03

CHAPTER

BIOPHYSICS LECTURE (3)

المحاضرة الثالثة

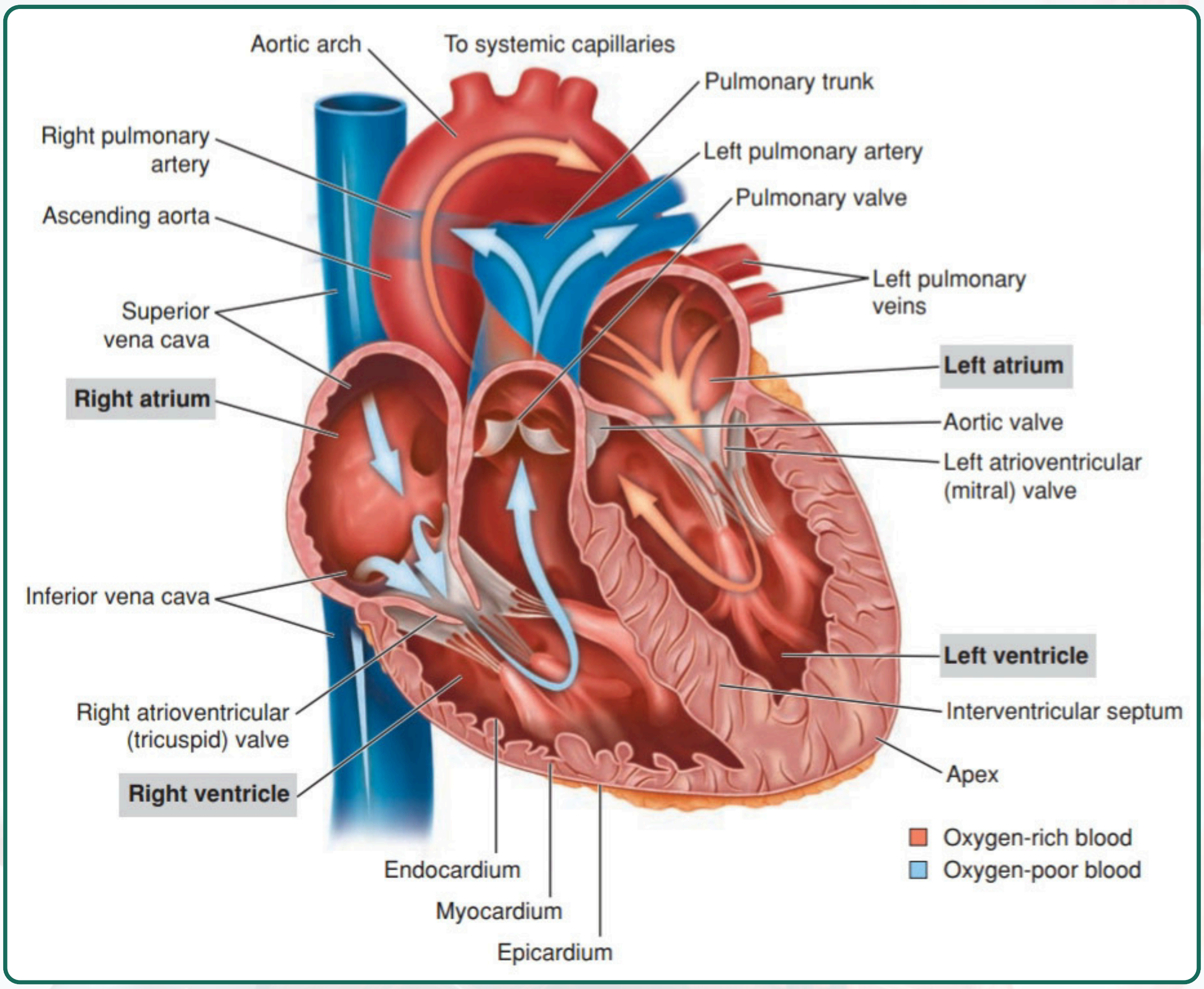
TOPICS

1. Heart
2. Heart conducting system
3. ELECTROCARDIOGRAPH

Scientific content prepared by

Booknerd Team

Heart



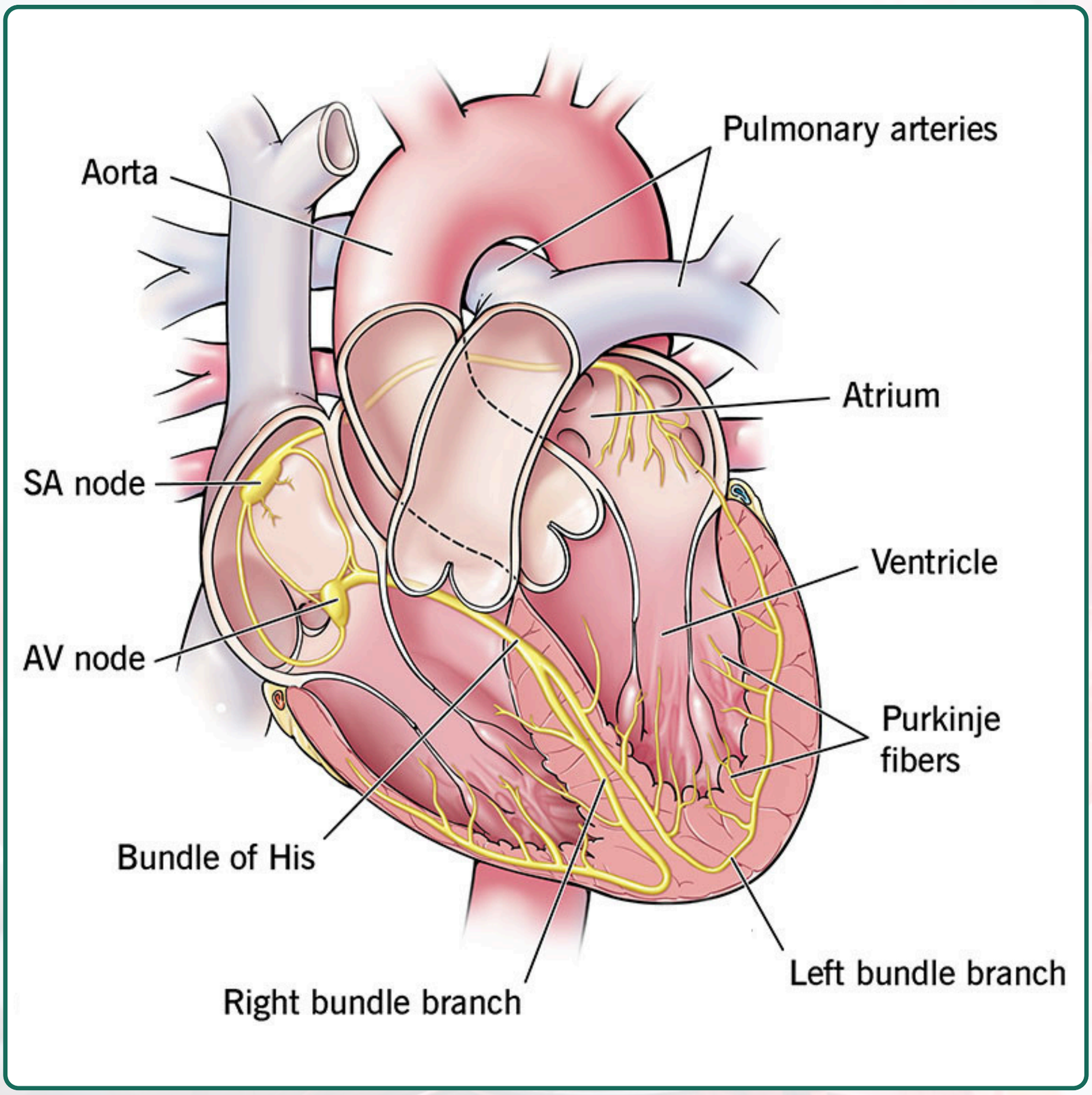
The heart is divided into four distinct chambers with muscular walls of different thickness.

