Guideline for stabilization & transfer of the collapsed neonate in a regional hospital to CHI

Call PICU: 1800 222 378

- There are many potential causes of collapse in a neonate – see boxes
- Many of these will require time-critical transfer for definitive care
- This guide aims to assist in the stabilisation & transfer of these infants

Recognition of Neonatal Shock

Classical findings in neonates are those of a 'cold shock' / elevated SVR state

- Tachycardia
- Poor perfusion: pallor, mottled/cool peripheries, weak pulses, ↑Cap refill T.
- ↓ level of consciousness / lethargy / irritability
- **Hypotension is a late sign. Do not be reassured by normal/high BP**

Other findings may include:

Apnoea, tachypnoea, hypothermia and hypoglycaemia

An APLS based structured ABCDE approach is recommended throughout with reference to the white boxes to assist with differential diagnosis & workup

Airway & Breathing

- Ensure airway patency is maintained – if apnoeic or obstructed breathing - recommend urgent anaesthesiology review
- Recommend a low threshold for intubation in the event of recurrent apnoea. **Resuscitate before intubation** wherever possible to avoid CVS collapse on induction of anaesthesia. See Intubation & Ventilation QR overleaf for advice
- Grunting/Kussmaul breathing may be 2nd to metabolic acidosis – check Gas
- Aim to **maintain O2 sats between 94-98%**. Hyperoxia can be harmful. Titrate FiO_2 diligently.
- If there is work of breathing associated with hypoxia start high flow O_2 nasal cannula at 2L/Kg/min
- If cyanotic heart lesion is suspected discuss urgently with cardiology in CHI. O_2 saturation target may need to be amended to 75-85%

Circulation

- Obtain IV access – very low threshold for using **IO**. PIV attempts x2 only
- Unless signs of heart failure **– Give 10ml/kg Hartmann's via IV push**
- Reassess +/- repeat bolus up to 40ml/kg →fluid refractory shock. Stop boluses if signs of deterioration/heart failure - may need early inotropes
- Prepare **adrenaline** as first line inotrope if signs of heart failure or >40ml/kg fluids given & still shocked. Commencement under direction of PICU. Prepare noradrenaline once adrenaline commenced for 2nd line use.
- Aim for iCa (on blood gas) of >1mmol/L - replacement dose overleaf

Start **Dinoprostone** (prostin) if concern for duct dependent cardiac lesion:

- If shocked, start at 10-20nanograms/kg/min & **discuss with cardiology** for ongoing support and discussion re dosing (may need 50-100ng/kg/min)
- Hypotension & apnoeas are common with higher doses - prepare for both
- Likely to need intubation if being transferred on >15nanograms/kg/min

Administer empiric antibiotics to all infants:

Cefotaxime 50mg/Kg + Gentamicin 5mg/kg + Benzylpenicillin 100mg/kg as per Clinibee guidance . **Do not delay administration** to obtain blood cultures.

Don't ever forget the glucose!

- NGT recommended – leave open on bile bag for drainage on transfer
- 100% Maintenance IVF with 0.9% NS + 10% Dextrose recommended
- Check blood glucose regularly – prone to hypoglycaemia
- Treat hypoglycaemia with **3ml/kg** Dex 10% **AND** inc. dextrose conc. in fluids

First Line Investigations

- CXR +/- PFA if concerns re intrabdominal pathology
- ECG if tachycardic / concerns re arrhythmia
- Point of care ultrasound to assess ventricular function if trained personnel available. (Formal paediatric ECHO if available)
- Send (in order) **VBG /Culture /U&E /LFT /NH3 /FBC /Coag /CRP**
- Urine C&S / viral NPA recommended

Potential Underlying Diagnosis

The boxes below are an aide memoire for the most likely causes of neonatal collapse. Whilst not designed to be exhaustive, they highlight many of the cardinal features of some of the most common presentations.

Sepsis

Should always be presumed

- ↑or ↓HR / ↑ RR or apnoeic
- Low/high temperature
- Pale & mottled, cool peripheries
- Elevated/normal lactate

Add acyclovir if coagulopathy/abnormal LFTs/ signs of encephalitis or a history of Herpes Simplex contact

Cardiac

↑HR / >220 → ?SVT – immediate ECG

Murmur / cardiomegaly / abnormal heart shape on CXR

Duct dependent cardiac lesion:

- Hypoxia unresponsive to O_2 / Reduced or absent femoral pulses / 4 limb BP/Sats differential
- If pink with shock + poor pulses – possible HLHS

Myocarditis/cardiomyopathy

- Arrhythmias / pulmonary oedema / +liver edge/ no response to fluid bolus / cardiomegaly on CXR

