

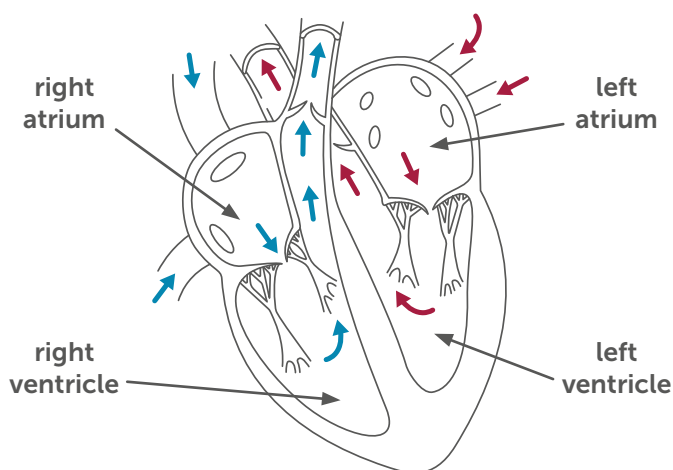
# Arrhythmias and cardiomyopathy

## An introduction to heart rhythm disturbances

- The heart normally beats in sinus rhythm, controlled by electrical signals from within the heart.
- When electrical signals are disrupted this can cause arrhythmias - when the heart beats too fast, too slow or erratically.
- Some arrhythmias are harmless. Others require treatment with medication, surgery or devices.

The heart is made up of four chambers, two on the right and two on the left. The upper chambers are the atria, which collect blood coming into the heart. The lower chambers are the ventricles, which receive blood from the atria above. The ventricles pump the blood out of the heart to the organs of the body.

### The structure of the heart and how blood flows



In these illustrations deoxygenated blood is shown in blue, oxygenated blood is shown in red.

### The cardiac cycle

Blood flows around the body in 'double circulation'; travelling through the heart twice on each complete cycle (from the heart to the lungs to pick up oxygen then from the heart to the rest of the body to deliver oxygen). The following is how this happens:

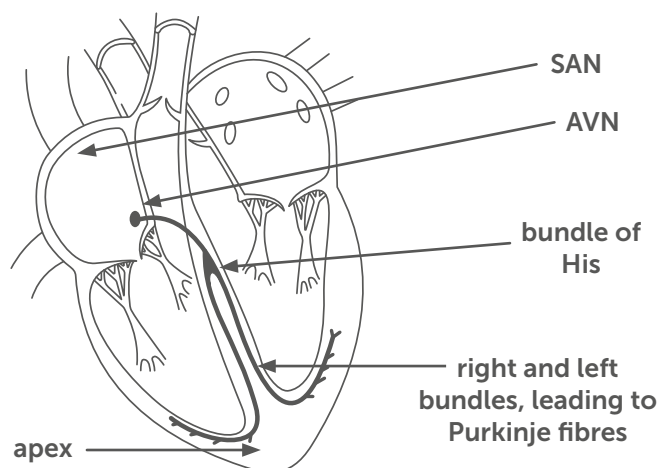
- Deoxygenated blood (carrying no oxygen) enters the right atrium and the chamber fills with blood
- The atrium contracts, forcing the blood into the right ventricle
- The right ventricle is relaxed and fills with blood
- The ventricle contracts forcing the blood out of the heart through the pulmonary artery
- Blood flows to the lungs where it picks up oxygen
- From the lungs, blood flows into the left atrium
- The left atrium contracts, forcing blood into the ventricle
- Once full, the left ventricle contracts, forcing the

blood out through the aorta to the body to deliver oxygen

- The relaxation and contraction of the left and right ventricles usually happens simultaneously.

### How the heart beats

The heartbeat is controlled from within the heart itself, from an area of specialised muscle cells called the sinoatrial node or 'SAN' - the heart's pacemaker.



