Intensive Care Medicine
Working Knowledge

Emergency guidelines - UK based

2. **ALS Adult**
3. **ALS Children**
4. **Airway management ABCD (DAS)**
5. **Intubation checklist (NAP4)**
6. **Unanticipated difficult intubation (DAS)**
7. **Difficult intubation during RSI (DAS)**
8. **Failed intubation and difficult ventilation (DAS)**
9. **Trachy emergency – patent upper airway (NTSP)**
10. **Trachy emergency – laryngectomy (NTSP)**
11. **Trachy bleeding (local/ICMWK)**
12. **Sudden hypoxia on ICU (local/ICMWK)**
13. **Adult tachycardia (RCUK)**
14. **Adult bradycardia (RCUK)**
15. **Sudden hypotension (local/ICMWK)**
16. **Post-resuscitation (RCUK)**
17. **Anaphylaxis (RCUK)**
18. **Extravasation (Kansas univ)**
19. **LA toxicity (AAGBI)**
21. **Malignant hyperthermia (AAGBI)**

Compiled by ICMWK March 2016

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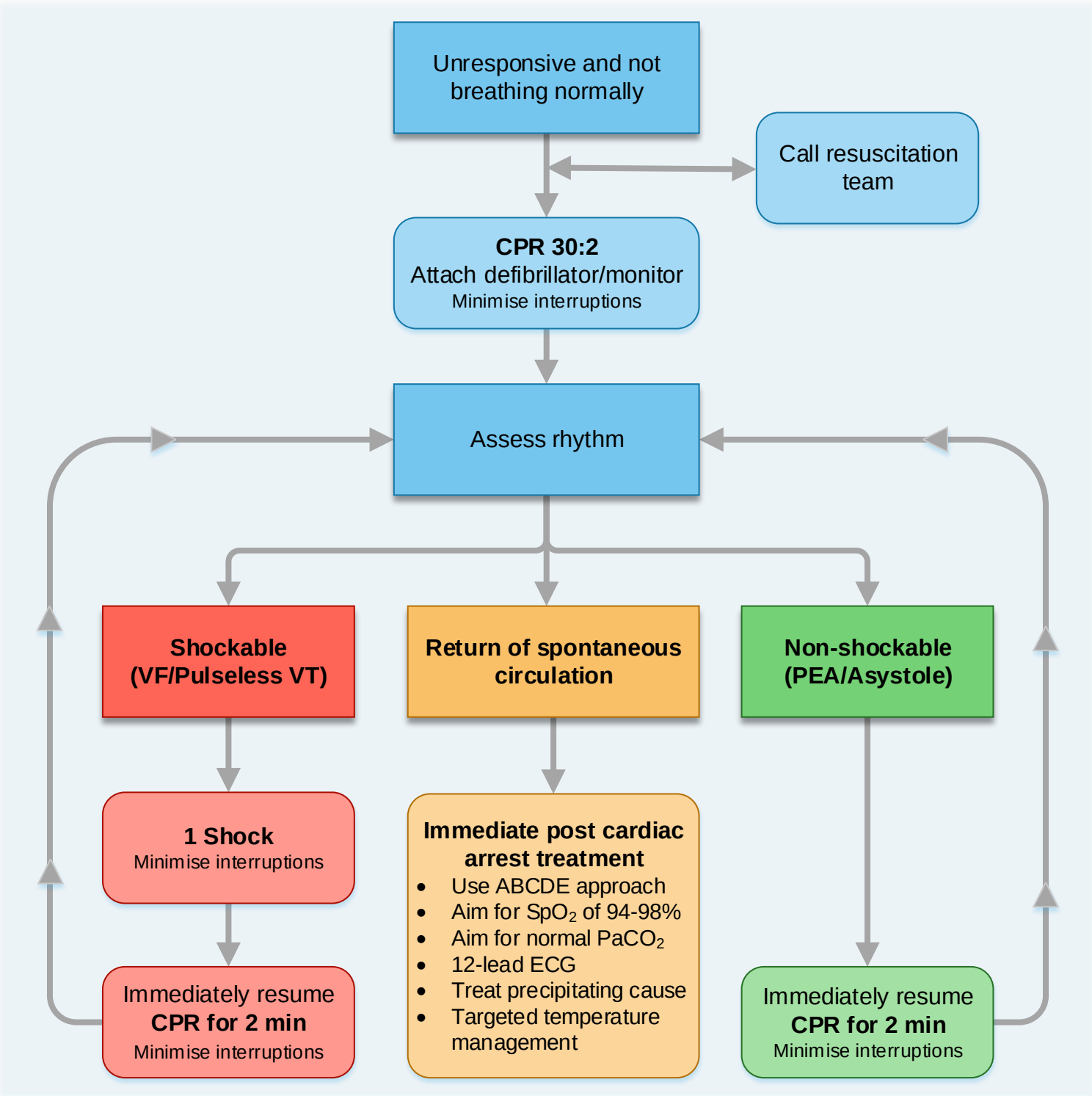
Adult Advanced Life Support



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

Consider

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

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Paediatric Advanced Life Support

