University of Reading

WEEK 3 SUPPLEMENT

HEART HEALTH

A Beginner's Guide to Cardiovascular Disease

HEART FAILURE

Heart failure can be defined as the failing (insufficiency) of the heart as a mechanical pump due to either acute damage (eg. Heart attack) or chronic overwork (eg. Hypertension, valvular diseases). It is a progressive condition, gradually worsening, though the body undergoes some amazing adaptations to prolong the function of the heart for as long as possible. You can find out more about heart failure from the British Heart Foundation at **www.bhf.org.uk/heart-health/conditions/heart-failure.aspx**

FIGURE 1
Heart failure can be classified into 4 categories or classes, depending upon the severity, which are numbered 1 to 4. Class 1 is relatively mild, only causing symptoms with intense physical activity. Class 4 is end stage heart failure, with symptoms occurring even when at rest.

Heart failure is diagnosed through several tests including chest x-rays to look at the size of the heart, echocardiograms (an ultrasound of the heart) to provide information about the structure (particularly the heart valves) and function of the heart, and computed tomography (CT) and magnetic resonance imaging (MRI) which provide detailed anatomical images. You can find out more about each of these tests from the British Heart Foundation at:

www.bhf.org.uk/heart-health/tests/chest-x-ray.aspx

www.bhf.org.uk/heart-health/tests/echocardiogram.aspx

www.bhf.org.uk/heart-health/tests/mri-scans.aspx

You can see an amazing video clip of a cardiac MRI at **youtu.be/G4dFVeP9Vdo**

HYPERTENSION (HIGH BLOOD PRESSURE)

Blood pressure is the physical pressure exerted by the blood on the blood vessels. It is transiently increased by the contraction of the heart forcing the blood through the vessels. You can find out more about hypertension from the British Heart Foundation at **www.bhf.org.uk/heart-health/conditions/high-blood-pressure.aspx**

