

Management of PDA in the NICU

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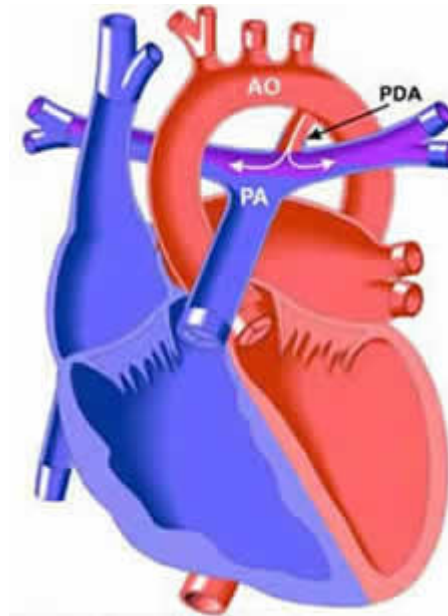
Mednax

Covenant Healthcare

Patent Ductus Arteriosus

- **Ductus arteriosus part of the fetal circulation**
- **Diverts Blood away from the lungs**
- **In term infants ductus closes by 72 hrs**
- **In preterm infants patent ductus arteriosus is common, inversely related to gest age**
- **75% in infants less than 28 weeks**

PDA



Mechanism of Ductal Closure

- Fetal ductus is kept patent by low art PO₂ and Prostaglandin E₂ produced partly by placenta
- At birth increase in PO₂ and decrease in PGE₂ triggers ductal constriction
- Functional closure in 10-15 hours
- Ductal tissue hypoxia leads to cell death
- In 2-3 weeks anatomic closure

Ductal Closure in Preterm

- **Ductal closure delayed in preterm infants**
- **Risk inversely proportional to gest age**
- **Risk is higher in infants < 30 weeks**
- **Risk higher in infants with RDS**
- **Risk higher if no prenatal steroids**

Ductal Closure in Preterm

- **Oxygen has less constrictor effect due to greater sensitivity to PGE2 and NO**
- **Less ductal tissue hypoxia in preterm due to thin wall**

Pathophysiology of PDA

- Decreased systemic organ blood flow and tissue oxygenation
- Increased blood flow to the lungs
- Doppler US and near infra red spectroscopy has shown decreased flow and oxygenation

Pathophysiology

Effects on the Lungs

- Increased lung water and pulmonary edema
- Reduction in lung compliance
- Increased ventilation and oxygenation requirements, lung injury
- Chronic Lung Disease
- Pulmonary haze

Pathophysiology Effect on GI Tract

- **Decreased mesenteric blood flow**
- **GI injury**
- **Translocation of bacteria**
- **Necrotizing enterocolitis (NEC)**
- **Local ischemia, spontaneous intestinal perforation (SIP)**

Pathophysiology

Effects on CNS

- **Alterations in cerebral blood flow, intraventricular hage (IVH)**

Pathophysiology

Renal Effects

- **Decreased blood flow to kidney**
- **Elevated BUN, creatinine**
- **Decreased kidney function, poor urine output**

Signs

- **Heart murmur**
- **Bounding pulses**
- **Wide Pulse Pressure**
- **Active precordium**
- **Metabolic acidosis**

Symptoms

- **Hypotension**
- **Resp distress**
- **Pul hage, bloody tracheal asp**
- **Poor urine output**

Chest xray findings

- **Cardiomegaly**
- **Pulmonary edema**

PDA



Echocardiography

- **Amount of ductal shunt**
- **Ductal diameter**
- **Size of chambers of heart, enlargement of atria, ventricular**
- **Myocardial function**

Treatment of PDA

- **Medical Treatment**
- **Surgical treatment**

- **Aggressive treatment**
- **Conservative or expectant management**

Treatment of PDA

Medical

- **Indomethacin --- FDA approved**
- **Ibuprophen ---- FDA approved**

- **Acetoaminophen --- Not FDA approved**

Indomethacin

- Prostaglandin inhibitor
- PDA closure in 70%
- 1-2 courses are given
- Prophylaxis --- decrease in severe IVH
- Side effects:
- Risk of bleeding
- NEC
- SIP
- Renal dysfunction

Ibuprofen

- **Prostaglandin Inhibitor**
- **Not approved for prophylactic use**
- **Does not decrease IVH**
- **Ductal closure in 70%**
- **Decreased risk of renal dysfunction and NEC**

Acetoaminophen

- **Not FDA labeled for neonatal use**
- **Prostaglandin inhibitor at another site (peroxidase) on the prostaglandin synthase enzyme**
- **Ductal closure 70%**
- **No effect on kidney or intestine**
- **Concern for hepatotoxicity**
- **Safety data lacking**

Aggressive VS Conservative Treatment

- **Aggressive Treatment**
 - Prophylactic treatment**
 - Early ECHO and treatment**
- **Medical treatment, if fails, ligation**

Conservative Management

- **Spontaneous closure in sig number of VLBW infants**
- **Treatment only if cardio-pulmonary compromise with a hemodynamically significant PDA**
- **Fluid restriction**
- **Diuretics**

