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THE STRUCTURE AND FUNCTION OF MYOCARDIUM

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Abstract:

The article discusses the structural structure of the heart muscles, the cardiac muscles, the contraction mechanism, the principle of its operation, and negative consequences that occur when the heart muscles are disturbed.

Keywords: *Muscle, sarcomere, actin, myozone, excitability, myocardium, troponin, tropomyosin, myocardial infarction, thrombus, sucker muscle.*

Introduction

Introduction: Muscles, in turn, are divided into skeletal, smooth and cardiac muscles. And we will now focus on the structure of the heart muscles and its mechanism of action. Cardiac muscles have a transverse orientation and are composed of cylindrical cells located parallel to each other. A special feature of the heart muscle is the existence of intermediate disks in the area of mutual connection of heart muscle cells. Contraction of heart muscles is rhythmic and does not obey human will.

The structure of the heart muscles is complex and special, and ensures constant and rhythmic contractions of the heart. This structure consists of the following main parts:

1. **Cardio myocytes:** Heart muscle cells are long and interconnected. They are multinucleated and contain a large number of mitochondria, which ensures fast and efficient production of energy.
2. **Intercalated discs:** These structures are located between cardio myocytes and connect cells together. They contribute to the rapid propagation of electrical signals, which allows synchronous contraction of the heart.

3. **T-tubules:** These are ducts that penetrate into the cell membrane, providing a quick and efficient movement of calcium ions, which controls the contraction of the heart muscle.
4. **Sarcoplasmic reticulum**: It is an organelle that deals with the storage and release of intracellular calcium ions. It plays an important role in controlling the contraction and relaxation of the heart muscle.
5. **Myofibrilla:** These are long protein fibers consisting of actin and myosin filaments. They are divided into units called sarcomeres and reduce the mechanism of contraction.

The heart muscle is specially composed for constant and rhythmic contractions, and their structure is highly specialized. By working together, these structures ensure that the heart functions as a pump.

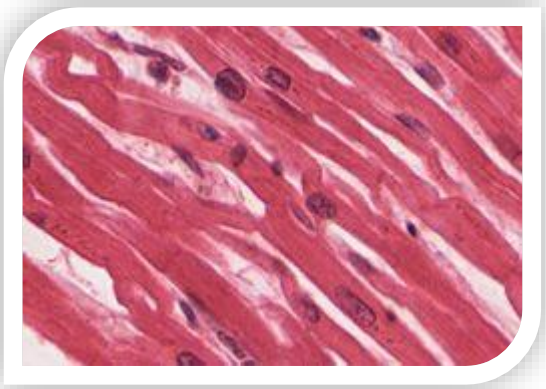

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Photo 1. Heart muscles

Features of the heart muscles: Heart muscles differ in structure, composition from the smooth muscles of the skeleton and internal organs. The anatomical histological, physiological aspect of the muscles in general is studied in two. Skeleton muscles transverse muscles differ in their specific structure and physiological qualities. Some of the features of the heart muscles are characteristic of general tissues, while others are characteristic only of the heart muscles. The body's skeleton muscles always keep the body moving in balance. But he muscles do not strain the body like the muscles of internal organs, but a lot of freedom. For example: while standing, the leg, the spine's skeleton muscles contract and keep the body upright. Other muscles will be relaxed even if the muscles that provide breath movement work with tension when sitting.

The extracurricular state of the muscles of the internal organs (heart) becomes less. The heart muscles are constantly agitated, having extirpated oxygen and nutrients, spending a lot of energy. That is why the heart muscles have their own physiological qualities.

1. The property of permeability is characteristic of the heart muscles. Conduction is provided through special conductive systems in the heart muscle system. In the heart, such a conductive system will consist of special nerve nodes and muscle fibers. The most basic excitable node is the Keith – Fleck node, which locates the heart over the right subunits to the venous sinus section, is called Kiss-Fleck in some literature.
2. The Ashof Tovar Node located in the atrioventricular part.
3. Gissa knot-legs.
4. Purkine fibers.

This system is called **Heart conduction systems**.

Any effects that come to the heart (reflector and humoral) are transmitted through the conductive system at different speeds. In the compartment part of the heart,the rate of interaction in the sinus node-Kiss Fleck part is 1-1.2 mm/second, and in the Ashof commodity this rate is sharply reduced-that is, 0.02-0.03 mm/second. In the case of the Gissa bond, however, the velocity increases dramatically and reaches 1.5-5 mm/second, with 1000-5000 mm/second in the Purkunye fibers and 0.3-0.5 mm/second in the ventricle section where the velocity decreases again. On the basis of such a transfer of this speed, the work of the heart is provided. There was no rhythm in the work of the heart if the effect was the same in different parts without different. That is, varying the rate of conduction ensures the sequence of cardiac work. Conduction disorders cause heart blacada.

