Patient Information

Arrhythmogenic Right Ventricular Cardiomyopathy

1. The Normal Heart

The heart is a special muscle that contracts regularly and continuously, pumping blood to the body and the lungs. It has four chambers – two at the top (the atria) and two at the bottom (the ventricles). The pumping action of the heart is caused by a flow of electrical signals through the heart. These electrical signals repeat themselves in a cycle and each cycle causes one heartbeat.

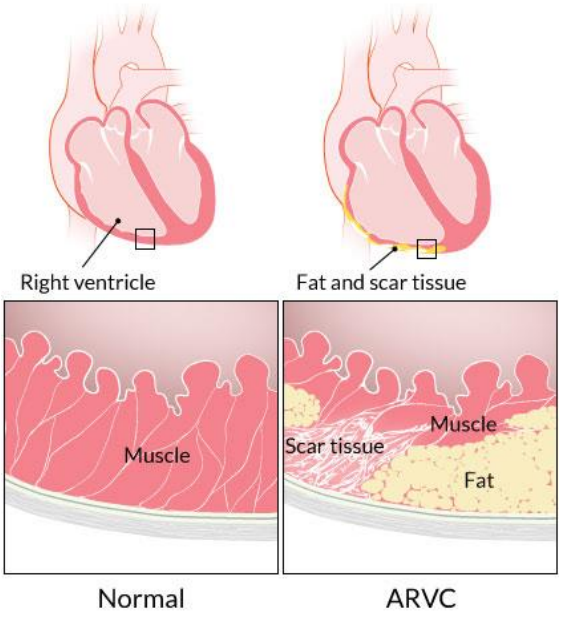
2. Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC)

ARVC is a disease of the heart muscle (cardiomyopathy). It mainly affects the ventricles of the heart and causes arrhythmias (abnormal heart rhythms). ARVC mainly affects the right ventricle, but can also affect the left ventricle. The disease is also called Arrhythmogenic Cardiomyopathy, as the main symptoms are caused by arrhythmias. ARVC may also affect the atria of the heart. Having ARVC means that there is a problem with the molecules (proteins) that hold the heart muscle cells together. In patient with ARVC, these proteins do not develop properly and cannot keep the heart muscle cells tightly together. When this happens the heart muscle cells separate from each other, become weak and die. Next, the area of the heart where the muscle cells have died becomes inflamed and the lost cells are replaced with scar tissue and fat. This affects the structure of the heart muscle, and the ventricle wall can become thin and stretched. This causes two main problems:

1. the electrical signals through the heart that are responsible for the heartbeat may be affected, and this can cause arrhythmias;
2. the thin walls of the ventricles of the heart are unable to pump blood normally.

3. Prevalence & Inheritance

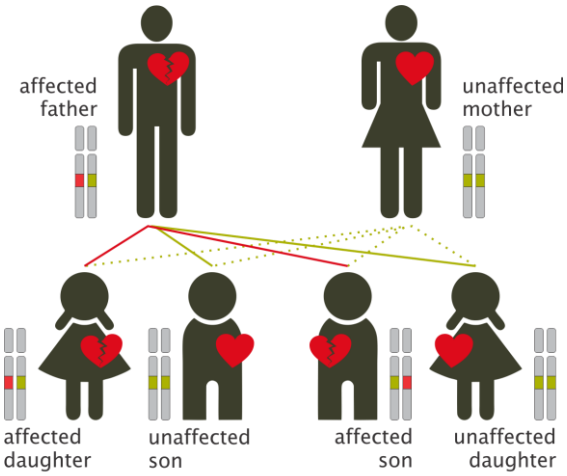
ARVC is rare compared to some other types of cardiomyopathy. Around 1 in every 2000 - 5000 persons has ARVC; this is the estimated prevalence of the disease.



Source: Ted Rogers Centre for Heart Research

ARVC often has a genetic cause. This means that it is caused by a defect (a mutation) in a gene that can be passed on through families. A gene is part of our DNA which contains a code for making a molecule (a protein). ARVC is caused by a mutation in the genes that contain codes for specific molecules (proteins) in the heart. Every person has two copies of each gene that can be linked to ARVC. A mutation in only one of the two copies of one of these genes (from the father or from the mother) is enough to develop ARVC. This is called an autosomal dominant disorder and a parent who carries it has a 50 percent (1 in 2) chance of passing the mutation to each child. The chance that a child will not inherit the mutated gene is also 50 percent. Sometimes, ARVC can be an autosomal recessive disease. This means that two mutations on both copies of a gene (from both the father and the mother) are needed to develop ARVC. Whether ARVC is an autosomal dominant disease or an

autosomal recessive disease depends on the gene and mutation involved. In some cases, a new (de novo) mutation can occur in the egg or sperm cells or in an embryo. In these cases, the child's parents do not have the mutation and ARVC, but the child does have ARVC and can pass the mutated gene to his or her own children.



