

## Clinical Guideline

**PDA: Patent Ductus Arteriosus - Guidance for Referral for Cardiological Assessment and Possible Ligation for Preterm Infants**

<b>SETTING</b>	Women's and Children's Division, Bristol Royal Hospital for Children (BRHC) and Neonatal intensive Care Unit (NICU) St Michael's Hospital, All Referring Institutions to BRHC for PDA assessment / ligation in the South West of England and South Wales Areas.
<b>FOR STAFF</b>	All medical and nursing staff
<b>PATIENTS</b>	Preterm neonates with PDA

**Containing:**

1. Referral Process for Cardiological Assessment and Possible Ligation for Preterm Infants with Patent Ductus Arteriosus (PDA).
2. Neonatal cardiographic evaluation for patent ductus arteriosus
3. Appendix 1 - Patent Ductus Arteriosus information for parents
4. Appendix 2 - Patent Ductus Arteriosus referral form

Referral Process for Cardiological Assessment and Possible Ligation for Preterm Infants with Patent Ductus Arteriosus (PDA).

**Who should be referred and what should be done before referral / transfer to Bristol?**

PDA Ligation in preterm infants carries a significant (up to 10%) risk of mortality as well as significant risk of post-operative morbidity. Therefore it is a procedure that should only be considered in infants for whom the alternative (i.e. not ligating the ductus) is deemed by the treating doctors to carry a higher risk of adverse outcome.

The published data on outcomes for infants in whom ligation has or has not been performed does not permit a simple evidence-based approach to identify those infants for whom ligation is most appropriate.

Ligation of a PDA should only be considered for the following groups of infants, and (except in unusual circumstances) when the following conditions have been met:

- a. The infant has a "*clinically significant*" PDA (see below)
- b. The infant was born at 30 weeks gestation or less
- c. The infant is now 3 weeks or more of age
- d. The infant is currently ventilator-dependent and not making clear progress towards extubation\*\*
- e. Treatment with indomethacin/ ibuprofen has been considered and at least one course (usually two) has been given if appropriate unless contra-indications to treatment present.
- f. The infant has already received a course of steroid treatment for chronic lung disease, or the treating neonatal team consider that there is a contra-indication to this treatment.
- g. The infant has been given at least a short course of diuretic therapy to improve pulmonary compliance.
- h. There is currently no evidence of untreated infection or NEC.

\*\*Although the great majority of infants referred for PDA ligation will be ventilator dependent, a small group may be considered for ligation if they are on high level FiO<sub>2</sub> and / or Continuous Positive airways Pressure (CPAP) and cannot be weaned, and /or they are not tolerating sufficient enteral nutrition to grow and the PDA is felt to be the main factor underlying this problem.

Almost all infants who are to be considered for PDA ligation should meet the criteria, or have an identifiable contra-indication to such treatment options.

### **Echocardiographic Evaluation for Haemodynamically significant patent arterial duct. Refer to separate PDA evaluation sheet.**

Criteria that support the diagnosis of a haemodynamically significant duct:

- Minimum ductal dimension > 2 mm at its narrowest point
- LA:Ao ratio >1.5
- Peak left to right ductal maximum velocity <2m/s
- Holodiastolic flow reversal in the descending aorta at level of the diaphragm

### **Who should be involved in the initial discussion/decision re transfer, and how can we ensure good inter-professional communications?**

The referring neonatal team should contact the cardiology team in South Wales\*\*\* or Bristol, and also discuss the infant with the on-service neonatologist at St Michael's Hospital at the earliest opportunity – it is commonly helpful for the St Michael's' Hospital team to know of the existence of an infant who may require PDA ligation but who is currently going through the later stages of the above pre-transfer treatment options.

A faxed referral form should be completed by all the referring teams to both BRHC cardiology and UHB NICU if formally referring a patient.

\*\*\*For referrals from South Wales the Welsh cardiology team will communicate the echo findings to the Bristol cardiology team.

Most infants being considered for PDA ligation will be listed for discussion at the weekly Joint Cardiac Conference (JCC) meeting, however, decisions and arrangements may need to be made more rapidly, so transfer should not be delayed by the timing of the JCC meeting. The decision to ligate the PDA or not will be made by the receiving neonatologist with input from the cardiologist(s) on service and the referring neonatologist. If there is clinical urgency and all on-service professionals agree that ligation is clearly indicated, infants requiring a PDA ligation do not necessarily need to be discussed at JCC.

### **What should be said to parents, and how can we ensure consistency of communication with them?**

The condition of small sick preterm infants can change rapidly. Even in infants who have a large, haemodynamically significant PDA on one day, a repeat assessment the following day may show much less marked findings, the PDA may even have closed spontaneously, or another problem may have arisen.