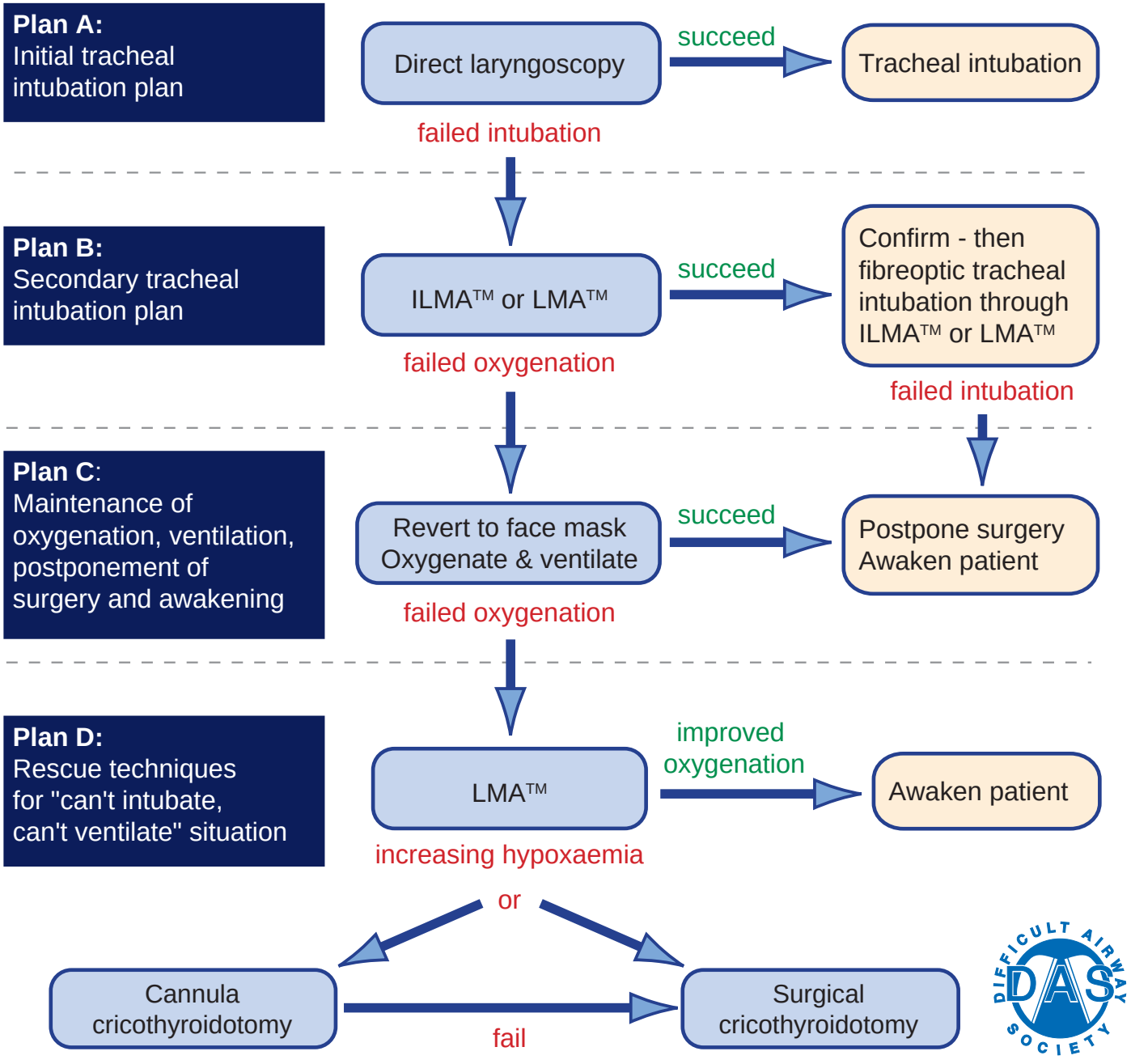
During CPR

- 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
- Consider amiodarone after 3 and 5 shocks

Reversible Causes

- Hypoxia
- Hypovolaemia
- Hyper/hypokalaemia, metabolic
- Hypothermia

- Thrombosis (coronary or pulmonary)
- Tension pneumothorax
- Tamponade (cardiac)
- Toxic/therapeutic disturbances


Plan A:
Initial tracheal intubation plan
Direct laryngoscopy
succeed
Tracheal intubation
failed intubation
Plan B:
Secondary tracheal intubation plan
ILMA™ or LMA™
succeed
Confirm - then fibreoptic tracheal intubation through ILMA™ or LMA™
failed oxygenation
failed intubation
Plan C:
Maintenance of oxygenation, ventilation, postponement of surgery and awakening
Revert to face mask Oxygenate & ventilate
succeed
Postpone surgery Awaken patient
failed oxygenation
Plan D:
Rescue techniques for "can't intubate, can't ventilate" situation
LMA™
improved oxygenation
Awaken patient
increasing hypoxaemia
or
Cannula cricothyroidotomy
fail
Surgical cricothyroidotomy
DIFFICULT AIRWAY SOCIETY
DAS

APPENDIX 1

Example intubation checklist for ICU and emergency department

EMERGENCY INDUCTION CHECKLIST

Prepare Patient

- ❑ Is preoxygenation optimal?
  - ❑ $ETO_2 > 90\%$
  - ❑ Consider CPAP
- ❑ Is the patient's position optimal?
  - ❑ Consider sitting up
- ❑ Can the patient's condition be optimised any further before intubation?
- ❑ How will anaesthesia be maintained after induction?

Prepare Equipment

- ❑ What monitoring is applied?
  - ❑ Capnography
  - ❑ SPO_2 probe
  - ❑ ECG
  - ❑ Blood pressure
- ❑ What equipment is checked and available?
  - ❑ Self-inflating bag
  - ❑ Working suction
  - ❑ Two tracheal tubes
  - ❑ Two laryngoscopes
  - ❑ Bougie
  - ❑ Supraglottic airway device
- ❑ Do you have all the drugs required?
  - ❑ Consider ketamine
  - ❑ Relaxant
  - ❑ Vasopressor

Prepare Team

- ❑ Allocate roles;
  - ❑ Team leader
  - ❑ First Intubator
  - ❑ Second Intubator
  - ❑ Cricoid Pressure
  - ❑ Intubator's Assistant
  - ❑ Drugs
  - ❑ MILS (if indicated)
  - ❑ Rescue airway
- ❑ How do we contact further help if required?

Prepare for difficulty

- ❑ If the airway is difficult, could we wake the patient up?
- ❑ What is the plan for a difficult intubation?
  - ❑ Plan A: RSI
  - ❑ Plan B: e.g. BMV
  - ❑ Plan C: e.g. ProSeal LMA
  - ❑ Plan D: e.g. Front of neck
- ❑ Where is the relevant equipment, including alternative airway?
  - ❑ DO NOT START UNTIL AVAILABLE
- ❑ Are any specific complications anticipated?

