

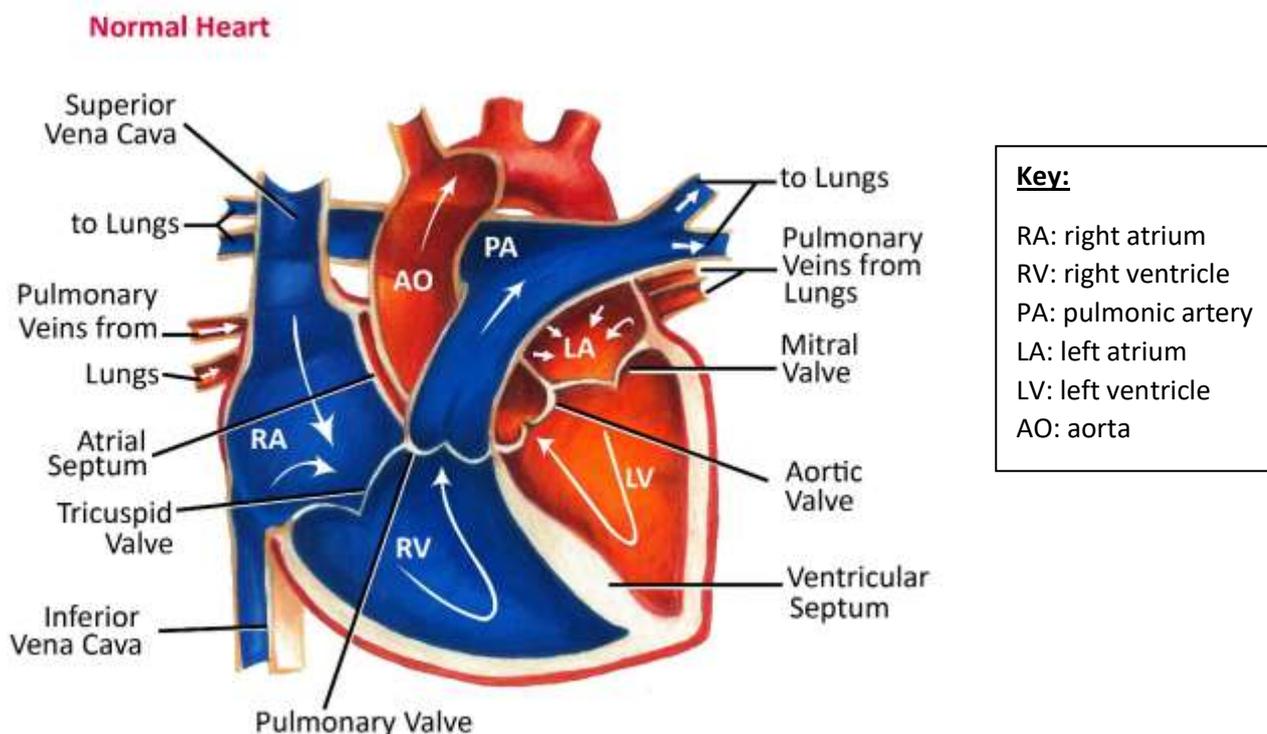


## Bradycardia in Dogs

### How does the heart work?

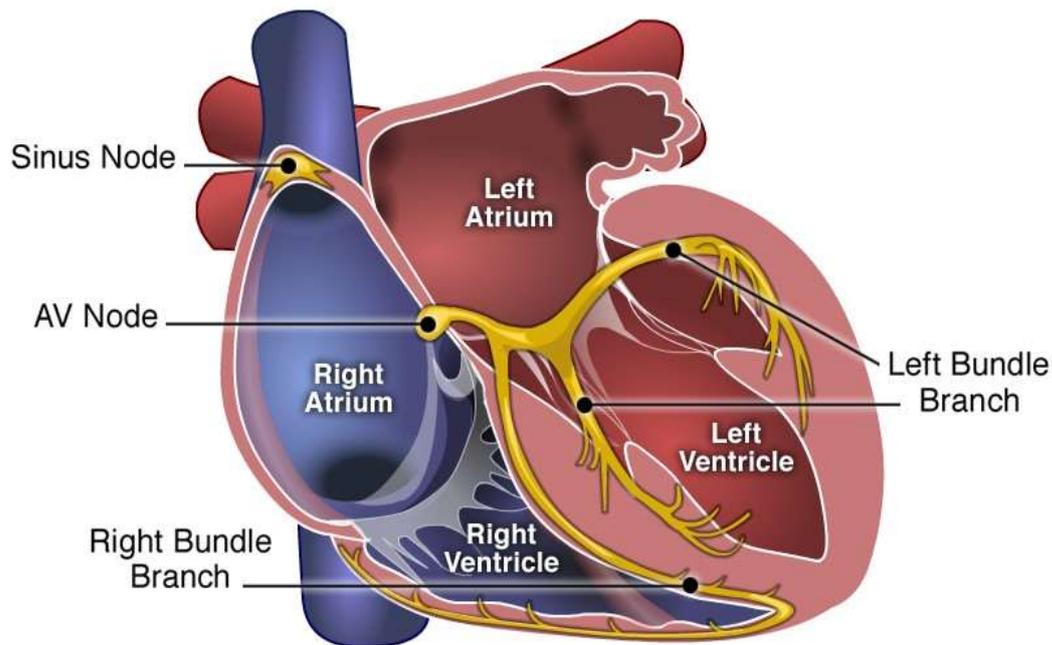
The heart is the organ responsible for pumping blood to and from all tissues of the body. The heart is divided into right and left sides. The job of the right side is to pump oxygen-deficient blood returning from the body into the lungs where fresh oxygen is collected and carbon dioxide is removed. The oxygen-rich blood returning from the lungs enters the left side of the heart where it is pumped into the aorta then to the rest of the body via the arterial system.

Each side of the heart has two chambers, an upper atrium and a lower ventricle. Between the atrium and ventricle on each side lies a valve – the tricuspid on the right and the mitral on the left – that regulates blood flow into the chambers. As the heart pumps, these valves act as one-way gates allowing blood to flow from the atrium above to the ventricle below and preventing blood from flowing back into the atrium. From the ventricles, blood is then forced to flow out into the pulmonary artery (on the right) or the aorta (on the left) through a second series of one-way valves called the pulmonic valve and the aortic valve, respectively.





The heart muscles contract after they are stimulated by an electrical impulse. A small area of special tissue in the right atrium called the sinoatrial (SA) node starts an electrical impulse (it's like the heart's spark plug), that spreads out over both atria before reaching a region called the AV node. From here, the impulse travels down special electrical tracts (or wiring) within the ventricles (this is the conduction system of the heart). The electrical impulses cause the heart to contract in a coordinated fashion: the atria contract first and push blood into the ventricles; then the ventricles contract and push blood to either the lungs (right ventricle) or the rest of the body (left ventricle). This electrical impulse can be recorded on an electrocardiogram (ECG).



