



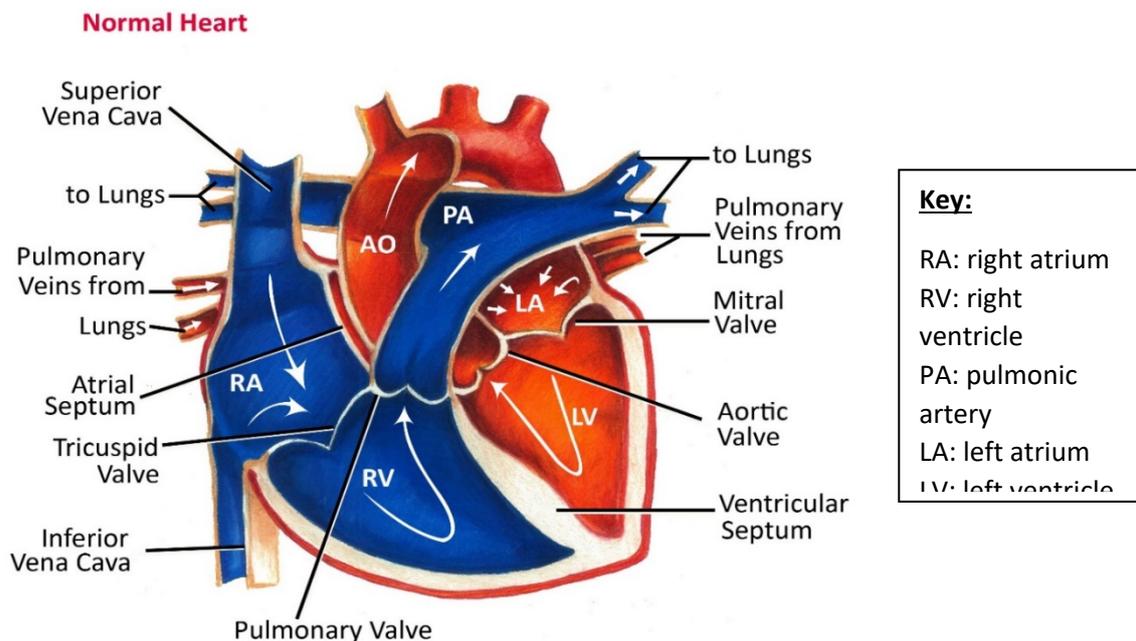
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Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)

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.

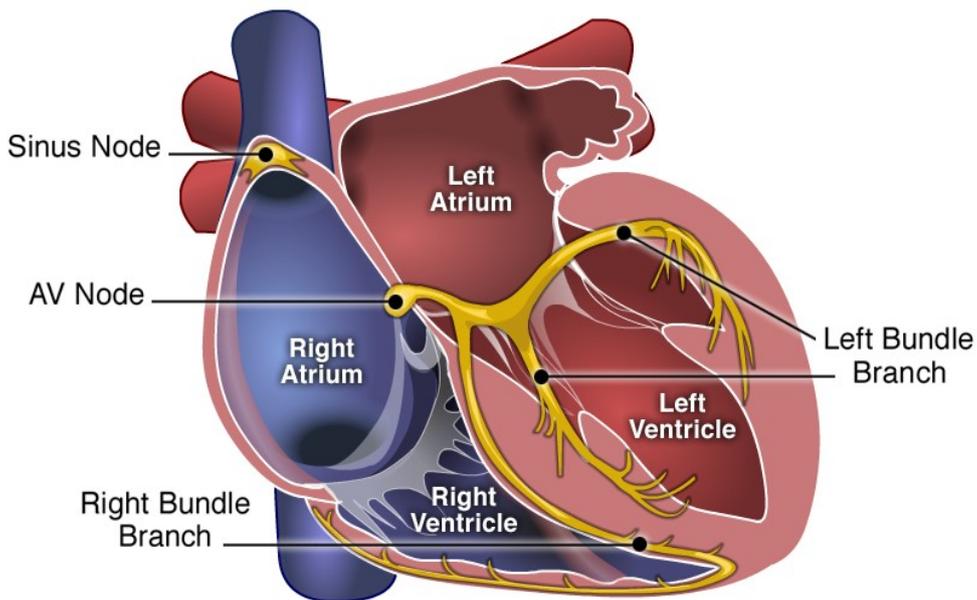
Each side of the heart has two chambers, an upper atrium and a lower ventricle. Between the atrium and ventricle on each side lies a valve – the tricuspid on the right and the mitral on the left – that regulates blood flow into the chambers. As the heart pumps, these valves act as one-way gates allowing 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.





