The Newcastle upon Tyne Hospitals NHS Foundation Trust

Newcastle Neonatal Services Guideline : PDA - Patent Arterial Duct

Version No:	9
Effective From:	13 November 2024
Expiry Date:	13 November 2027
Date Ratified:	08 November 2024
Approval:	G10

1. Introduction

Patency of the arterial duct (patent ductus arteriosus, PDA) is normal at birth and during the early adaptation to air breathing. In healthy babies most ducts close spontaneously. However in VLBW infants the spontaneous closure rate by day 10 is about 35% (1). Prolonged patency is associated with respiratory disease in preterm babies, but many still close spontaneously.

2. Guideline scope

This document acts as a guide for the management of symptomatic PDAs in preterm infants being cared for on ward 35 RVI.

3. Guideline

Clinical problems are caused when blood is shunted L→R. The degree of shunting is determined in part by the diameter of the duct but more by the balance of pressures between right and left sides. During the acute phase of HMD right sided pressures are high. In this phase it is common to find a widely patent duct but little or no flow across it. As lung disease improves pulmonary arterial (PA) pressures fall and the duct remains open, L→R shunting occurs from the aorta to the PA. This gives rise to a rapid fall in pulse pressure following systole and a reduced forward flow during diastole. In extreme cases there may be absent or even retrograde flow in diastole leading to compromised tissue perfusion (GI tract and kidneys especially). The high pulmonary blood flow reduces lung compliance resulting in increased work of breathing and pulmonary oedema.
The commonest clinical presentations of a PDA are:

- a murmur detected on routine auscultation, ventilatory requirements that are increasing, or failing to improve, cardiorespiratory collapse after extubation, metabolic acidaemia

Clinical signs of a significant shunt are:

- a precordial heave (may be visible), a loud murmur especially if extending into diastole (*but note that you can still have a large PDA without a murmur*), a gallop rhythm, full volume pulses

3.1. Assessment

2D echocardiography with colour doppler is the method of choice. Although a large left atrium (LA:Ao >1.4:1) implies a significant L→R shunt this can be misleading where there is significant atrial shunting. A dilated LA may remain large even after ductal closure. Measure the diameter of the duct using colour flow mapping, particularly during the first week of life - a minimal ductal diameter above 1·5 mm is probably significant. Look for evidence of retrograde diastolic flow in the descending aorta and gut blood vessels. Assess the velocity of flow in diastole. If there is high flow rate in systole followed by a low flow rate in diastole this implies that there is little restriction to flow and that the duct is large with high volume shunting. Assess the direction of the shunt and the velocity of the blood flow across the duct using continuous wave Doppler measurements. Imaging may also identify LV volume overload and give an indication of myocardial performance. **CXR** may identify progressive cardiomegaly or pulmonary oedema.

3.2. Management

This will depend on the clinical circumstances but in general:

- give enough oxygen to the myocardium
- maintain fluid intake unless receiving >150ml/kg/day
- if shunt significant discuss with consultant and consider treatment.
- Medical closure: Likely to be effective only in the first three weeks of life. Ibuprofen (for dose see Neonatal formulary) is the first line of treatment. It is associated transient renal impairment. Gastrointestinal problems are uncommon (2,3) There should be full documented discussion with the parents of any infant who is being commenced on ibuprofen, including capturing the risks that have been discussed. Monitor renal function, urine output and fluid balance with daily weight. **Do not** continue ibuprofen without consultant involvement if there is a significant fall in urine output or other signs of worsening renal function.
- Surgical closure: Some babies may require surgical closure either due to failure of medical treatment or due to other complications where the consultant feels that surgical closure is more appropriate.

4. Ligation of arterial duct - procedure

Ligation of the duct

- may be required if ibuprofen treatment is unsuccessful (sometimes a 2nd course is used but this always requires consultant involvement).
- may be required if there are contraindications to ibuprofen e.g. gastro-intestinal pathology or renal impairment;

- The consultant neonatologist will discuss the case with one of the consultant cardiologists.

Good communication at all levels is essential to ensure both safety and efficiency. The procedure for transfer is as follows:

1 Inform the parents of the reasons for ligation and outline the procedure and risks i.e. low risk but requires GA, increased chance of instability post-op for 1-2 days, possible need for chest drain.

2 Ask the parents to attend on paediatric cardiothoracic ITU at Freeman at least 1 hour prior to planned surgery so that the surgeons can take consent.