Thus it is very important for parents to understand that, although the best assessment before transfer is that surgical ligation of the PDA is the most likely and most appropriate course of treatment, the operation itself carries some risk, and therefore the cardiac team in Bristol, together with the neonatal team will need to make a final assessment before proceeding to perform this operation. It is very important that the family is informed that the baby's condition may change, and the operation may not be performed immediately, or at all.

The referring team must therefore as far as possible ensure the family understands before the baby is transferred that such changes may occur. The parents should be given the information leaflet "Patent Ductus Arteriosus Assessment and your Baby".

It is also very important that the Bristol teams (both cardiac and neonatal) recognise the importance of maintaining good communication with the referring team and the family so that, if the baby's condition changes, and the operation is delayed or deemed to be not required, there is no implied criticism of the referring team, their management of the baby or their previous assessment. Similarly the referring team needs to recognise that changes in the provisional plan may need to be made if the baby's condition changes, or if the Bristol team feel that, after careful assessment,

an alternative approach may be better. Fundamental changes to the planned medical or surgical management of the baby will only be made in the best interests of the baby, and in discussion with the referring team.

## Neonatal cardiographic evaluation for patent ductus arteriosus

### Requested Anatomy and Parameters

#### Assess for presence of Persistent foramen Ovale (PFO) / Atrial Septal Defect (ASD)

##### Assessment of left heart:

- 2-D LA diameter in long axis view (mm)
- Left atrial area ( $\text{cm}^2$  – trace in ventricular systole)
- LA to Ao ratio (Ao dimension on M-mode at early systole, LA dimension on M-mode at end ventricular systole, both leading edge to leading edge – see figure below)
- Left ventricular dimensions and function:
  - LV end systolic and end diastolic dimensions either on 2D or M-mode at level of tips of MV
  - Using LV end diastolic and end systolic dimensions calculate fractional shortening

##### Assessment of PDA and its effects:

- Record peak systolic arterial blood pressure at time of assessment
- Record whether or not there is a clear ductal ampulla
- Record minimum PDA size (mm) in short axis and “ductal view”
- Assess PDA using continuous and pulsed-wave Doppler (NB – ECG trace on)
  - Record direction of PDA shunt (exclusive L→R, bidirectional, exclusive R→L)
  - Record highest systolic ductal velocity
  - Record highest diastolic ductal velocity
- Record aortic flow using PW Doppler at level of diaphragm (subcostal view) – note whether there is diastolic flow reversal
- Record superior mesenteric artery flow using PW Doppler – note whether there is absence of diastolic flow

##### Exclusion of other pathology

Has the scan excluded duct-dependent congenital heart disease?

Has the scan excluded coarctation of the aorta or suspected arch pathology? Record the diameter of the aortic isthmus (segment of aorta between L subclavian artery and PDA).

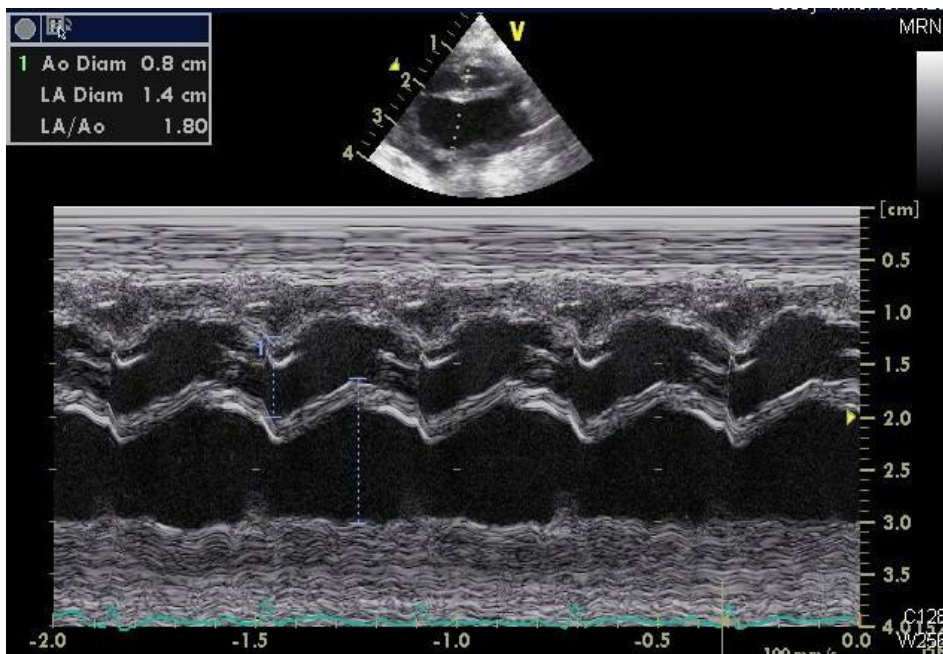
##### Criteria that support the diagnosis of a haemodynamically significant duct