1. **The right atrium receives blood low in oxygen from all body tissues through the superior vena cava and the inferior vena cava.**
2. **The blood then enters the right ventricle and is pumped to the lungs through the pulmonary artery.**
3. **Blood returns from the lungs high in oxygen and enters the left atrium through the pulmonary veins.**
4. **Blood enters the left ventricle and is forcefully pumped into the aorta to be distributed to all tissues.**

One-way valves in the heart keep blood moving in a forward direction.

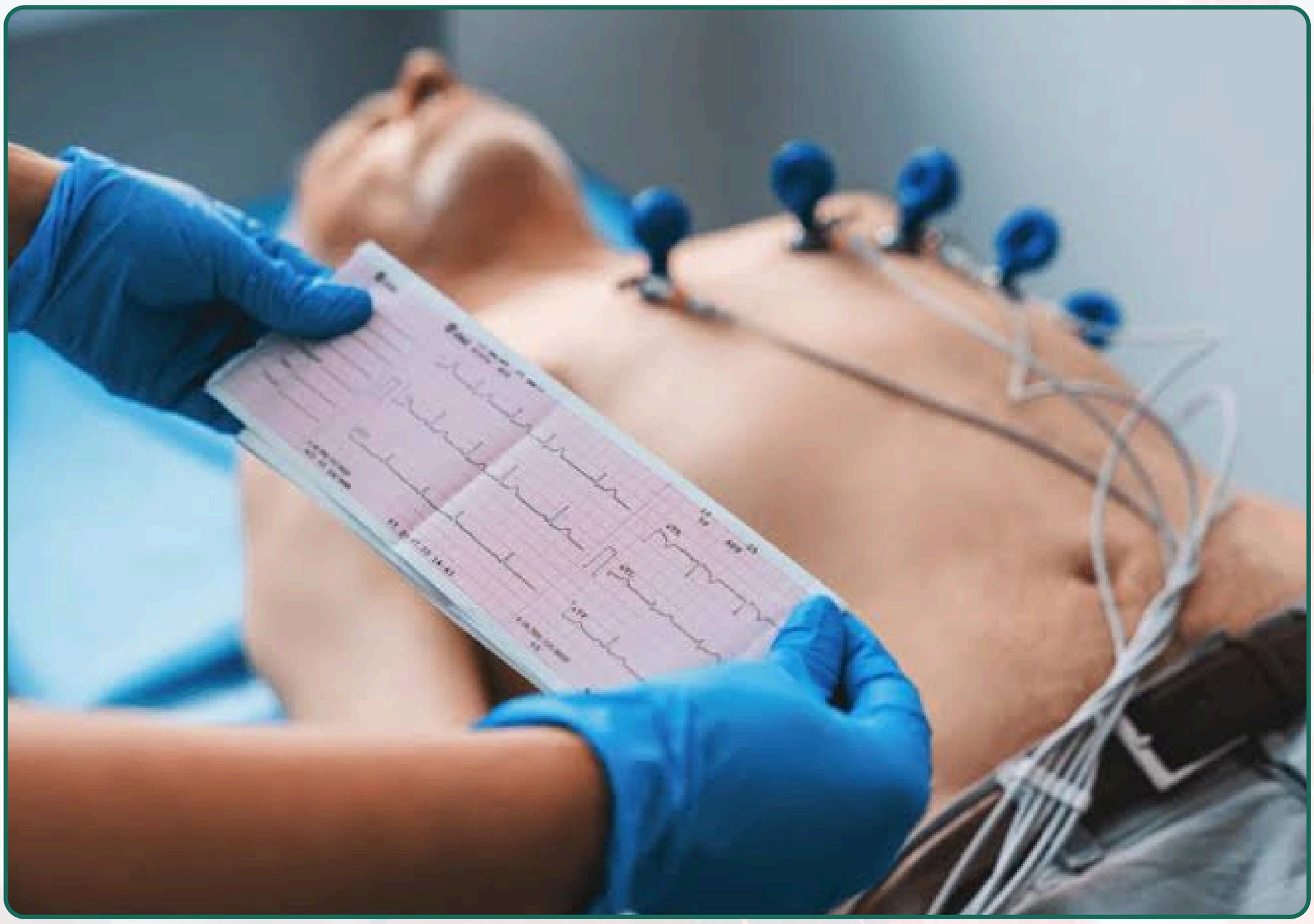
- **“Tricuspid” valve RA to RV**
- **Pulmonary or pulmonic valve RV to pulmonary trunk (branches R and L) .**
- **Mitral valve (the bicuspid one) LA to LV**
- **Aortic valve LV to aorta**

