PAEDIATRIC ADVANCED LIFE SUPPORT

Cardiac arrest is a condition associated with "no-flow" and "low flow" of circulation.
Early recognition and institution of effective cardiopulmonary resuscitation (CPR) will allow the best chance for return of spontaneous circulation (ROSC), survival to discharge and low incidence of neurological deficit.
High quality CPR in the paediatric patient will help restore blood flow to vital organs.
Management of perioperative cardiac arrest includes provision of effective CPR using available intraoperative monitoring while treating the cause.

Response to a perioperative cardiac arrest

- Inform the surgical and nursing team, cease surgery
- Increase FiO2 to 100% Oxygen and Start chest compression if pulse poor or absent (determine within 10 seconds)
- Call for help, activate "Code Blue" and obtain the "Crash Cart"
- Stop the administration of potentially deleterious substances
- Run balanced IV fluids rapidly if the patient is hypovolaemic. Hypovolaemia is a common cause of paediatric perioperative cardiac arrest.
- Determine the cause, if possible, and manage appropriately
- Assign a leader, roles to team members and maintain a detailed contemporaneous resuscitation record. This will help recall necessary facts, decision points and management.

Airway management
If not intubated, do so but avoid undue interruption of chest compressions. Intubation will reduce the risk of aspiration and prevent the need to interrupt compressions to deliver ventilation.
A cuffed endotracheal tube (ETT) is useful in the presence of poor lung compliance, high airway resistance or large glottic gas leak with an uncuffed ETT.
Suspected opioid overdose should be treated with naloxone.

In the patient with a difficult airway, a laryngeal mask airway (LMA) may be an alternative to endotracheal intubation. Constantly review LMA

position as malposition causes gastric distension, splints diaphragm, reduces effective ventilation and increases risk of aspiration.

Effective Chest compression

Compression should be done on a firm surface, place the **resuscitation board** below the patient

Hand position

Infant: 2 fingers on the chest (one finger below inter nipple line) or
2 thumb encircling the chest

Child: Place hand(s) on the lower half of the sternum

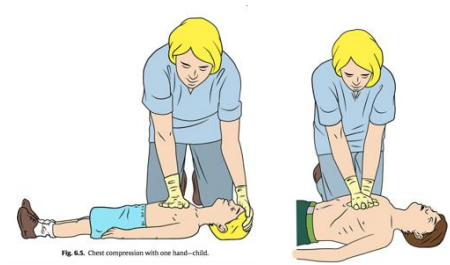


Fig. 6.5. Chest compression with one hand--child.

Push hard and fast, depth 1/3 of anteroposterior diameter of chest

- Allow complete chest recoil
- Rate 100-120/minute
- Minimise interruptions in chest compressions.
- Rotate rescuers may be rotated every 2 minutes to prevent fatigue or earlier if it occurs. The switch should take less than 5 seconds.

Chest compression-to-ventilation ratio
No advanced airway i.e. bag-valve-mask BVM, ventilate enough to see chest rise
15:2 if < 12 years
30:2 if > 12 years

Advanced airway in place (includes supraglottic device or ETT)
Avoid hyperventilation,
Apply asynchronous ventilation with respiratory rates
Infant 30/min (1 in 2s)
1-12 yr 20/min (1 in 3s)
>12 yr 12/min (1 in 5s)

Defibrillation and cardioversion

Unstable tachycardias (SVT and VT with pulse) in peri-arrest situations need cardioversion.

For SVT 0.5 – 1 J/kg increase to 2 J/kg if needed

For VT 1 J/kg increase to 2-4 J/kg if needed

Select 'Sync' button on defibrillator to synchronize shock (avoid VF due to R on T phenomenon)

Two shockable rhythms in cardiac arrest are –

- Ventricular fibrillation (VF)
- Pulseless ventricular tachycardia

Shock recommended as early as possible.

Charge defibrillator during CPR to minimize interruptions.

Ensure patient is clear before shock delivery.

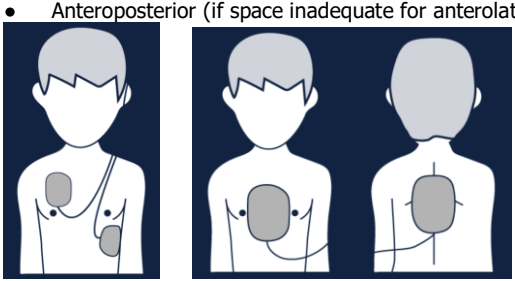
Pediatric paddles should be used < 1 year or < 10 kgs.