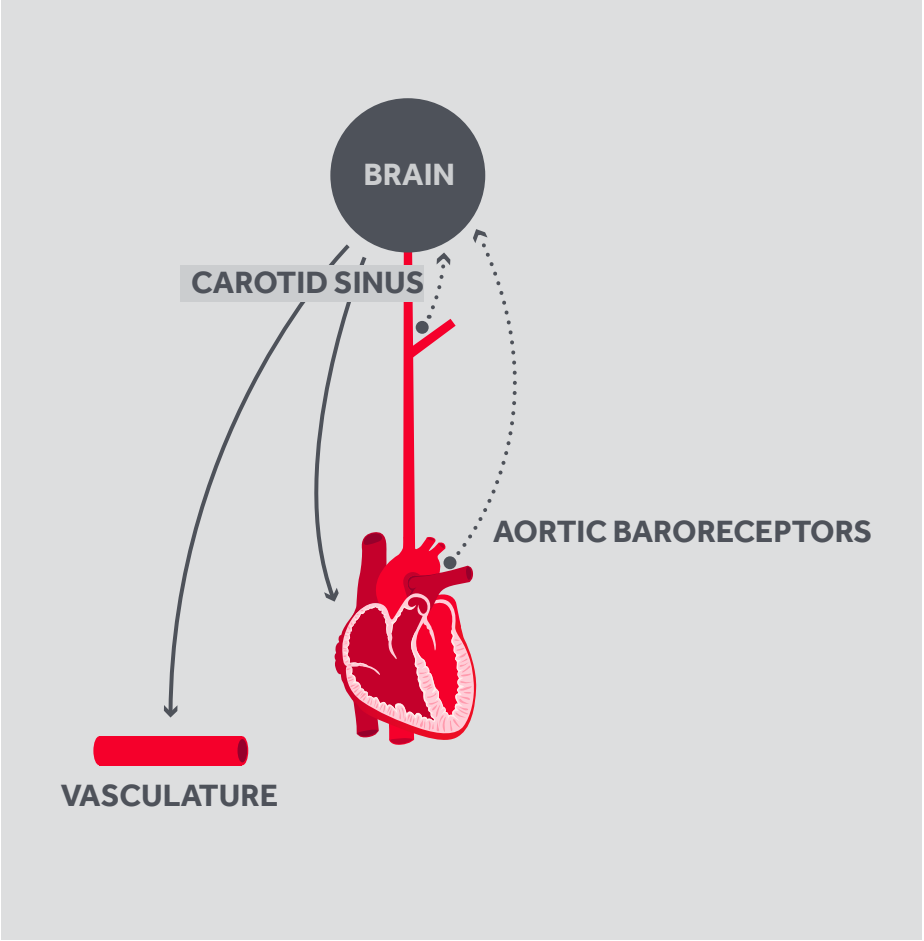


FIGURE 2

The baroreceptor reflex refers to special sensors (receptors) that can measure pressure (like a barometer measures the pressure to help predict the weather) and is partly responsible for regulating blood pressure. Special sensors sit in the aortic arch (aortic baroreceptors) and in the carotid artery (carotid sinus). If these sensors measure a drop in blood pressure they send messages to the brain. The brain then sends messages to the heart (telling it to contract faster and harder) and to the blood vessels (telling the smooth muscle in the blood vessel wall to contract (vasoconstriction)), thus increasing the blood pressure.

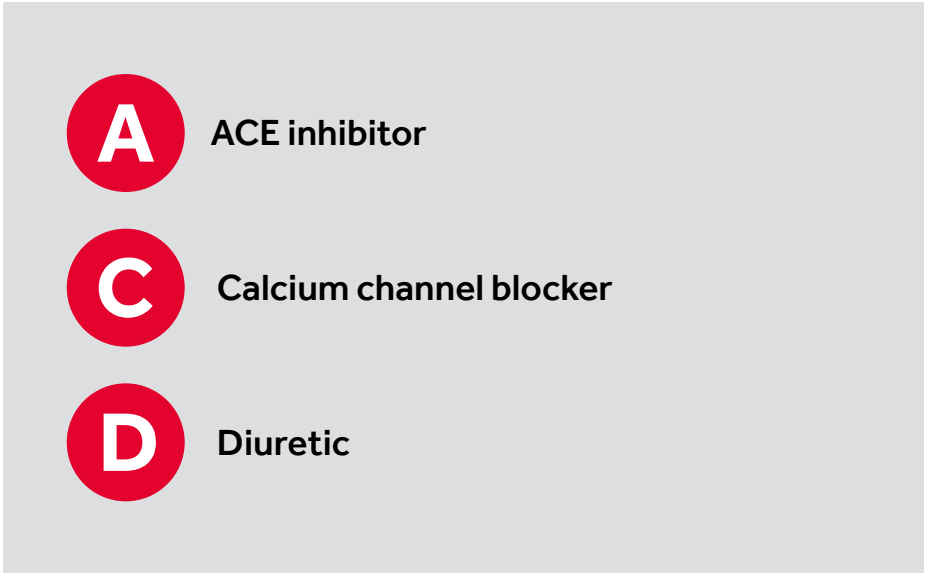
MEASURING BLOOD PRESSURE

Blood pressure is measured with a sphygmomanometer. This gives 2 values for blood pressure, the systolic pressure and the diastolic pressure. Systolic pressure is the pressure exerted by the blood on the arteries as the heart contracts. Diastolic pressure is the pressure exerted by the blood on the arteries when the heart is relaxed. Both systolic and diastolic values give the doctor important information about the state of the circulatory system. The values are usually expressed as 2 numbers with the systolic pressure given first and then the diastolic pressure, for example 120/80mmHg. Normal blood pressure is considered to be a systolic pressure of less than 120mmHg and a diastolic pressure of less than 80mmHg (at rest), though it is normal to increase with physical activity. Hypertension is defined as a systolic pressure of greater than 140mmHg or a diastolic pressure greater than 90mmHg (at rest, and on more than one occasion).

FIGURE 3

Patients with a resting blood pressure that lies between normal (120/80mmHg) and hypertension (140/90mmHg) are often given life style advice to try and bring their blood pressure down to normal levels. Patients with blood pressure classified as hypertension are often given both life style advice and possibly medication. The NICE (National Institute for Health and Care Excellence, UK) pathway for the treatment of hypertension indicates the use of the ACD strategy where patients are started on an ACE inhibitor or a calcium channel blocker depending on their age, racial background and medical history. Normally newly diagnosed patients under 55's are prescribed ACE inhibitor drugs. The over 55's and black people of African or Caribbean family origin (of any age) would initially receive a calcium channel blocker.

