**PATENT DUCTUS ARTERIOSUS- A CONGENITAL HEART DEFECT AFFECTING NEWBORNS**

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**Abstract:**

Patent ductus arteriosus (PDA) is a congenital heart condition that affects some babies, more often premature infants. The ductus arteriosus, a small opening, is a component of the baby's blood circulation system in mother's womb. Usually, it disappears soon after birth. But, sometimes it remains patent and leads to blood flow difficulties between heart and lungs, known as patent ductus arteriosus. PDA can occasionally resolve itself. When it doesn't, medical professionals use medication, catheterization, and surgery to treat PDA and re-establish normal circulation. Small patent ductus arteriosus is frequently trouble-free and may never require treatment. Untreated, a big patent ductus arteriosus might allow oxygen-poor blood to flow in the wrong directions. This may cause heart failure and other issues by weakening the heart muscle.

**Anatomy:**

A foetal conduit called the ductus arteriosus permits oxygenated blood from the placenta to bypass the baby's lungs while still inside the womb. At birth, blood travels from the right ventricle to the lungs for oxygenation, the lungs fill with air with the first breaths, and the pulmonary vascular resistance decreases. The ductus constricts as a result of the reduced ductus arteriosus flow and elevated arterial oxygen tension. In healthy, full-term babies, the ductus arteriosus is effectively closed by 12 to 24 hours of age. Within two to three weeks, the permanent (anatomic) closure is complete.

The ductus arteriosus (DA) does not close quickly in premature infants, and side effects may necessitate pharmacological or surgical closure.[1][2][3]

In Foetal circulation, the ductus arteriosus is a normal vessel that allows blood from the right ventricle to bypass the pulmonary circulation and reach the descending aorta. Embryologically, the ductus arteriosus is a remnant of the distal sixth aortic arch and connects the proximal descending aorta to the main pulmonary artery. The ductus enters the anterior pulmonary artery directly posterior to the arch of the aorta. Usually, it is conical in shape with a big aortic end and a smaller pulmonary end. The ductus's size, length, and shape can vary greatly, though..

Based on its angiographic features, the Patent Ductus Arteriosus (PDA) is classified into the various following types:

* Type A: Conical
* Type B: Window
* Type C: Tubular
* Type D: Complex
* Type E: Elongated

**Epidemiology:** In infants, patent ductus arteriosus is the most prevalent cardiac condition. Premature babies are more frequently diagnosed with the disease by medical professionals.

In the USA, 8 out of every 1,000 preterm newborns and 2 out of every 1,000 full-term births experience it. [4]

The danger rises as the baby is born earlier. The incidence in Premature babies inversely related to body weight and gestational age of an infant… It is shown as

10% of infants born between 30 and 37 weeks of pregnancy experience PDA.

Between 25 and 28 weeks of pregnancy, 80% of babies are affected.

90% of babies shows PDA if born before 24 weeks of pregnancy.[5]

**Pathophysiology:** The ductus arteriosus, a typical link between the pulmonary artery and aorta, is required in normal foetal circulation. The ductus arteriosus closes after birth as a result of the increase in PaO2 and decrease in prostaglandin concentration, usually starting within the first 10 to 15 hours of life. The ductus arteriosus will remain patent if this natural process does not take place..

Physiologic effects vary with ductal size. Small ductus symptoms are uncommon. A big left-to-right shunt (blood flow from the descending aorta via the patent ductus arteriosus into the pulmonary arteries) is brought on by a huge untreated ductus. If the ductus persists in being open after delivery, it is linked to bronchopulmonary dysplasia (BPD), necrotizing enterocolitis, intraventricular haemorrhage, congestive heart failure, and renal failure. [6,7,8]

**Signs and symptoms:** The size of the opening between a baby's aorta and pulmonary artery determines the PDA symptoms. Your baby might not exhibit any symptoms if the opening is small. Some persons don’t show any symptoms until adulthood. However, a large PDA often cause heart failure symptoms in infants or adults such as

**Symptoms with large PDA:**

Rapid or forceful breathing

Dyspnoea- Shortness of breath

Respiratory diseases that are common

Tachycardia- Increase in heart rate than normal resting heart beat

Heart murmurs (a "whooshing" sound caused by irregular heart blood flow)

Poor eating and sluggish weight gain

Inability to feed or fatigue while feeding

Sweating or crying while feeding

**Causes and risk factors:** Experts are unsure of the precise cause of PDA. Infants who are premature (born more than three weeks before the expected due date) are substantially more likely to experience it. According to studies, PDA affects 65% of children who are born before the 28th week of pregnancy. It is uncommon in fully developed infants and twice as common in girls as in boys.

