
# PHYSIOLOGY OF CARDIAC ACTIVITY

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**ABSTRACT**

*"Physiology of cardiac activity" discusses the intricate workings of the heart and the physiological processes involved in regulating its activity. The annotation provides a comprehensive overview of the topic, including the structure and function of the heart, the cardiac cycle, and the electrical conduction system. Additionally, it explores the regulation of cardiac activity through the autonomic nervous system and hormonal control. The annotation may also touch upon common cardiac disorders and the importance of understanding the physiology behind cardiac activity for medical professionals and researchers in the field of cardiology. This topic is essential for anyone interested in gaining a deeper understanding of the mechanisms that drive the pumping action of the heart and its role in maintaining overall body function.*

The heart functions as a pump and acts as a dual pump in the cardiovascular system to ensure a constant circulation of blood throughout the body. This circulation includes the systemic circulation and the pulmonary circulation. Both vessels carry blood, but they can also be seen in the form of gas they carry. Pulmonary circulation collects oxygen from the lungs and releases carbon dioxide for exhalation. The systemic circuit transports oxygen to the body and returns the relatively deoxygenated blood and carbon dioxide back to the pulmonary vessels.[1]

Blood flows through the heart in one direction, from the atria to the ventricles, and through the pulmonary artery into the pulmonary circulation, and the aorta into the systemic circulation. The pulmonary artery (also the trunk) branches into the left and right pulmonary arteries to supply blood to each lung. Blood is prevented from flowing backward (reflux) by the tricuspid, mitral, aortic, and pulmonary valves. [citation needed]

The function of the right heart is to collect deoxygenated blood, in the right atrium, from the body through the superior vena cava, inferior vena cava, and from the coronary sinus and to pump it through the tricuspid valve, through the right ventricle, through the semi-valvular valve. pulmonary circulation and into the pulmonary artery into the pulmonary circulation,

where carbon dioxide can be exchanged for oxygen in the lungs. This happens through passive diffusion. In the left heart, oxygenated blood returns to the left atrium through the pulmonary vein. It is then pumped into the left ventricle via the mitral valve and into the aorta for complete trunk circulation. Finally, in the systemic capillaries, tissue and cellular fluid exchange occurs; oxygen and nutrients are provided to the cells for metabolism and exchange of carbon dioxide and waste[1] In this case, oxygen and nutrients escape from the capillary system to be taken by the cells used in their metabolism, carbon dioxide and waste products enter the bloodstream. [first]

The ventricles are stronger and thicker than the atria, and the muscular wall surrounding the left ventricle is thicker than the wall surrounding the right ventricle due to the higher force required to pump blood through the systemic circulation. The atria facilitate circulation primarily by allowing uninterrupted venous blood flow to the heart, preventing the inertia of the interrupted venous blood flow that would occur with each ventricular systole.[2]

Cardiac muscle tissue has the ability to self-regulate the heart rate, the unique ability to initiate the action potential of the heart at a fixed rate - rapidly propagating impulses from cell to cell to activate the entire heart. contractile heart. This automaticity is further regulated by the endocrine and nervous systems.[1]

There are two types of cardiac muscle cells:

Cardiac muscle cells have the ability to contract easily, and cardiomyocytes transform into the pacemaker cells of the electrical conduction system. Cardiac muscle cells make up the majority (99%) of the cells in the atria and ventricles. These contractile cells respond to action potential impulses from the pacemaker cells and are responsible for contractions to pump blood around the body. Pacemaker cells make up only (1% of the cells) and form the conduction system of the heart. They are usually much smaller than contractile cells and have few myofibrils or myofibrils, meaning they have limited contractility. Their function is similar to that of neurons in many ways.[1] His and Purkinje bundles are specialized cardiac muscle cells that function in the conduction system.

Cardiac muscle cells are significantly shorter and smaller in diameter than skeletal muscle cells. Cardiac muscle (like skeletal muscle) is characterized by striations - light and dark bands due to the organized arrangement of muscle fibers and muscle fibers in the sarcomere along the cell. The T (horizontal) tubes are the deep recesses of the sarcolemma (cell membrane) that enter the cell, allowing electrical impulses to go inside. In the myocardium, T-tubes are found only on the Z lines.[1] When an action potential causes cells to contract, calcium is released from the cell's substrate network as well as from the T tubules. Calcium release triggers slippage of actin and myosin muscle fibers leading to contraction.[3] Abundant sources of mitochondria provide the energy needed for contractions. Normally, cardiomyocytes have a single central nucleus, but can also have two or more.[1]

Cardiac muscle cells branch freely and are connected by junctions called intercalated discs that support synchronous muscle contraction.[4] Sarcolemma (membrane) of adjacent cells linked at intercalated discs. These include desmosomes, specialized binding proteoglycans, tight junctions, and a large number of gap junctions that allow ions to pass between cells and help synchronize contractility. The connective tissue between cells also helps to tightly bind cells together to resist the force of contraction.[1]

The myocardium undergoes aerobic respiration, mainly metabolizing lipids and

carbohydrates. Oxygen from the lungs binds to hemoglobin and is also stored in myoglobin, so an ample supply of oxygen is available.