This Checklist is not intended to be a comprehensive guide to preparation for induction

RTIC Severn

Unanticipated difficult tracheal intubation- during routine induction of anaesthesia in an adult patient

Direct laryngoscopy → Any problems → Call for help

Plan A: Initial tracheal intubation plan

Direct laryngoscopy - check:
Neck flexion and head extension
Laryngoscope technique and vector
External laryngeal manipulation - by laryngoscopist
Vocal cords open and immobile
If poor view: Introducer (bougie) - seek clicks or hold-up
and/or Alternative laryngoscope

Not more than 4 attempts, maintaining:
(1) oxygenation with face mask and
(2) anaesthesia

succeed → Tracheal intubation

Verify tracheal intubation
(1) Visual, if possible
(2) Capnograph
(3) Oesophageal detector
"If in doubt, take it out"

failed intubation

Plan B: Secondary tracheal intubation plan

ILMA™ or LMA™
Not more than 2 insertions
Oxygenate and ventilate

succeed → Confirm: ventilation, oxygenation, anaesthesia, CVS stability and muscle relaxation - then fibreoptic tracheal intubation through IMLA™ or LMA™ - 1 attempt
If LMA™, consider long flexometallic,nasal RAE or microlaryngeal tube
Verify intubation and proceed with surgery

failed oxygenation
(e.g. SpO_2 < 90% with FiO_2 1.0)
via ILMA™ or LMA™

failed intubation via ILMA™ or LMA™

Plan C: Maintenance of oxygenation, ventilation, postponement of surgery and awakening

Revert to face mask
Oxygenate and ventilate
Reverse non-depolarising relaxant
1 or 2 person mask technique
(with oral ± nasal airway)

succeed → Postpone surgery
Awaken patient

failed ventilation and oxygenation

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation

DIFFICULT AIRWAY SOCIETY DAS

Difficult Airway Society Guidelines Flow-chart 2004 (use with DAS guidelines paper)

Unanticipated difficult tracheal intubation - during rapid sequence induction of anaestheia in non-obstetric adult patient

Direct laryngoscopy → Any problems → Call for help

Plan A: Initial tracheal intubation plan

Pre-oxygenate
Cricoid force: 10N awake → 30N anaesthetised
Direct laryngoscopy - check:
- Neck flexion and head extension
- Laryngoscopy technique and vector
- External laryngeal manipulation - by laryngoscopist
- Vocal cords open and immobile

If poor view:
- Reduce cricoid force
- Introducer (bougie) - seek clicks or hold-up and/or Alternative laryngoscope

succeed → Tracheal intubation

Not more than 3 attempts, maintaining:
(1) oxygenation with face mask
(2) cricoid pressure and
(3) anaesthesia

Verify tracheal intubation
(1) Visual, if possible
(2) Capnograph
(3) Oesophageal detector
"If in doubt, take it out"

failed intubation

Plan C: Maintenance of oxygenation, ventilation, postponement of surgery and awakening

Maintain 30N cricoid force

Plan B not appropriate for this scenario

Use face mask, oxygenate and ventilate
1 or 2 person mask technique
(with oral ± nasal airway)
Consider reducing cricoid force if ventilation difficult

succeed → Postpone surgery and awaken patient if possible or continue anaesthesia with LMA™ or ProSeal LMA™ - if condition immediately life-threatening

failed oxygenation
(e.g. SpO_2 < 90% with FiO_2 1.0) via face mask

LMA™
Reduce cricoid force during insertion
Oxygenate and ventilate

succeed → Postpone surgery

failed ventilation and oxygenation

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation

DIFFICULT AIRWAY SOCIETY DAS

Difficult Airway Society Guidelines Flow-chart 2004 (use with DAS guidelines paper)

Failed intubation, increasing hypoxaemia and difficult ventilation in the paralysed anaesthetised patient: Rescue techniques for the "can't intubate, can't ventilate" situation

failed intubation and difficult ventilation (other than laryngospasm)

Face mask
Oxygenate and Ventilate patient
Maximum head extension
Maximum jaw thrust
Assistance with mask seal
Oral ± 6mm nasal airway
Reduce cricoid force - if necessary

failed oxygenation with face mask (e.g. SpO_2 < 90% with FiO_2 1.0)

call for help

LMA™ Oxygenate and ventilate patient
Maximum 2 attempts at insertion
Reduce any cricoid force during insertion

succeed → Oxygenation satisfactory and stable: Maintain oxygenation and awaken patient

"can't intubate, can't ventilate" situation with increasing hypoxaemia

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation

or

Cannula cricothyroidotomy

Equipment: Kink-resistant cannula, e.g. Patil (Cook) or Ravussin (VBM)
High-pressure ventilation system, e.g. Manujet III (VBM)

Technique:
1. Insert cannula through cricothyroid membrane
2. Maintain position of cannula - assistant's hand
3. Confirm tracheal position by air aspiration - 20ml syringe
4. Attach ventilation system to cannula
5. Commence cautious ventilation
6. Confirm ventilation of lungs, and exhalation through upper airway
7. If ventilation fails, or surgical emphysema or any other complication develops - convert immediately to surgical cricothyroidotomy

fail →

Surgical cricothyroidotomy

Equipment: Scalpel - short and rounded (no. 20 or Minitrach scalpel)
Small (e.g. 6 or 7 mm) cuffed tracheal or tracheostomy tube

4-step Technique:
1. Identify cricothyroid membrane
2. Stab incision through skin and membrane
   Enlarge incision with blunt dissection (e.g. scalpel handle, forceps or dilator)
3. Caudal traction on cricoid cartilage with tracheal hook
4. Insert tube and inflate cuff

Ventilate with low-pressure source
Verify tube position and pulmonary ventilation

Notes:
1. These techniques can have serious complications - use only in life-threatening situations
2. Convert to definitive airway as soon as possible
3. Postoperative management - see other difficult airway guidelines and flow-charts
4. 4mm cannula with low-pressure ventilation may be successful in patient breathing spontaneously

DIFFICULT AIRWAY SOCIETY DAS

Emergency tracheostomy management - Patent upper airway

Call for airway expert help
Look, listen & feel at the mouth and tracheostomy
A Mapleson C system (e.g. 'Waters circuit') may help assessment if available
Use **waveform capnography** when available: exhaled carbon dioxide indicates a patent or partially patent airway

Is the patient breathing?

No → Call Resuscitation Team
CPR if no pulse / signs of life

Yes → Apply high flow oxygen to **BOTH** the face and the tracheostomy

Assess tracheostomy patency

Remove **speaking valve** or **cap** (if present)
Remove **inner tube**
Some inner tubes need re-inserting to connect to breathing circuits

Can you pass a suction catheter?

Yes →
The tracheostomy tube is patent
Perform tracheal suction
Consider partial obstruction
Ventilate (via tracheostomy) if not breathing
Continue ABCDE assessment

No →
Deflate the **cuff** (if present)
Look, listen & feel at the mouth and tracheostomy
Use waveform capnography or Mapleson C if available

Is the patient stable or improving?

Yes →
Tracheostomy tube partially obstructed or displaced
Continue ABCDE assessment

No →
REMOVE THE TRACHEOSTOMY TUBE
Look, listen & feel at the mouth and tracheostomy. Ensure oxygen re-applied to face and stoma
Use waveform capnography or Mapleson C if available

Is the patient breathing?