Pediatric self-adhesive pads should be used < 8 years or < 25 kgs (with dose attenuator when using AED)

Maintain at least 1-2 cms distance between pads/paddles.

Pad/paddle position –

- Anterolateral
- Anteroposterior (if space inadequate for anterolateral placement)



(Image credit: MDPRO)

Monitor of effective CPR

Monitor End-tidal CO2 (ETCO2) for effectiveness of CPR (ETCO2 of > 20 mmHg).

A sudden increase in ETCO2 level indicates that adequate ROSC has occurred.

100 % oxygen should be used during CPR due to the presence of tissue hypoxia.

After the ROSC, concentration of inspired oxygen is adjusted to keep oxygen saturation of 94-99% Avoid hypocarbia due to excessive ventilation and high peak inspiratory pressures as this will compromise cerebral blood flow.

Ventilate to deliver enough tidal volume to just achieve visible chest rise. On ROSC, ventilate at a rate of 20 - 30/minute depending on age normal values.

Monitoring the diastolic blood pressure DBP, if an arterial line present, can be considered to guide the quality of resuscitation

Infants: > 25 mmHg

1–12 years: > 30 mmHg

> 12 years: > 35 mmHg

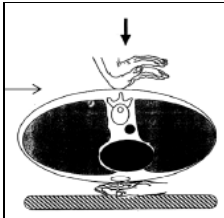
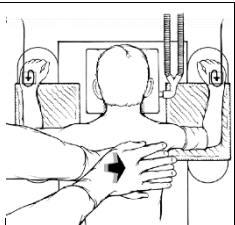
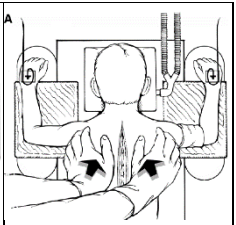
Point of care ultrasound may be used during resuscitation to identify the cause and assess efficacy of CPR, but it should not interrupt chest compressions.

Resuscitation in prone position

Patient should be turned supine immediately, however if there's delay chest compression in prone position must be initiated

The images shown below illustrate the techniques

A firm support must be placed under the chest to facilitate effective chest compressions

		
Note hand below	Hands over T7-10 vertebral bodies	Hands are placed either side of wound

The thumb-encircling method stabilises the chest

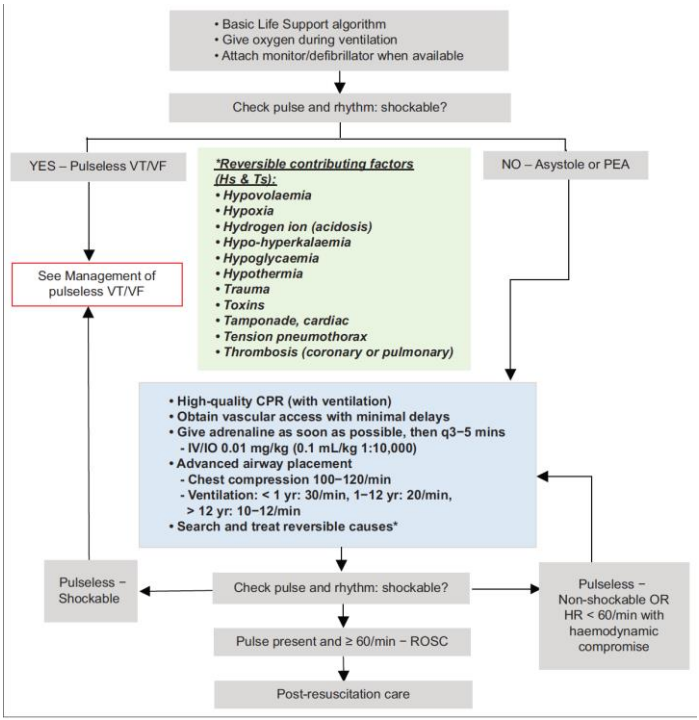
Vascular access during CPR
Peripheral cannulation recommended if no pre-existing vascular access
Central venous access should not be attempted during ongoing CPR
In case of difficult vascular access, opt for intraosseous access