The second stage is to combine ACE inhibitors and calcium channel blockers and finally a diuretic to try and lower the blood pressure. If this still fails it is likely that the patient would be referred to a specialist for further treatment, as would people with medical histories or conditions that would counter-indicate any of these drugs. The ACD guidance and definition of hypertension does not apply during pregnancy. You can find out more about the management of hypertension from the NICE pathways at **pathways.nice.org.uk/pathways/hypertension**



VALVULAR DISEASE

FIGURE 4
Valvular disease can affect any of the 4 heart valves, though it more commonly affects the 2 valves on the left side of the heart (the mitral/bicuspid valve and the aortic valve) due to the higher forces exerted upon them. The valves can become either stenotic (narrowed) or regurgitant/prolapsed (leaky). You can find out more about valvular disease from the British Heart Foundation at **www.bhf.org.uk/heart-health/conditions/heart-valve-disease.aspx**

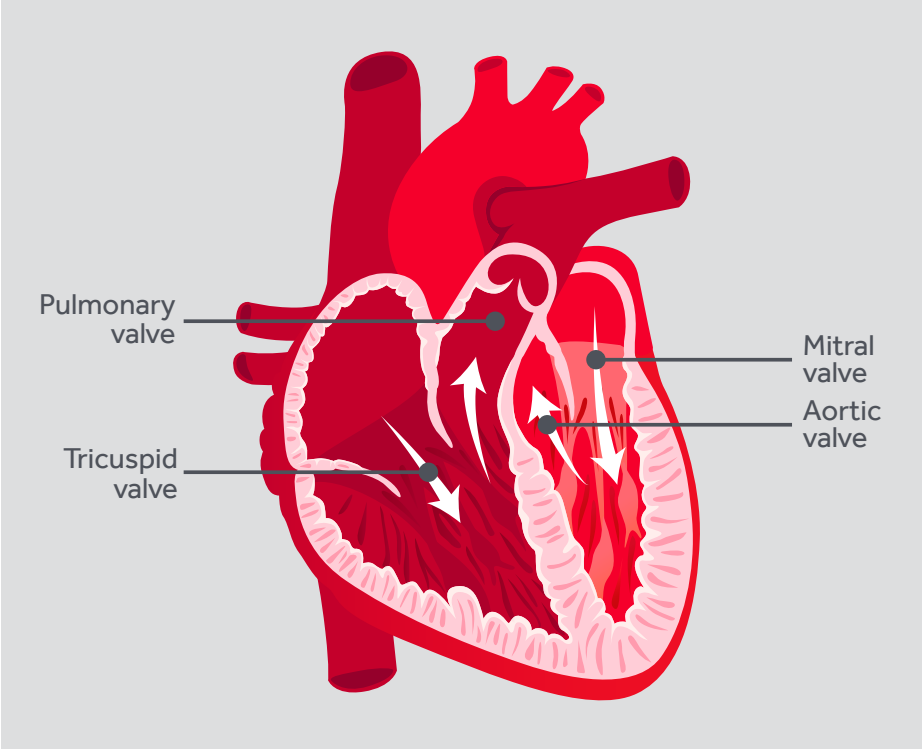
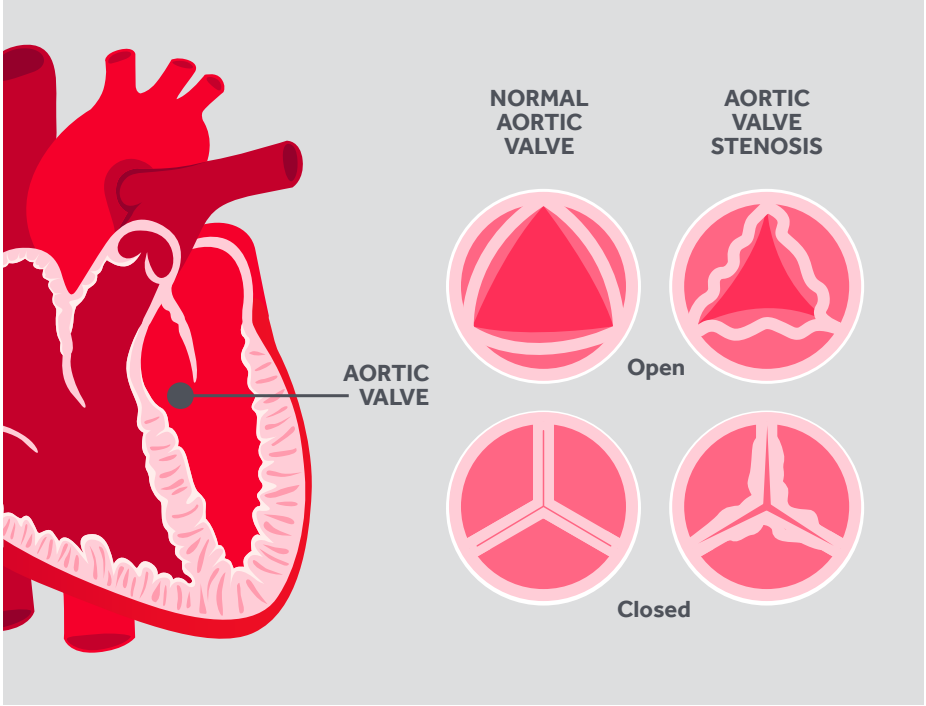


