

PERSISTENT PULMONARY HYPERTENSION

Definition

Persistent pulmonary hypertension (PPHN) of the newborn is defined as a failure of normal pulmonary vasculature relaxation at or shortly after birth, resulting in impedance to pulmonary blood flow which exceeds systemic vascular resistance, such that unoxygenated blood is shunted to the systemic circulation.

Some known precipitating factors contributing to failure of pulmonary vasculature relaxation are:

- hypoxia
- meconium
- cold stress
- lung disease
- hypoglycaemia
- sepsis

Diagnosis

- *history*
 - presence of precipitating factors during antenatal, intrapartum, postnatal periods
- *respiratory signs*
 - signs of respiratory distress (tachypnoea, grunting, nasal flaring, chest retractions)
 - onset at birth or within the first 4 to 8 hours of life
 - marked lability in pulse oximetry
- *cardiac signs*
 - central cyanosis (differential cyanosis between the upper and lower body may be noted clinically, by pulse oximetry and blood gasses)
 - prominent precordial impulse
 - low parasternal murmur of tricuspid incompetence
- *radiography*
 - lung fields
 - normal, parenchymal lesions if lung disease is present, or oligoemia
 - cardiac shadow
 - normal sized-heart, or cardiomegaly (usually right atrial or ventricular enlargement)
- *echocardiography- important to:*
 - exclude congenital heart disease.
 - define pulmonary artery pressure using tricuspid incompetence, ductal shunt velocities.
 - define the presence, degree, direction of shunt through the duct / foramen ovale.
 - define the ventricular outputs.

Differential Diagnosis

In centres where there is a lack of readily available echocardiography and/or Paediatric Cardiology services, the challenge is to differentiate PPHN from Congenital Cyanotic Cardiac diseases. Differentiating points between the two are:

- babies with congenital cyanotic heart diseases are seldom critically ill at delivery
- bradycardia is almost always due to hypoxia, not a primary cardiac problem
- infants with cyanotic lesions usually do not have respiratory distress
- the infant with PPHN usually had some perinatal hypoxia and handles poorly
- the cyanosed cardiac baby is usually pretty happy, but blue

Management

General measures

- preventing and treating
 - hypothermia, hypoglycaemia, hypocalcaemia, hypovolaemia, anaemia
- avoid excessive noise, discomfort and agitation.
- minimal handling

Sedation

- morphine – given as an infusion at 20 mcg/kg/hr. Morphine is said to be a safe sedative and analgesic even in the preterm infants.
- midazolam – its use cannot be recommended among the preterm population especially those with a gestational age less than 34 weeks, in view of deleterious effects on the cerebral circulation leading to an increase in adverse long term neurodevelopmental outcomes.

Ventilation

- conventional ventilation – adopt ‘gentle ventilatory’ approach by
 - avoidance of hyperventilation (i.e. hypocarbia and hyperoxia).
 - hypocarbia causes neuronal cell death leading to white matter necrosis and periventricular leukomalacia. Aim for a pCO₂ of 35-55mmHg.
 - hyperoxia leads to chronic oxygen dependency and bronchopulmonary dysplasia
Aim for a pO₂ of at least 50 mm Hg.
 - ventilating to achieve a tidal volume of 5mls/kg³
 - short inspiratory time (0.2-0.3 sec) to prevent alveolar overdistension
 - inadvertently increasing ventilatory settings may lead to overdistention of the lungs and high mean airway pressures compromising venous return to the heart which further aggravates systemic hypotension as cardiac output is compromised
- High Frequency Oscillatory ventilation (HFOV)
 - may be effective in PPHN secondary to a pulmonary pathology (role is controversial)

Circulatory support

- Inotropes improve cardiac output and enhances systemic oxygenation.
Poorly substantiated in PPHN, especially with the use of iNO, though the pulmonary vasodilating effect help improve cardiac output and systemic blood pressure.
- However, inotropes are still recommended in institutions without facilities for iNO

Dopamine	5 – 15 mcg/kg/min
Dobutamine	5 – 15 mcg/kg/min
Adrenaline	0.1 – 1.0 mcg/kg/min

Vasodilators

- inhaled nitric oxide (iNO)- selective pulmonary vasodilator (dose 5 - 20 ppm)
 - in term and near term infants (> 34 weeks gestational age)
 - it reduces the need for Extracorporeal membrane oxygenation (ECMO)

There is insufficient evidence to support iNO use for preterm infants < 34 weeks age.

- Tolazoline, Prostacycline and Sildenafil

Extracorporeal membrane oxygenation (ECMO)

ECMO is effective in PPHN, though usage has declined since the use of iNO and HFOV.

Practices not recommended for routine use

- sodium bicarbonate
- magnesium sulphate
- paralysing agents