No → Call Resuscitation team
CPR if no pulse / signs of life

Yes → Continue ABCDE assessment

Primary emergency oxygenation

Standard **ORAL airway** manoeuvres
Cover the stoma (swabs / hand). Use:
- Bag-valve-mask
- Oral or nasal airway adjuncts
- Supraglottic airway device e.g. LMA

Tracheostomy STOMA ventilation
- Paediatric face mask applied to stoma
- LMA applied to stoma

Secondary emergency oxygenation

Attempt **ORAL intubation**
Prepare for difficult intubation
Uncut tube, advanced beyond stoma

Attempt **intubation of STOMA**
Small tracheostomy tube / 6.0 cuffed ETT
Consider Aintree catheter and fibreoptic 'scope / Bougie / Airway exchange catheter

Emergency laryngectomy management

Call for airway expert help
Look, listen & feel at the mouth and laryngectomy stoma
A Mapleson C system (e.g. 'Waters circuit') may help assessment if available
Use **waveform capnography** whenever available: exhaled carbon dioxide indicates a patent or partially patent airway

Is the patient breathing?

No → Call Resuscitation Team
CPR if no pulse / signs of life

Yes → **Apply high flow oxygen to laryngectomy stoma**
If any doubt whether patient has a laryngectomy, apply oxygen to face also*

Assess laryngectomy stoma patency

Most laryngectomy stomas will NOT have a tube in situ

Remove **stoma cover** (if present)
Remove **inner tube** (if present)
Some inner tubes need re-inserting to connect to breathing circuits
Do not remove a tracheoesophageal puncture (TEP) prosthesis

Can you pass a suction catheter?

Yes → **The laryngectomy stoma is patent**
Perform tracheal suction
Consider partial obstruction
Ventilate via stoma if not breathing
Continue ABCDE assessment

No →
Deflate the **cuff** (if present)
Look, listen & feel at the laryngectomy stoma or tube
Use waveform capnography or Mapleson C if available

Is the patient stable or improving?

Yes → Continue ABCDE assessment

No →
REMOVE THE TUBE FROM THE LARYNGECTOMY STOMA if present
Look, listen & feel at the laryngectomy stoma. Ensure oxygen is re-applied to stoma
Use waveform capnography or Mapleson C if available

Is the patient breathing?

No → Call Resuscitation Team
CPR if no pulse / signs of life

Yes → Continue ABCDE assessment

Primary emergency oxygenation

Laryngectomy stoma ventilation via either
Paediatric face mask applied to stoma
LMA applied to stoma

Secondary emergency oxygenation

Attempt **intubation of laryngectomy stoma**
Small tracheostomy tube / 6.0 cuffed ETT
Consider Aintree catheter and fibreoptic 'scope / Bougie / Airway exchange catheter

* Laryngectomy patients have an end stoma and **cannot be oxygenated via the mouth or nose**
Applying oxygen to the face and stoma is the default emergency action for all patients with a tracheostomy

Tracheostomy bleeding

Lightly blood-stained secretions only?	☐	**Early (days 1-3) – likely benign - observe** **Late (after day 3) – senior review**

Significant frank blood?		
Call for help	☐	**1. ICU consultant and senior nursing staff** **2. ENT surgeon – on call consultant at John Radcliffe will coordinate. May also be one in clinic or theatre on site (put days here)** **3. General surgeon** **4. Senior anaesthetist**
100% oxygen	☐	Or high flow via trachy mask
Inflate cuff	☐	Temporary over-inflation can be considered (usually at least 20 ml (for Portex tubes)
Sit nearly fully upright	☐	45 degrees if hypotensive
Suction via tracheostomy	☐	Large gauge catheter to retrieve clots
Attach water's circuit or self-inflating bag, and end-tidal monitoring	☐	Consider assisting ventilation or take over
Finger pressure in sternal notch or at bleeding point if obvious	☐	If heavily sedated, consider packing pharynx
Suction pharynx	☐	Remove clots
Next measures	☐	1. Kaltostat or adrenaline-soaked ribbon gauze - tuck into trachy wound. 2. Inject lidocaine + adrenaline 1:200,000 around trachy site. 3. Sedation if coughing is excessive or struggling with ventilation (+/- muscle relaxant) 4. Correct known coagulopathy or reverse anticoagulants where possible

Bleeding still through tracheostomy despite cuff inflation?		
Profuse?	☐	Consider intubation via mouth and: • distal balloon placement • Intentional endobronchial intubation • double-lumen tube • bronchial blocker. Or consider palliation.
Not profuse but not settling?	☐	Adrenaline nebs IV +/- nebulized tranexamic acid. Consider plans as for profuse bleeding.
Haemostasis achieved?	☐	Bronchoscopy and upper airway scope CXR Physiotherapy Consider possibility that it was a 'herald bleed' (re TIF below)

Causes

Early
- Suction or movement of tracheostomy

Late
- Granulation tissue
- Stoma site infection
- Tracheo-innominate fistula

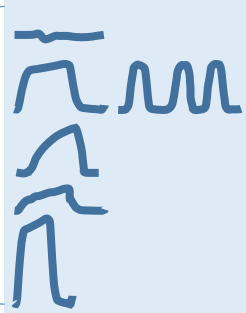
Also consider:
- Bleeding from non-trachy surgical site if present and nearby.
- Upper respiratory tract bleeding (eg epistaxis)
- Haemoptysis unrelated to tracheostomy

Sudden hypoxia on the ICU – cause not clear

1. Call for help

2. 100 % inspired oxygen

3. Check end tidal CO2 trace



- Flat or n/a → Consider cardiac arrest, ventilator failure, then tracheal or tube obstruction - follow tracheal tube algorithm
- Normal MV or SV trace
- Bronchospasm or obstructed airway
- Falling CO or poor compliance
- Inadequate MV (or hypermetabolic state)

