CONDITION

Patent ductus arteriosus

Patent ductus arteriosus is a blood vessel near the heart that stays open after birth.

WHAT IT IS
Persistent opening between the aorta and pulmonary artery

BODY SYSTEM
Heart and circulation

MAIN SYMPTOMS
Often none, fast breathing, poor feeding, poor weight gain

WHAT CAUSES IT
Delayed closure after birth, often linked to prematurity

HOW IT IS DIAGNOSED
Echocardiogram with Doppler blood-flow imaging

MAIN TREATMENT
Monitoring, medicines, catheter closure, or surgery

CAN IT BE CURED?
Yes - closure can seal it permanently

IS IT AN EMERGENCY?
Sometimes - severe breathing difficulty or blue-grey skin

LONG-TERM OUTLOOK
Usually excellent after closure, poorer with irreversible lung damage

Overview

Patent ductus arteriosus, or PDA, is an opening between two major blood vessels near the heart. "Patent" means open.

Before birth, a blood vessel called the ductus arteriosus connects the pulmonary artery to the aorta. The pulmonary artery normally takes blood to the lungs. The aorta carries blood from the heart to the body.

This connection is necessary during pregnancy because a fetus receives oxygen through the placenta rather than the lungs. After birth, the lungs begin working and the ductus arteriosus usually narrows and closes.

With PDA, the vessel remains open. Blood can then move from the aorta back toward the lungs. The amount depends mainly on the width of the opening and the pressure in the blood

vessels.

A small PDA may cause no symptoms and may only be found during a routine examination. A large PDA can send too much blood through the lungs and make the heart work harder. Over time, an untreated large opening can damage the heart and lung circulation.

PDA is especially important in babies born prematurely. In these babies, it may be one part of a more complex period of breathing and circulation problems after birth.

Symptoms

Symptoms depend on the size of the PDA, the baby's age and whether there are other heart or lung conditions.

A small PDA often causes no noticeable problems. A clinician may hear a heart murmur, which is an extra sound caused by blood moving through the opening.

A larger PDA in a baby may cause:

Premature babies may need more oxygen or breathing support than expected. Their blood pressure and urine output can also be affected. These signs are not specific to PDA, so tests are needed to understand the cause.

Older children and adults with a previously undetected PDA may have no symptoms. If the opening is large, they may become short of breath during activity, tire easily or feel a forceful heartbeat.

Blue or grey skin is not typical of an uncomplicated PDA. It can occur if severe lung-vessel damage eventually reverses the direction of blood flow. This is a serious late complication.

- Fast or difficult breathing
- Tiring, sweating or pausing during feeds
- Taking longer than expected to feed
- Poor weight gain
- A fast heartbeat or strong, bounding pulses
- Frequent chest infections or ongoing breathing problems

Causes and risk factors

PDA happens when the ductus arteriosus does not complete its normal closing process after birth.

Changes in oxygen levels and natural chemicals called prostaglandins help control closure. In premature babies, the vessel may be less ready to respond to these changes. Illness affecting oxygen levels or circulation can also influence whether it remains open.

Factors associated with PDA include:

PDA is not usually caused by anything a parent did or did not do during pregnancy. Most cases are not inherited in a simple, predictable way.

In some congenital heart conditions, an open ductus arteriosus is needed to maintain blood flow to the lungs or body. In that situation, specialists may deliberately keep it open with medicine until another procedure can be performed. This is different from treating an isolated PDA.

- Premature birth, especially at an earlier stage of pregnancy
- Certain genetic conditions or congenital heart differences
- A family history of congenital heart conditions
- Rubella infection during pregnancy
- Being born at high altitude, where oxygen levels are lower

Diagnosis

A PDA may first be suspected because of a heart murmur, strong pulses, breathing problems or difficulty gaining weight. Premature babies may be assessed because they need ongoing breathing support.

An echocardiogram is the main test used to confirm the diagnosis. This is an ultrasound scan of the heart. It shows the ductus, the direction and amount of blood flow, and whether the heart chambers are enlarged.

Doppler imaging, which is part of the echocardiogram, measures blood movement through the opening. The scan also helps rule out other heart conditions.

Other tests may provide supporting information:

The size of the opening alone does not determine treatment. The care team also considers symptoms, heart changes, breathing support, age and the likelihood of natural closure.

- A chest X-ray can show heart enlargement or extra blood flow through the lungs
- An electrocardiogram, or ECG, records the heart's electrical activity
- Oxygen measurements and blood tests may help assess an unwell newborn

Treatment and management

Not every PDA needs immediate closure.

A small PDA in a baby or child may be monitored with examinations and echocardiograms. Some openings close naturally, especially during infancy. Monitoring checks that the heart is not enlarging and that symptoms are not developing.

Management in premature babies is more complex. Some PDAs close without treatment as the baby grows. Support may include careful management of fluids, nutrition, oxygen and breathing assistance.

Medicines that reduce prostaglandin activity can encourage closure in some premature babies. Ibuprofen or indomethacin may be used in neonatal care. Acetaminophen, also called paracetamol, is used in some circumstances. These medicines require hospital supervision because they can affect the kidneys, intestines, liver, bleeding risk or blood flow to other organs. They are not treatments to give at home for PDA.

Medicines are generally less effective for closing a PDA in full-term older babies and children. When closure is needed, a catheter procedure is often considered.