Among the prenatal conditions and exposures related to PDA are calcium channel blockers, cocaine use, magnesium exposure, and diabetes in mothers. PDA has been connected to neonatal disorders and exposures such as extreme preterm birth, respiratory distress syndrome, neonatal infection, high altitude delivery, excessive fluid administration, loop diuretics, aminoglycosides, cimetidine, and heparin. [9,10]

**Risk factors:**

PDA can occasionally coexist with other heart conditions. Congenital heart abnormalities like PDA may become more common as a result of:

Specific genetic disorders- eg: Down syndrome (Trisomy 21),  [Loeys–Dietz syndrome (LDS), an autosomal dominant genetic connective tissue disorder seen in other heart defects also.](https://en.wikipedia.org/wiki/Loeys%E2%80%93Dietz_syndrome)

A history of congenital heart disease in the family.

Unborn foetal distress

Pregnancy-related infections in the mother or foetus, including rubella-

Other risk factors for pregnancy, such smoking or taking certain medications.

**Diagnosis:** A health care provider may notice the signs of PDA soon after birth. During a physical exam, they listen for a heart murmur or congestion in the lungs. They also check the baby’s pulse rate and blood pressure.

Various non-invasive tests for PDA help identify signs of the hole and may include…

Echocardiogram— an ultrasound scan used to capture the motion of the heart

Electrocardiogram— a test that uses electrodes to evaluate the heart.

X ray Chest- Reveals about heart size and blood flow to the lungs. [11]

**Complications:** Small ductus arteriosus patents may not result in complications. Larger, unattended faults may result in

* **Pulmonary hypertension:** A medical condition that cause elevated blood pressure in the lungs. The heart and lungs experience erratic blood flow as a result of a large PDA. Pressure in the pulmonary artery increases as a result. The smaller blood arteries in the lungs are damaged over time by the increased pressure. Eisenmenger syndrome is a type of irreversible and potentially fatal lung injury.
* **Heart failure:** Symptoms such as rapid breathing, often with gasping breaths, and poor weight gain.
* **Endocarditis:** A patent ductus arteriosus can increase the risk of infection of the heart tissue, called endocarditis. It can be life-threatening.

**Treatment:** Infants who are gestationally more mature may be supported by cautious care of a PDA while waiting for spontaneous closure. To treat pulmonary oedema, conservative management techniques include a cautious fluid restriction (110 to 130ml/kg/d while monitoring urine output) and raising peak expiratory pressure (PEEP). Due to the paucity of evidence that diuretics enhance outcomes in very preterm infants, the possibility that they impede PDA closure, and the potential difficulty in managing electrolyte imbalances in these infants, diuretics are contentious. [11,12,13]

The course of treatment differs whether the infant is full term or preterm infants.

**Preterm infants- Treatment approach:**

Fluid restriction might make the ducts close easier.

A patent ductus arteriosus is often left untreated in premature new-borns who do not have respiratory or other compromises.

A COX inhibitor (such as ibuprofen lysine or indomethacin; may occasionally be used to close the PDA in preterm children with a hemodynamically severe PDA and poor respiratory status. COX inhibitors stop the synthesis of prostaglandins, which is how they function. Based on urine production, three doses of indomethacin are administered intravenously (IV) every 12 to 24 hours; doses are postponed if urine output is less than 0.6 mL/kg/hour. Ibuprofen lysine 10 mg/kg orally, followed by two doses of 5 mg/kg spaced 24 hours apart, is an option.

**Full term Infants- Treatment approach:**

In general, COX inhibitors are ineffective in full-term new-borns.

The optimal method of treatment for PDA in children older than one year is transcatheter closure. Some experts also believe that transcatheter closure is the best option for term neonates and early babies. There are several catheter-delivered occlusion devices that can be used, such as coils and septal duct occluders.

In new-borns under one year old with ductal architecture unsuitable for transcatheter closure, surgical division and ligation may be preferable over the transcatheter method. Closure should be carried out following medical stabilisation in cases when the patent ductus arteriosus has a shunt large enough to result in heart failure or pulmonary hypertension symptoms. Closure is an option for persistent PDAs without heart failure or pulmonary hypertension at any time after one year. Delaying the treatment gives the wound time to heal naturally and reduces the likelihood of a vascular problem. [14]

**Prognosis:** The prognosis is favourable for new-borns who just have an isolated PDA. The prognosis for preterm new-borns depends on other comorbidities. Most kids have a normal life expectancy after PDA closure. Rarely does the PDA close on its own. Nearly 80–90% of neonates who get indomethacin will have their PDA successfully closed. Under the condition that the patient has not yet developed fixed pulmonary hypertension, a surgical closure is always necessary in adults. The PDA relates the blood flow rate to the morbidity and mortality. Pulmonary hypertension can develop without treatment and cause early mortality.

**Prevention:**

A patent ductus arteriosus cannot be prevented, as far as is known. To have a safe pregnancy, nevertheless, it's crucial to take all reasonable precautions. Here are some fundamentals:

* Eat healthy diet
* Exercise regularly
* Early prenatal care
* Avoid smoking and alcohol during pregnancy
* Get recommended vaccines before or during pregnancy
* Control of blood sugar levels

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