Lipids and glycogen are also stored in the plasma and they are broken down by mitochondria to release ATP. The cells undergo convulsive-like contractions with a prolonged refractory period, followed by a brief relaxation period as the heart fills with blood for the next cycle.[1]

Transmits cardiac action potentials through the cardiac conduction system

It is not clear how the electrical signal travels through the atria. It appears to move afferently, but the Bachmann bundle and the coronary sinus muscle act as conduction between the two atria, where systole occurs almost simultaneously.[5][6][7] In the ventricles, the signal is carried by specialized tissues called Purkinje fibers, which then transmit the electrical charge to the heart muscle.[8]

If embryonic heart cells are separated in a Petri dish and kept alive, each can generate its own electrical impulse followed by a contraction. When two independently beating embryonic cardiomyocytes are placed together, the cell with the higher inherent rhythm sets the speed and impulse from the faster to the slower cell to trigger contraction. As more tiles are joined, the fastest tile continues to assume speed control. A fully developed adult heart retains the ability to generate its own electrical impulses, activated by the fastest cells, as part of the cardiac conduction system. Components of the cardiac conduction system include atrial and ventricular syncytial, sinoatrial node, atrioventricular node, bundle of His (atrioventricular bundle), bundle branches, and Purkinje cells.[1]

Normal sinus rhythm is established by the sinoatrial (SA) node, the pacemaker. The SA node is a specialized cluster of cardiomyocytes in the superior and posterior wall of the right atrium, very close to the opening of the superior vena cava. The SA node has the highest depolarization rate.[1]

This impulse peregrination from its starting point in the SA knot through the gallerias through specialized internodal pathways, to the contractile cells of the atrial muscle and the atrioventricular knot. The internodal pathways correspond of three bands( anterior, medium, and posterior) that lead directly from the SA knot to the coming knot in the conduction system, the atrioventricular knot. The palpitation takes about 50 ms( milliseconds) to travel between these two bumps. The relative significance of this pathway has been batted since the impulse will reach the atrioventricular knot only by following the cell- to- cell pathway through the myocardial contractile cells in the gallerias. In addition, there's a technical pathway called the Bachmann pack or the interventricular band that conducts impulses directly from the right patio to the left patio. Anyhow of the pathway, when the impulse reaches the atrioventricular septum, the connective towel of the cardiac shell prevents the impulse from traveling into the cardiac myocytes of the ventricles, except at the atrioventricular knot.( 1) The electrical event, the depolarizing surge, is the detector for muscle compression. The depolarization surge begins in the right patio and the impulse passes through the upper part of both gallerias to the contractile cells. The contractile cells also begin to contract from the top to the bottom of the gallerias, effectively pumping blood into the ventricles.( 1)

The atrioventricular( AV) knot is a alternate group of technical myocardial conduction cells, located in the lower part of the right patio in the atrioventricular septum. The septum prevents impulses from traveling directly to the ventricles without passing through the AV

knot. There's a critical pause before the AV knot depolarizes and transmits impulses to the atrioventricular pack. This transmission detention is incompletely due to the small periphery of the knot cells, which slows down the palpitation. In addition, conduction between knot cells is less effective than between conductive cells. These factors mean that it takes about 100 ms for the palpitation to pass through the knot. This pause is important for heart function, as it allows the heart muscle cells of the gallerias to complete their compression to pump blood into the ventricles before the impulse is transmitted to the cells in the heart itself. the seventh. With extreme stimulation of the SA knot, the AV knot can transmit beats up to 220 per nanosecond. This establishes the typical maximum heart rate in a healthy youthful person. Hearts that are damaged or stimulated by medicines can contract at a advanced rate, but at this rate, the heart can no longer pump blood as efficiently.( 1)

Originating at the atrioventricular knot, the pack of His passes through the interventricular septum before dividing into two pack branches, generally appertained to as the left and right packets. The left branch of the pack has two packets. The left branch of the pack perfuses the left ventricle and the right branch to the right ventricle. Because the left ventricle is much larger than the right, the left branch of the pack is also significantly larger than the right. corridor of the right pack branch taradiddle within the medium band and force the right papillary muscles. Because of this connection, each papillary muscle receives an impulse at the same time, so they begin to contract contemporaneously just before the rest of the myocardial contractile cells in the ventricles. This is allowed to allow pressure to form on the anterior cruciate ligaments before the right ventricle contracts. There's no corresponding throttle band on the left wing. The two branches of the pack descend and reach the apex of the heart where they connect with the Purkinje filaments. This passage lasts about 25ms.( 1)

Purkinje filaments are fresh myocardial conduction filaments that transmit impulses to myocardial contractile cells in the ventricles. They extend throughout the myocardium from the top of the heart to the atrioventricular septum and to the base of the heart. Purkinje filaments have a fast conduction haste and electrical impulses reach all ventricular myocytes in about 75 milliseconds. Since electrical stimulation begins at the apex, compression also begins at the top and moves toward the base of the heart, like squeezing a tube of toothpaste from below. This allows blood to be pumped out of the ventricles and into the aorta and pulmonary box. The total time ceased from palpitation inauguration in the SA knot until ventricular depolarization is roughly 225ms.( 1)

The action potential differs significantly between the conduction and contractile cardiomyocytes. While sodium Na+ and potassium K+ ions are essential, calcium Ca2+ ions are also essential for both cell types. Unlike skeletal muscle and nerve cells, cardiac conduction cells do not have a stable resting potential. Conductor cells contain a series of sodium ion channels that allow a slow inflow of sodium ions, normally gradually increasing the membrane potential from an initial value of -60 mV to about -40 mV. As a result, the movement of sodium ions induces spontaneous depolarization (or potential pre-depolarization).[1]

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