO_2$
SpO_2
ECG
Invasive blood pressure
CVP

Repeated bloods

ABG
U&Es (potassium)
FBC (haematocrit/platelets)
Coagulation

4 Follow-up

- Continue monitoring on ICU, repeat dantrolene as necessary
- Monitor for acute kidney injury and compartment syndrome
- Repeat CK
- Consider alternative diagnoses (sepsis, phaeochromocytoma, thyroid storm, myopathy)
- Counsel patient & family members
- Refer to MH unit (see contact details below)

The UK MH Investigation Unit, Academic Unit of Anaesthesia, Clinical Sciences Building, Leeds Teaching Hospitals NHS Trust, Leeds LS9 7TF. Direct line: 0113 206 5270. Fax: 0113 206 4140. Emergency Hotline: 07947 609601 (usually available outside office hours). Alternatively, contact Prof P Hopkins, Dr E Watkins or Dr P Gupta through hospital switchboard: 0113 243 3144.

Your nearest MH kit is stored Main Recovery in the Main Operating Theatres.

This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.

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Malignant Hyperthermia Crisis Task Allocations

AAGBI Safety Guideline

The successful management of a malignant hyperthermia crisis requires multiple simultaneous treatment actions. This is made far easier through effective teamwork and specific task allocation.

1st anaesthetist - commence immediate management (on guideline sheet)

The anaesthetist diagnosing MH or the most senior anaesthetist responding should assume the role of clinical leader once immediate management actions have been undertaken and avoid becoming focused on a single task.

2nd anaesthetist - resuscitation

- Ensure dantrolene is given in correct dose (2.5mg/kg initially then 1mg/kg every 10-15min)
- Commence TIVA
- Management of hyperkalaemia
- Management of arrhythmias
- Management of acidosis
- Renal protection (forced alkaline diuresis)

1st anaesthetic nurse/ODP

- Collect MH kit
- Collect cold saline & insulin
- Set up lines (arterial/CVC)
- Runner for resuscitation drugs/equipment

2nd anaesthetic nurse/ODP (ideally two people)

- Draw up dantrolene as requested by anaesthetist in charge of resuscitation

3rd anaesthetist - lines/investigations

- Site arterial line
- Send bloods for
    - ABG – repeated (approx every 30 min initially)
    - U&Es
    - CK
    - FBC
    - Coagulation screen
    - Cross match
- Central venous access
- Urinary myoglobin
- Monitor core and peripheral temperatures

Surgical team

- Catheterise
- Complete/abandon surgery as soon as feasible
- Undertake cooling manoeuvres

Adapted from the Malignant Hyperthermia Australia and New Zealand (MHANZ) MH Resource Kit with permission