ALCAPA: Hx of distress/dyspnoea with feeds/↓wt gain

Obstr.TAPVD: Shock + cyanosis. 'Wet lungs' on CXR

Discuss with cardiology if cardiac lesion suspected

Inherited Metabolic Disorder/ Toxins

Reduced GCS, Seizures, Vomiting

- Marked acidosis + ↑ ketones - ?Organic Acidaemia
- Resp Alkalosis + ↑Ammonia - ?Urea Cycle defect
- Hypoglycaemia +↓/no ketones - ?Fatty acid Oxid. D

Stop all feeds. Start **10% Dex** in maintenance fluids

Send urgent **Ammonia** + blood gas + ketones

Discuss with metabolic team if IMD suspected

Consider naloxone if history of methadone use in home

Send urine for toxicology screen

Endocrine

Shock + Hypoglycaemia → Consider hypothalamic – pituitary – adrenal axis conditions e.g.

Congenital Adrenal Hyperplasia:

- Hypoglycaemia (often refractory to dextrose bolus)
- Shock refractory to fluid resuscitation
- ↓Na / ↑K (salt wasting crisis)

Treat shock + hypoglycaemia (**3ml/kg** Dex 10%)

Send serum cortisol/17-OHP if possible

Give 10mg hydrocortisone IV by slow push

Discuss with CHI Endocrinologist if any suspected

Trauma / Surgical

Abusive head trauma/intracranial bleed:

- Focal neurology/bulging fontanelle/abnormal pupils
- Seizures/encephalopathy
- Cushing triad - ↓HR/ ↑BP/ irregular respirations

Give 1mg vit K if not given at birth

CT brain if stabilised sufficiently to tolerate

Abdominal surgical emergencies: Volvulus/NEC

Abdo distension/bilious vomit/blood in stools

NPO + NGT + PFA + contact surgeons in CHI

Respiratory Support tools

High Flow set-up <25L/min flow

Pre-Intubation Checklist

Intubation Equipment Sizing Guide

Invasive Ventilation setup <15Kg

Paediatric Intubation & 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

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

CHI GUIDELINE FOR DOSING, PREPARATION AND ADMINISTRATION OF DINOPROSTONE INFUSION FOR NEONATES

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) } / Default start dose

Drug	Category	Weight Band	SCI (Normal)	Diluent	Usual Dose Range	Default Dose and Rate Calculator *All Weights in kg - rounding can occur*	
						Default Start Dose	Default Rate (mL/hr)
Adrenaline	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
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
Milrinone Maintenance	Cardio	All ≤5kg	5mg/50mL	Glucose 5%w/v	0.25-0.75	0.5microgram/kg/min	0.3 x Wt
		>5 - ≤10kg	10mg/50mL	NaCl 0.9%w/v	microgram/kg/min		0.15 x Wt
Dinoprostone	Cardio	All ≤5kg	50microgram/50mL	Glucose 5%w/v	5-10nanogram/kg/min	5 nanogram/kg/min	0.3 x Wt
Dinoprostone (High Dose)	Cardio	All ≤5kg	400microgram/50mL	Glucose 5%w/v	As per cardiologist	40 nanogram/kg/min	0.3 x Wt
Midazolam	CNS	≤2.5kg	10mg/50mL	Glucose 5%w/v	Sedation:	1microgram/kg/min	0.3 x Wt
		>2.5 - ≤5kg	25mg/50mL	NaCl 0.9%w/v	0-4microgram/kg/min		0.12 x Wt
		>5 - ≤10kg	50mg/50mL	Glucose 10%w/v			0.06 x Wt
Morphine	CNS	≤2.5kg	2.5mg/50mL	Glucose 5%w/v	Neonate:	20microgram/kg/hr	0.4 x Wt
		>2.5 - ≤5kg	5mg/50mL	NaCl 0.9%w/v	0-20microgram/kg/hr		0.2 x Wt
		>5 - ≤10kg	10mg/50mL	Glucose 10%w/v	>1mth old:0-40microgram/kg/hr		0.1 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) as slow IV infusion over 10minutes
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

Emergency Drug Calculator

P37 Activation Guide

Sepsis Guideline

Metabolic Emergency Guidelines

Time Critical Pre-Departure Checklist

Neonatal Collapse

To be completed by referring team prior to departure

Contact the accepting PICU intensivist via

1800 222 378 for advice during transfer

IPATS Irish Paediatric Acute Transport Service

CCRS Critical Care & Retrieval Services

Airway / Ventilation Considerations

Intubated Child:

- Appropriately Sized ETT & NGT well secured ☐
- CXR performed & ETT & NGT position reviewed ☐
- $ETCO_2$ & O_2 sats visible on transport monitor targeting ETC02 4.5-6Kpa & Sats 94-98% ☐
- 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 ☐

