International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 3, March-April 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Motion Potentials of Cardiomyocytes, the Mechanism of Cardiomyocytes in the Heart

Tohirova Jayrona Izzatillo Qizi

Faculty of Medicine, Samarkand State Medical University, Samarkand, Uzbekistan

ABSTRACT

Muscles are made up of muscle fibers wrapped in a special membrane called the sarcolemma. The protoplasmic substance of muscle fibers and myofibrils of many contractile elements are described in detail.

KEYWORDS: *Cardiomyocytes, pathology, function, functions of cardiomyocytes*

How to cite this paper: Tohirova Jayrona Izzatillo Qizi "Motion Potentials of Cardiomyocytes, the Mechanism of Cardiomyocytes in the Heart" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-3, April 2022, pp.2018-2020, URL: www.ijtsrd.com/papers/ijtsrd49861.pdf

IJTSRD49861

The cardiovascular system acts as a pump, delivering blood to tissues and organs. Blood performs its various functions only when it is in motion. The cardiovascular system includes the heart, blood vessels, and lymphatic vessels.

- The heart is the organ that pumps blood to tissues and organs.
- Arteries are a group of blood vessels that carry blood from the heart to other blood vessels, narrowing as they branch. It mainly carries oxygen-saturated blood (with the exception of the pulmonary arteries).
- Capillaries are small blood vessels that exchange oxygen, carbon dioxide, and nutrients between tissue and blood.
- Veins are a group of blood vessels formed by capillaries that grow larger and larger to carry blood to the heart.
- Lymphatic vessels - starting from the lymphatic capillaries and returning tissue fluid to the blood. Lymphatic capillaries join to form larger vessels, and larger lymphatic vessels flow into a vein.

Topography of the heart

The heart (Latin: cor) is a muscular organ that carries out the rhythmic movement of blood in the small and large circulatory systems. It is located in the anterior thoracic cavity of the chest. Most of it is on the left. The average weight is 300 grams for men and 250 grams for women. The heart has 4 chambers (right and left ventricles, right and left ventricles). There is a 3-valve valve between the left ventricle and the left ventricle, and a 2-valve valve between the right ventricle and the right ventricle. There are hemispherical valves between the left ventricle and the aorta, and between the right ventricle and the pulmonary arteries.

Heart chambers and valves

The structure of the wall. The heart wall consists of three layers: the inner endocardium, the middle myocardium and the outer epicardium. The heart is also surrounded on the outside by the pericardium.

The endocardium is the relatively thin layer of the heart. It consists of the endothelium and the subendothelial layer, which is made up of connective tissue that acts as a base for it. Beneath these layers lies a muscle-elastic layer consisting of elastic fibers and smooth muscle fibers.

The thickest layer of the heart is the myocardium, which is made up of the heart muscle. Cardiac muscle cells are called cardiomyocytes. They are arranged in series to form the heart muscle fiber. In the myocardium, typical and atypical muscle fibers are distinguished. Typical muscle fibers contract and atypical muscle fibers conduct impulses.

The muscle fibers are connected to each other by intermediate plates. Interstitial plates act as trophic and impulse conductors.

Cardiac conduction system. The conduction system of the heart includes atypical muscle fibers. They generate impulses and transmit them to typical muscle fibers. The conduction system of the heart is composed of the sinus node (Kis-Flak), the ventricular atrioventricular node (Ashof-Tovar), and the interventricular tuft (GIS tuft) and its fibers. The gis tuft splits in two to form 1 pair of Purkinje fibers. You can better imagine this in the image below.

The epicardium is a connective tissue covered by a single layer of epithelium (mesothelium). Connective tissue contains adipose tissue, blood vessels and nerve fibers.

The conduction system of the heart

Function: The heart muscle, like other muscles, is excitable, permeable, and contractile. However, the heart is also characterized by automation. Excitability is the occurrence of biochemical and biophysical changes in a tissue as a result of impulses (action potentials). Conductivity is the distribution of the action potential generated in one cell to another. We have already considered the conduction system of the heart. Contraction manifests itself in the form of a response to the action potential generated in the heart muscle. The process of contraction of the limbs by impulses that occur without external influences is called automation.

We often hear that the heart does not use the blood in the heart chambers. However, the blood that enters the aorta is the first to supply blood to the coronary arteries. The heart is supplied with blood through 1 pair of coronary arteries.