Heart conducting system



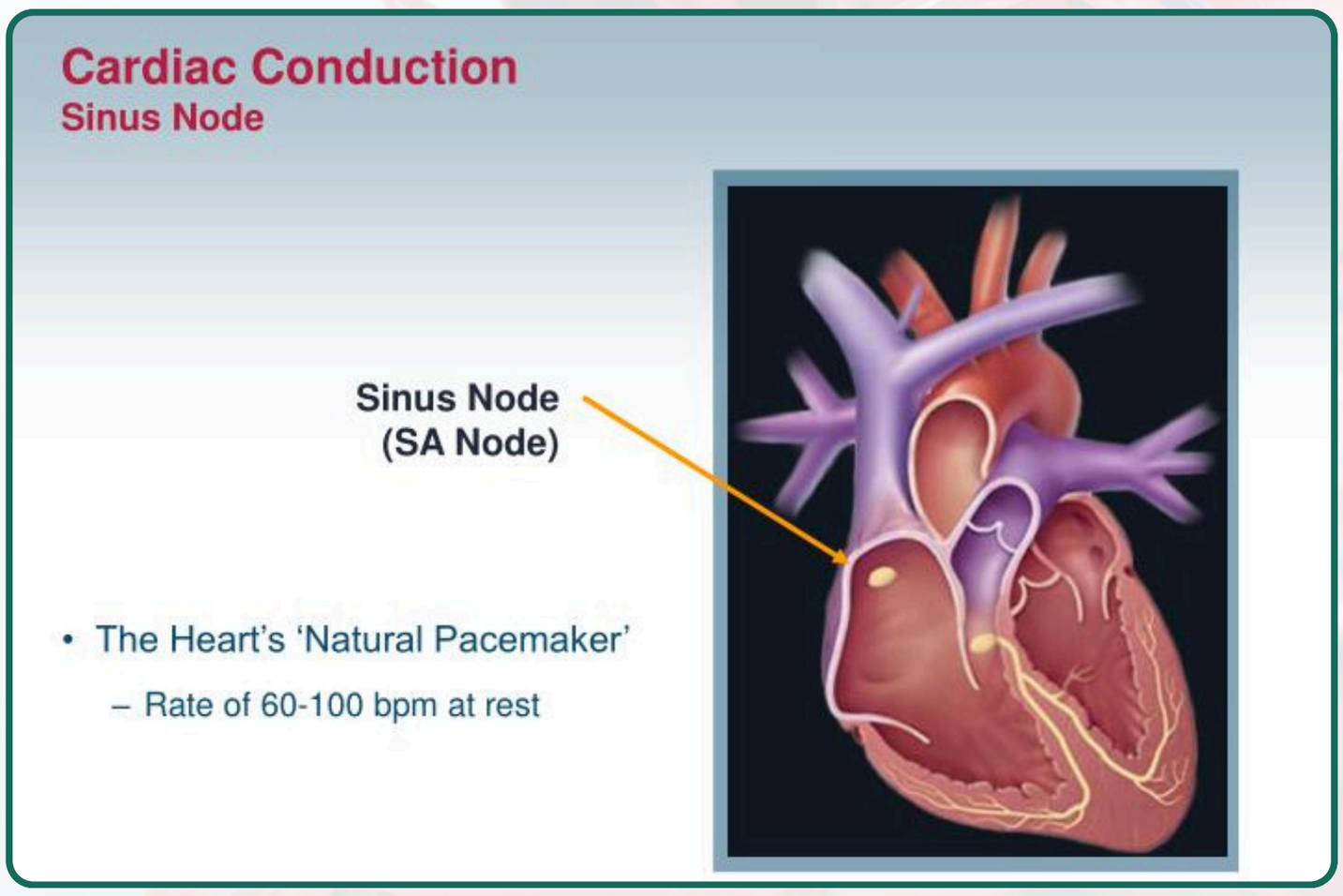
- **Action potentials originate in the Sino-Atrial (SA) node, and travel across the wall of the atrium from the sino-atrium node to the atrioventricular node (AV).**
- **Action potential pass slowly through the AV node to give the atria time to contract.**
- **They then pass rapidly along the atrioventricular bundle, which extends from the AV node through the fibrous skeleton into the interventricular septum.**
- **The atrioventricular bundle divides into right and left bundle branches, and action potentials descend rapidly to the apex of each ventricle along the bundle branches.**
- **Action potentials are carried by the purkinji fibers from the bundle branches to the ventricular wall.**
- **The rapid conduction from the atrioventricular bundle to the ends of the purkinji fibers allows the ventricular muscle cells to contract, providing a strong contraction.**