4. Tracheal suction (in-line if present, or use suction catheters)

5. Assess chest movement and listen to chest

Findings	Diagnoses to consider	Management
Obstructed appearance (see-sawing), bilaterally quiet, ↓Expansion & compliance	**Consider tracheal or tube obstruction**	Follow tracheal tube algorithm. Then consider these:
Quiet & reduced expansion **on one side**, + reduced compliance	**Endobronchial intubation** Has ETT moved in further (usually not more than 24cm at teeth)?	• Consider withdrawing 1-2 cm • CXR +/- bronchoscopy
	Pneumothorax or haemothorax Trauma, new line or drain, high ventilation pressure, in-situ chest drain fault.	• Needle decompression or drain (or resolve drain issue). • CXR/CT if stabilises
	Pulmonary haemorrhage Bronchiectasis, abscess, TB, or tumour?	• Airway specialist and thoracic surgeon involvement. • CXR/CT
	Collapse/atelectasis due to sputum, or aspiration	• Suction (+/- saline) • Recruitment breaths with ventilator or bag • Consider bronchoscopy

New widespread wheeze
+/- reduced compliance
	Bronchospasm
	COPD/asthma
	Anaphylaxis
	Aspiration
	Feeding tube malposition
	Vomiting
	Pulmonary oedema
	New ischaemia
	Recent fluid bolus
		• Suction
		• ECG/CXR +/- Echo/troponin
		• Consider
		  • Bronchodilators/steroid
		  • Furosemide/nitrate
		  • Stop feeding, empty stomach
		  • Bronchoscopy

New widespread crackles
+/- reduced compliance
	Pulmonary oedema
	New ischaemia
	Recent fluid bolus
	Aspiration
	Feeding tube malposition
	Vomiting
		• Suction
		• ECG/CXR +/- Echo/troponin
		• Consider
		  • Furosemide/nitrate
		  • Stop feeding, empty stomach
		  • Bronchoscopy

Normal breath sounds and compliance	**Low cardiac output state** MI PE Haemorrhage Tamponade	• ECG/Echo • Assess volume status (?CO monitoring, PPV) • FAST/CT

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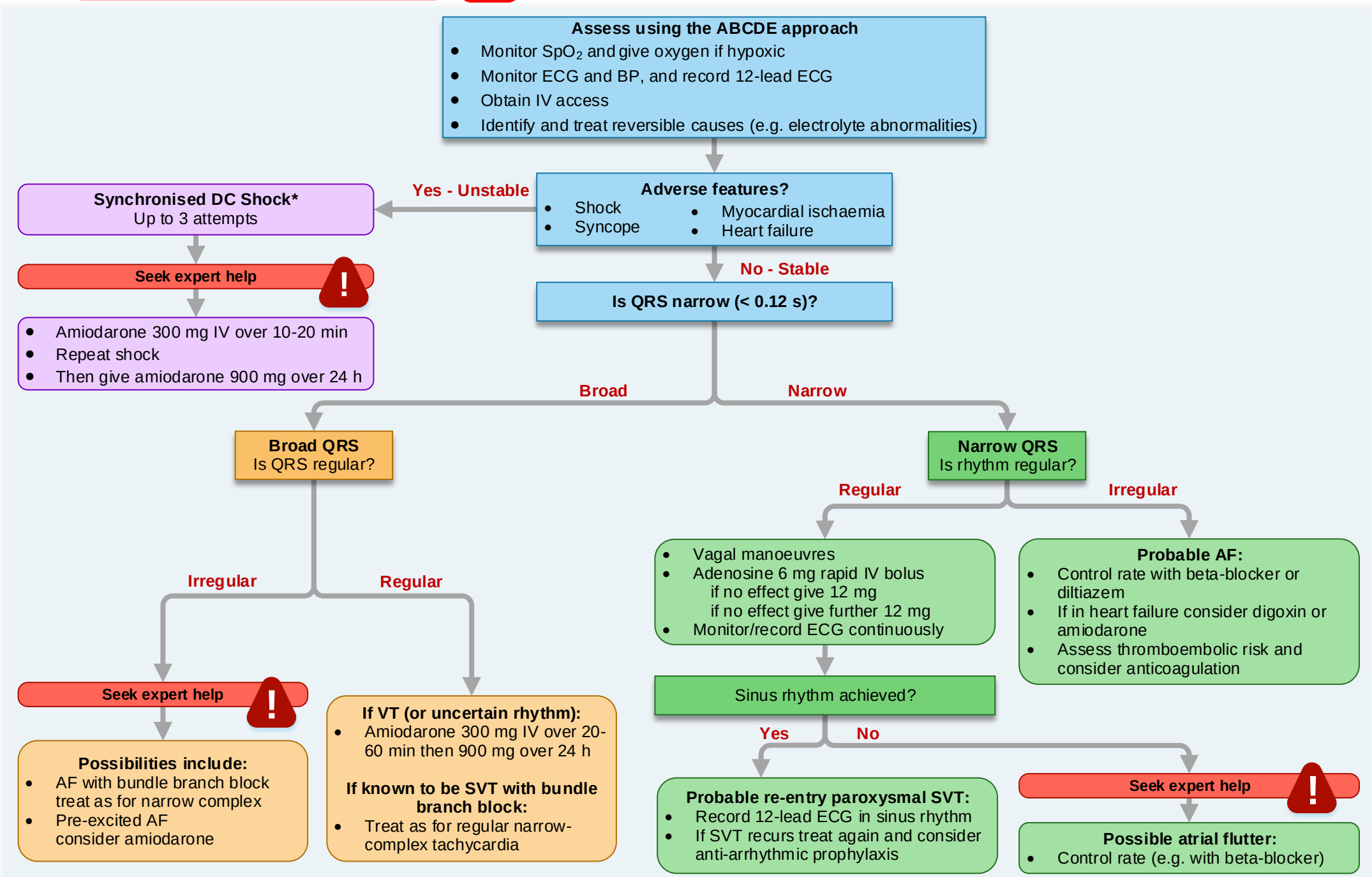
Adult Tachycardia (with pulse) Algorithm