The heart muscles are characterized by an excitability characteristic of all tissues that is central to the heart.

Heart sucker muscles. Suckling muscles are muscles located in the ventricles of the heart. They are joined by two-layer (mitral) and three-layer caps located between the femora and ventricles through the umbilical cords and contract to prevent the systole (ventricular contraction) inversion or prolapse of these pores. The suckling muscles make up about 10% of the total heart mass.

Photo 2. Suckling muscles and wedge threads

Structure: the two-layer cap (mitral valve) sucker muscles in the left ventricle are called the anterior-lateral and posterior-medial muscles.

- Blood supply of anterior-lateral muscles: left anterior descending artery — diagonal branch (LAD) and left recurrent artery — impenetrable marginal branch (LCX)
- Blood supply to the back-middle muscles: right crown artery - posterior intercarcal artery (RCA)

The back-middle muscle often ruptures. Because it is supplied with only one blood vessel. Therefore, the closure of the right crown artery — the posterior intercarcal artery-leads to rupture of the sucker muscles.

Function:

The suckling muscles of the right and left ventricles begin to contract shortly before the ventricle contracts and maintain the entire tension. This strengthens the umbilical and Inter-ventricular pores against prolapse, preventing the ventricular blood from regressing back into the ventricular spaces i.e., when exposed to high pressure in the ventricles.

Clinical significance: rupture of the sucker muscles causes myocardial infarction and impaired function due to ischemia. Both complications lead to a lack of a bilayer cap (mitral valve).

Photo 3. Suckling muscle infarction.

Contraction mechanism: Again, the heart muscles have the same excitability, permeability and contractility as other muscles. There is also an automation feature in the heart. Excitability is the result of an impulse to a tissue, in which biochemical and biophysical changes occur (the occurrence of an action potential). Excitability is caused by the exchange of ions through the channels of potassium, sodium and other ions. Contraction is manifested in the form of a response reaction to the action potential generated in the heart muscle. The muscle layer of the heart is called the myocardium, and the contraction of the heart muscles is carried out by sarcomeres located in its cells.

The mechanism of contraction of the heart muscle is a complex and synchronized process, controlled by electrical signals and the movement of ions. This process consists of the following steps:

1. The beginning of the electrical impulse: contraction begins at the sinoatrial (SA) node. The SA node is the natural rhythm starter of the heart and is located at the top of the heart. This node generates and propagates an electrical impulse.

2. Pulse propagation: the electrical impulse spreads through the atria (the upper sections of the heart), causing them to contract. This reaches the atrioventricular (AV) node.

3. AV node and Giss bundle: the AV node pulse holds for a short period of time, allowing the blood of the atria to be completely squeezed into the ventricles (lower sections of the heart). The impulse then passes through the Giss bundle to the ventricles.

4. Purkinje fibers: the Giss bundle propagates momentum through Purkinje fibers along the ventricles. These fibers rapidly dissipate momentum, allowing the ventricles to contract synchronously.

5. Role of calcium ions: electrical impulse depolarizes cell membranes, which leads to the release of calcium ions from the sarcoplasmic reticulum into the cell cytoplasm. Calcium ions bind to troponin and tropomyosin in myofibrils, activating the reciprocal movement of actin and myosin filaments.

6. Actin and myosin cross-acting: in the presence of calcium ions, actin filaments bind and “lock” with myosin heads. Myosin Heads break down ATP molecules to produce energy, and contraction is achieved by cross-pushing actin filaments.

7. Relaxation: after contraction, calcium ions are returned again to the sarcoplasmic reticulum and actin-myosin bonds are broken. This ensures the relaxation process.

The mechanism of contraction and relaxation of the heart muscle ensures a constant and rhythmic contraction of the heart, ensuring the effective circulation of blood throughout the body.

Most serious diseases are caused by a violation of the mechanism of contraction of the heart muscle. The most common disease among them is myocardial infarction.

Myocardial infarction (also known as heart attack) is an acute period of ischemia of the heart muscle characterized by a cessation of blood flow to the heart when blood supply is disrupted. If within fifteen minutes the blood does not begin to flow again, part of the heart dies (heart muscle necrosis). This is the part of the heart that has dead tissue and is called myocardial infarction.

Necrosis can be wide or small foci. According to the location of necrosis: there are anterior myocardial infarction, lateral myocardial infarction and interventricular infarctions.