Intraosseous access
Suitable locations

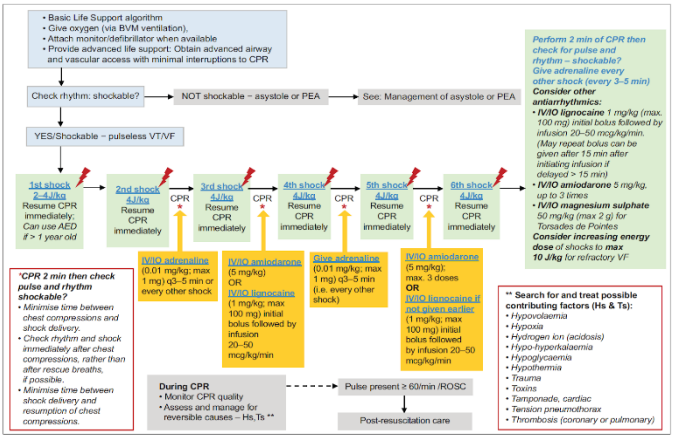
- Proximal tibia
- Distal tibia
- Distal femur

Intraosseous needle (15 mm, 25 mm, 45 mm as per the depth of bone from skin)

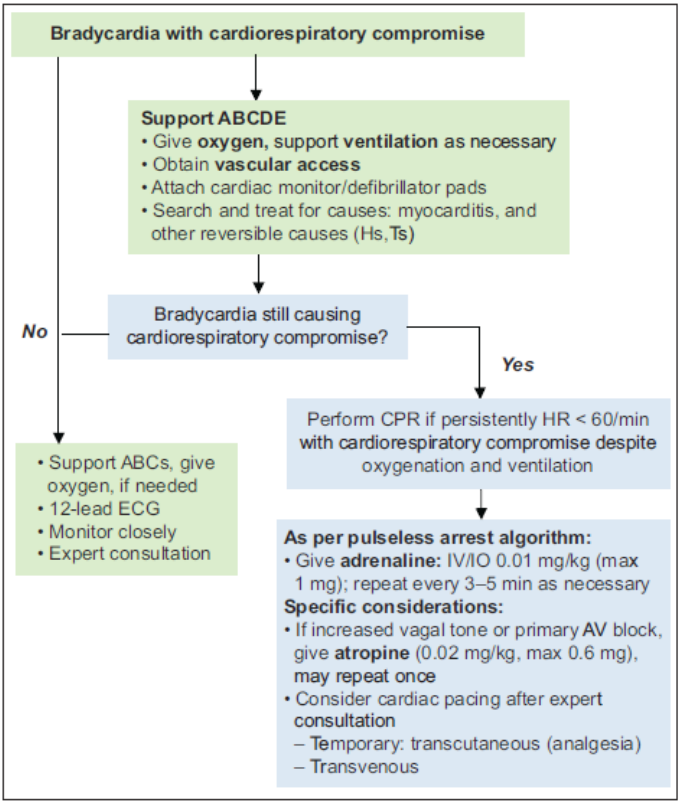
Flowchart shows the resuscitation algorithm for pulseless arrest



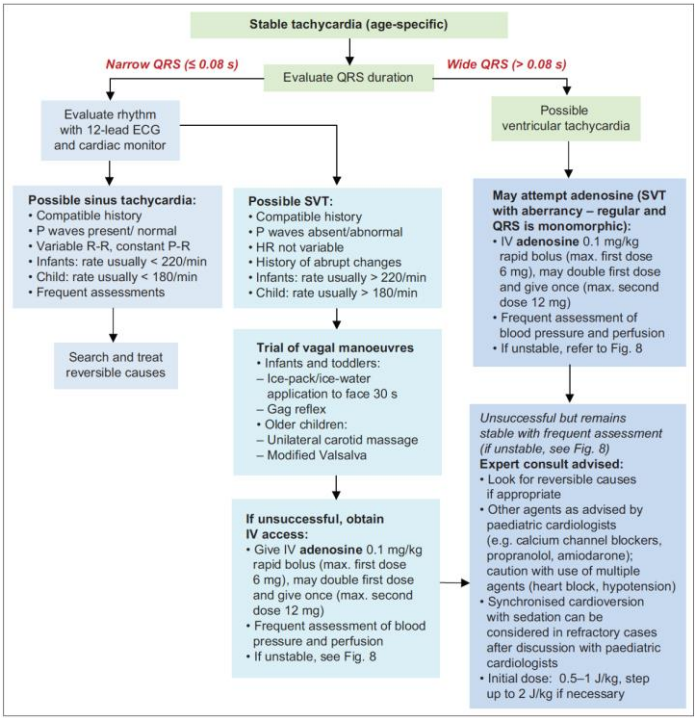
Flowchart shows the resuscitation algorithm for pulseless arrest with shockable rhythms