3 Check the FBC and U&E the day before and ensure electrolyte abnormalities are corrected. Consider the need for blood transfusion before surgery if haematocrit <40%. It is not necessary to discuss every baby with the anaesthetic team prior to transfer but ***discuss the following types of babies with the paediatric cardiothoracic anaesthetists prior to transfer***:

- thrombocytopenia, clotting or significant electrolyte abnormalities
- where FiO2 > 50%
- respiratory decompensation or treatment for sepsis in preceding 24 hours
- unstable infants with complicated respiratory, renal, GI, CNS disease or recent surgery etc***.***

4 Order a **full unit** of cross-matched blood (i.e. not just a pedi-pack) for the baby and ask blood bank to ensure it is sent to Freeman. The transport SpR must have a clear understanding of the baby's primary and most recent medical problems. The SpR acts as the 'continuity' physician between the neonatal team and the cardiothoracic team. Ensure the baby is intubated and ventilated prior to transport to the Freeman. Do this well ahead of time. If you have to be at Freeman for 08:00 you need to be *leaving* in the ambulance at 7.30. To achieve this you need to be ventilating at about 06:00 so you have time to do CXR (if necessary), check blood gas and adjust. Always check a blood gas before departure even if the baby has been chronically ventilated.

5 If opiates have not recently been given, give a bolus of 200µg/kg morphine prior to setting off, but make sure you inform the anaesthetist.

6 Transport should be timed to arrive on paediatric cardiothoracic ITU at least 30 minutes before surgery is due. Ring them again before you set off from the RVI to inform them.

7 The baby should stay in the transport incubator under the care of the transport team until going to theatre.

8 On return from theatre

- the baby should be stabilised and returned to the transport incubator under the care of the transport team
- do not leave until satisfied about the baby's condition
- make sure there is a note of the operation in the infant record and clarify what stitch has been used (and when it should be removed if non dissolvable)
- make sure that details of the baby's condition and treatment during anaesthesia are available in the infant's case record (it may be easiest to photocopy the anaesthetic record)
- Check a **blood gas** prior to departure and show to anaesthetic team (hypocarbia is common)

- There may be a chest drain in situ. It is usual to get a **CXR** before leaving for the RVI to confirm tube placement and the absence of any pneumothorax. Ensure the anaesthetic team are aware of the CXR findings
- Ring ward 35 RVI before you set off.
- Consider a further dose of 200µg/kg morphine prior to departure if no opiates have been given. Check with the anaesthetist to ensure you know what drugs have been given.

9 Check a blood gas within 20 minutes of arriving back at the RVI. Observe for hypovolaemia postoperatively and give volume support as necessary. Watch the urine output and monitor cardiovascular status carefully. Inotropes may be needed. If they are, it may be appropriate to avoid those that cause increased afterload. Discuss with a consultant.

10 As with any laparotomy or thoracotomy, effective doses of opiates (i.e. greater than the doses used for 'sedation' alone) need to be given for at least 2 - 3 days post operatively for pain.

4.1. Pre-op check list for PDA ligation

(i.) Parents informed and arranged to attend at Freeman
(ii.) Check FBC/U&E day before and correct significant anaemia/electrolyte abnormality
(iii.) Consider need to discuss with paediatric cardiothoracic anaesthetist
(iv.) ADULT unit blood cross matched and sent to Freeman
(v.) Check requirement for platelet transfusion etc. If platelets needed inform transfusion lab.
(vi.) Baby intubated and ventilated and blood gas checked
(vii.) Take infant case record and relevant CXRs to Freeman.
(viii.) SpR and nurse organised and ambulance booked to arrive 30 minutes before planned surgery
(ix.) Freeman rung before setting off.

5. References

1 Prevalence of Spontaneous Closure of the Ductus Arteriosus in Neonates at a Birth Weight of 1000 Grams or Less. *Pediatrics.* 2006;117;1113-1121

2 Ahmed Cherif, Naima Khrouf, Sami Jabnoun,et al. Randomized Pilot Study Comparing Oral Ibuprofen With Intravenous Ibuprofen in Very Low Birth Weight Infants With Patent Ductus Arteriosus. Pediatrics 2008;122;e1256-e1261

3 Ohlsson A, Walia R, Shah S. Ibuprofen for the treatment of patent ductus arteriosus in preterm and/or low birth weight infants. Cochrane Database Syst Rev. 2008 Jan 23;(1):CD003481

PDA LIGATION REFERRAL / ACCEPTANCE FORM

Family Name		GP's Name	
First Name		GP's Practice	
Address		Address	
Post Code		Post Code	
Male/Female			
D.o.B.		Current Height	
NHS No.		Current Weight	
Referred from			
Hospital:		Consultant:	
Hospital No.:		Registrar:	
Contact number for referring doctor:			

Call taken by (Freeman Hospital)	Referral date
Registrar:	Consultant:

***MRSA STATUS:** (*Must be recorded)

Once completed please e-mail this form to the Consultant Cardiologist on-call and Frances Bray (Secretary)

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