- Minimum ductal dimension > 2 mm at its narrowest point
- LA:Ao ratio >1.5

- Peak left to right ductal maximum velocity <2m/s
- Holodiastolic flow reversal in the descending aorta at level of the diaphragm

### Echocardiographic Contraindications to surgical ductal closure

- Duct-dependent congenital heart disease
- Coarctation of the aorta or suspected arch pathology
- Any right to left shunting at ductal level



### References:

1. Targeted Neonatal echocardiography in the Neonatal Intensive Care Unit: Practice Guidelines and Recommendations for Training. Mertens L et al. J Am Soc Echocardiogr 2011;24:1057-78.
2. Does echocardiography facilitate determination of haemodynamic significance attributable to the ductus arteriosus? Sehgal A & McNamara P. Eur J Pediatr.2009;168:907-91
3. Echocardiographic Assessment of Ductus Arteriosus Shunt in Premature Infants. Silverman N et al. Circulation 1974; 50: 821-825

### QUERIES

Contact NICU Ext 21736 / 21737

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## Patent Ductus Arteriosus Assessment and your Baby - Information for Parents

### Patent ductus arteriosus information

A baby in the womb gets its oxygen from the placenta and not from the lungs.

The ductus arteriosus (or duct) is a blood vessel that allows blood to bypass the baby's lungs when in the womb.

When babies are born the duct will usually close in a few of days.

If the duct remains open, it is known as a patent ductus arteriosus, or PDA.

Having a PDA means a baby has extra blood flowing to the lungs. As a result, there can be extra strain on the left-hand side of the heart, which has to collect and pump the extra blood. The extra blood passing to the lungs may also mean that the lungs do not work as efficiently as they should.

### Why does my baby have a PDA?

PDA is often seen in babies born very prematurely and does not have anything to do with what you did or did not do during the pregnancy.

Often the PDA will close on its own or with medicines. Sometimes it stays open in very premature babies and this may be a sign that your baby's lungs have some changes due to being born so early.

### What are the signs and symptoms of PDA?

The signs and symptoms will vary depending on the size of the PDA and the age of your baby-

**Small PDA** Your baby may not have any symptoms and the PDA may only be picked up at a routine examination where a heart murmur is heard.

**Large PDA** Your baby may have signs that the heart is struggling to cope with the extra work, such as breathlessness or needing a machine such as CPAP or a ventilator to help with breathing. Your baby may also have difficulty absorbing feeds and failure to grow properly.

### How is PDA diagnosed?

Your baby will have an ultrasound scan of the heart (an echocardiogram, or "echo"). It allows doctors to see the PDA, the main blood vessels, the structure of the heart, how blood is moving through the heart and the effect the abnormal blood flow is having on the heart, lungs and body.

Doctors will look to see whether the left ventricle (the main pumping chamber to the body) is bigger than it should be. They will also look to check that the blood pressure in the lungs is high (pulmonary hypertension).

The doctors will also try to work out if your baby's lungs are being affected by the blood flowing from the PDA and whether they should use medicines to treat your baby's PDA or lungs.

### How is PDA treated?

This will depend on how your baby is doing, the size of the PDA and how the extra blood flow through the heart and lungs is affecting your baby.

Sometimes it may be best to wait a little bit to see if the PDA gets smaller on its own.

Sometimes the treatment is with medicines, such as Brufen (Ibuprofen), to try to close the PDA.

Sometimes doctors will need to give your baby diuretics (to make your baby pass more urine) to help with removing extra water from the lungs.

Sometimes doctors need to treat a baby's lungs with steroids to make the lungs better.

If these methods are not appropriate or do not work, your baby may need surgery, to ligate (tie-off) the PDA and so make blood flow normally around your baby's body.

### What happens next?

Your baby's doctors and cardiologists (heart doctors) will discuss your baby's condition and heart scan findings with the cardiologists and NICU specialists in Bristol.

Your baby may then be transferred to Bristol, usually the NICU at St. Michaels Hospital, for further assessment.

A further assessment will be needed at St Michael's Hospital because his/her condition might have changed, even in the relatively short time since his/her previous assessment at the local hospital. Your baby will have a heart scan done by the Cardiology specialists in Bristol to check his / her heart. The Neonatal team will review your baby's health, lungs, and ventilation. The Neonatal and Cardiology teams will discuss the findings and plan for further medical management or for surgery.