*Conscious patients require sedation or general anaesthesia for cardioversion

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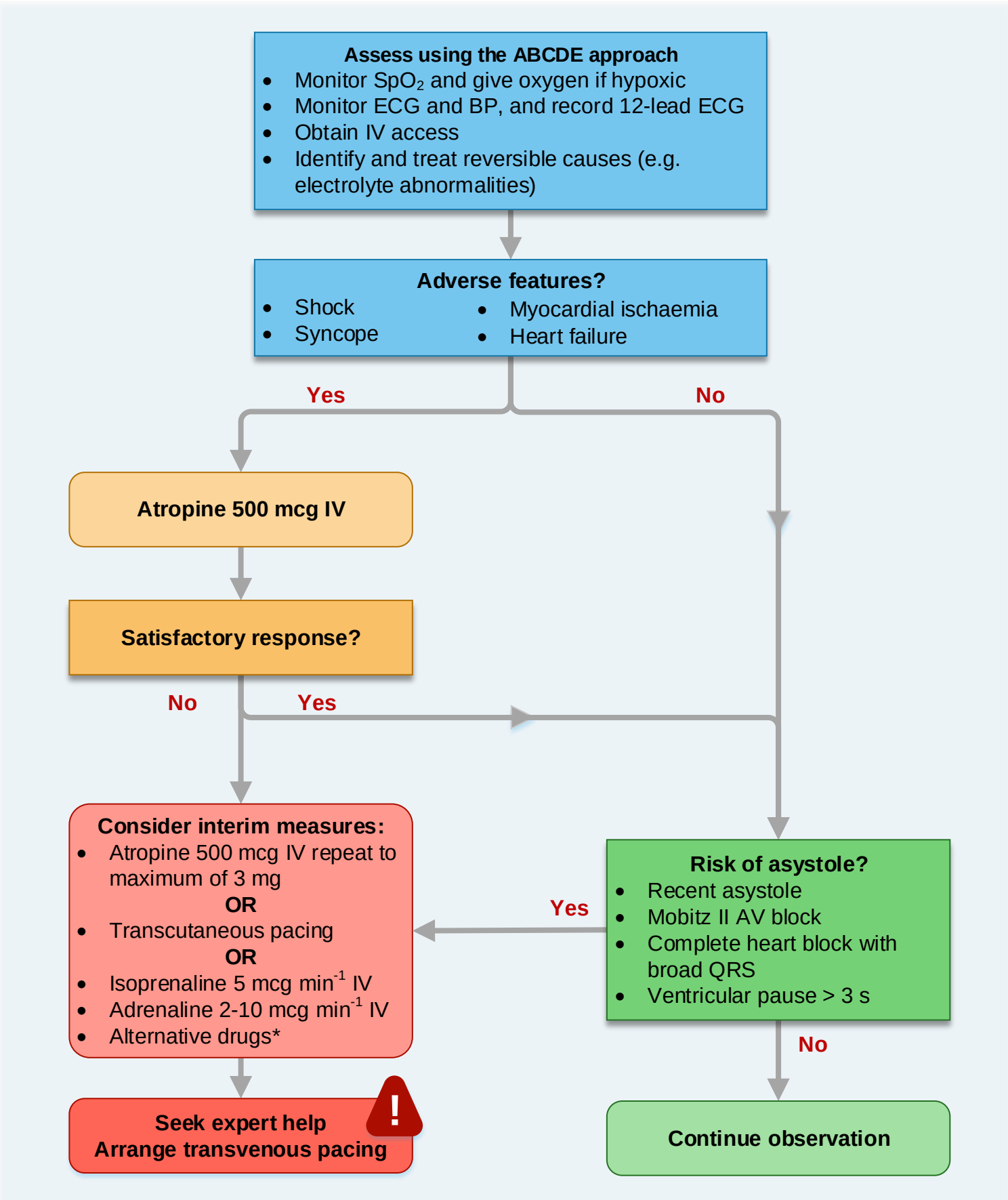
Adult Bradycardia Algorithm



*** Alternatives include:**

- Aminophylline
- Dopamine
- Glucagon (if bradycardia is caused by beta-blocker or calcium channel blocker)
- Glycopyrrolate (may be used instead of atropine)

Sudden hypotension on ICU – cause not clear

Call for help!

Ensure hypotension is not due to respiratory compromise	☐	Obvious pneumothorax?
		Ventilation difficulty - disconnection, bronchospasm, sudden drop in Vt?

SBP <50 mmHg or possible loss of cardiac output? start CPR.		
Tilt bed or raise legs	☐	
Request fluid bolus	☐	Hartmann's and plan to run 500ml stat
Request bolus dose vasopressor	☐	Metaraminol 0.5mg/ml 0.5mg (1ml) at a time Adrenaline 10 mcg/ml (1ml from a minijet into 10ml saline) 10 mcg (1ml) at a time
Is this the true BP and what is the rhythm?	☐	Feel for pulse. Look at the end-tidal CO_2 trace. Quickly check arterial line waveform and transducer position. If there is a waveform, assume it's correct. Re-zero if necessary.
Look for blood	☐	Check for blood in the bed, bowel, stomach, new tense abdomen, or leak from haemofilter circuit
Check infusions	☐	Check for kinked line, displaced CVC, syringe driver failure?
Check skin	☐	Look for new rash and swelling
ECG	☐	Decide whether this is hypovolaemic, distributive, cardiogenic (including arrhythmia) or obstructive shock.
Request or do ultrasound FICE +/- FAST	☐	
Request CXR	☐	
Cardiac output monitoring	☐	ODM if asleep and no central access, otherwise LIDCO, or echo.

Consider :

- Overt or concealed haemorrhage
- MI
- Arrhythmia – rule out VT, if new AF consider cardioversion.
- PE
- Concealed haemorrhage – retroperitoneal, small bowel, thorax
- Tamponade (recent central venous access, pacing wire etc.)
- Drug reaction – anaphylaxis or inadvertent bolus (including epidural)
- Intracranial haemorrhage
- New sepsis – take cultures and get antibiotic advice

Further treatment:

- Consider increasing dose of adrenaline or noradrenaline
  NOT dobutamine/dopamine/milrinone or vasopression
- Treat specific problem
  order blood, plan for DCCV, CT; **call** surgeon, endoscopist, cardiologist

