

HEART STRUCTURE AND ITS DISEASES

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Abstract

This article analyzes the anatomical structure of the heart, its main components, and the structure of the pericardium. The heart is one of the most important organs of the body and serves as the central organ of the circulatory system. The article provides a concise anatomical description of the heart's atria, ventricles, valves, and conduction system. Furthermore, the article highlights the pericardial layer surrounding the heart and its physiological significance. In addition, the causes, pathogenesis, and clinical manifestations of pericardial inflammation—pericarditis—are discussed, along with its effects on cardiac function. The study results contribute to a deeper understanding of heart anatomy and pericardial diseases and hold significant relevance for medical practice.

Keywords

Heart anatomy, pericardium, pericarditis, atria, ventricles, heart valves, circulatory system, cardiac conduction system, inflammation, cardiology.

The heart is located in the thoracic cavity, behind the sternum, and pumps blood to all parts of the body. It functions similarly to a pump. The heart consists of four chambers: two atria and two ventricles. The right atrium is located at the level of the 3rd–4th, and in some individuals the 4th–5th ribs. It contributes to pulmonary circulation, sending blood to the lungs to be oxygenated. The next chamber is the right ventricle, which occupies the anterior and larger part of the heart. Therefore, in the event of any injury or penetration, the right ventricle is most likely to be affected. On the left side, there is also an atrium and a ventricle. The left atrium is located at the level of the 3rd–4th ribs and is responsible for delivering blood to the systemic circulation. Compared to the right atrium, its wall is thicker because it must pump blood through the systemic circulation, which operates under higher pressure. The left atrium is primarily visible from the posterior side of the heart, which makes it less susceptible to injury. The left ventricle is located at the level of the 4th–5th ribs and participates in the systemic circulation. Its wall is thicker than that of the right ventricle due to the higher pressure required to pump blood through the systemic circulation.

The heart is composed of three layers:

1. Pericardium
2. Myocardium
3. Epicardium

These layers extend from the outer surface inward. Now, let us examine each of them individually. The pericardium is the tough outer layer that surrounds the heart and contains a very small amount of collagen (about 1 mm). It is inelastic and non-elastic. It receives innervation from the phrenic nerves (C3–C5). If this layer is damaged, pain may be felt in the



trapezius muscle and shoulder region. The pericardium is divided into two main layers: the fibrous pericardium and the serous pericardium.

The fibrous pericardium is the outermost layer and is attached to the adventitial layer of the major blood vessels, the central tendon of the diaphragm, and the sternum. Because the fibrous pericardium is inelastic, the accumulation of excessive fluid around the heart can lead to a condition called cardiac tamponade. In this condition, the collected fluid exerts external pressure on the heart, preventing it from contracting properly. As a result, the blood in the superior vena cava cannot enter the heart due to the increased intracardiac pressure, causing blood to be redirected into the veins of the neck. This leads to visible distension and bluish discoloration of the neck veins. This condition is often associated with pain. For example, if a patient presents with cardiac pain, leaning forward can relieve the pain as the fluid shifts away from the heart, which can help in the diagnosis of cardiac tamponade. To treat this condition, the accumulated fluid in the heart is removed through a procedure called pericardiocentesis. During the procedure, a needle is inserted at a 40–45 degree angle near the sternum, typically in the intercostal space between the 5th and 6th ribs, and all the fluid is drained. This reduces the pressure on the heart, and the heart itself continues to produce the necessary amount of fluid. However, there is a potential risk: if the needle is slightly misaligned during pericardiocentesis, it can damage the internal thoracic artery, potentially causing hypovolemic shock in the patient.

The serous layer of the pericardium is further divided into two layers: the parietal and visceral layers. The parietal layer lines the inner side of the fibrous pericardium. The visceral layer, also referred to as the epicardium in some literature, covers the heart itself and contains the coronary arteries that supply blood to the heart. Additionally, adipose tissue can also be observed in this layer. Between the parietal and visceral layers, there is normally about 20 ml of fluid, which reduces friction during heart contractions. This volume is physiological; if it increases, it can interfere with the heart's contraction.