Electrocardiograph



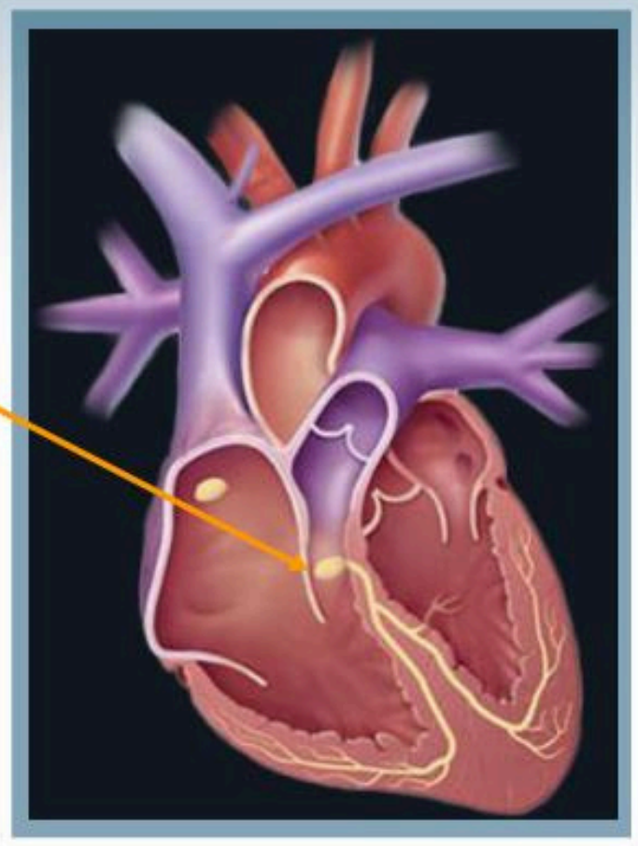
- **The electrocardiograph (ECG) is the recording on the body surface of the electrical activity generated by heart.**
- **In order to record an ECG waveform, a differential recording between two points on the body are made.**
- **ECG measurement information is collected by electrodes placed at designated locations on the body. It is the best way to measure and diagnose abnormal rhythms of the heart**

Heart conducting



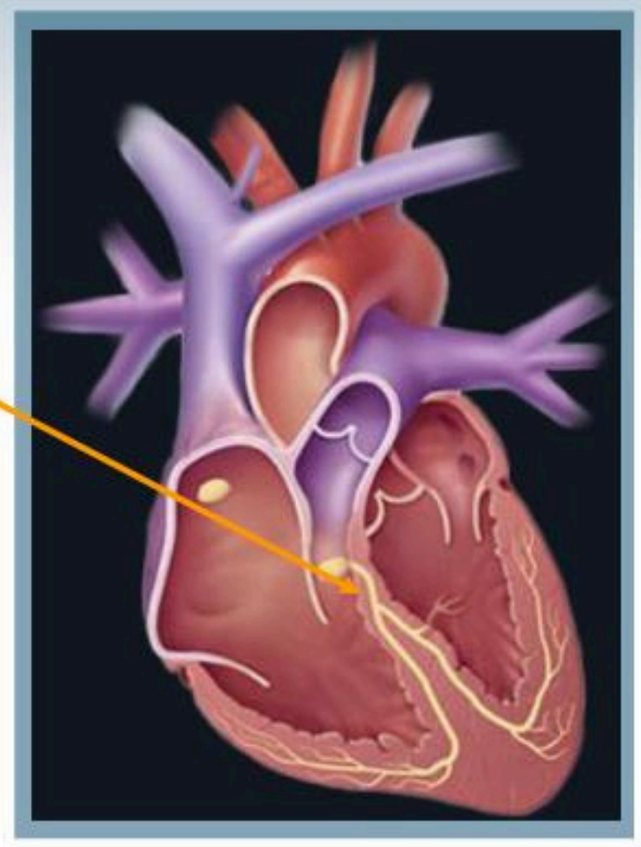
Heart conducting

Cardiac Conduction
AV Node



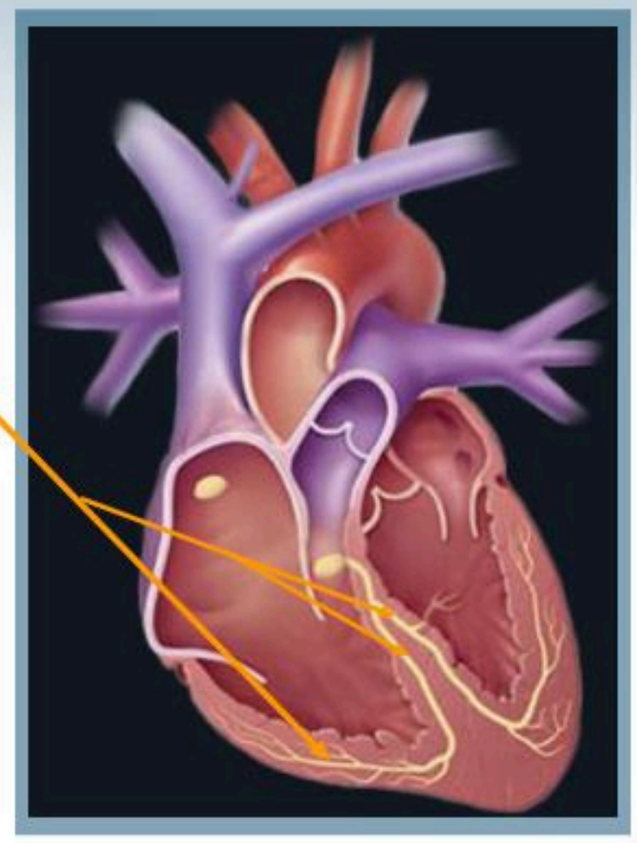
- Receives impulses from SA node
- Delivers impulses to the His-Purkinje System
- Delivers rates between 40-60 bpm if SA node fails to deliver impulses

Cardiac Conduction
HIS Bundle



- Begins conduction to the ventricles
- AV Junctional Tissue:
  - Rates between 40-60 bpm

