

Conduction System of the Heart

Background: Some cardiac muscle cells are able to “decide” when they should beat (autorhythmicity). These cells are relays in the heart’s conduction system.

Purpose: Ensure that the heart beats as a coordinated unit at a steady rate (~75 beats/minute). Of course, this rate can be modified by the autonomic nervous system (sympathetic or parasympathetic activity)—see below.

- 1) **Sinoatrial (SA) node: pacemaker** for the entire heart. Impulse spreads throughout atria to the
- 2) **atrioventricular (AV) node.** Then the atria contract. Next the impulse moves on to the
- 3) **AV bundle (bundle of His), then down the**
- 4) **Bundle branches, and finally up the**
- 5) **Purkinje fibers:** myocardium of the walls of the ventricles.—This final step causes the ventricles to contract from the apex upward, forcing blood out of the pulmonary trunk and the aorta.

Damage to the SA node results in a slower than needed heart rate and sometimes is treated by installing an artificial pacemaker.

Damage to the AV node is called a heart “block” because it effectively blocks the electrical signal from reaching the ventricles. The ventricles then beat at a slow 40-60 beats/minute.

Arrhythmias: uncoordinated atrial and ventricular contraction

Fibrillation: rapid uncoordinated shuddering of the heart. Heart is useless as a pump and leads to death unless a regular beat is quickly restored.

Tachycardia: resting heart rate of greater than 100/minute.

Bradycardia: resting heart rate of less than 60/minute.

Modifying the Beat:

The cardioacceleratory center of the medulla oblongata has neurons that project down the spinal cord to T1-T5. There they synapse with motor neurons of the sympathetic nervous system. The preganglionic neuron synapses with the postganglionic neuron in the cervical or thoracic sympathetic chain ganglia. From there, the postganglionic fibers run through the cardiac plexus the heart where they innervate the SA and AV nodes, the myocardium and the coronary arteries. Norepinephrine is released—causing increased heart rate and coronary vessel dilation.

Electrocardiogram (ECG) AKA EKG (German “kardiac”)—“Electric writing of the heart”

When impulses pass through the heart, electrical currents are generated that spread throughout the body. These impulses can be detected on the body surface and recorded.

P wave: caused by depolarization of the atria; occurs immediately before atrial contraction

QRS wave: depolarization of the ventricles; occurs immediately before ventricular contraction—during this time, the atria repolarize, although it is such a tiny blip it is masked by ventricular depolarization.

T wave: repolarization of the ventricles

A change in these waves can indicate heart problems.