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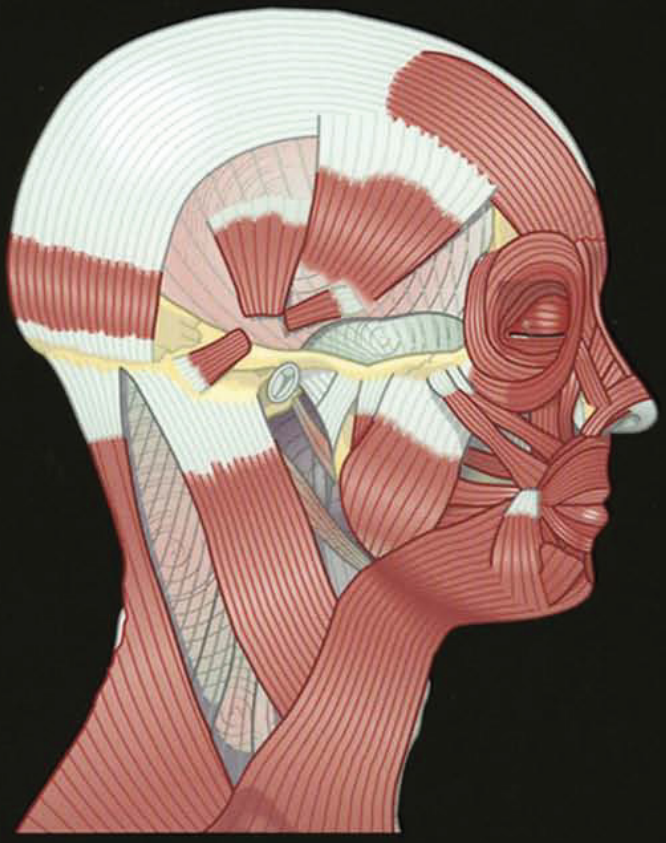
41ST EDITION



Edited by

Dr Harvey Marcovitch

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membrane is known as epicardium; the muscular substance as myocardium; and the smooth lining membrane as endocardium.

Important nerves regulate the heart's action, especially via the vagus nerve and with the sympathetic system (see NERVOUS SYSTEM). In the near part of the atria lies a collection of nerve cells and connecting fibres, known as the sinu-atrial node or pacemaker, which forms the starting-point for the impulses that initiate the beats of the heart. In the groove between the ventricles and the atria lies another collection of similar nerve tissue, known as the atrioventricular node. Running down from there into the septum between the two ventricles is a band of special muscle fibres, known as the atrioventricular bundle, or the bundle of His. This splits up into a right and a left branch for the two ventricles, and the fibres of these distribute themselves throughout the muscular wall of the ventricles and control their contraction.

Openings There is no direct communication between the cavities on the right side and those on the left; but the right atrium opens into the right ventricle by a large circular opening, and similarly the left atrium into the left ventricle. Into the right atrium open two large veins, the superior and inferior venae cavae, with some smaller veins from the wall of the heart itself, and into the left atrium open two pulmonary veins from each lung. One opening leads out of each ventricle – to the aorta in the case of the left ventricle, to the pulmonary artery from the right.

Before birth, the FETUS's heart has an opening (foramen ovale) from the right into the left atrium through which the blood passes; but when the child first draws air into his or her lungs this opening closes and is represented in the adult only by a depression (fossa ovalis).

Valves The heart contains four valves. The mitral valve consists of two triangular cusps; the tricuspid valve of three smaller cusps. The aortic and pulmonary valves each consist of three semilunar-shaped segments. Two valves are placed at the openings leading from atrium into ventricle, the tricuspid valve on the right side, the mitral valve on the left, so as completely to prevent blood from running back into the atrium when the ventricle contracts. Two more, the pulmonary valve and the aortic valve, are at the entrance to these arteries, and prevent regurgitation into the ventricles of blood which has been driven from them into the arteries. The noises made by these valves in closing constitute the greater part of what are known as the heart sounds, and can be heard by anyone who applies his or her ear to the front of a person's chest. Murmurs heard accompanying these sounds indicate defects in the valves, and may be a sign of heart disease (although many murmurs, especially in children, are 'innocent').

Action At each heartbeat the two atria contract and expel their contents into the ventricles, which at the same time they stimulate to contract together, so that the blood is driven into the arteries, to be returned again to the atria after having completed a circuit in about 15 seconds through the body or lungs as the case may be. The heart beats from 60 to 90 times a minute, the rate in any given healthy person being about four times that of the respirations. The heart is to some extent regulated by a nerve centre in the MEDULLA, closely connected with those centres which govern the lungs and stomach, and nerve fibres pass to it in the vagus nerve. The heart rate and force can be diminished by some of these fibres, by others increased, according to the needs of the various organs of the body. If this nerve centre is injured or poisoned – for example, by lack of oxygen – the heart stops beating in human beings; although in some of the lower animals (e.g. frogs, fishes and reptiles) the heart may under favourable conditions go on beating for hours even after its entire removal from the body.