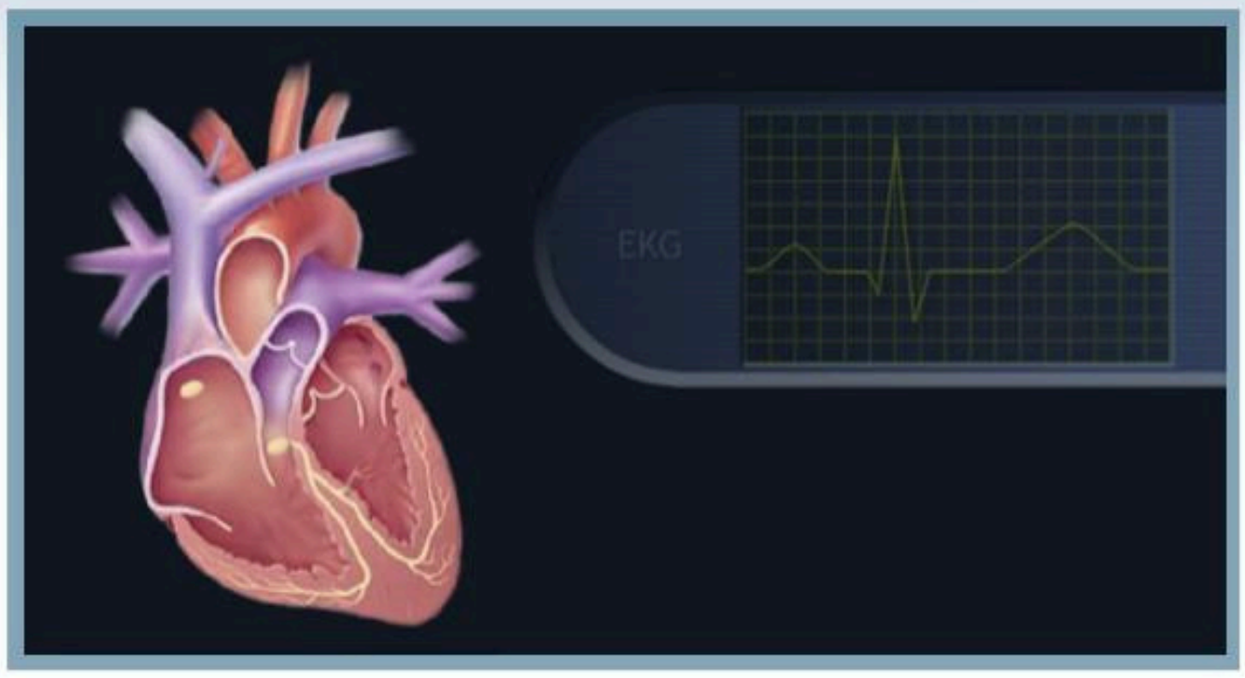
Cardiac Conduction
Purkinje Fibers



Bundle Branches and Purkinje Fibers

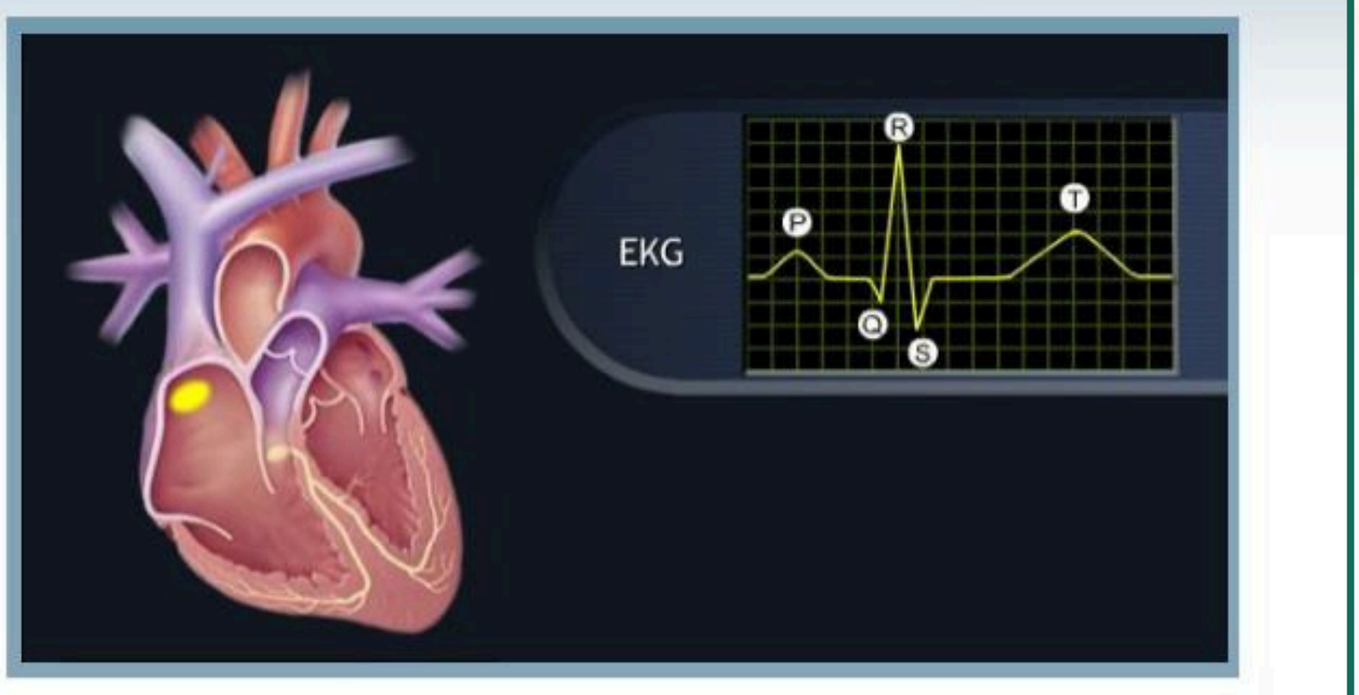
- Moves the impulse through the ventricles for contraction
- Provides 'Escape Rhythm':
  - Rates between 20-40 bpm