The SAN spontaneously generates and conducts regular electrical impulses which make the chambers of the heart relax and fill, or contract and empty, in sequence to force blood through the heart and to the lungs and the body. As the SAN controls the rhythm and speed of the heartbeat, it is sometimes referred to as the 'pacemaker'. The following is how this happens:

- The SAN spontaneously generates regular electrical impulses.
- The electrical impulses travel through the atria to the atrioventricular node (AVN).
- The AVN acts as a junction regulating the impulse to the bottom chambers of the heart (ventricles).
- The electrical impulse passes down a group of fibres called the Bundle of His, which sits in the septum (the muscular wall between the two ventricles).
- From the Bundle of His, the electrical activity spreads into the left and right bundle branches and to the smaller fibres throughout the ventricle (Purkinje fibres).

- As the electrical impulse travels through different parts of the heart, the heart beats (contracts), forcing blood into the next structure.

For more information about how the heart works see our information sheet 'About the heart'.

 [www.cardiomyopathy.org  
/information-resources](http://www.cardiomyopathy.org/information-resources)

## What is a normal rhythm?

The normal rhythm of the heart is called 'sinus rhythm'. This is when the electrical signals that control the heart beat are relayed through the heart, causing the heart's chambers to fill and empty effectively and in sequence.

The speed at which the heart beats (pumps blood out) will vary, and depends on what the person is doing. For example, the heart beats more quickly when someone is exercising, getting more oxygen to the muscles. It beats slower when someone is resting, as there is less 'demand' for oxygen. A normal 'resting' heartbeat is usually between 60 and 100 beats per minute in an adult, but it can vary from person to person.

## What are arrhythmias?

'Arrhythmia' is a general term for any abnormal heart rhythm, where the heart is not beating in sinus rhythm. Arrhythmias happen when the electrical signals that control the heartbeat are disrupted in some way.

Arrhythmias are changes in heartbeat that happen independently of the person's state (not caused by the person's activity or emotion). For example, the heart would normally beat faster during exercise, or in response to emotions such as fear or stress, but if the heart beats too fast out of context (where there is no other known cause), it may be an arrhythmia.

Some arrhythmias start in the atria (top chambers of the heart) and may be called 'supraventricular' as they start above (supra) the ventricles. Some start in the ventricles (the bottom chambers) and are called 'ventricular'.

Arrhythmias can cause the heart to beat too fast (called 'tachycardia', usually more than 100 beats per minute in an adult) or too slow (called 'bradycardia', usually less than 50 beats per minute in an adult). Some cause 'fibrillation' where the electrical signals cause the heart to beat erratically (called 'fibrillation') and be uncoordinated.

*Note: arrhythmias are sometimes referred to as 'dysrhythmia', and either term can be used.*

## What is the effect of arrhythmias?

Arrhythmias can reduce how effective the heart is at beating and pumping blood around the body. This is because the heart's chambers are uncoordinated or unable to pump properly.

Some arrhythmias are normal and do not need treatment. For example, 'sinus arrhythmia' is normal and can happen with changes in breathing. Some arrhythmias are short-lived and may cause no lasting problem for the person. They may not even be aware of them happening.

However, some people may be aware of a change in how their heart is beating. It might feel like it is pounding or fluttering, which can be uncomfortable. This is referred to as a palpitation. Arrhythmias can also cause feelings of dizziness, light-headedness or loss of consciousness, due to the reduced output of blood from the heart. In some serious and rarer arrhythmias, it can be life-threatening.

## Types of arrhythmia

The following pages explain types of arrhythmia that may happen in people with cardiomyopathy. They are diagnosed with an ECG (electrocardiograph). This test records the electrical activity of the heart, and looks at the heart rate and rhythm, and how the electrical signals are conducted through the heart.

## Supraventricular arrhythmias

### Atrial fibrillation (AF)

Atrial fibrillation (AF) is a common arrhythmia which can affect anyone, at any age. In cardiomyopathy it can be caused by changes in the heart's structure, resulting from the underlying condition, for example where the muscle is enlarged, such as in dilated cardiomyopathy.

