

- **Post Cardiac Arrest Syndrome (PCAS)** = period with highest risk of developing ventricular arrhythmias and reperfusion injuries after ROSC.
- This is secondary to prolonged ischaemia then reperfusion of vital organs, primarily the myocardium and central nervous system. Its systemic effects are similar to those seen in severe sepsis.
- There are four stages to PCAS – for the purposes of this guide we will focus on management of the Immediate (first 20min) and Early (20min-12hr) period.

Maintain Airway/Respiratory Support

- Insertion of **definitive airway** post return of circulation is recommended
- Lower doses of induction agent recommended – avoid hypotension - e.g. (Ketamine 1-2mg/kg + Rocuronium 1.2mg/kg)
- Cuffed ETT preferred due to risk of aspiration/nosocomial infection.
- Confirm ETT position with **CXR** prior to transfer
- Keep oxygen saturations between **94 - 99%**. Single ventricle physiology 75-85%
- An arterial line is recommended. Use ABG to maintain **PaO2 10-14kPa & PaCO2 4.5 – 6.0kPa**
- Ventilate with initial PEEP 5cmH2O – see link to paediatric ventilation guide overleaf for suggested starting settings
- **Continuous ETCO2** mandatory to monitor airway patency and keep pCO2 in target range
- Insert NGT on free drainage (with drainage bag) to empty and decompress stomach

Maintain Haemodynamic stability

- Maintain **minimum** systolic BP $\geq 5^{\text{th}}$ centile for age – see table across.
- If Hypotensive/hypovolaemic – 5-10ml/kg 0.9% Normal Saline as IV push then reassess
- If fluid resistant – consider **inotropes** – Choice of inotrope is patient specific – discuss with PICU where possible before commencement
- IVF @ 80% maintenance for age– NaCl 0.9%. Add dextrose 5% if <1yr OR hypoglycaemic. Keep blood glucose >4mmol/L
- Maintain Hb >100g/L. FFP, platelets and tranexamic acid can be considered if blood loss significant or ongoing
- Ensure **x2 Peripheral IV lines** (or IO) for transfer
- Point of care ECHO by trained personnel / formal echocardiography can be helpful in diagnosis/management i.e. O/R pericardial effusion / assess vent. function/filling status

Min BP Target >5th centile		
Age	MAP	SBP
Neonate	>CGA	>60
0-6months	>45	>70
>6mo – 2yrs	>55	>80
>2yrs – 10yr	>65	>90
>10yrs	>65	>100

Arrhythmias are common. 12 lead ECG beneficial if present – can be reviewed by cardiology in CHI if concerns. Normalise electrolytes. Prophylactic anti-arrhythmics are not recommended. T/F patient with defibrillation pads in place in case of shockable dysrhythmia.

Neuroprotection

- Adequate sedation – 1st line – **Morphine** load 20-50mcg/kg then infusion @ dose 20mcg/kg/hr (range 20-40mcg/kg/hr) AND **Midazolam** load 25-50mcg/kg then infusion @ 2mcg/kg/min (range 1-5mcg/kg/min). Avoid propofol if possible
- Reduce risk of seizures with **Levetiracetam** 40mg/kg or phenytoin 20mg/kg IV (levetiracetam is preferred choice)
- Treat clinical seizures as per APLS guideline
- Maintain **normothermia** (36 – 37°C). Monitor **core** temp (rectal/oesophageal). Cool aggressively if hyperthermic >37°C
- If shivering occurs – commence neuromuscular blockade (NMB). Ensure adequate sedation before paralyzing.
- Nurse with head in **midline** and **head at 30° – 45°**.

Consider Underlying Aetiology

- FBC / U&E / Amylase/ LFT/ Coag / CRP / Ammonia / Troponin / Toxicology / Blood gas / Type and screen – all recommended unless cause of arrest is clear
- Urgent non-contrast CT brain is recommended if cause of arrest is unclear – (**NO** immediate role in prognostication)
- Consider APLS 4 H's & 4 T's and rule out where possible
- Consider sepsis and cover with IV Cefotaxime if concerns re same and send blood cultures
- If there is known or possible underlying cardiac pathology – early discussion with Cardiology in CHI is essential
- If child has a life limiting condition, consider discussion with family regarding their wishes if arrest recurs

Respiratory Support tools



Pre-Intubation
Checklist



Intubation Equipment
Sizing Guide



Invasive Ventilation
setup <15Kg



Invasive Ventilation
setup >15Kg



Paediatric Ventilation
Guide

Critical Infusions

These infusions are a guide to those commonly used. Choice of medication, dose and route lie with the medically responsible clinician