In men under 60 years of age, myocardial infarction occurs five times more often than in women of the same age. This is due to the early development of atherosclerosis in men.

Causes

The main and most common cause of myocardial infarction is a violation of blood flow in the crown (coronary) arteries, which supplies the heart muscle with blood and, accordingly, oxygen. Most often, such a violation occurs against the background of atherosclerosis of the arteries, in which atherosclerotic plaques (plaques) appear on the wall of the vessels. Other causes of this disease:

- ✓ ischemic heart disease;
- ✓ diabetes, hypertension;
- ✓ any stage of obesity;
- ✓ stressful situations;
- ✓ nicotine and alcohol addiction.

Symptoms

In the development of a heart attack, symptoms occur not immediately step by step:

- ✓ steno cardia;
- ✓ After that, with a burning sensation in the chest, severe pain appears in the heart. Pain can spread to the hands, shoulders, stomach and lower jaw, as well as other organs and parts of the body;
- ✓ Pallor, cold and sticky skin output;
- ✓ Arrhythmia.

Necrotic damage to heart tissue can lead to varaja, low blood pressure, shortness of breath, swelling of the legs and arms. During the period of the appearance of blisters on the veins, the signs cease to manifest.

Diagnostics

This disease is diagnosed by ECG, blood analysis (its composition has characteristic signs of a heart attack), as well as coronary angiography.

Treatment method

When a patient is suspected of having myocardial infarction, treatment begins immediately with admission to the nearest hospital and urgent complex resuscitation measures are taken. It is very important to calm the patient.

With the help of narcotic painkillers, pain is lost, arrhythmias, heart failure and cardiogenic shock are stopped.

If the patient's condition is satisfactory, coronary angioplasty (surgery to widen the wall of the arteries) is performed on the day or the next day of hospitalization.

Rehabilitation and its duration depend on how damaged the heart is. Rehabilitation consists of specialist-controlled recovery therapy, a special light diet, and physical activity.

Dangerous aspects

- ✓ pulmonary edema;
- ✓ cardiogenic shock;
- ✓ death (death from a heart attack occurs in 35% of cases)

Prevention

- ✓ careful treatment of chronic diseases;
- ✓ body weight control;
- ✓ abstinence from harmful habits;
- ✓ control psychological and physical stress.

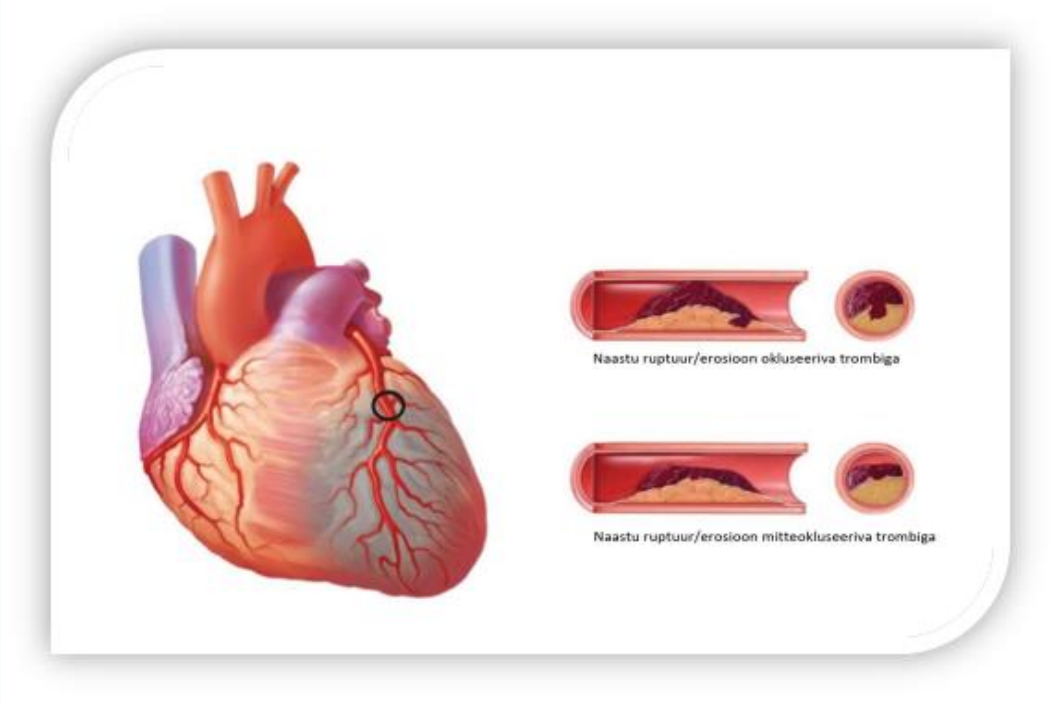


Photo 4. Myocardium infarction

Development and regeneration of cardiac muscle tissue. The heart muscle tissue develops from the mesoderm, the visceral sheet of the splanchnoyome. From this sheet, a myoepicardial plate is formed, from the cells of which the myocardium and epicardium are formed. The mesenchyma cells of the myoepicardial plate differentiate into myoblast cells to form cardio myocytes and fuse through intercalary plates.