## What is bradycardia?

Bradycardia means a slow heart rate. There are many causes of bradycardia in dogs and not all of them are a call for concern (in fact some types of bradycardia are completely normal). However, there are 2 conditions that can cause the heart rate to drop so low that specific treatment is required: heart block and sick sinus syndrome.

The normal conduction system was discussed above, however, occasionally the heart's spark-plug and/or wiring can be disrupted. Heart block and sick sinus syndrome are the two most common causes of such a disruption (the specific cause of both these conditions is unknown). Specifically, sick sinus syndrome prevents the sinoatrial node from working normally, whereas heart block prevents the AV node from



working properly. These both result in an abnormally slow heart rate because without the regular spark-plug (or normal AV node function), “emergency life-support back-up systems” take over to keep the heart beating. Although life-saving, these emergency systems can only operate at a low heart rate.

When such a disruption occurs, the pet usually develops exercise intolerance, weakness and/or fainting. Because many of these pets are older, owners sometimes attribute more subtle signs of slowing down to aging when in fact it is due to a slow heart rate.

A diagnosis of heart block or sick sinus syndrome can generally be made with a short ECG tracing performed by your veterinarian. In addition, an echocardiogram (cardiac ultrasound) will often be performed by your cardiologist to assess the overall structure and function of the heart (which is particularly important if a pacemaker is being considered).