The cardiomyocyte membrane is permeable to K 4 ions, but not relatively permeable to Na ions. higher than in the extracellular space. The concentration of "Na", on the contrary, is higher than in the extracellular space. cell. The relative impermeability of the membrane to calcium maintains a high gradient of calcium concentration between the extracellular space and the cytoplasm. The release of K + from the cell along the concentration gradient results in a loss of total intracellular positive charge. The anions do not coexist with K 4 ions, so an electric potential is generated and the inner surface of the cell membrane is negatively charged relative to the outer one. Thus, the resting membrane potential is formed under conditions of equilibrium between two opposing forces: the motion of K + along the concentration gradient and the electric attraction of the negatively charged intracellular cavity of positively charged ions K".

Typically, the resting membrane potential of ventricular cardiomyocytes varies from -80 to -90 mV. If the membrane potential is less negative and reaches the limit value, then in the cardiomyocyte, as in the cells of other excitable tissues (nerves, skeletal muscles), the action potential appears, that is, depolarization occurs will be. The action potential up to +20 mV leads to a temporary increase in the membrane potential of the cardiomyocyte. In contrast from the action potential of the neuron comes the plateau phase, which lasts 0.2-0.3 s after the peak in the action potential of the cardiomyocyte. The action potential of skeletal muscle and nerves is related to the opening of the membrane as a rapid sodium channel opening, the action potential of cardiomyocytes is also related to the opening of fast sodium channels (initial rapid repolarization phase) and slow calcium channels. (plateau phase). In addition, depolarization is accompanied by a temporary decrease in membrane permeability for potassium. Membrane permeability for potassium is then restored, sodium and calcium channels are closed, and membrane potential returns to its original level.

It is mainly determined by the transmembrane concentration gradient of K + ions and ranges from minus 80 to minus 90 mV in most cardiomyocytes (except sinus nodes and AV nodes). When excited, cations enter the cardiomyocytes and their temporary depolarization occurs - the action potential.

The ion mechanisms of the action potential in working cardiomyocytes and in the cells of the sinus nodes and AV nodes are different, so the form of the action potential is also different.

The cardiomyocytes of the His-Purkinje system and the working myocardium of the ventricles are divided into five phases in the action potential. The rapid depolarization phase (phase 0) occurs as a result of the infiltration of Na + ions through fast sodium channels. Then, after a short phase of early rapid repolarization (phase 1), a slow depolarization phase or plateau begins (phase 2). This is due to the simultaneous entry of Ca2 + ions through slow calcium channels and the release of K + ions. The late rapid repolarization phase (stage 3) is associated with the predominance of K + ions. Finally, stage 4 is the resting potential.

Bradyarrhythmias can occur as a result of a decrease in the frequency of occurrence of exposure potentials or a violation of their conductivity.

The ability of some heart cells to generate spontaneous action potentials is called automatism. This ability is possessed by sinus node cells, the atrial conduction system, the AV nodes, and the His-Purkinje system. After the automation effect potential is exhausted (i.e., in stage 4), something called spontaneous (slow) diastolic depolarization is observed instead of the resting potential. This is due to the influx of Na + and Ca2 + ions. As a result of spontaneous diastolic depolarization, the action potential occurs when the membrane potential reaches the limit.

Conductivity, i.e. the speed and reliability of the drive, in particular, depends on the specific characteristics of the action potential: the lower its slope and amplitude (in phase 0), the higher the speed and reliability of the conduction will be low.

In many diseases and under the influence of a number of drugs, the rate of depolarization decreases in phase 0. In addition, permeability also depends on the passive properties of cardiomyocyte membranes (intracellular and intercellular resistance). Hence, the rate of conduction of excitation in the longitudinal direction (i.e., along the myocardial fibers) is higher than in the transverse (anisotropic permeability).

During the action potential, the excitability of cardiomyocytes decreases sharply - until complete excitability. This property is called refractoriness. During absolute refractoriness, no stimulus is able to excite the cell. In a period of relative refractoriness

References:

[1] https://mymedic.uz/

[2] Propaedeutics of internal diseases: / A. Gadayev, M. Sh. Karimov, H. S. Akhmedov; Ministry of Health of the Republic of Uzbekistan, Tashkent Medical Academy. Tashkent: Muharrir Publishing House, 2012, 708 p.

[3] Hans-Holger Ebert,, Simple ECG analysis: interpretation, differential diagnosis ”2010

[4] Sekrety_kardiologii_Oliviya_V_Edey.djvu

[5] Propedevtika_vnutrennix_bolezney.pdf

[6] Tsimmerman_Klinicheskaya_Elektrokardiografiya.pdf

[7] Belenkov_Yu_N_,_Oganov_R_G_Kardiologiya.pdf

[8] Murashko_V_V _, _ A_V_Strutynskiy_El.pdf

[9] Chazov_E_I_Bolezni_serdtsa_i_sosudov.pdf

[10] T,me/kasallikUZ