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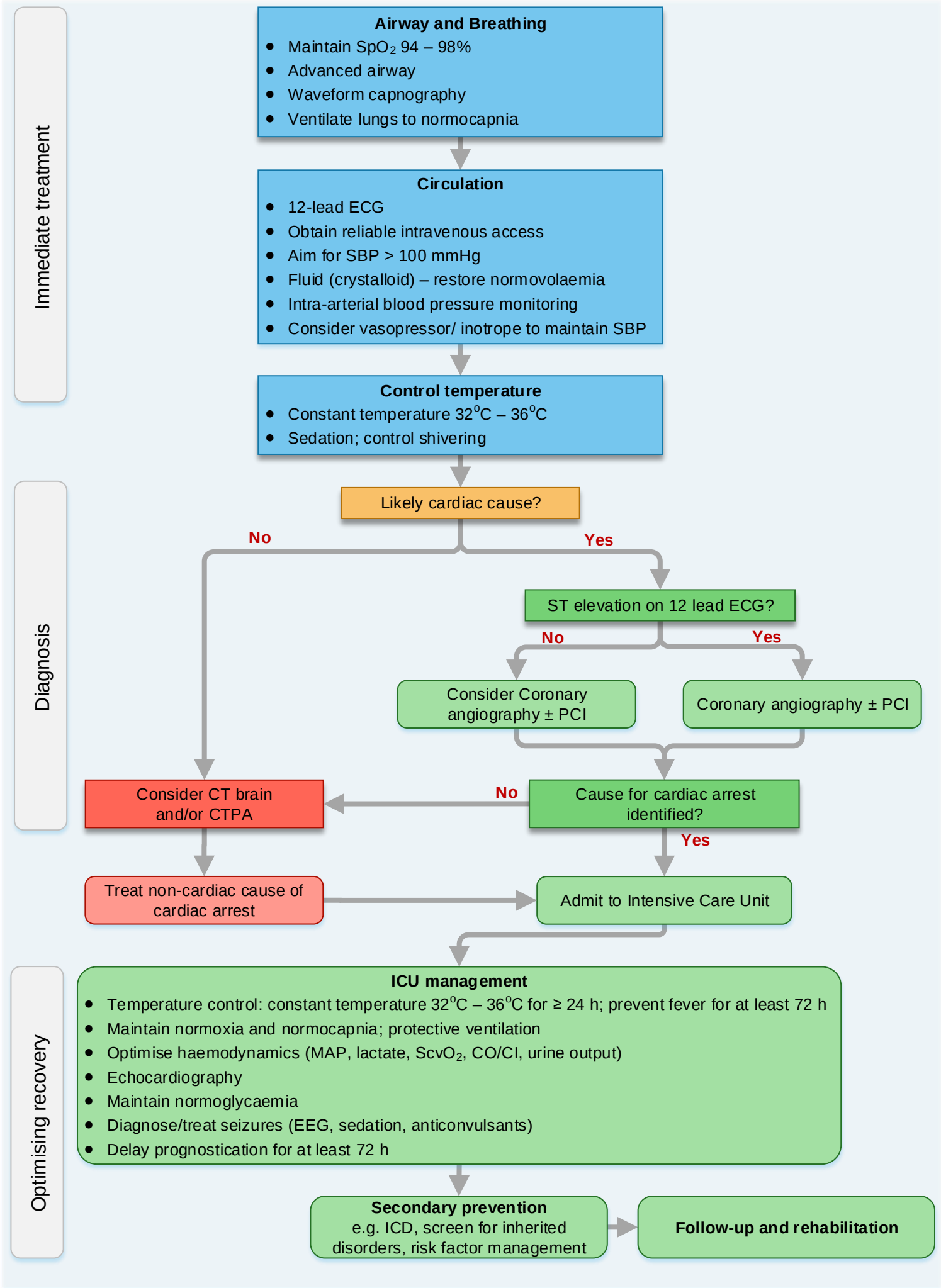
Post-resuscitation Care

(ROSC and comatose)



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Anaphylaxis algorithm

Anaphylactic reaction?

↓

Airway, Breathing, Circulation, Disability, Exposure

↓

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
- Raise patient's legs

↓

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 micrograms IM (0.5 mL)
• Child more than 12 years:	500 micrograms IM (0.5 mL)
• Child 6 -12 years:	300 micrograms IM (0.3 mL)
• Child less than 6 years:	150 micrograms IM (0.15 mL)

Adrenaline IV to be given **only by experienced specialists**
Titrate: Adults 50 micrograms; Children 1 microgram/kg

3 IV fluid challenge:

Adult - 500 – 1000 mL
Child - crystalloid 20 mL/kg

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 micrograms/kg	25 mg

March 2008

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GUIDE TO EXTRAVASATION MANAGEMENT IN ADULT & PEDIATRIC PATIENTS

Large, well-designed, controlled clinical trials in humans are not available to support the development of extravasation management guidelines. Available data generally consists of case reports, trials utilizing animal models, and small studies with evidence of poor or inconsistent quality. This lack of evidence creates challenges in validating specific interventions and presents barriers to guideline development.

Interventions listed within this guide were derived from a consensus of the cited tertiary references. Greater consideration was given to more detailed, substance-specific references when a consensus was not apparent.

The information provided is intended as a general guide only. Consult additional references and product labeling for more detailed information.

THE UNIVERSITY OF KANSAS HOSPITAL
KUMED

1 Stop injection/infusion immediately. [1,3, 5-7]
Leave the needle/catheter in place. [1,5-7]

2 Slowly aspirate as much of the drug as possible. [3,5-7]
Do not apply pressure to the area. [3,6-7]

3 Remove IV access while aspirating.[7]
Use of this site for further IV access is not recommended.[1,7]

4 Inform physician and obtain orders per substance-specific measures. [1,6,7]

5 Elevate the area for 48 hours to minimize swelling. [1,3,6-7]

6 Initiate substance-specific measures per physician order.[1,3,4,6-8]

RELATED POLICIES
Nursing Standard of Practice & Procedures:
1) Extravasations, Patient Management of
2) Care of the Patient by a Non-Chemotherapy Certified RN

REFERENCES
1. Mullin S, Beckwith CM, Tyler LS. Prevention and management of antineoplastic extravasation injury. *Hospital Pharmacy*. 2000; 35:57-76.
2. eFacts [database online]. St. Louis, MO: Wolters Kluwer Health, Inc.; 2005.
3. Gahart BL, Nazareno AR. Intravenous Medications. 21st ed. St Louis: Elsevier Mosby; 2005.
4. McEvoy G, ed. American Hospital Formulary Service: Drug Information. Bethesda: American Society of Health-System Pharmacists, Inc; 2003.
5. Lexi-Comp [database online]. Hudson, OH: Lexi-Comp, Inc; 2007.
6. Polovich M, White JM, Kelleher LO, eds. Chemotherapy and biotherapy guidelines and recommendations for practice. 2nd ed. Pittsburgh, PA: Oncology Nursing Society; 2005.
7. Camp-Sorrell D. Developing extravastation protocols and monitoring outcomes. *J Intravenous Nursing* 1998; 21(4):232-239.
8. Thomas, Juliana. Letter. New York, NY: Sanofi-Aventis; 2005 Sept 26.
9. Mouridsen HT, Langer SW, et al. Treatment of anthracycline extravasation with Savene (dexrazoxane): results from two propective clinical multicentre studies. *Annals of Oncology*, 2007; 18: 546-550.