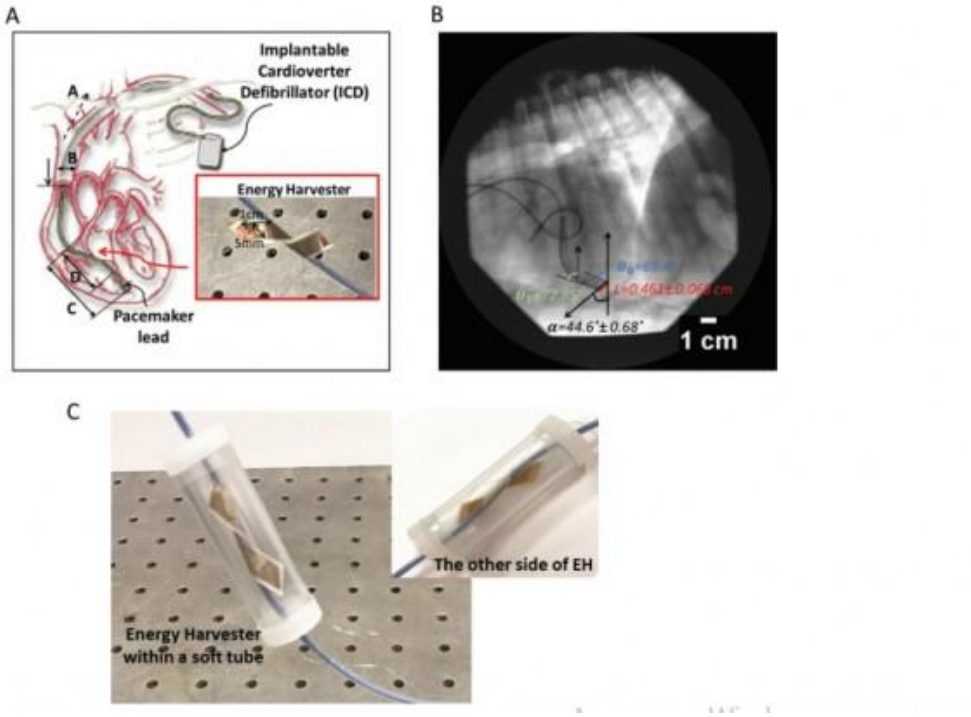
The regeneration of the cross-cardiac muscle tissue varies with age. While cardio myocytes have the ability to divide in infants, cardio myocytes that die due to the absence of satellite (satellite) cells in the adult body and old people, as well as cardio myocytes losing the ability to divide, do not regenerate, and a connective tissue scar forms in their place (in myocardial infarction).

Technology for powering a pacemaker with the help of heart muscles:

Currently, engineers have developed a technology for powering a pacemaker with the help of heart muscles

Engineers at the University of Texas created a piezoelectric generator that converts the energy of heart contractions into electricity and is capable of powering a pacemaker.

Cardio stimulants normalize cardiac activity in patients with disturbances in cardiac activity with electrical impulses. The device is installed in the chest using a surgical procedure, and every 5-10 years it is necessary to replace its battery. The autonomous operation of the pacemaker does not put any weight on the heart, and there is no need to replace the device battery.



Conclusion

Physical activity can increase muscle strength and working capacity through changes such as increased muscle volume and increased metabolic capacity. Different forms of activity produce different biochemical and morphological adaptations in the muscles. In general, the tissue must be active in order to maintain the ability to live. Inactivity leads to atrophy, especially in muscle tissue. Sports medicine and scientific research have shown that different training regimes can cause very specific changes in the muscles. Strength training that puts strong forces on the muscles increases the number of contractile filaments (myofibrils) and the volume of the sarcoplasmic reticulum (see Figure 1). High-intensity exercise increases the activity of muscle enzymes. Fractions of glycolytic and oxidative enzymes are closely related to the intensity of work. In addition, long-term intensive exercise increases capillary density.

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