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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 ARVC?

Cardiomyopathy literally translates into heart (*cardio*) muscle (*myo*) disease (*pathy*). Boxers get a specific type of cardiomyopathy called arrhythmogenic right ventricular cardiomyopathy (ARVC). This leads to microscopic infiltration of the right ventricular muscle with fatty tissue. The exact cause is unknown, but genetics likely plays a large role (a specific mutation has been identified in Boxers with ARVC). In comparison to most other cardiomyopathies, the heart structure and function remains normal in most Boxers with ARVC (i.e. there is no decline in pumping function or heart enlargement). The main issue in ARVC is the development of heart rhythm disturbances (arrhythmias) called ventricular arrhythmias or ventricular ectopy. Because of the changes to the right ventricle, this part of the heart can spontaneously discharge and briefly adopt the role of the heart's 'spark-plug.' The problem with this is that the rate of discharge is often far too high resulting in abnormally high heart rates (often greater than 300 beats/minute).

These dogs are prone to fainting and sudden cardiac death. The fainting most commonly happens when they develop a very fast heart rate. Sudden death usually occurs when this fast rate degenerates into ventricular fibrillation (cardiac arrest).



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A small number of Boxers with ARVC can develop cardiac pump dysfunction and enlargement which may lead to the development of congestive heart failure (fluid backing up in the lungs and/or body cavities such as the abdomen).

How is ARVC diagnosed?

Boxers with ARVC may not have any abnormalities on physical examination. The only clue to the presence of ARVC might be a history of fainting. Occasionally your vet may detect an arrhythmia (irregular heart beat) when listening to your pet's heart with a stethoscope.

A definitive diagnosis of ARVC can normally only be made with 24-hour holter electrocardiography. This is a 24-hour ECG recording of your dog's heart rate and rhythm. The monitor is attached to the animal as it goes about its normal daily activities. There are certain diagnostic holter criteria that must be met for the diagnosis of ARVC. Holter analysis and interpretation is generally best performed by a specialist veterinary cardiologist.

An echocardiogram (cardiac ultrasound) is sometimes also performed however in most instances this is completely normal.

Are there other conditions that can mimic ARVC?

Yes. Boxers are also prone to a condition called vasovagal syncope. This is a benign form of fainting in this breed and is due to an exaggerated reduction in heart rate and/or blood pressure triggered by sudden exercise/exertion (in contrast, the cause of fainting in ARVC is due to a heart rate that is too fast). Holter monitoring will normally allow differentiation of ARVC and vasovagal syncope and this is very important because treatment and prognosis are quite different for these two conditions.

What treatment is available for ARVC?

Not all dogs with ARVC require treatment (certain holter criteria need to be present before treatment is recommended). However, for Boxers that are fainting or those with severe ventricular arrhythmias, anti-arrhythmic therapy (medications) is normally recommended. Unfortunately, even though anti-arrhythmic treatment can reduce the frequency and severity of fainting episodes, it does not completely eliminate the risk of sudden cardiac death.

Occasionally other medications may be needed (e.g. diuretics to treat congestive heart failure) however this is uncommon.

What about exercise?

Although exercise in theory may precipitate fainting or even increase the risk of sudden cardiac death, exercise is not necessarily discouraged (unless there is a specific reason such as severe ventricular arrhythmias or frequent fainting). Most importantly, dogs with ARVC should not be forced to do any exercise they don't want to do. Also, exercise in hot weather is best avoided.



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What is the prognosis?

The prognosis is highly variable from dog to dog. Although there is a theoretical risk of sudden cardiac death in all dogs with ARVC, many can live long and happy lives.

Occasionally, anti-arrhythmic therapy is not effective and does not control the fainting episodes. If these episodes are frequent enough, some owners will opt for euthanasia at this point because of quality of life concerns.

Additional Resource:

<http://vetmed.tufts.edu/heartsmart/>

This is a very useful and well-written resource, providing pet owners with a clear and credible source of information about veterinary cardiology.