Heart conducting



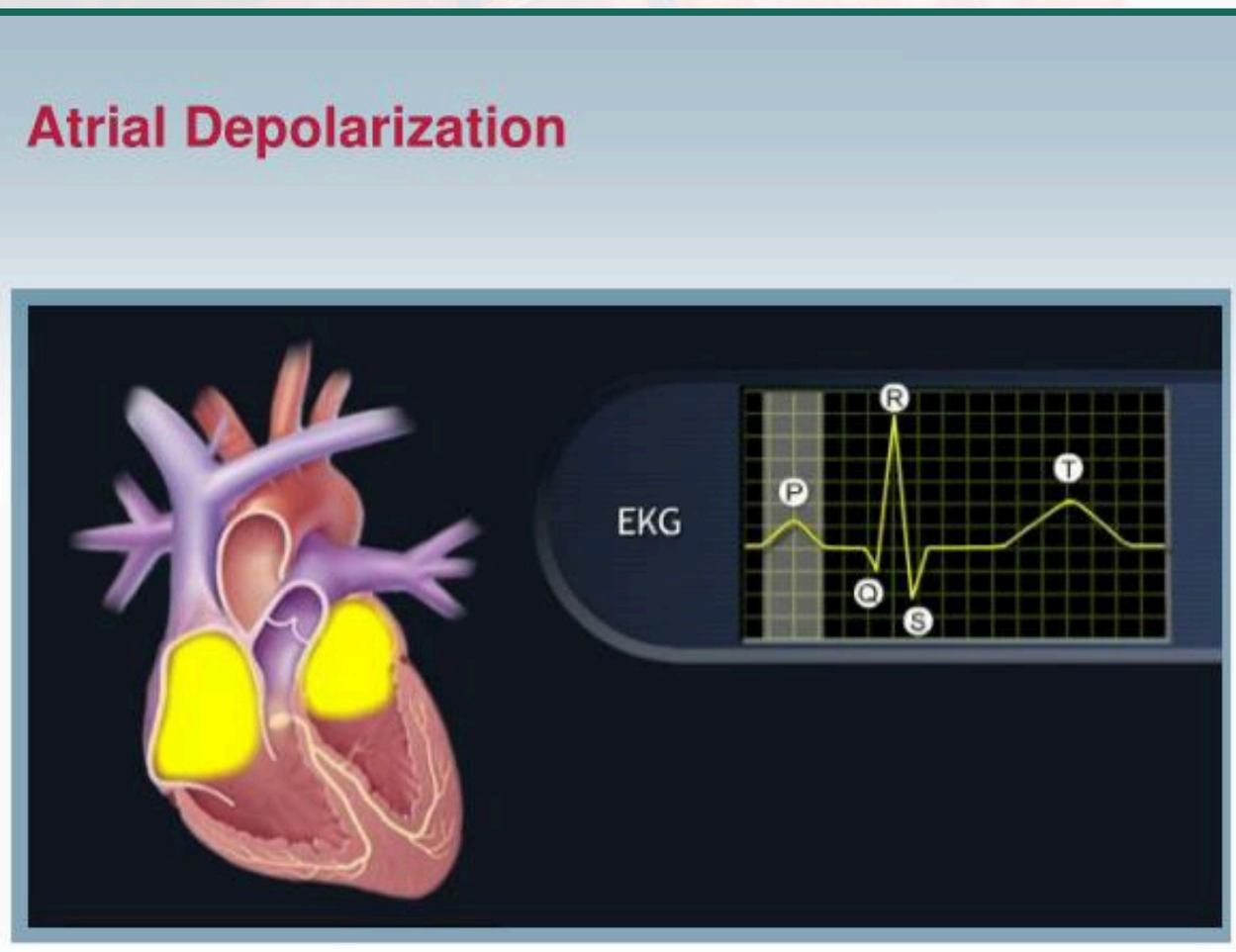
Impulse Formation In SA Node

- Initiation of the cardiac cycle normally begins with initiation of the impulse at the SA (sinoatrial) node.

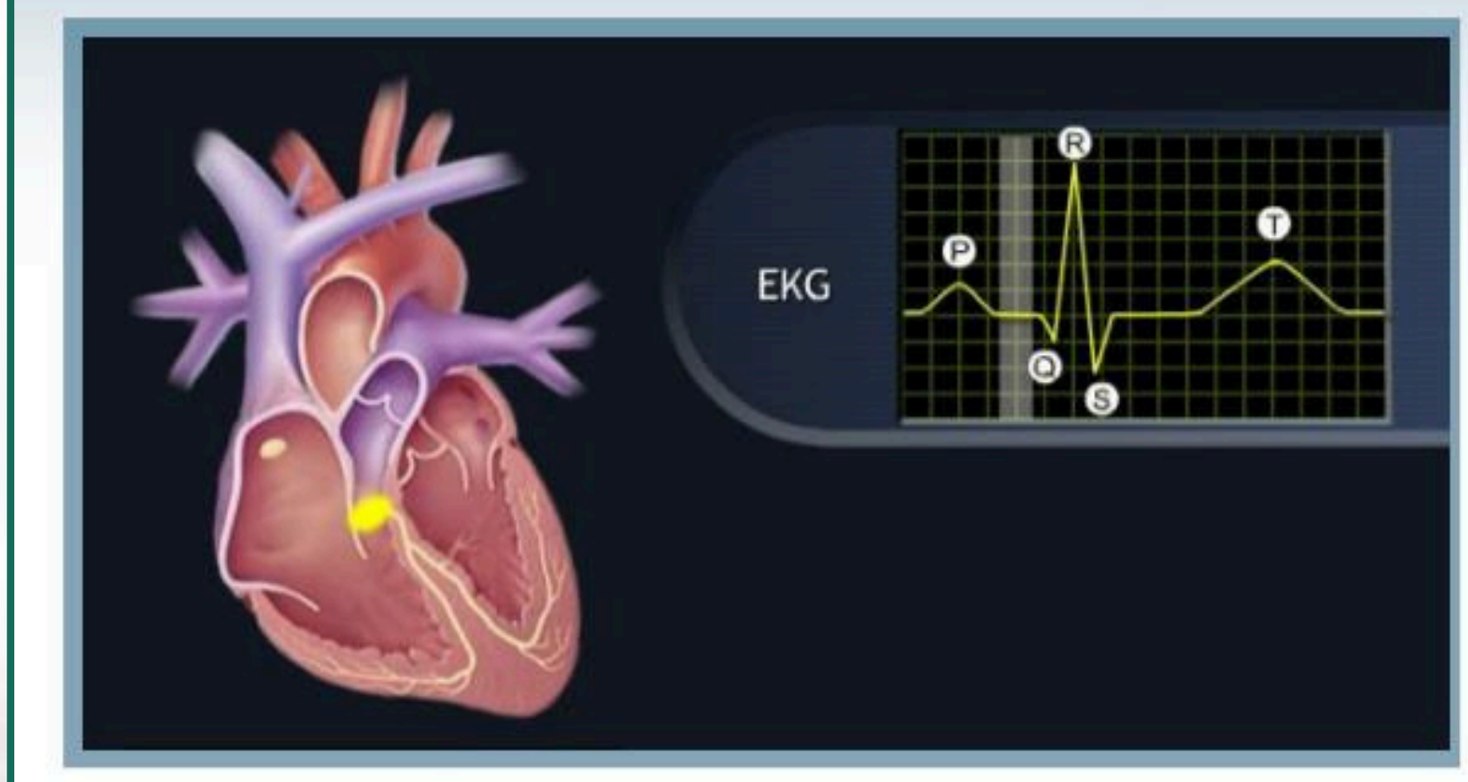


Atrial Depolarization

- After the SA node fires, the resulting depolarization wave passes through the right and left atria, which produces the P-wave on the surface EKG and stimulates atrial contraction.