AF occurs in the top chambers of the heart, in the atrium. In AF, the normal electrical messages that cause the heart muscle to contract are interrupted by abnormal electrical impulses from the atria walls and pulmonary veins, in a series of 'micro' circuits. This means that unlike the normal contraction, the atria contracts in a manner that is fast, random, and uncoordinated (called fibrillation). The blood flow around the atria becomes turbulent. Some of these electrical impulses are passed through to the ventricles below, causing an irregular heartbeat. Sometimes the electrical impulses in the atrium travel through the AVN to the ventricle quickly, causing a faster heartbeat, which is more likely to cause symptoms.

AF can be paroxysmal (on and off) or persistent (for a long, continuous period of time). It can reduce the effectiveness of the heart's pumping and cause palpitations, breathlessness and dizziness. Although AF is not life-threatening, the turbulent flow of blood in the atria can increase the risk of blood clots forming. This can increase the risk of stroke if a blood clot moved and blocked blood flow to the brain.

Patients with AF are often prescribed anticoagulants (such as warfarin or apixaban) to reduce the chance of blood clots forming, if a patient is at a higher risk. AF does not necessarily require treatment, however, if someone experiences symptoms such as palpitations or dizziness, then there are various treatment options.

Antiarrhythmic drugs are often used successfully to control the heart rate and rhythm. If these are ineffective, a procedure called an 'ablation' can be performed for suitable patients. This is a procedure performed using 'keyhole' surgery. Areas of the heart are cauterised (burnt) to stop the electrical impulses being conducted. This may target small circuits in the atria. If the AF is conducting quickly to the ventricles, another type of ablation can be performed to cauterise and block the atrioventricular node. A pacemaker would be implanted to take over the electrical signalling for the ventricles.

In some cases electrical cardioversion is used. This is where, under general anaesthetic, an electrical shock is given to the heart to reset it back into normal rhythm.

### Atrial flutter

Atrial flutter is another common arrhythmia. Atrial flutter occurs in the top chambers of the heart, called the atrium. The atrium is beating (contracts and

relaxes) in a regular rhythm but faster than normal, because of an additional abnormal electrical circuit. This means that it beats more frequently, typically 2 or 3 times faster than the ventricle below.

Atrial flutter can reduce the effectiveness of the heart's pumping and cause palpitations, dizziness and breathlessness. Although it is not life-threatening, it can increase the risk of blood clots forming. This can increase the risk of a stroke if a clot blocks blood flow to the brain. Patients with atrial flutter are often prescribed anticoagulants (such as warfarin or apixaban) to reduce the chance of blood clots forming, if a patient is at higher risk.

Like atrial fibrillation, atrial flutter does not necessarily require treatment, however if someone experiences symptoms such as palpitations or dizziness, then there are various treatment options. Antiarrhythmic drugs are often used successfully to control the heart rate and rhythm. If these are ineffective, a procedure called an ablation can be performed for suitable patients. This is a procedure performed using keyhole surgery. The abnormal electrical circuit in the heart is cauterised to stop the electrical impulses conducting.

### Bundle branch block (BBB)

The bundle branches (left and right) pass conduction from the atrioventricular node and Bundle of His, through to the lower chambers of the heart (the ventricles), causing the chambers to contract. Disease or scarring of these areas can result in a block of electrical impulses passing through these electrical branches of the heart.

A blockage in either of the bundle branches causes the heartbeat to alter, due to abnormal spread of the electrical impulse. This results in the ventricles contracting in an uncoordinated or dyssynchronous manner.

BBB may not need treatment, depending on how often it happens and how it affects the individual. As there is a blockage in the electrical system of the heart, BBB may be an early sign of atrio-ventricular block (discussed below). If this is the case, a pacemaker may be considered to prevent slow heart rhythms (bradycardia).