FIGURE 5
When heart valves become stenotic they become narrowed. This prevents them from opening fully. If the aortic valve becomes stenotic it is harder for blood to exit the left ventricle. This causes the muscle of the left ventricle to work harder and it can become thickened.

What do you think happens if the mitral/bicuspid valve becomes stenotic?



HYPERTROPHY

FIGURE 6

When heart valves become stenotic they become narrowed. This prevents them from opening fully. If the aortic valve becomes stenotic it is harder for blood to exit the left ventricle. This causes the muscle of the left ventricle to work harder and it can become thickened – 'hypertrophy'.

What do you think happens if the mitral/ bicuspid valve becomes stenotic?

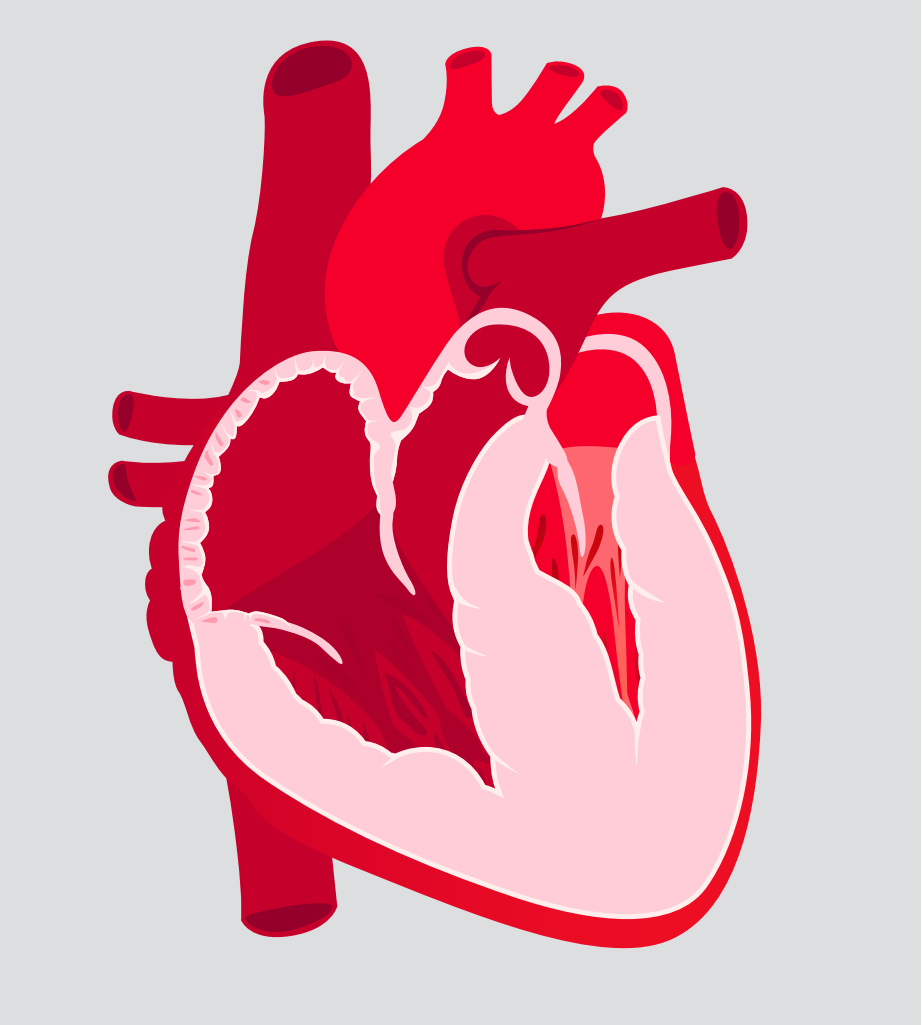
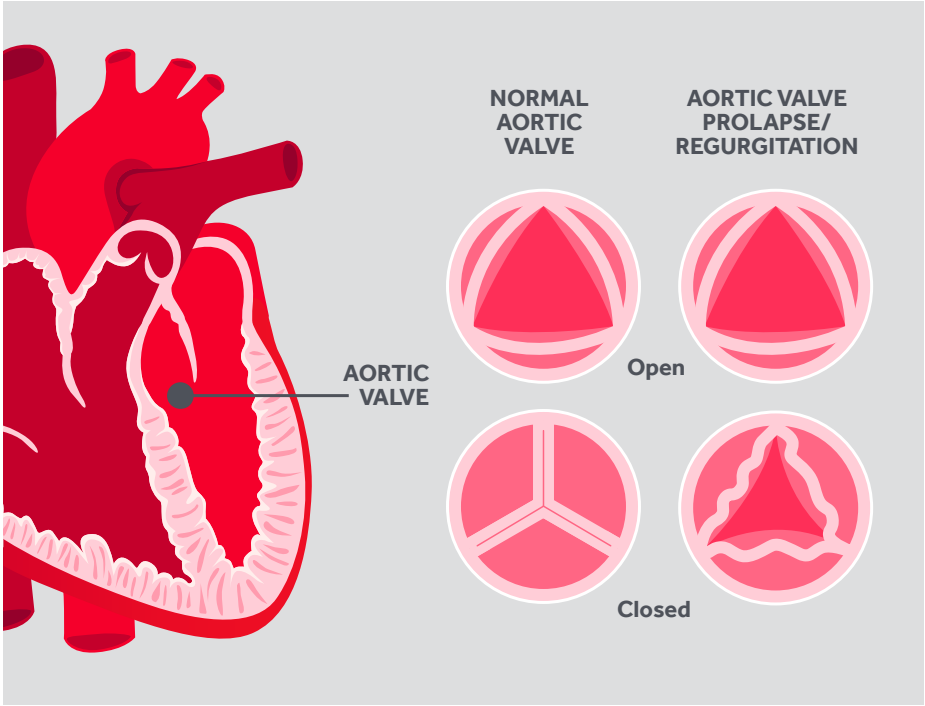