Child on NIV/HFNCC:

- NGT inserted and attached to bile bag for drainage ☐
- Appropriate size intubation equipment available for transfer ☐
- HFNCC: Suggest 2L/Kg/min ☐
- CPAP: Suggest starting at low PEEP 3/4cmH_20 for tolerance and inc. as required to PEEP of 5-7cmH_20 ☐

Please ensure a blood gas (cap/venous/arterial) is measured once on transport ventilator
Please use the IPATS oxygen calculator to ensure sufficient oxygen for the transfer

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 no art line ☐
  Please do not delay transfer for art line insertion
- Individualised approach to BP management. Discuss targets with PICU/Cardiology before departure ☐
- Maintenance & rescue fluid available ☐
- **Adrenaline infusion** prepared and connected to patient even if not immediately required. ☐
- If on Adrenaline – call PICU re additional inotrope to prepare– likely Noradrenaline ☐
- 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

Tolerance of NIV or procedural sedation: ☐
If required, intermittent fentanyl 0.5-1mcg/kg or ketamine 0.25-0.5mg/kg can be administered. Low dose infusions of same are also generally well tolerated if required

Intubated Children: ☐
Morphine 20mcg/kg/hr + midazolam 2mcg/kg/min suggested starting doses

Avoid propofol/inhaled anaesthetic agents in all ages in this condition

Suggested bolus CNS medications for transfer

Use & dose at discretion of medically responsible consultant.

Due to reduced cardiac output, please titrate doses and allow additional time for metabolism and eventual effect.

Have push dose pressor of choice available when administering any sedation bolus

Recommended drugs for intubation include: ☐
Ketamine 0.5-1mg/kg (titrated/repeated to effect)
Rocuronium 0.6-1.2mg/kg
+/- Fentanyl 1-2mcg/kg (titrated/repeated to effect)

Document Details	
Document Type:	Clinical Guideline
Document Name:	**Guideline for stabilization & transfer of the collapsed neonate in a regional hospital to CHI**
Document Location:	
Version:	1.0 May 2023
Effective From:	May 2023
Review Date:	May 2025
Author:	Dr Cathy Gibbons
Approved by:	Dr Cathy Gibbons Consultant Intensivist CHI/NASCCRS Dr Heike Brüell, Consultant Intensivist CHI/NASCCRS Dr Siobhan Whelan, Consultant Paediatric Intensivist CHI/NASSCRS Prof Ellen Crushell Consultant in Paediatric metabolic medicine Dr Ciara McDonnell, Consultant Paediatric Endocrinologist Dr Colm Breatnach Consultant in Paediatric Cardiology & intensive care medicine Dr Terrence Prendiville Consultant Paediatric Cardiology Dr Regina Cooke, Consultant General Paediatrician, Portiuncula Regional Hospital, Ballinasloe
Related Documents:	

The Irish Paediatric Acute Transport Service (IPATS) in conjunction has produced this clinical guideline with review by the PICU department in CHI and relevant specialists. 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.

Further reading / Resources

1. Lal N, Varshney T. The collapsed newborn in the emergency department. *BJA Educ*. 2018;18(8):254-258. doi:10.1016/j.bjae.2018.05.004 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7808019/

2. A practical guide for the management of the collapsed neonate – Part 1 recognition and initial management. https://resources.wfsahq.org/atotw/a-practical-guide-for-the-management-of-the-collapsed-neonate-part-1-recognition-and-initial-management/

3. Royal Children's Hospital Melbourne Clinical Practice Guideline for the Recognition of the seriously unwell neonate and young infant. https://www.rch.org.au/clinicalguide/guideline_index/Recognition_of_the_seriously_unwell_neonate_and_young_infant/

4. Northwest and North Wales Paediatric Transport Service Guide for the management of the collapsed neonate / infant file:///Users/cathygibbons/Downloads/collapsed_neonateinfant_june_2022_-_january_2025.pdf

5. KIDS - NTS Guide to the care of the collapsed infant/neonate https://kids.bwc.nhs.uk/wp-content/uploads/2021/02/Neonatal-collapse.pdf

6. North East Children's Transport and Retrieval Guideline for neonatal collapse. https://www.newcastle-hospitals.nhs.uk/wp-content/uploads/2021/02/NECTAR_Neonatal_collapse_V1.0.pdf

7. Evelina Children's Hospital & South Thames Retrieval Service Guideline for neonatal collapse: https://www.evelinalondon.nhs.uk/resources/our-services/hospital/south-thames-retrieval-service/neonatal-collapse-nov-2017.pdf