During catheter closure, a specialist guides a thin tube through a blood vessel, usually from the groin, to the heart. A plug or coil is placed inside the PDA to stop blood flow. The device remains in place as tissue grows over it. Suitability depends on the child's size, the shape of the PDA and the expertise available.

Surgery may be used when catheter closure is not suitable, when a premature baby is too small for a particular device, or when other treatment has not worked. The surgeon closes the vessel with a clip or tie, usually through an incision between the ribs.

After a procedure, follow-up may include an echocardiogram and checks of the closure device or surgical site. The cardiology team will explain any temporary limits on activity and whether dental precautions are needed during healing.

Complications

A small PDA may never cause complications. The risks are greater when a large opening remains untreated.

Possible complications include:

If severe pulmonary hypertension develops, blood may eventually flow in the opposite direction through the PDA. This is called Eisenmenger syndrome. Closing the PDA at that

stage can be unsafe, so specialist assessment is essential.

In premature babies, PDA is associated with conditions such as long-term lung disease, intestinal injury and bleeding in the brain. Prematurity and serious newborn illness also contribute to these problems, so the PDA is not always their direct cause. This is one reason treatment decisions are made individually rather than closing every PDA automatically.

Catheter procedures and surgery also have risks, including bleeding, infection, movement of a device or narrowing of a nearby blood vessel. The specialist team balances these risks against the effects of leaving the PDA open.

- Heart failure, meaning the heart cannot keep up with the extra workload
- Poor growth because feeding and breathing use extra energy
- Enlargement of the heart's left-sided chambers
- High blood pressure in the lung arteries, called pulmonary hypertension
- Permanent lung-vessel damage after years of excessive blood flow
- Infective endocarditis, an uncommon infection of the heart's inner lining

Prevention

Most cases of PDA cannot be prevented. Premature closure or failure to close is not something a parent can control.

Rubella during pregnancy can cause congenital heart conditions, including PDA. Checking rubella vaccination status before pregnancy can reduce this risk. Rubella vaccination is not given during pregnancy, so anyone who is pregnant and thinks they have been exposed should contact their maternity team.

Good pregnancy care may help identify factors linked with premature birth, but it cannot prevent every early delivery or every PDA. There is no food, supplement or activity proven to guarantee that the ductus arteriosus will close normally.

Living with it and what to expect

Many people with a small PDA feel well and have no limits in everyday life. Follow-up may involve periodic examinations or echocardiograms to check the size of the opening and its effect on the heart.

If a PDA closes naturally or is successfully closed before lasting heart or lung damage

develops, the long-term outlook is usually excellent. Most children can take part in normal play, school and exercise after recovery. A cardiologist can advise if temporary restrictions are needed after a procedure.

Premature babies may remain in hospital because of prematurity and lung development even after the PDA improves. Closing the PDA does not necessarily resolve every breathing, feeding or growth problem immediately. Progress often follows the baby's overall development.

After catheter or surgical closure, a small amount of blood flow may occasionally remain. This may close over time or require further monitoring. Repeat treatment is sometimes needed but is not routine.

People with pulmonary hypertension or another congenital heart condition may need lifelong specialist care. Their activity, pregnancy and treatment plans may require individual assessment.

Keep routine follow-up appointments even when there are no symptoms. These visits are used to check growth, heart size, blood flow and recovery rather than because a problem is expected.

When to get medical help

Arrange a routine medical review if a baby or child:

Contact the cardiology or procedure team promptly if there is increasing pain, redness, swelling, bleeding or discharge at a catheter or surgical site. A new fever after a recent heart procedure also needs medical advice.

Seek urgent medical assessment if breathing is becoming difficult, feeding has dropped sharply, urine output is much lower than usual, or a baby is unusually sleepy and hard to wake.

Call emergency services for severe breathing difficulty, blue or grey lips or skin, collapse, unresponsiveness, or sudden severe weakness. These symptoms can have several causes and should not be assumed to be from PDA.

- Tires, sweats or breathes quickly during feeds
- Is feeding poorly or not gaining weight as expected
- Has ongoing fast breathing without obvious distress
- Becomes unusually tired during normal activity
- Misses planned heart follow-up

Common questions

Is a PDA the same as a hole in the heart?

Not exactly. It is an open blood vessel outside the heart that connects the aorta and pulmonary artery. This is different from a hole in the wall between the heart's chambers, although both can create abnormal blood flow.

Can a PDA close on its own?

Yes. Some PDAs close naturally, particularly in young babies. Closure can take longer in premature babies. The chance of natural closure becomes lower as a child gets older, but the timing cannot be predicted from symptoms alone.

Does every PDA need treatment?

No. A small PDA that is not affecting the heart may only need monitoring. Treatment is more likely when there are symptoms, heart enlargement, significant extra blood flow through the lungs or difficulty with breathing and growth.

Is PDA surgery open-heart surgery?

PDA surgery usually does not require opening the heart or using a heart-lung bypass machine. The surgeon normally reaches the vessel through the side of the chest. Many PDAs can instead be closed through a catheter without chest surgery.

Can someone exercise with a PDA?

Many people with a small or successfully closed PDA can exercise normally. Restrictions may apply for a short time after treatment or when there is pulmonary hypertension, heart enlargement or another heart condition. The cardiology team can confirm what is safe.

Can PDA come back after it is closed?

A completely closed ductus does not usually reopen. A small residual leak may remain after a procedure and is monitored with echocardiograms. If the remaining flow is important, further treatment may be considered.

Sources

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