FIGURE 7

When heart valves become regurgitant or prolapsed they become leaky. They are unable to close to form a tight seal and prevent backflow of blood. If the aortic valve becomes regurgitant it allows blood to flow back into the left ventricle after contraction. This causes the left ventricle to be stretched.

What do you think happens if the mitral/ bicuspid valve becomes regurgitant?



ARRHYTHMIAS

Just like a house, both the plumbing and electrics are important for the running of the heart. If the small coronary arteries (plumbing) are narrowed or blocked this can result in a reduced flow of vital blood and oxygen to the heart muscle. This prevents the heart from working optimally. Likewise, if the electrical system of the heart which controls the rate (speed) and rhythm (regularity) of the heartbeat isn't functioning well, the heart is also unable to pump blood around the body. The electrical activity can be measured with an electrocardiogram (ECG). Entire books have been written about interpreting ECGs. It is a useful tool in the hands of experts as many factors can affect it, from diseases and medications to anxiety and electrical interference.

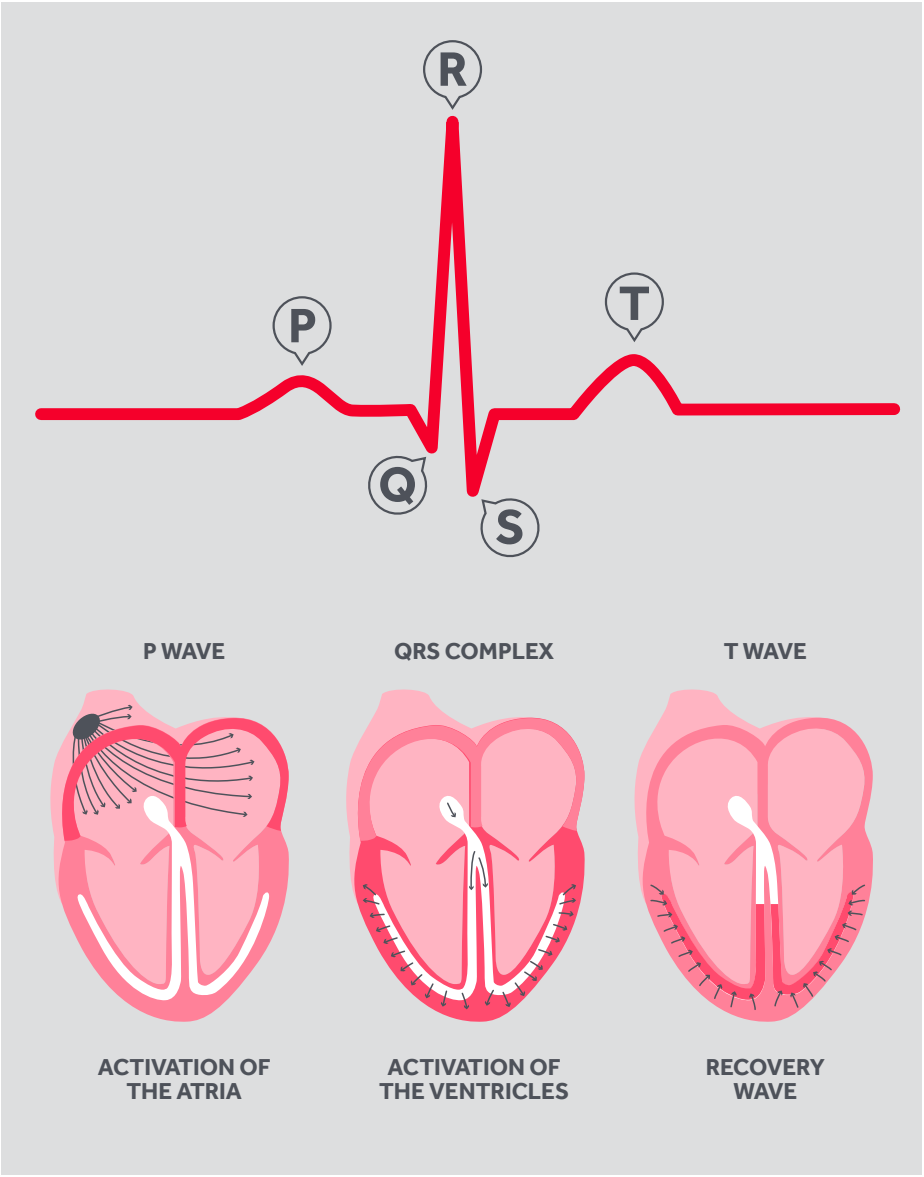


FIGURE 8
For each heartbeat an ECG produces a line with a series of peaks and troughs that represent the change in electrical activity of the heart. It starts with a small peak called the P wave which represents the electrical activation of the 2 atria, causing them to contract.

There is then a short gap known as the PR interval where the electrical signal travels from the atria, through the sinoatrial node and down the septum of the heart to the apex. The QRS complex is the trough, largest peak, trough, and represents the electrical activation of the 2 ventricles, causing the ventricles to contract from the apex upwards, pushing blood upwards towards the aorta and pulmonary artery. This is followed by the T wave which is the small peak that represents the recovery of the ventricles.

FIGURE 9

An arrhythmia is an irregular heartbeat. An ECG measures the rate and rhythm of the heart, with abnormalities named in terms of this rate and rhythm. A normal heart should beat 60 to 100 times a minute. Tachycardia (or a tachy arrhythmia) is a fast heartbeat ie. greater than 100 bpm (beats per minute), shown on an ECG as more frequent repeats of the normal peaks and troughs.

Bradycardia (or brady arrhythmia) is a slow heartbeat ie. less than 60 bpm (beats per minute), shown on an ECG as less frequent repeats of the normal peaks and troughs. Fibrillation is an erratic or uncoordinated heartbeat that is unable to sufficiently pump blood, shown on an ECG as a loss of the usual pattern of peaks and troughs. Arrhythmias are also described in terms of the location of the problem. For example ventricular tachycardia is a fast rate of the ventricles contracting, whilst atrial fibrillation is the uncoordinated contraction of the atria.

You can find out more about arrhythmias from the British Heart Foundation at **www.bhf.org.uk/heart-health/conditions/abnormal-heart-rhythms.aspx**