

Who needs a permanent cardiac pacemaker?

Normal electrical stimulation and conduction in the heart

The contraction of the heart is dependent upon the heart muscle being stimulated by transmission of an electrical impulse. The contraction occurs in phases. Normally, an electrical impulse builds up in the upper portion of the right atrium (the receiving chamber for blood coming from the body generally). This is called the sinoatrial (SA) node. An electrical pulse is passed into the right atrium and across to the left atrium. The muscle of both atria contracts and this leads to the filling of the right and left ventricles. The electrical waves from the right and left atria arrive at the junction of the two atria with the two ventricles and are stored in the atrioventricular (AV) node. A level is reached whereby the AV node discharges into the ventricles. In the ventricles the charge is carried along rapidly conducting pathways into the muscle fibres. These pathways are referred to as the left and right conducting bundles. The muscle fibres then contract. The right ventricle pumps its blood into the circulation within the lungs. This blood receives oxygen in the lungs, and it disposes of carbon dioxide through the lungs. The left ventricle pumps out oxygenated blood it has received from the lungs, via the left atrium into the aorta to pass under pressure to all parts of the body.

The integrity and effectiveness of the SA node, AV node and left and right conducting bundles are essential for proper phased contraction of the heart, including the heart rate (pulse rate, beats per minute).

The system is marvellously efficient - until it breaks down, ages or becomes insensitive to stimulation (as an example, the heart may not speed up with activity, leading to breathlessness, fatigue or fainting.)

The SA node may have become unresponsive. The AV node may become blocked or the conducting system in the ventricular bundles may become blocked, thereby not transmitting the impulses it receives from the right and left atria. This "heart block" may be slight (grade 1), moderate (grade 2) or complete (grade 3).

A permanent pacemaker is usually required for treatment of grade 3 block and often required for grade 2 block. Hence permanent pacing needs are increasing to avoid blackouts, fainting, confusion and heart failure.

The pacemaker

A cardiac pacemaker is an implanted device, consisting of sensing capacity to receive, record and transmit electrical impulses within the heart. It consists of a computing/analysing system, connected to a lead or leads. The leads carry the information to the computer component. The computer generates electrical stimuli which are then carried via the leads to stimulate the heart to contract - to continue pumping at a chosen rate. Thus, if heart-beats do not occur when they should, the pacemaker system detects the absence of an appropriately timed normal electrical stimulus and replaces it with a pacemaker generated impulse. The system is driven by lithium batteries which last for years.

The procedure

The size of the implanted system is now quite small, and usually after being implanted causes no inconvenience. The device is usually placed surgically in a small pocket made in the muscle in the front upper chest (see left). This is a system which has been progressively refined over the past few decades and further development continues through the work of biomedical engineers. As implantation involves surgery, it is somewhat uncomfortable or painful for several days. After some weeks it is usual to be unaware of the existence of the pacemaker. The surgery includes the insertion of the lead or leads. The leads from the pacemaker are inserted into a vein and passed into the right atrium and ventricle (see below). The surgery may be undertaken by an appropriately

trained and skilled cardiologist or cardiovascular surgeon.

Most permanent pacemakers are inserted into older people - another product of an ageing population. I hope you will live long and well and will never need a pacemaker. If you do receive a pacemaker it is well worth knowing that you should, with a pacemaker, be fully active and well.

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