A decision will then be made, on a case-by-case basis, as to whether PDA surgery is needed or not.

This type of operation (PDA ligation) is usually straightforward, but can have complications. This will be discussed with you once a decision for surgery has been made, at the time of signing a consent form for surgery.

The operation is done through an incision (cut) on the left side of the chest, under the armpit. Your baby will be on a ventilator for this process and will be given medicines to keep your baby calm, and free of pain and stress.

Your baby will be transferred back to your local hospital after the Bristol team is satisfied your baby is stable and well.

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*Arising from a multidisciplinary meeting held in Bristol on December 7<sup>th</sup> 2012.* Co-authors Drs. Geraint Morris Swansea, Jenny Calvert Cardiff, Sunil Reddy Newport, David Evans Southmead, Alex Allwood Plymouth (Neonatology), John Forsey Bristol, Mark Walsh Bristol and Dirk Wilson Cardiff (Paediatric Cardiology), Andrew Parry Bristol (Cardiothoracic Surgery).

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Appendix 2

**Standard Operating Procedure and Referral Form**  
**Referral for Assessment and Possible Ligation of PDA from Hospitals outside of UHBristol**

Fax to both UHB Cardiology 0117 342 8432 and UHB NICU 0117 342 5721

<b>Referral Hospital</b>	_____	<b>Date of referral</b>	_____
<b>Name of Patient</b>	_____	<b>Date of Birth</b>	_____
<b>Gestation</b>	_____	<b>Age</b>	_____
<b>Current Gestation</b>	_____		
<b>Birth Weight</b>	_____	<b>Current Weight</b>	_____

**Previous Medical History/Co-Morbidities**

\_\_\_\_\_  
\_\_\_\_\_

**Ventilator / Respiratory Support**

Mode \_\_\_\_\_ Settings \_\_\_\_\_ MAP \_\_\_\_\_  
 FiO<sub>2</sub>(%) \_\_\_\_\_ ETT size and position \_\_\_\_\_ PO/Nasal (circle)

Previous planned extubation(s), ventilator settings and outcome

\_\_\_\_\_  
\_\_\_\_\_

Dexamethasone Y / N \_\_\_\_\_

Last Chest X-Ray findings \_\_\_\_\_

**Cardiological Evaluation**

Hepatomegaly Y / N \_\_\_\_\_ Cardiomegaly Y / N \_\_\_\_\_

Presence of PFO / ASD : Y / N \_\_\_\_\_

Left atrial / Aortic ratio:

LV end systolic dimension: \_\_\_\_\_

LV end end diastolic dimension: \_\_\_\_\_

LV fractional shortening: \_\_\_\_\_

Presence of ampulla (Y / N) : \_\_\_\_\_

Minimum PDA size (mm): Short axis \_\_\_\_\_ "Ductal view" \_\_\_\_\_

Highest systolic ductal velocity: \_\_\_\_\_ Highest diastolic ductal velocity: \_\_\_\_\_

Peak systolic arterial blood pressure at time of assessment (mmHg): \_\_\_\_\_

Direction of PDA shunt (circle): Exclusive L→R \_\_\_\_\_ Bidirectional \_\_\_\_\_ Exclusive R→L \_\_\_\_\_

Reversal / Absent of flow in (circle):

Descending aorta Y / N / not assessed

Superior Mesenteric artery Y / N / not assessed

Duct-dependent congenital heart disease excluded? Y / N

Coarctation of the aorta or suspected arch pathology excluded? Y / N

**Treatment**

NSAIDs Y / N Courses and timing \_\_\_\_\_

NSAIDs, if "No", list contraindications  
 Loop diuretic tried Y / N - list Rx and doses

**Current medications**

Inotropes : Dopamine  Dobutamine  Hydrocortisone  Other

Feeds / Nutrition \_\_\_\_\_

Abdominal distension or GI aspirates \_\_\_\_\_

**Assessment of sepsis**

Recent cultures (including surface swabs)

\_\_\_\_\_

Any history of (circle): MRSA Y / N Pseudomonas Y / N  
 Latest CRP (date) \_\_\_\_\_ Latest platelet count (date) \_\_\_\_\_

Coagulation / INR \_\_\_\_\_

**Other**

Significant peripheral oedema (circle) Y / N

Cranial USS results (date)

\_\_\_\_\_

**Social**

List any social concerns

\_\_\_\_\_

Mother's full name \_\_\_\_\_

Mother's best contact number \_\_\_\_\_

Father's full name \_\_\_\_\_

Father's best contact number \_\_\_\_\_

Parents have independent transport? Y / N

Parents received explanation and information leaflet re assessment and possible litigation Y / N

Referred by: Name ..... Signature.....

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