It is important to try and identify the cause of BBB. For example, left bundle branch block can happen in both dilated and hypertrophic cardiomyopathy, and can affect how effectively the heart pumps, due to the uncoordinated beat. If the heart function in this case is reduced, a biventricular pacemaker (called CRT or Cardiac Resynchronisation Therapy) may be needed to help resynchronise (co-ordinate) the heartbeat. This aims to improve how effectively the heart pumps, increase the output of blood, and reduce any symptoms.

## Sick sinus syndrome

Sick sinus syndrome occurs when the heart's natural pacemaker, the SAN, is diseased. This results in a slow heart rate, referred to as bradycardia. The severity of disease can differ, sometimes causing a slower than normal heart rate, sometimes resulting in pauses in the heartbeat or in the worst case, result in a slow heartbeat occurring from below the AVN, referred to as a junctional escape rhythm.

For some patients with paroxysmal (intermittent) atrial fibrillation, the SAN can take time to reactivate once the AF stops, resulting in an initial pause or slow heart rhythm. This is referred to as tachy/brady syndrome.

A slow heart rate can be normal, particularly in patients who are very athletic. In patients who are symptomatic to sick sinus syndrome, the treatment is a pacemaker. This is a small electrical box implanted beneath the collarbone, with electric wires connected to the inside of the heart. The pacemaker monitors a patient's heartbeat and when absent, sends a small electrical pulse to make the heart beat.

## Heart block

Heart block or atrioventricular (AV) block happens when there is disease to the AVN. The messages from the SAN may be partially blocked or completely blocked within the AVN. This results in the heart beating too slowly (bradycardia) or can result in pauses in the heart beat. Heart block can be classified as either first, second or third-degree, depending on the symptoms:

- First degree heart block - the transmission of the impulse to the ventricles through the AVN is slowed. The person will probably have no obvious symptoms, and may not be aware that they have it. It may be found during tests for other conditions. First degree heart block doesn't usually need treatment.
- Second degree heart block - as the AVN disease progresses some of the impulses from the atria are not conducted to the ventricles through the AVN. This may happen regularly but not on every beat (2:1). The person may have symptoms that need to be treated, such as feeling light-headed, short of breath, dizzy or blackouts (loss of consciousness).
- Third degree heart block - as the disease progresses the AVN blocks completely and the signals from the SAN do not travel through to the ventricles. This could result in long pauses between heartbeats or a very slow heartbeat from the bottom chambers (escape rhythm). The symptoms are similar to second degree heart block, but worse, and the person is more likely to suffer from blackouts.

As heart block is likely to progress, patients with advanced second degree or third-degree heart block will need treatment regardless of their symptoms. The treatment for heart block is a pacemaker. This is a small electrical box implanted beneath the collarbone,

with electric wires connected to the inside of the heart. The pacemaker monitors a patient's heartbeat and when absent sends a small electrical pulse to make the heart pump.

## Ventricular tachycardia (VT)

Ventricular tachycardia (VT) is a dangerous arrhythmia that starts due to abnormal electrical activity happening within the ventricle walls.

This is usually as a result of scarring within the ventricles, which alters the electrical circuits. The slow electrical conduction of the scarred tissue combined with the fast electrical conduction of the healthy surrounding tissue, forms its own circuit which can knock out the normal heart beat. It causes the ventricles to beat too quickly and out of synchrony with the atria. This means that the ventricle doesn't have time to fill properly, so blood cannot be pumped around the body effectively. VT can be caused by different heart conditions, including a heart attack, some genetic conditions and may happen in people with heart failure or cardiomyopathy. VT can be brief and not cause any problems. However, it can be more prolonged. It is likely to cause dizziness, light-headedness, palpitations and sometimes blackouts (loss of consciousness). If the loss of consciousness is prolonged this would be an emergency and would require resuscitation. If the VT is sustained (does not stop), an electrical shock would need to be delivered by a defibrillator. This resets the heart's electrics and hopefully restores a normal (sinus) rhythm.