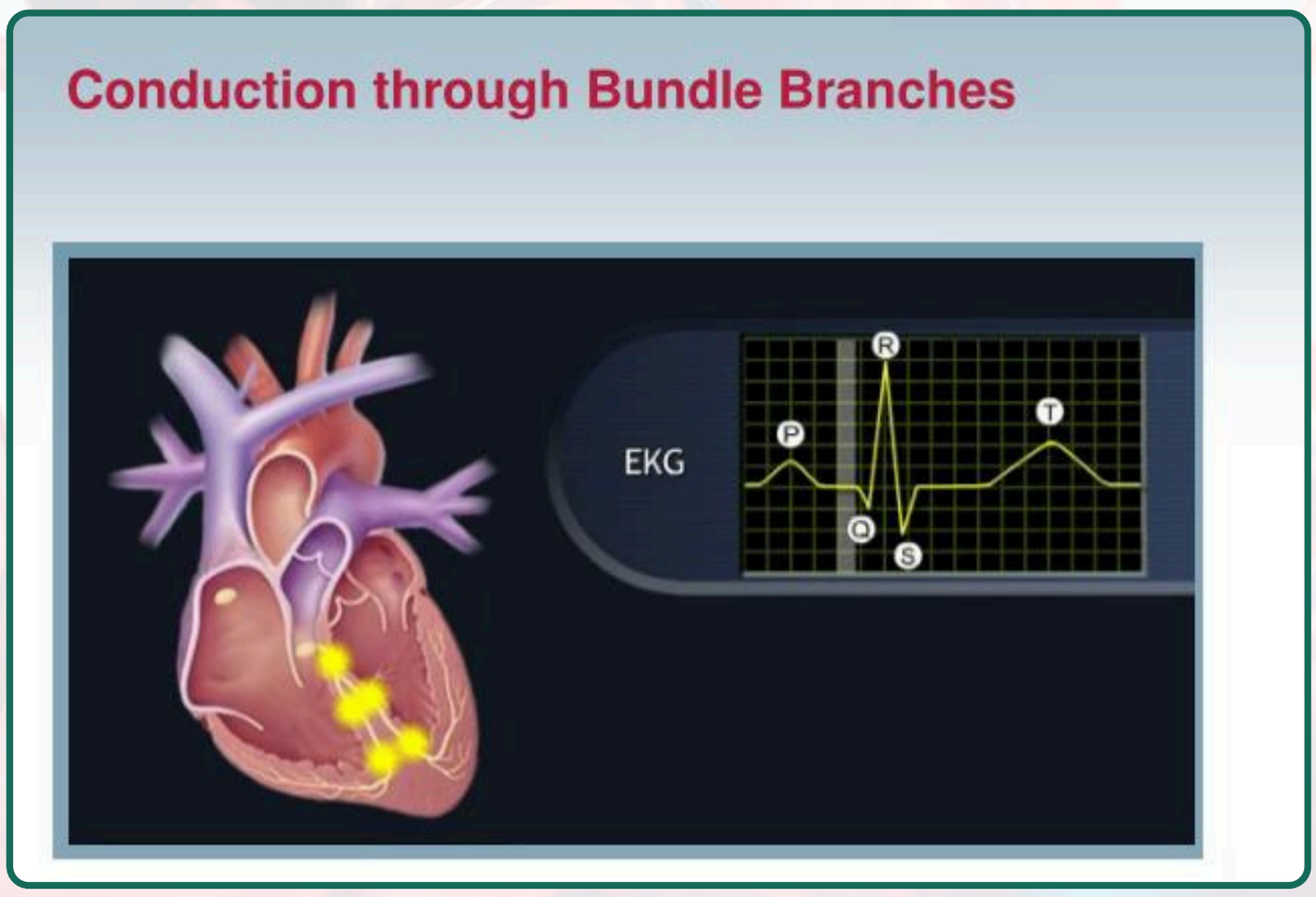
Delay At AV Node



- Following activation of the atria, the impulse proceeds to the atrioventricular (AV) node, which is the only normal conduction pathway between the atria and the ventricles.
- The AV node slows impulse conduction, which allows time for the atria to contract and for blood to be pumped from the atria to the ventricles prior to ventricular contraction.
- Conduction time through the AV node accounts for most of the duration of the PR interval.
- Just below the AV node, the impulse passes through the bundle of His. A small portion of the last part of the PR interval is represented by the conduction time through the bundle of His.

