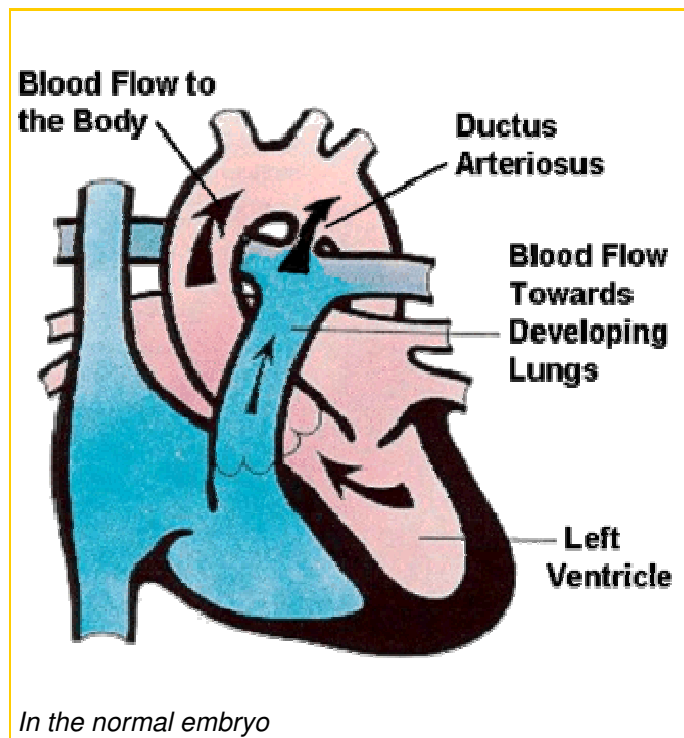


Patent Ductus Arteriosus

The term PDA conjures up images of handheld mini-computers for most people but in veterinary cardiology, PDA stands for the condition patent ductus arteriosus, the most common congenital heart defects in dogs.

So what is a Ductus Arteriosus and why shouldn't it be Patent?

Everybody had a ductus arteriosus once, but it was a long time ago, back in one's fetal days. As a developing fetus, one depends on one's umbilical circulation to supply oxygen. After all, not only are the lungs not developed yet but there is no air to breathe inside mom's uterus. But we still have a heart and it still pumps blood even in the fetal stage. The problem is that we really need the blood to bypass the non-functional lung and that is where the ductus arteriosus comes in. The ductus arteriosus is a small channel connecting the pulmonary artery (which will one day carry blood to the lungs) and the aorta (which already carries blood to the rest of the body). Because the lung is developing, full of fluid, and generally not ready to do anything, blood vessels growing there have high resistance. In other words, it would take a lot of force from the heart to circulate blood there. Since there is a low resistance channel wide open, blood diverts into the ductus arteriosus, by-passing the lungs, and circulating through the rest of the fetal body.



In the normal embryo

At birth, everything changes. We take our first breath. Our lungs begin to work as they were meant to: to exchange gases. They fill with air and the circulatory resistance drops. It then becomes easier for the blood to flow to the lung rather than through the ductus. Normally, the ductus closes within the first 3 days of life and is securely closed by day 7 to 10 of life. Blood now flows the way it is supposed to: from the right side of the heart to the lung to pick up oxygen then back to the left side of the heart to the body to deliver the oxygen. Then back through the same circle again, over and over.

Sometimes the ductus does not close as it should. It remains open or "patent." When the ductus stays open, blood from the aorta which has just been replenished with oxygen from the lungs will want to flow not to the body, but to the low resistance ductus opening and into the pulmonary artery and lungs again. This is called a left to right shunt and creates an assortment of problems.

Why Left to Right Shunting is Bad

The body has its oxygen requirement and demands to be serviced by the heart. The problem is that a great deal of blood (how much depends on the size of the ductus) that has just gotten oxygen is shunting back to the pulmonary circulation rather than carrying oxygen to the body. In order to meet the body's oxygen demand, the heart is going to have to pump all the more blood to cover what circulates in the shunt as well as what the body needs. This is a lot of extra work for the heart and failure can result,

leading to coughing, weakness, and difficulty breathing. In fact, more than 25% of pups have some degree of heart failure at the time their patent ductus is discovered. Treatment for PDA involves surgical tying off of the ductus with a piece of suture or coil.

THE GOOD NEWS: If this can be accomplished, all the heart problems are reversible. If heart failure is present, it will need to be controlled with medicine before surgery is possible.

If the volume overload to the lung's circulation is allowed to go on indefinitely (and the patient has not died from heart failure), resistance increases in the lung and the shunt may diminish or even reverse to a right to left shunt. Increased resistance in the lung circulation is called pulmonary hypertension. A right to left shunt is no longer something that can be fixed and the patient will be very sick from heart disease at some point in their life, often by the age 2 to 3.

Diagnosis of PDA

A characteristic murmur can be heard in patients with a patent ductus arteriosus. The murmur is described as sounding like a washing machine and is often called a "continuous" or "machinery" murmur. Discreet heart "thumps" sometimes cannot be made out; only the continuous whooshing of the murmur is heard. The murmur is best heard with the stethoscope positioned in the patients left "arm pit." If the condition progresses to right to left shunting, no murmur will be heard. If the left side of the heart has enlarged to deal with the PDA, sometimes there is also mitral regurgitation, which produces another kind of murmur.

An increased index of suspicion exists for breeds of dogs with a known predisposition to PDA. These breeds include German Shepherd Dog, Miniature Poodle, Keeshond, Cocker Spaniel, Pomeranian, Collie, and Shetland Sheepdog.

The work-up to confirm the presence of the ductus will include chest radiographs to rule out fluid build up from heart failure, and to look for characteristic enlargement of the aorta and the left side of the heart where the extra blood volume is contained. Echocardiography clinches the diagnosis as all the chamber sizes are measured and the patent ductus can actually be seen.

Treatment: Surgical Ligation

This is the traditional method of repair. The chest is opened and a piece of suture is used to tie off the patent ductus. Generally a specialist is required to perform this procedure but complication rate is less than 5%, with less than 2% requiring a second procedure due to re-opening of the ductus. A failed surgical correction can sometimes be corrected by coil embolization (see details below)

Treatment: Coil Embolization

If the ductus is not too large, a second option exists: percutaneous transarterial coil embolization. Here, coils made of steel and Dacron are placed in the ductus from an external artery in the leg or throat. The coil essentially causes small clots to form and plug the narrow end of the ductus. A 2.4% mortality rate is associated with this procedure. It is appealing as it is less invasive. While it takes weeks to fully recovery from PDA surgery, puppies who have their PDAs repaired by coil embolization often go home on a day or two.

Without treatment, 2/3 of affected puppies will die before reaching age one year.