SPECIFIC SUBSTANCES

Calcium
Carmustine
Etoposide
Teniposide
Vinblastine
Vincristine
Vindesine
Vinorelbine

Dacarbazine

Potassium

Sodium bicarbonate

Cisplatin (> 20 mL and concentrations ≥ 0.5 mg/mL)

Mechlorethamine

Dobutamine
Dopamine
Epinephrine
Norepinephrine
Phenylephrine

Aminophylline
Dactinomycin
Daunorubicin*
Dextrose 10%
Doxorubicin*
Epirubicin*
Esmolol
Idarubicin*
Irinotecan
Magnesium sulfate
Metoprolol
Mitomycin
Nafcillin
Paclitaxel
Parenteral nutrition
Phenytoin
Radiocontrast Media

Other agents that have been reported to cause irritation, phlebitis, or necrosis with extravasation include but may not be limited to:

Arsenic trioxide
Bleomycin
Busulfan
Carboplatin
Cladribine
Cyclophosphamide
Cytarabine
Cytarabine, liposomal
Dexrazoxane
Docetaxel
Dolasetron
Floxuridine
Fluorouracil
Gemcitabine
Gemtuzumab
Ifosfamide
Mitoxantrone
Oxaliplatin
Pamidronate
Plicamycin
Promethazine
Streptozocin
Thiotepa
Topotecan
Valrubicin

WARM OR COLD THERAPY

Physician's order should be obtained to initiate warm or cold therapy when suspect extravasation is greater than 24 hours old

Apply warm packs for 15-20 minutes at least four times a day

Apply warm packs for 15-20 minutes at least four times a day

Apply cold compress for 15-20 minutes at least four times a day

Apply cold compress for 15-20 minutes at least four times a day

Note on Oxaliplatin: Some references suggest cold compresses as a therapeutic alternative for oxaliplatin extravasation. Oxaliplatin administration is associated with sensory neuropathies that may be exacerbated or precipitated by cold temperatures or objects. Utilization of warm therapy may be more comfortable for patients with oxaliplatin-associated sensory neuropathy. [8]

Note on Promethazine: The package insert states that there "is no proven successful management of (extravasation) after it occurs, although sympathetic block and heparinization are commonly employed during acute management". This is based on results in animals with other known arteriolar irritants. A case study report entitled "Extravasation of i.v. promethazine" can be found in Am J Health-Syst Pharm. 1999; 56:1742-3.

***Note on Anthracyclines:** Dexrazoxane may be used to treat anthracycline extravasations in adult patients. Treatment should begin as soon as possible and no later than 6 hours after extravasation. [9]

ANTIDOTE

Physician's order required prior to antidote administration

Hyaluronidase

Sodium thiosulfate

Phentolamine

7 Document all procedures in the medical record. [1,6,7]
Complete Patient Safety Net (PSN) Report.
Provide patient education. [1,6,7]

Documentation recommendations reproduced/adapted from: Mullin S, Beckwith MC, Tyler LS. Prevention and management of antineoplastic extravasation injury. *Hospital Pharmacy*. 2000; 35:57-76.

SUGGESTED INFORMATION FOR DOCUMENTATION
(MAY VARY BASED ON PATIENT CARE SETTING)

Drug and infusion information
- Drug name, dose, volume, and concentration
- Amount of extravasated drug
- Total amount of drug infused
- Other agents administered and the sequence of administration
- Method of IV administration (e.g., push, drip)
- Location of venous access
- Type of venous access device (e.g., central, peripheral)
- Needle size and type
- Extravasation site, size, and color description (may delineate infiltrated area on patient's skin with felt-tip marker)
- Patient complaints or statements at the time of vesicant or irritant infusion

Interventions
- Describe the physical measures used to prevent further extravasation.
- Note physician contacted.
- Note the name, dose, and route of antidotes.
- Describe use of warm or cold compresses.
- Describe the site.
- Consult wound team
- Note surgical or other medical consultations requested.
- Ensure that the patient has follow-up appointment.
- Pain management follow up & reassessment.

SUGGESTED PATIENT EDUCATION

Provide instructions.
- Ensure that the patient is able to obtain follow-up care and evaluation.
- Describe the care of the site: elevate arm; use warm or cold compresses; protect from sun or abrasion; do not immerse in water.
- Instruct patient to call provider for any of the following: increased pain, skin color change, increased edema or swelling, stiffness in the extremity, skin breakdown, fever, any additional questions.

8 Observe the region for pain, induration or necrosis. [1,3,6]
Continue warm/cold therapy for 48-72 hours. [1,3]
Advise patient to resume activity with affected limb as tolerated. [1]
Consider surgical evaluation for persistent or worsening symptoms. [3,7]

ANTIDOTE PREPARATION AND ADMINISTRATION INSTRUCTIONS

Hyaluronidase (Amphadase [bovine])[2]
Preparation: Use solution as provided (150 unit/1 mL vial); do not dilute further. Inject subcutaneously or intradermally into the extravasation site using a 25-gauge needle or smaller. Dosage: The dose is 150 units (1 mL) given as five 0.2 mL injections into the extravasation site at the leading edge; change the needle after each injection.

Phentolamine (Regitine)[2,5]
Prepare by diluting 5 mg phentolamine in 10 mL of 0.9% sodium chloride. Inject subcutaneously into the extravasation area within 12 hours of extravasation. Blanching should reverse immediately; additional injections may be required if blanching returns. Do not exceed 0.1-0.2 mg/kg or 5 mg total.

Sodium Thiosulfate[5]
Mix 4 mL of sodium thiosulfate 10% with 6 mL sterile water for injection to prepare a 0.17 mol/L (4%) solution. Inject 3-10 mL subcutaneously into extravasation site; use clinical judgment and size of extravasation site to determine volume. This dosing is based on limited and varied information.

Dexrazoxane[9]
Mix each 500mg vial with 50mL of diluent (provided by manufacturer); mixed solution should be further diluted in 1000mL NS and begin administration within 4 hours. Infuse over 1 to 2 hours in a large caliber vein in an extremity/area other than the one affected by the extravasation. Cooling procedures such as ice packs should be removed from the area at least 15 minutes before administration in order to allow sufficient blood flow to the area of extravasation. ADULT Dose: 1000mg/m^2 (maximum 2000mg) on Days 1 and 2, 500mg/m^2 (maximum 1000mg) on day 3. Adjust dose for renal impairment.

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 .....

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.

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).

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 .....