40.3C: The Cardiac Cycle

The cardiac cycle uses mechanical actions and electrical signals to push blood in and out of the heart.

Learning Objectives

• Summarize the cardiac cycle and explain the role of the SA node and the AV node in regulating the its rhythm

Key Points

• During the cardiac cycle, the heart contracts via systole, pushing blood out of the heart, and relaxes via diastole, filling the heart with blood.
• Cardiomyocytes, or cardiac cells, are striated and are responsible for the pumping of the heart; they are the only muscle cells with intercalated disks.
• The heart’s internal pacemaker regulates and times the beating of the heart via electrical signals.
• Electrical signals start at the SA node, causing atria contraction, and then move on to AV node, delaying electrical impulses to allow blood from the atrium to fill the ventricles.
• Signals move from the AV node to the bundle of His and then to the Prukinje fibers, which then allows the ventricles to contract.

Key Terms

• **bundle of His**: specialized heart muscle cells that transmit electrical impulses from the AV node in the heart to the muscle cells of the heart wall, which contract in response producing the heart beat
• **sinoatrial (SA) node**: impulse-generating (pacemaker) tissue located in the right atrium of the heart, and thus the
The main purpose of the heart is to pump blood through the body; it does so in a repeating sequence called the cardiac cycle. The cardiac cycle is the coordination of the filling and emptying of blood by electrical signals that cause the heart muscles to contract and relax. The human heart beats over 100,000 times per day. In each cardiac cycle, the heart contracts (systole), pushing out the blood and pumping it through the body. This is followed by a relaxation phase (diastole), where the heart fills with blood. The atria contract at the same time, forcing blood through the atrioventricular valves into the ventricles. Closing of the atrioventricular valves produces a monosyllabic “lup” sound. Following a brief delay, the ventricles contract at the same time forcing blood through the semilunar valves into the aorta and the pulmonary artery (which transports blood to the lungs). Closing of the semilunar valves produces a monosyllabic “dup” sound.

The pumping of the heart is a function of the cardiac muscle cells, or cardiomyocytes, that comprise the heart muscle. Cardiomyocytes are distinctive muscle cells that are striated like skeletal muscle, but pump rhythmically and involuntarily like smooth muscle; they are connected by intercalated disks exclusive to cardiac muscle. Cardiomyocytes are self-stimulated for a period of time; isolated cardiomyocytes will beat if given the correct balance of nutrients and electrolytes.
Cardiomyocytes are striated muscle cells found in cardiac tissue. The autonomous beating of cardiac muscle cells is regulated by the heart’s internal pacemaker that uses electrical signals to time the beating of the heart. The electrical signals and mechanical actions are intimately intertwined. The internal pacemaker starts at the sinoatrial (SA) node, which is located near the wall of the right atrium. Electrical charges spontaneously pulse from the SA node, causing the two atria to contract in unison. The pulse reaches a second node, the atrioventricular (AV) node, between the right atrium and right ventricle, where it pauses for approximately 0.1 seconds before spreading to the walls of the ventricles. This pause allows the blood in the atria to empty completely into the ventricles before the ventricles pump out the blood. From the AV node, the electrical impulse enters the bundle of His, then to the left and right bundle branches extending through the interventricular septum. Finally, the Purkinje fibers conduct the impulse from the apex of the heart up the ventricular myocardium, causing the ventricles to contract. The electrical impulses in the heart produce electrical currents that flow through the body and can be measured on the skin using electrodes. This information can be observed as an electrocardiogram (ECG): a recording of the electrical impulses of the cardiac muscle.

**Electrical signals:** The beating of the heart is regulated by an electrical impulse that causes the characteristic reading of an ECG. The signal is initiated at the sinoatrial valve. The signal then (a) spreads to the atria, causing them to contract. The signal is (b) delayed at the atrioventricular node before it is passed on to the (c) heart apex. The delay allows the atria to relax before the (d) ventricles contract. The final part of the ECG cycle prepares the heart for the next beat.


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