NON- SCI
infusion table



CHI - SCI infusion
table



All medication
dosing/route
information can be
found on the CHI
'Clinibee' app

CHI SCI Standard Concentrations PICU/Theatre: CONTINUOUS INFUSIONS AND LOADING DOSES (Version 4 Feb 2019)					Rate Calc (mL/hour)	Required Dose	Default Rate (mL/hour)
Drug	Category	Weight Band	SCI (Normal)	Diluent	Usual Dose Range	Default Start Dose	
						Default Dose and Rate Calculator All Weights in kg - rounding can occur	
Adrenaline	Cardio	All ≤5kg	1mg/50mL	Glucose 5%w/v	0 -0.1microgram/kg/min	0.05microgram/kg/ min	Default Rate (mL/hr)
		>5 - ≤10kg	3mg/50mL	NaCl 0.9%w/v			0.15 x Wt
		All >10kg	6mg/50mL	Glucose 10%w/v			0.05 x Wt
Milrinone Maintenance	Cardio	All ≤5kg	5mg/50mL	Glucose 5%w/v	0.25-0.75 microgram/kg/min	0.5microgram/kg/m in	0.3 x Wt
		>5 - ≤10kg	10mg/50mL	NaCl 0.9%w/v			0.15 x Wt
		>10 - ≤20kg	20mg/50mL				0.075 x Wt
		>20kg	50mg/50mL (Neat)				0.03 x Wt
Noradrenaline	Cardio	All ≤5kg	1mg/50mL	Glucose 5%w/v	0 -0.1microgram/kg/min	0.05microgram/kg/ min	0.15 x Wt
		>5 - ≤10kg	3mg/50mL	NaCl 0.9%w/v			0.05 x Wt
		All >10kg	6mg/50mL				0.025 x Wt
Midazolam <i>(Large volume neat solution may be given using 250ml empty bag for patients > 20kg)</i>	CNS	≤2.5kg	10mg/50mL	Glucose 5%w/v	Sedation: 0-4microgram/kg/min	1microgram/kg/min	0.3 x Wt
		>2.5 - ≤5kg	25mg/50mL	NaCl 0.9%w/v			0.12 x Wt
		>5 - ≤10kg	50mg/50mL	Glucose 10%w/v	Status Epilep: 0-24microgram/kg/min		0.06 x Wt
		>10 - ≤20kg	50mg/50mL				0.06 x Wt
		>20kg	100mg/50mL				0.03 x Wt
Morphine	CNS	≤2.5kg	2.5mg/50mL	Glucose 5%w/v	Neonate: 0-20microgram/kg/hr	20microgram/kg/hr	0.4 x Wt
		>2.5 - ≤5kg	5mg/50mL	NaCl 0.9%w/v			0.2 x Wt
		>5 - ≤10kg	10mg/50mL	Glucose 10%w/v	>1mth old: 0-40microgram/kg/hr		0.1 x Wt
		>10 - ≤20kg	20mg/50mL				0.05 x Wt
		>20kg	50mg/50mL				0.02 x Wt

Frequently used intermittent medications

Doses for quick reference only – please prescribe using the CHI 'CLINIBEE' app or after direct consultation with accepting Consultant

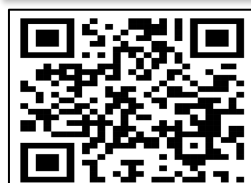
Fluid Bolus: Hartmann's Solution 5-10ml/kg
Ca Gluconate 10% w/v: 0.11mmol/kg (max 4.5mmol) (Target ionized Ca (on blood gas) of 1.2-1.4)
Sodium Bicarbonate 8.4%: 1mmol/kg (1ml/kg)
Dextrose 10%: 2ml/kg
Hydrocortisone: 2mg/kg (max up to 100mg)
Phenylephrine Bolus: (5-20mcg/kg – max 500mcg)
Synchronised D/C Shock: 1-2J/kg

In case of cardiac arrest

Adrenaline IV/IO/IM 10mcg/kg (0.1ml/kg 1:10,000)
Amiodarone – (VT/VF after shock 3&5) - 5mg/kg
Atropine – 20mcg/kg (min dose 100mcg, max 600mcg)
Magnesium (if torsade suspected) 50mg/kg – max 2g

D/C shock – VT/VF 4J/kg
AED – Paediatric attenuated if 1-8yrs / Adult >8yr

Useful Checklists & Resources



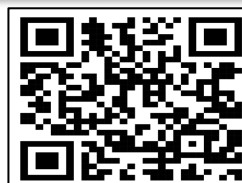
Stabilisation of child
in Adult ICU



PICU Referral Tool



Pre-Departure
Checklist



P37 Activation Guide

Time Critical Pre-Departure Checklist

Child with ROSC following arrest

To be completed by referring team prior to departure

Contact with the accepting PICU intensivist via

1800 222 378 for advice during transfer

Airway / Ventilation Considerations

Appropriate Sized ETT well secured with spare intubation set available ☐

NGT inserted and attached to bile bag for drainage ☐

CXR performed and ETT & NGT position modified if required ☐

Vent set to achieve 6-8ml/kg/min Tv + RR to keep ETCO₂ in target. PEEP typically set to 5cmH₂O ☐

Patient in midline and elevated to 30° – 45° for transfer ☐

Blood gas (cap/ven/art) checked once on transport ventilator. Blood glucose reviewed. ☐