Surgical Treatment

- **Ligation**
- **Percutaneous Transcatheter closure**

Surgery

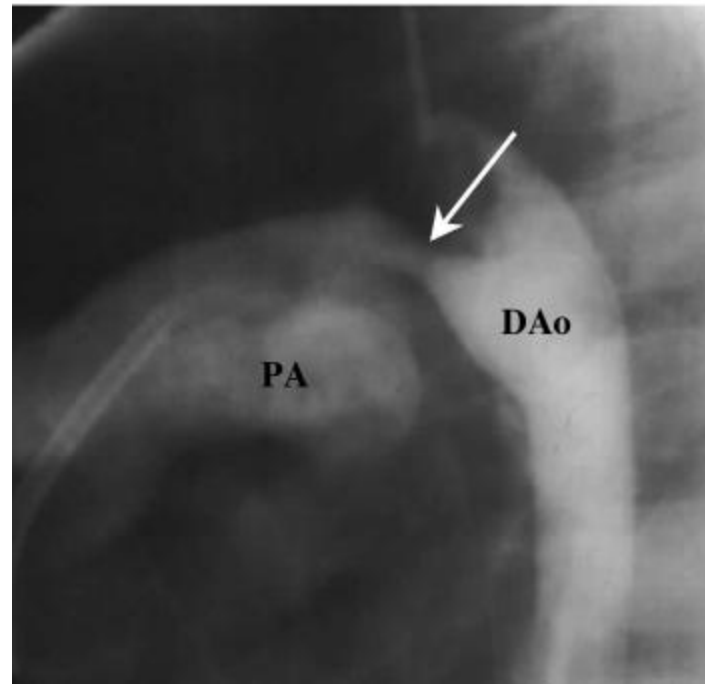
PDA Ligation

- **Done if medical treatment fails**
- **Increased risk of BPD, severe ROP**
- **Increased risk of neurodevelopmental impairment**
- **Chylothorax**
- **Infection**
- **Vocal cord paralysis**

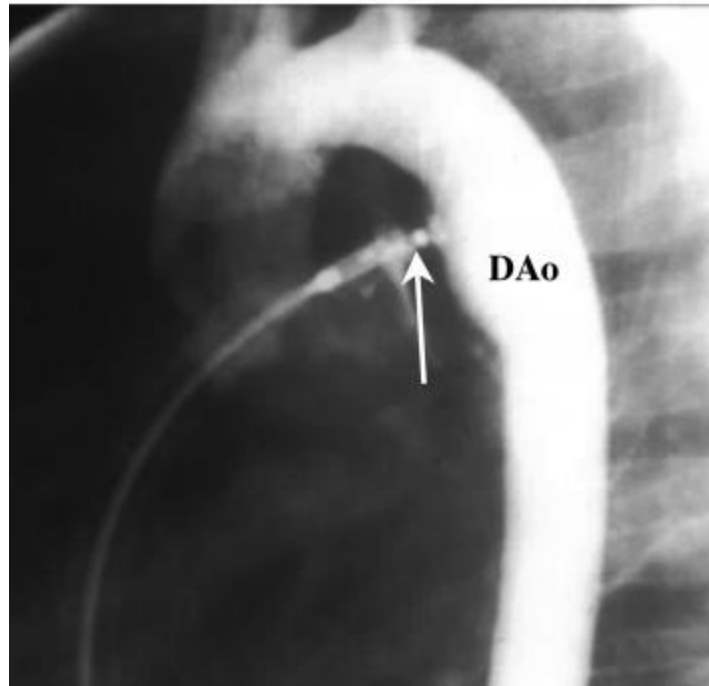
Surgical Closure

- **Percutaneous Transcatheter Closure**
- **Coil, other devices**
- **Less invasive**
- **Fewer adverse effects**
- **94% success rate**
- **Usually 6 months, 6 kg**
- **Small study successful with < 3 kg**

Lateral Aortogram in PDA



Lateral Aortogram-PDA Closure



Post operative consequences of PDA ligation

**Sudden and dramatic changes in cardiac
physiology**

**Fall in preload due to sudden reduction
in pulmonary blood flow**

**Increase in afterload due to increase in
systemic vascular resistance**

Myocardial dysfunction

Post Ligation cardiac Syndrome Definition

- **Fall in systolic pressure below 3rd %ile requiring inotropes**
- **Increasing vent requirement and Fio₂ at least 20%**

Post Ligation Cardiac Syndrome

- **6-12 hrs post surgery**
- **Hypotension**
- **Hypoxemia**
- **High mortality, (33% vs 11%)**
- **Occurs in upto 50% of infants undergoing PDA ligation**

Pre-operative risk factors for PLCS

- **Early ligation, within the first 4 weeks, Vs late ligation , after 4 weeks.
27% vs 5%**
- **Presence of NEC or preoperative shock**
- **Birth weight less than 1000 gms**
- **Less than 26 weeks gestational age**

Pulmonary mechanics after PDA ligation

- **Improved compliance after PDA ligation**
- **LV dysfunction may lead to pul edema**
- **Lung collapse may interfere with ventilation**

Management of PLCS

- **Decreased Preload: Volume**
- **Increased afterload: Avoid dopamine and epinephrine, use dobutamine, milrinone**
- **Hydrocortisone**
- **Ventilator management: Compliance improves and weaning MAP prevents overdistension and improves venous return**
- **Left Ventricular dysfunction may cause pulmonary edema**
- **Lung collapse may interfere with ventilation**

Outcomes

- **Risks and benefits of treatments vs risks of continued PDA**
- **Comparable outcomes with both aggressive and conservative approaches in randomized controlled trials**