SOUTHAMPTON OXFORD
NEONATAL TRANSPORT

Managing the Hypoxic Newborn

Consider early referral to SONeT for transfer to tertiary centre

Important Information and considerations:

- Ventilation: assess work of breathing, blood gases, chest x-ray appearance (rule out air leak)
- Cardiovascular: HR, MBP, perfusion, lactic acidosis, femoral pulses. Echo should not be prioritised over clinical management or a potential transfer – start prostin early if concerns.
- Screen and treat for sepsis
- Neurology: If already muscle relaxed CFAM should be applied if available. Consider criteria for therapeutic hypothermia in context of PPHN (discuss with supervising consultant).
- Cranial ultrasound scan if considering ECMO.
- Review antenatal and birth history: risk factors for sepsis, antenatal scan, condition at birth, resuscitation
-Obtain central and arterial access.

Table 1. Differential diagnosis of hypoxemia in newborn infants.

	Lung Disease without PPHN	Cyanotic Congenital Heart Disease	PPHN
History	Fetal distress, PROM, chorioamnionitis	Antenatal diagnosis	Often negative other than in secondary PPHN
Respiratory distress	Present	Usually absent	Often present
Oxygen saturation on pulse oximetry	Improves with supplemental oxygen	Fixed low saturations Minimal response to supplemental oxygen	Labile saturations. Differential cyanosis
Hyperoxia test *	PaO_2 often > 150 mm Hg	PaO_2 often < 100 mm Hg	PaO_2 often > 100 mm Hg
$PaCO_2$	Elevated	Normal/low	Often elevated (except in idiopathic PPHN)
Hyperoxia-Hyperventilation *	PaO_2 > 150 mm Hg	PaO_2 often < 100 mm Hg	PaO_2 improves with hyperventilation
Chest X ray	Abnormal	Abnormalities of cardiac silhouette and pulmonary vascularity	Decreased vascularity in idiopathic PPHN
Echocardiogram	Normal	Structural cardiac abnormalities	Structurally normal heart (see text for characteristic echo findings of PPHN)

* Both hyperoxia and hyperoxia hyperventilation tests are not used routinely in clinical practice due to increased availability of echocardiography in most institutions. These tests expose the infant to hyperoxia and hypocarbia with the potential to cause oxidative stress and decreased cerebral perfusion respectively.

Mathew and Lakshminrusimha, 2017

For reference: 1 kPa = 7.5 mmHg, 13.3 kPa = 100 mmHg, 20 kPa = 150 mmHg

Management:

Respiratory support

- In most instances if FiO_2 ≥ 60%, intubate and ventilate. [Discuss with Supervising Consultant]
- Early liberal oxygen use-wean when stable.
- Ensure secure and well-positioned ETT, with leak <30%.
- Optimise MAP: Consider using a longer IT (0.4-0.5 s) or higher PEEP. HFOV may be required (if available)
- Sick ventilated babies with PPHN will benefit from sedation and muscle relaxation
- Aim to keep arterial PaO2 8-12kPA and preductal sats ≥ 95% if possible.
- **OI = $\frac{FiO_2\ (\%) \times MAP\ (cmH2O) \times 100}{PaO_2\ (kPa) \times 7.5}$** Calculate oxygenation index with each arterial gas.
- Monitor pre and post ductal saturation gap.
- Aim for normocarbia ($PaCO_2$ 4.0 – 6 kPa). Consider use of HFOV (when requiring high PIPs >28cmH2O) (if available). If ventilation difficult, discuss with supervising consultant.
- Start nitric oxide if FiO_2 ≥ 60% & or OI ≥ 20-25 & or PaO2 < 13kPa despite 100% O2 and/or persistent pre-post ductal saturation difference ≥ 10% &or echo evidence severe PPHN with severe hypoxemia. If no response within 30 minutes, then consider stopping (some conditions causing hypoxia such as obstructed TAPVC can be made worse with iNO)
- Consider Surfactant administration - only on advice of supervising consultant

Management:

Cardiovascular

- Consider an echo if practioner available and will change management. Transfer to cardiac centre should not be delayed obtaining an echo. Consider images being reviewed by cardiologist.
- Maintain BP at upper limit of normal range (mBP 45-50 mmHg).
- Ensure adequate filling (Max fluid boluses of 30 ml/kg) in 10ml/kg aliquots.
- Consider staring inotropes **(Flow chart).** Discuss further inotropes with supervising consultant.

Other considerations

- Antibiotics: First line (Dependent on local policy).
- Maintain strict fluid balance.
- Correct metabolic acidosis with bicarbonate (in case of hypernatraemia or hypercapnia, use THAM). Aim to keep pH 7.35-7.45 in the early phase of management.
- Optimise temperature, glucose, haemoglobin, calcium and magnesium.
- Continue to assess if the baby meets the criteria for therapeutic hypothermia/seizures.

ECMO

If OI≥40 for ≥3 hours despite maximal treatment, liaise with the on-call SONeT consultant regarding referral to an ECMO centre. Refer to quaternary service referral guideline – https://www.sort.nhs.uk/media/SONeT/Guidelines/Clinical-pathways/referral-to-quarternary-service-FINAL-Sept-2024.pdf

Southampton: SORT hotline 023 8077 5502,

Leicester ECMO team with mobile ECMO service: Tel 0300 3003200.

CATS ECMO referral (conference call with GOSH CICU consultant): Tel 0207 430 5868.

FLOWCHART FOR TREATMENT SEQUENCE in PPHN