The solution for these pets is to “rewire” their heart with an artificial pacemaker that provides the regular electrical signals (at a programmed rate that is much higher than the heart’s intrinsic back-up systems). Almost universally, pets needing a pacemaker improve clinically (often quite dramatically) once the pacemaker is implanted and adjusted. Without a pacemaker, clinical signs often worsen, and pets usually succumb to their disease within 1 to 2 years (dogs with heart block that do not receive a pacemaker are at risk of sudden death). Pacemakers can often extend this survival by several years, depending on the overall health of the pet.

## **What is a pacemaker and how is it placed?**

A pacemaker is made up of a pulse generator (a small computer and battery) and a specialised wire (called a pacing lead). The pulse generator is about the size of a 50-cent coin and contains an energy supply and a computer that monitors and controls the rhythm of the heart. The lead transmits electrical impulses in both directions between the pulse generator and the heart, so that the pulse generator “knows” when to send an impulse and when to wait.

Pacemakers used in pets are identical to those used in people; the only difference is that they are usually obtained from the manufacturer after the shelf-life of the power source has decreased below acceptable limits for use in people. Because of the generally shorter life span of animals, these pacemakers can be successfully implanted in pets at a substantially lower cost than if a new pacemaker was being implanted.

The pacemaker lead is typically placed through the jugular vein in the right side of the neck, down into the inside of the heart (specifically inside the right ventricle) and



attached to the heart wall. Occasionally, the pacemaker lead may be placed through the diaphragm and attached to the outside of the heart; this method is mainly used in cats. Some dogs may have one pacing lead, while others will have multiple pacing leads, depending on the heart problem and the size of the patient. The type of pacemaker used, its placement, and number of pacing leads is decided by the cardiologist/surgeon implanting the system. If the lead is placed through the jugular vein, the pulse generator is placed in a pocket under the skin – usually on the side of the neck. If the lead is placed through the diaphragm, the pulse generator is attached to the inside of the abdominal wall.

Prior to anaesthesia but while under sedation, a temporary pacemaker is often placed so that the pet's heart rate can be controlled during anaesthesia. Since pacemaker implantation is a moderately risky procedure, complications can occur. These include problems under anaesthesia, such as abnormal heart rhythms, puncture of the heart or vessels, infection, or rarely death during the procedure. Once the pacemaker is implanted, it may stop functioning if the pacing lead becomes dislodged, or the strength of the impulse provided by the generator is too low. Most of these problems can be corrected.

### **What special care is needed once my pet comes home?**

Initially, rest and recuperation are advised while the pacemaker and the lead “heal” into place. After a couple of weeks, the sutures are removed, and normal activity can be resumed. Usually at this time, the pacemaker is adjusted to provide an appropriate signal (not too big as that would waste battery power and not too small as that could fail to stimulate the heart). This adjustment is done by the cardiologist using a device that checks the pulse generator through the skin. It is completely painless.

Occasionally, a swelling develops over the site where the pulse generator has been implanted. If this occurs, consult the cardiologist who implanted the pacemaker. Under no circumstances should your local veterinarian address this issue without consulting the cardiologist. It is usually a simple problem to deal with, if handled correctly. While petting, you will normally be able to feel the pacemaker under the skin; it feels like a flat hard metal disc. It's usually located on the side of the neck or over the shoulder blade.

### **What should pets with pacemakers avoid?**

If your dog requires advanced imaging, such as a magnetic resonance imaging (MRI), it is important to consult a veterinary cardiologist before the scan because the MRI will negatively affect the pacemaker.



Dogs with pacemakers should avoid metal detectors, and strong electrical or magnetic fields of any sources (i.e. power plants, junk yards). In addition, mobile phones should be kept a minimum of 6 inches away from the pacemaker generator at all times to avoid interference, even when the phone is turned off. With rare exceptions, bumping the pacemaker won't affect it, so don't be afraid to let your dog play as desired.

### **How often does my pet need to be examined?**

Rechecks to evaluate pacemaker function and battery life are usually performed several times in the weeks/months following pacemaker implantation and then yearly. Additional rechecks are recommended at the discretion of your cardiologist, or if your dog becomes weak or collapses.

### **Are there medications that can help?**

Unfortunately, in almost all cases of heart block, no medications can increase the heart rate (therefore an artificial pacemaker is the only option in these animals). Dogs with sick sinus syndrome may sometimes (at least initially) respond to medications designed to increase heart rate. Unfortunately, in many of these 'initial responders' an artificial pacemaker is eventually still required (the medications simply stop working).