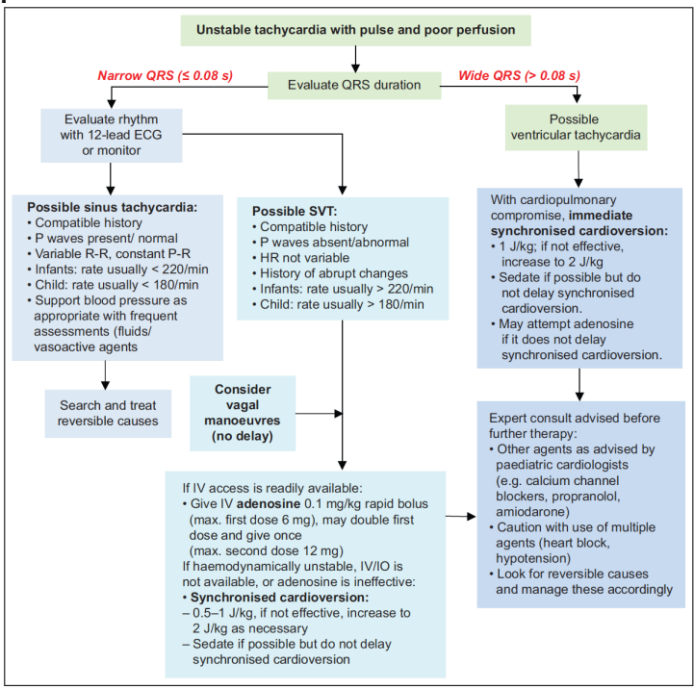
Flowchart shows the algorithm for bradycardia



Flowchart shows the algorithm for stable tachycardia



Flowchart shows the algorithm for tachycardia with poor perfusion



Debriefing

Debriefing of the team should be done by the team leader - to learn from the event and to support those involved

Post cardiac-arrest care checklist

A&B: oxygenation and ventilation

- O_2: avoid hypoxia and hyperoxaemia – measure oxygenation and target normoxaemia (maintain SpO_2 at 94%–98%).
- CO_2: Measure $PaCO_2$, target a clinically appropriate value and avoid hypocapnia.

Circulation: haemodynamic monitoring

- Set haemodynamic goals after return of spontaneous circulation and monitor blood pressure.
- Use parenteral fluids and/or inotropes or vasopressors to maintain systolic blood pressure greater than the fifth percentile.

Disability: neuromonitoring

- Treat clinical seizures and do not routinely use pharmacologic prophylaxis for seizures.

Environment and exposure: targeted temperature management

- Measure and monitor core temperature; prevent and treat fever.
- Normothermia (36°C–37.5°C) should be maintained in children who remain comatose after out-of-hospital and in-hospital cardiac arrests.

Glucose control and electrolytes

- Measure glucose and avoid hypoglycaemia (keep blood glucose above 3.5 mmol/L).
- Maintain electrolytes within normal ranges to avoid life-threatening arrythmias.

Sedation

- Treat with sedatives and anxiolytics

Prognosis

- Always consider multiple modalities (clinical and others) over any single predictor factor.
- Electroencephalogram may be useful within the first 7 days and somatosensory evoked potentials may be useful after 72 hours.
- Blood biomarkers may be measured repeatedly over 72 hours.
- Neuroimaging (such as computed tomography in the initial hours and magnetic resonance imaging during the first 6 days) may be of value.

Reference:
Singapore Paediatric Resuscitation Guidelines 2021
Singapore Med J 2021; 62(8): 372-389