ETCO₂ in ventilation circuit and visible on transport monitor – targeting 4.5-6Kpa ☐

Oxygen titrated to achieve O₂ sats between 94-98% - avoid hypoxia AND hyperoxia ☐

Appropriately sized ETT suction catheters available (uncuffed ETT size x2 = Catheter French) i.e. 3.5 cuffed ETT has same internal diameter as a 4.0 uncuffed ETT ∴ (4 x 2) = 8 F suction catheter ☐

Maintain normothermia – monitor core body temp

Circulation Considerations

It is always recommended that cardiac arrest medications are brought in addition to, and kept separate from, those suggested below

Working Vascular Access x2 (IV/IO) ☐

Continuous ECG monitoring on transport monitor ☐

NIBP set to auto q3-5min if art line unavailable ☐

Maintain **minimum systolic BP/MAP** ≥ 5th centile – see page 1 of guide for table ☐

Rescue fluid available – 0.9% Saline ☐

Have first line inotrope prepared and connected to patient ☐

Ensure patient has defib pads in place & team have reviewed dose/defib use ☐

If patient is already on an inotrope – discuss with PICU re additional inotrope to bring on transfer

Push dose pressors: (to correct hypotension)

Choice & dose at discretion of medically responsible consultant.

1. Adrenaline **1:100,000**

Add 1ml Adrenaline 1:1000 to 100ml NS = 10mcg/ml solution (label clearly)

Dose - 0.1ml/kg = 1microgram/kg per dose

2. Ephedrine diluted to conc. of 3mg/ml –as per Clinibee:

Dose – 1-12yr = 500micrograms/kg

Dose - >12yr = 3-7.5miligrams

IPATS Suggestion: Doses 100-200mcg/kg up to 3-6mg typically sufficient – Titrate with great care

3. Phenylephrine 100mcg/ml - as per Clinibee:

Dose - >1mo - 12yrs = 5-20micrograms/kg (max 500mcg)

Dose - >12yrs = 100-500micrograms

IPATS Suggestion: Doses 1-2mcg/kg up to 50-100mcg typically sufficient – Titrate with great care

Sedation / Neurosurgical Considerations

Post intubation sedation:

In view of likely myocardial depression & simultaneous need for deep sedation for neuroprotection we recommend:

Morphine 20-40mcg/kg/hr **AND** Midazolam 2-5mcg/kg/min **AND** Intermittent/continuous muscle relaxant ☐

Suggested bolus CNS medications for transfer

Use & dose at discretion of medically responsible consultant.

Dose titration recommended if haemodynamically unstable

1. Ketamine 0.5-2 mg/kg
2. Rocuronium - 0.6-1.2 mg/kg
3. Lorazepam Dose 0.1mg/kg max 4mg for seizures
4. Fentanyl 1-2mcg/kg

We recommend avoiding propofol/inhaled anaesthetic agents in all ages in this condition due to high risk of myocardial depression

Further reading / Resources

1. Paediatric post cardiac arrest care – scientific statement from the American Heart Association
<https://www.ahajournals.org/doi/full/10.1161/CIR.0000000000000697>
2. Post cardiac arrest syndrome – Epidemiology, Pathophysiology, Treatment and Prognostication. A consensus statement from the international liaison committee on resuscitation.
<https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.108.190652>
3. 2019 American Heart Association Focused Update on Pediatric Advanced Life Support: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care
<https://www.ahajournals.org/doi/10.1161/CIR.0000000000000731>
4. Post-Resuscitation Hypotension is Associated with Increased Mortality following Pediatric Cardiac Arrest. Berg et al Crit Care Med. 2014 June ; 42(6): 1518–1523. doi:10.1097/CCM.0000000000000216.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4085105/pdf/nihms-606132.pdf>
5. Pediatric Post-Resuscitation Management. Aaron SL, Vega RM, Hai O. Treasure Island (FL): StatPearls Publishing; 2023 Jan.
<https://www.ncbi.nlm.nih.gov/books/NBK441991/>
6. Post cardiac arrest Care Pathway. Johns Hopkins All children's Hospital.
<https://www.hopkinsallchildrens.org/getattachment/8def5659-c0bd-41e7-8083-fa496931d527/Post-Cardiac-Arrest>
7. Children's Hospital of Philadelphia PICU/CICU Clinical Pathway for the care of children post-CPR
<https://www.chop.edu/clinical-pathway/cardiac-arrest-post-cpr-clinical-pathway>
8. Resuscitation Council UK. Paediatric Advanced life support guidelines – Post cardiac arrest care (PCAC)
<https://www.resus.org.uk/library/2021-resuscitation-guidelines/paediatric-advanced-life-support-guidelines>

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Related Documents:	See 'further reading/ resources – page 4

The Irish Paediatric Acute Transport Service (IPATS) has produced this document as a pragmatic decision support tool in the stabilization and transfer of a child following cardiac arrest. It has been designed for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.

This guideline represents the views of IPATS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.