PATENT DUCTUS ARTERIOSUS ● 1/3

RECOGNITION AND ASSESSMENT

Definition

- Persistent patency of the ductus arteriosus (PDA) is a failure of functional ductal closure by 48 hr or anatomical closure by aged 3 weeks

Factors associated with delayed closure

- Prematurity (significant PDA affects approximately 30% of very-low-birth-weight babies)
- Lack of antenatal corticosteroid prophylaxis
- Surfactant-deficient lung disease
- Hypoxaemia
- Volume overload

Adverse effects of PDA

- Haemodynamic consequences of left-to-right shunt in preterm babies can prolong ventilatory support and are associated with mortality and morbidity (chronic lung disease, pulmonary haemorrhage, intraventricular haemorrhage, necrotising enterocolitis and retinopathy of prematurity)
- Increased pulmonary blood flow (leading to increased work of breathing and respiratory deterioration)
- Reduced systemic blood flow (leading to acidosis and hypotension)

Symptoms and signs

- Can be absent even in the presence of a significant duct in first 7 days of life
- A significant left-to-right shunt is suggested by:
  - bounding pulses and wide pulse pressure (i.e. >25 mmHg)
  - hyperdynamic precordium (excessive movement of precordium)
  - low-pitched systolic or continuous murmur over left upper sternal edge (absence of a murmur does not exclude significant PDA)
  - signs of cardiac failure (tachypnoea, tachycardia, hepatomegaly, pulmonary oedema, generalised oedema etc.)
  - poor perfusion (hypotension, poor capillary refill, mottled skin and persistent acidosis)
  - increased or persistent ventilatory requirements

Differential diagnosis

- Other cardiac pathology (e.g. congenital heart disease, including duct-dependent lesions, arrhythmias or cardiomyopathy)
- Sepsis

INVESTIGATIONS

- SpO_2 monitoring
- Chest X-ray (cardiomegaly? pulmonary plethora?)
- Echocardiography
- to detect duct-dependent cardiac lesions and other cardiac pathologies that are difficult to exclude clinically
- if considering treatment with prostaglandin inhibitor
- echocardiographic assessment of significant PDA includes:
  - size of PDA (>1.5 mm)
  - volume loading of left atrium (LA/aorta ratio >1.5)
  - volume loading of left ventricle
  - velocity and flow pattern of ductal flow

IMMEDIATE TREATMENT

General measures

- Optimise oxygenation by appropriate ventilatory management
- Use of a higher PEEP (i.e. ≥5 cm H_2O) can help minimise effects of pulmonary oedema and risk of pulmonary haemorrhage
- Treat anaemia – maintain Hb ≥100 g/L with blood transfusion (consider concurrent dose of furosemide IV)
- Before starting medication, restrict fluid intake to 60–80% (e.g. from 150 mL/kg/day to 90–120 mL/kg/day)
- If fluid overload or pulmonary oedema, give 1 dose of furosemide IV in accordance with **Neonatal Formulary**

Specific measures

- Aim to convert haemodynamically significant PDA into insignificant PDA as complete duct closure may take weeks or months

Pharmacological treatment with prostaglandin inhibitor to initiate closure

- Ibuprofen is the drug of choice for this purpose. Indometacin is not currently available in the UK
- Pharmacological treatment is best used aged ≤2 weeks but can be effective ≤6 weeks

Indications

- Babies born <34 weeks' gestation with significant PDA – on clinical and/or echocardiographic assessment
- Includes ventilatory/CPAP dependent babies or PDA with haemodynamic effects (i.e. cardiac failure or poor perfusion)
- Monitor babies with non-significant PDA carefully and treat if becomes significant

Contraindications to ibuprofen

- Duct-dependent cardiac lesion
- Significant renal impairment: urine output <1 mL/kg/hr or creatinine >120 micromol/L
- Significant thrombocytopenia, i.e. platelet count $<50\times10^9$/L (course started or next dose given only after platelet transfusion)
- Suspected or definite necrotising enterocolitis (NEC)
- Active phase of significant bleeding (gastrointestinal or severe intracranial) – treat coagulopathy before starting course – see **Coagulopathy** guideline

Dose

- Calculate carefully and prescribe individually on single dose part of prescription chart so that contraindications checked before each dose
- Administer in accordance with **Neonatal Formulary**
- Ibuprofen has similar efficacy to indometacin but fewer renal side effects (can be used in babies with mild or previous renal dysfunction)

SUBSEQUENT MANAGEMENT

Monitoring pharmacological treatment

- Check before each dose:
  - creatinine (maintained <120 micromol/L)
  - urine output (maintained >1 mL/kg/hr)
  - platelet count (kept $\geq50\times10^9$/L with platelet infusions if needed)
  - concomitant nephrotoxic drug e.g. gentamicin/vancomycin (monitor levels carefully **or** use alternative non-nephrotoxic drug)
- Feed tolerance (feeds cautiously initiated or continued during treatment – briefly stopped during actual infusion)
- Clinical signs of PDA and baby's progress
- Echocardiography (if clinically indicated), repeated after 2–3 days of completion
- Fluid gradually liberalised after treatment based on:
  - daily weight (weight gain suggests fluid retention)
  - serum sodium (dilutional hyponatraemia common)

Persistence or recurrence of asymptomatic PDA

- **Persistence of murmur does not necessarily indicate return of PDA**
- Echocardiogram sometimes demonstrates physiological branch pulmonary stenosis
- If baby with asymptomatic murmur is making progress, plan echocardiography before discharge to decide follow-up

Persistent significant PDA and surgical referral

- If PDA significant after 48 hr of completion of first course of prostaglandin inhibitor, use second course of ibuprofen
- If PDA still significant but baby making progress (i.e. can be extubated or come off CPAP):
  - commence regular diuretics (furosemide + amiloride/spironolactone) to help control haemodynamic effects – in accordance with **Neonatal Formulary**
  - monitor closely

- If PDA still significant and baby ventilatory or CPAP dependent, discuss with cardiac centre for surgical ligation when:
  - prostaglandin inhibitor contraindicated
  - prostaglandin inhibitor not indicated (≥34 weeks with cardiac failure not controlled by diuretics)
  - prostaglandin inhibitor ineffective (usually after giving second course)
- Discuss further cardiac assessment and surgical ligation of PDA with cardiologist at regional cardiac centre and transport team – follow local care pathway (e.g. West Midlands PDA Ligation Referral Pathway)
- After surgical ligation, keep baby nil-by-mouth for 24 hr before gradually building up feeds (because of risk of NEC)

DISCHARGE POLICY FOR PERSISTENT PDA

- If PDA persistent clinically or echocardiographically at discharge or at 6 weeks follow-up, arrange further follow-ups in cardiac clinic (locally or at cardiac centre depending on local practice)
- If PDA reviewed locally still persistent at aged 1 yr or if clinically significant during follow-up (cardiac failure or failure to thrive), refer to paediatric cardiologist at regional cardiac centre to consider closure (first option is usually catheter closure)

Medical treatment of persistent PDA <34 weeks' gestation