VT may be treated with anti-arrhythmic drugs to control the heart's rhythm and help to prevent arrhythmias happening. In some cases, 'keyhole' surgery known as radio frequency ablation is used to cauterise (burn) the area of heart muscle that is generating the abnormal electrical activity, blocking the abnormal circuits. Some people will have an ICD (Implantable Cardioverter Defibrillator), to monitor the heart's rhythm and detect these ventricular arrhythmias (VT or VF). This is similar to an external defibrillator but continuously monitors the heart all the time. If VT occurs that does not settle itself, the ICD will pace the heart, delivering fast electrical impulses to interrupt the arrhythmia and break the circuit. This is called 'anti-tachycardia pacing' or 'ATP'. If the ATP doesn't restore sinus rhythm the ICD will deliver an electrical shock to try to reset the heart back into sinus rhythm.

## Ventricular fibrillation (VF)

Ventricular fibrillation (VF) is a very serious and dangerous arrhythmia. The contraction of the ventricles is uncoordinated and ineffective, due to 'quivering' or 'fibrillating' ventricles. As the heart is not beating effectively, the blood is not pumped out of the heart and around the body. This condition is life-threatening and requires urgent treatment with a defibrillator.

VF means that blood supply to the vital organs such as the brain is affected. Early symptoms can include dizziness and shortness of breath, and the person will lose consciousness and collapse.

VF can be a cause of cardiac arrest. This is when the output of the heart stops suddenly and the person collapses, which can be fatal. However, a shock to the heart (from an AED\* or ICD\*) interrupts these abnormal 'chaotic' signals. This literally 'de-fibrillates' (stops the fibrillation), and restores sinus rhythm.

There can be many causes of VF, including a heart attack, or developing from ventricular tachycardia. It can also be caused by cardiomyopathy. The risk of VF caused by cardiomyopathy can be treated in several ways. Medication such as anti-arrhythmic drugs control the heart's rhythm and help to prevent arrhythmias happening.

ICDs can be used to monitor the heart's rhythm and, if a dangerous arrhythmia such as VF is detected, give a shock to the heart to interrupt the arrhythmia and restore the normal heart rhythm.

*\*An AED (automated external defibrillator) is a portable machine that detects and treats abnormal heart rhythms by giving an electric shock to return the heart to a normal rhythm.*

*\*An ICD (implantable cardioverter defibrillator) is a device implanted into the chest, used to monitor the heart rhythm and give an electric shock to the heart if it detects a dangerous arrhythmia.*

To learn more about cardiac devices, watch 'Managing Devices; The Psychological and the Practical' by Jennifer Taylor and Jamie Walton from our 2023 National Conference, visit:

 [www.youtube.com/watch?v=1DSnQWcakzQ](https://www.youtube.com/watch?v=1DSnQWcakzQ)

## We're here for you

At Cardiomyopathy UK we offer help and support for you and your family. You can call our helpline to talk to our support nurses on 0800 018 1024. We can put you in contact with other people through our support groups, support volunteers and social media. To give us your feedback on this information resource or get more information about our services, contact us or visit our website:

 [www.cardiomyopathy.org](http://www.cardiomyopathy.org)

 [contact@cardiomyopathy.org](mailto:contact@cardiomyopathy.org)

This information resource was authored by Jamie Walton, Head of Cardiac Implantable Devices at University Hospitals Birmingham

© September 2024. Registered charity no 1164263 & no SC053398. Every effort is made to ensure that information is accurate. This information is not intended as a substitute for advice from your own doctors. Cardiomyopathy UK does not accept responsibility for action taken after reading this information. Please note that information may change after date of printing and is intended for a UK audience.

**a:** 75a Woodside Road, Amersham, Bucks, HP6AA  
**t:** 01494 791224

**helpline:** 0800 018 1024

**website & livechat:** [www.cardiomyopathy.org](http://www.cardiomyopathy.org)

 [facebook.com/cardiomypathyuk](https://facebook.com/cardiomypathyuk)

 [@cardiomypathy](https://twitter.com/cardiomypathy)

 [@cardiomypathyuk](https://www.instagram.com/cardiomypathyuk)