Autosomal dominant inheritance

4. Symptoms

ARVC can become worse over time. Symptoms are due to the electrical activity of the heart as well as to the structure of the heart and how well the heart muscle pumps. Abnormal electrical activity in ARVC can cause arrhythmias that result in palpitations (feeling your heart beating too fast), light-headedness and fainting. A decreased ability of the heart muscle (particularly the right ventricle) to pump can lead to fluid building up in the body and leading to swollen ankles, legs and tummy, and breathlessness.

5. Diagnosis

The most common tools to make the diagnosis of ARVC are the medical and family history, physical examination, a heart electrical tracing (the electrocardiogram or ECG), a heart ultrasound scan (echocardiogram), heart magnetic scan (magnetic resonance imaging or MRI), exercise testing, heart rhythm monitor (Holter), and electrical study of the heart (electrophysiology study or EPS) (*see* below).

5.1. ECG (electrocardiogram)

This is the most basic test. Small sticky patches (electrodes) are put onto the chest and sometimes to arms and legs. These are connected by wires to an ECG recording machine, which picks up the electrical activity for a few seconds that makes the heartbeat. Sometimes additional or repeated ECG-tests are necessary.

5.2. Echocardiogram (echo)

Echocardiogram uses ultrasound waves to look at the structures of the heart. An echocardiogram can detect different types of structural changes in the heart, for example heart muscle diseases like ARVC and heart valve abnormalities. Areas of thinning of the heart muscle can be identified.

5.3. MRI

An MRI scan uses a magnetic field to create images of the heart. The scanner itself is a large tube with a table in the middle, allowing the patient to slide into the tunnel. The test takes about one hour. An MRI is very good at showing the structure of your heart and blood vessels, showing the condition of your heart muscle, and identifying any scarring (fibrosis) within your heart.

5.4. Exercise test (stress test)

Exercise test is the same as the ECG described above, but is recorded before, during and after exercising on a treadmill or an exercise bike.This records any changes in the electrical patterns that occur with exercise.

5.5. Holter monitoring

Holter monitoring involves a small digital machine, which can be worn on a belt round the waist. Four or six ECG electrodes from the machine are taped to the chest. It then records the electrical activity of the heart for 24-48 hours, or for up to seven days. During the monitoring all activities are listed in a 'diary'.

5.6. Electrophysiology study (EPS)

This test involves having a long tube called a catheter inserted into a blood vessel and fed up to the heart. Electrical signals are sent through the catheter to the heart which makes it beat at different speeds. This is recorded and can be used to find where in the heart arrhythmias are coming from and can be used to decide treatment options.

5.7. Genetic testing

In just under half of the ARVC families, a mutation can be found in one of the genes that can cause ARVC. Because not all genes that can cause ARVC are known, a negative result of the genetic testing (i.e. when no mutation is found) does not rule out an inherited cause of the ARVC.

6. Therapy

Although there is no cure for ARVC, treatments help to control symptoms, and to decrease the long-term risk. Treatment focuses on improving the pumping of the heart, controlling arrhythmias and reducing the risk of life threatening arrhythmias (cardiac arrest). If patients are at high risk of sudden death (for example after a previous cardiac arrest) or if symptoms cannot be controlled by medication, an internal cardiac defibrillator (ICD) can be considered. The ICD constantly monitors the electrical activity of the heart and can recognize severe arrhythmias. The ICD can be programmed specifically to each individual patient. It can treat severe and rapid arrhythmias by sending electrical impulses or give an electric shock, and return a normal heartbeat. An ICD consists of 2 parts: the battery (the device) and the electrical lead that monitors the electrical activity of the heart and provides electrical impulses or an electrical shock to the heart. The lead of an ICD can be placed in the right heart chamber (via blood vessels) or under the skin in an area of the chest overlying the heart.

7. Lifestyle & Sports

There are key recommendations for patients (and families) that are diagnosed with ARVC, to prevent arrhythmias:

- avoidance of strenuous exercise - especially intense, competitive sport and heavy weight lifting;
- avoidance of sports is important for most carriers of a mutation;
- regular check-ups to monitor any changes in the disease;
- encouragement of relatives to be screened**.**

The diagnosis of ARVC and the ability to pass on the condition can lead to anxiety and many other questions. Medical social workers or psychologists have experience with this and may be helpful for the patient and the family members.

8. Follow-up

The heart doctor (cardiologist) will advise on how often follow-up is needed depending on symptoms, age, and treatment.

9. Family Screening

If a mutation in a gene is found in a patient with ARVC (*see Genetic testing*), family members of this patient (to start with the first-degree family members: mother, father, brothers, sisters, and children) can have genetic testing at a specialist genetic heart clinic. Family members in whom the same mutation (familial) is found, are called mutation carriers and will be followed by a cardiologist. Family members in whom the familial mutation is not found can be reassured. If there is not a mutation identified in a patient with ARVC, family members of this patient (to start with the first-degree family members) are advised to visit a cardiologist for heart tests. ARVC usually develops after puberty, as children grow into adults. However, some children have symptoms of the disease at an earlier age. Therefore the recommendation for children to be tested is from the age of ten years.

10. ARVC and Pregnancy

Before becoming pregnant it is important to discuss any potential risks, medication changes and care needed during the pregnancy.

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