Heart, Artificial

A mechanical device in the chest that enhances or takes over the pumping action of the HEART, thus maintaining the necessary level of circulation of blood through the lungs and other body structures. An artificial heart was first used in humans in 1985 and the three types in use are: an intra-aortic balloon pump, driven by compressed air, which inflates a balloon in the AORTA with every heartbeat, increasing the volume of circulating blood; an electrical device that assists the left VENTRICLE by pumping blood into the abdominal aorta; and a mechanical artificial heart that replaces a diseased heart that has been removed. As yet there is no artificial heart suitable for long-term use. Existing devices are intended to tide over a patient who is extremely ill until a live heart can be transplanted from a donor. The results from artificial hearts have been disappointing because of complications and also because the patients have usually been already dangerously ill.

Heart, Diseases of

Heart disease can affect any of the structures of the HEART and may affect more than one at a

time. Heart attack is an imprecise term and may refer to ANGINA PECTORIS (a symptom of pain originating in the heart) or to coronary artery thrombosis, also called myocardial infarction.

Arrhythmias An abnormal rate or rhythm of the heartbeat. The reason is a disturbance in the electrical impulses within the heart. Sometimes a person may have an occasional irregular heartbeat: this is called an ECTOPIC beat (or an extrasystole) and does not necessarily mean that an abnormality exists. There are two main types of arrhythmia: bradycardias, where the rate is slow – fewer than 60 beats a minute and sometimes so slow and unpredictable (heartblock) as to cause blackouts or heart failure; and tachycardia, where the rate is fast – more than 100 beats a minute. A common cause of arrhythmia is coronary artery disease, when vessels carrying blood to the heart are narrowed by fatty deposits (ATHEROMA), thus reducing the blood supply and damaging the heart tissue. This condition often causes myocardial infarction after which arrhythmias are quite common and may need correcting by DEFIBRILLATION (application of a short electric shock to the heart). Some tachycardias result from a defect in the electrical conduction system of the heart that is commonly congenital. Various drugs can be used to treat arrhythmias (see ANTIARRHYTHMIC DRUGS). If attacks constantly recur, the arrhythmia may be corrected by electrical removal of dead or diseased tissue that is the cause of the disorder. Heartblock is most effectively treated with an artificial CARDIAC PACEMAKER, a battery-activated control unit implanted in the chest.

Cardiomyopathy Any disease of the heart muscle that results in weakening of its contractions. The consequence is a fall in the efficiency of the circulation of blood through the lungs and remainder of the body structures. The myopathy may be due to infection, disordered metabolism, nutritional excess or deficiency, toxic agents, autoimmune processes, degeneration, or inheritance. Often, however, the cause is not identified. Cardiomyopathies are less common than other types of heart diseases, and the incidence of different types of myopathy (see below) is not known because patients or doctors are sometimes unaware of the presence of the condition.

The three recognised groups of cardiomyopathies are hypertrophic, dilated and restrictive.

- Hypertrophic myopathy, a familial condition, is characterised by great enlargement of the muscle of the heart ventricles. This reduces the muscle's efficiency, the ventricles fail to relax properly and do not fill sufficiently during DIASTOLE.
- In the dilated type of cardiomyopathy, both ventricles overdilate, impairing the efficiency of contraction and causing congestion of the lungs.
- In the restrictive variety, proper filling of the ventricles does not occur because the muscle walls are less elastic than normal. The result is raised pressure in the two atria (upper cavities) of the heart: these dilate and develop FIBRILLATION. Diagnosis can be difficult and treatment is symptomatic, with a poor prognosis. In suitable patients, heart TRANSPLANTATION may be considered.

Disorders of the heart muscle may also be caused by poisoning – for example, heavy consumption of alcohol. Symptoms include tiredness, palpitations (quicker and sometimes irregular heartbeat), chest pain, difficulty in breathing, and swelling of the legs and hands due to accumulation of fluid (OEDEMA). The heart is enlarged (as shown on chest X-ray) and ECHOCARDIOGRAPHY shows thickening of the heart muscle. A BIOPSY of heart muscle will show abnormalities in the cells of the heart muscle.

Where the cause of cardiomyopathy is unknown, as is the case with most patients, treatment is symptomatic using DIURETICS to control heart failure and drugs such as DIGOXIN to return the heart rhythm to normal. Patients should stop drinking alcohol. If, as often happens, the patient's condition slowly deteriorates, heart transplantation should be considered.

Congenital heart disease accounts for 1–2 per cent of all cases of organic heart disease. It may be genetically determined and so inherited; present at birth for no obvious reason; or, in rare cases, related to RUBELLA in the mother. The most common forms are holes in the heart (atrial septal defect, ventricular septal defect – see SEPTAL DEFECT), a patent DUCTUS ARTERIOSUS, and COARCTATION OF THE AORTA. Many complex forms also exist and can be diagnosed in the womb by fetal echocardiography which can lead to elective termination of pregnancy. Surgery to correct many of these abnormalities is feasible, even for the most severe abnormalities, but may only be palliative giving rise to major difficulties of management as the children become older. Heart transplantation is now increasingly employed for the uncorrectable lesions.

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