If the pericardium becomes infected by harmful microorganisms, this condition is called pericarditis. The associated pain can radiate to the following areas of the body:

1. The posterior part of the neck
2. The arms
3. The shoulders, especially the left shoulder, since the heart is located on the left side
4. The subclavicular (below the collarbone) and shoulder region.

Another heart disorder is mitral stenosis, which can occur congenitally or as a result of acquired conditions. In this disease, the bicuspid (mitral) valve becomes stenotic, causing blood to accumulate in the left atrium. As a result, the left atrium enlarges and compresses surrounding structures, including the esophagus and the recurrent laryngeal nerve. This condition is sometimes referred to in medicine as Ortner syndrome.

The blood supply of the heart is provided through the coronary arteries, which can be classified into three types depending on the individual:

1. Left dominant
2. Right dominant
3. Balanced or codominant, where both arteries contribute to supplying the heart with blood.



Now, let us examine the origins of these coronary arteries individually: The left anterior descending (LAD) artery supplies blood to the anterior two-thirds of the heart and the papillary muscles that control the heart valves. The posterior descending artery (PDA) supplies the interventricular septum (one-third), two-thirds of the ventricular walls, the posteromedial papillary muscles, as well as the sinoatrial (SA) and atrioventricular (AV) nodes.

If the posterior descending artery (PDA) originates from the left circumflex artery, the heart is considered left dominant. However, if it arises from the right coronary artery, it is considered right dominant.

The cardiac conduction system consists of specialized cells that ensure the rhythmic and coordinated contraction of the heart muscle. This system generates electrical impulses in the heart and ensures their propagation in a specific sequence. Normally, the cardiac impulse originates from the sinoatrial node (SA node), which is the natural pacemaker of the heart. The SA node is located in the upper part of the right atrium, at the junction with the superior vena cava. This node serves as the heart's primary pacemaker, producing approximately 60–100 electrical impulses per minute. The generated impulses spread through the atrial muscle, causing the atria to contract.

The impulses from the atria subsequently reach the atrioventricular node (AV node). The AV node is located in the lower part of the right atrium, within the region of the interatrial septum. Its main function is to briefly delay the impulse before transmitting it to the ventricles. This delay allows the atria to contract first, pushing blood into the ventricles, after which the ventricles contract.

From the AV node, the impulse passes through the Bundle of His. The His bundle runs downward along the interventricular septum and divides into two main branches, known as the right bundle branch and the left bundle branch. These branches transmit the impulses to the right and left ventricles, respectively. The left branch typically divides into anterior and posterior fascicles. Subsequently, the impulse rapidly spreads through the Purkinje fibers located along the ventricular walls. The Purkinje fibers conduct impulses very quickly, ensuring the ventricles contract simultaneously and efficiently. As a result, blood is pumped from the heart into the systemic and pulmonary circulation.

The cardiac conduction system transmits impulses in the following sequence: SA node → atrial muscle → AV node → Bundle of His → right and left bundle branches → Purkinje fibers. This system ensures the heart functions in a regular and efficient manner.

Conclusion: The heart is one of the most important organs in the human body and serves as the central organ of the circulatory system. Its anatomical structure is complex, consisting of four chambers—two atria and two ventricles. The heart wall is composed of the endocardium, myocardium, and epicardium, and the heart is externally enclosed by the pericardium. Normal heart function is closely dependent on its conduction system, valves, and coronary arteries. These structures ensure the rhythmic contraction of the heart muscle, unidirectional blood flow, and oxygen supply to the myocardium. Any disruption in heart function can lead to the development of various cardiovascular diseases. These include myocardial infarction, ischemic heart disease, pericarditis, arrhythmias, and many other pathological conditions. These diseases often arise as a result of narrowing of the coronary arteries, inflammatory processes, genetic



factors, or lifestyle-related causes. Heart diseases are among the most common and serious health threats in modern medicine. Studying the anatomy of the heart in depth, understanding its physiological functions, and identifying the causes and developmental mechanisms of cardiac diseases are of great importance in the field of medicine. To prevent heart diseases, it is important to maintain a healthy lifestyle, eat a balanced diet, increase physical activity, and undergo regular medical check-ups. Thus, knowledge of the heart's structure and its diseases is not only essential for medical professionals but also highly valuable for the general public. Such knowledge plays a crucial role in maintaining human health and reducing the incidence of cardiovascular diseases.

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