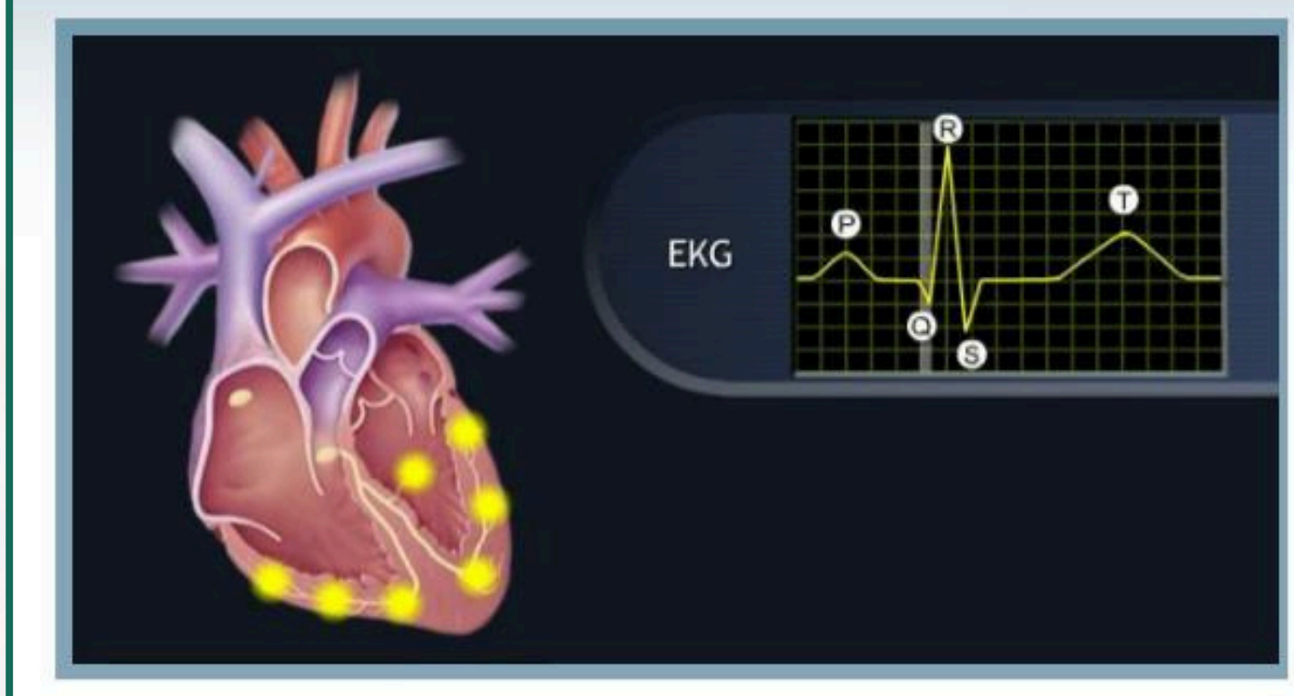
Conduction Through Bundle Branches

- After the impulse passes through the bundle of His, it proceeds through the left and right bundle branches. A small portion of the last part of the PR interval is represented by the conduction time through the bundle branches.



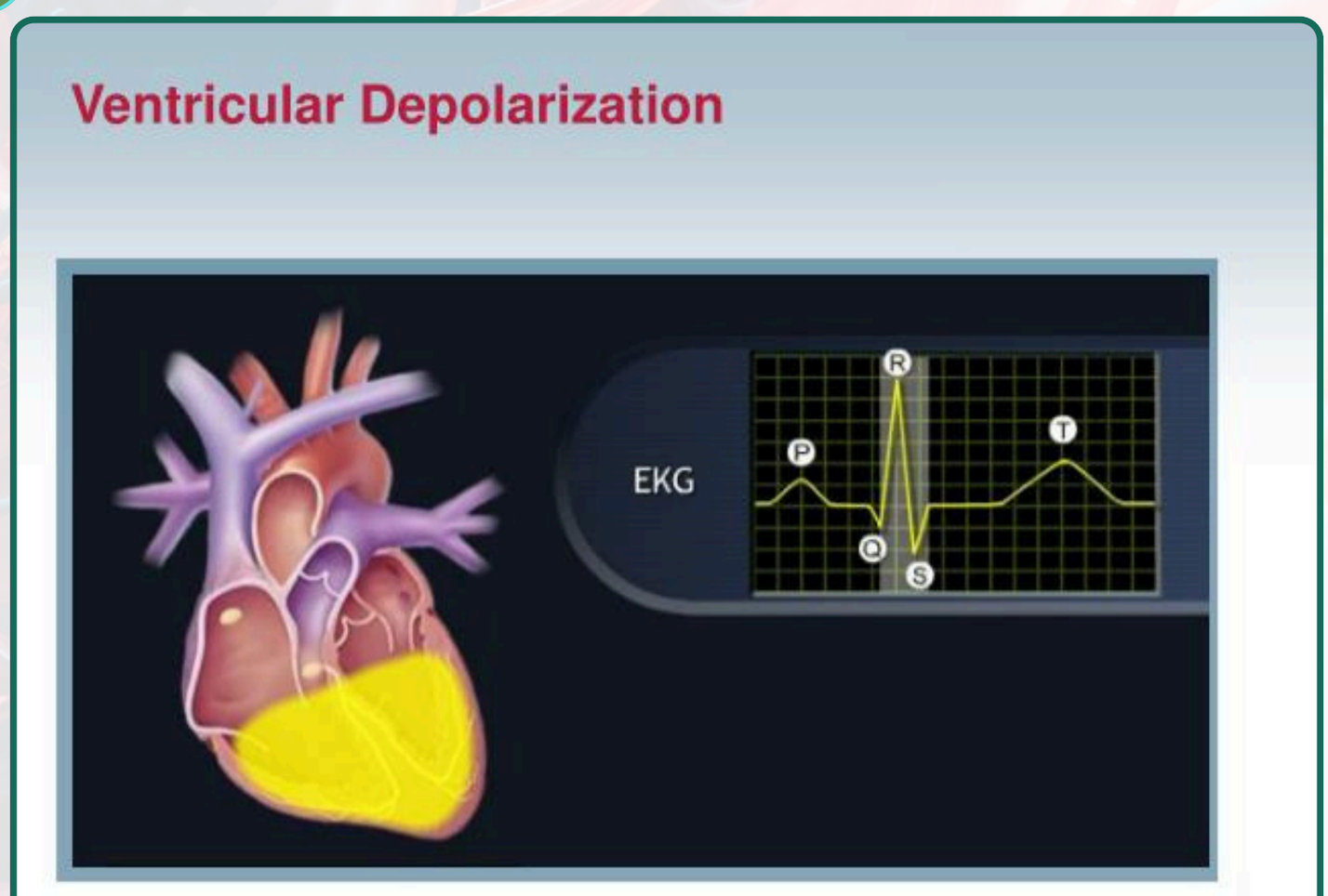
Conduction Through Purkinje Fibers

- Next the impulse passes through the Purkinje fibers (interlacing fibers of modified cardiac muscle). Conduction time through the Purkinje system is represented by a small portion of the last part of the PR interval.



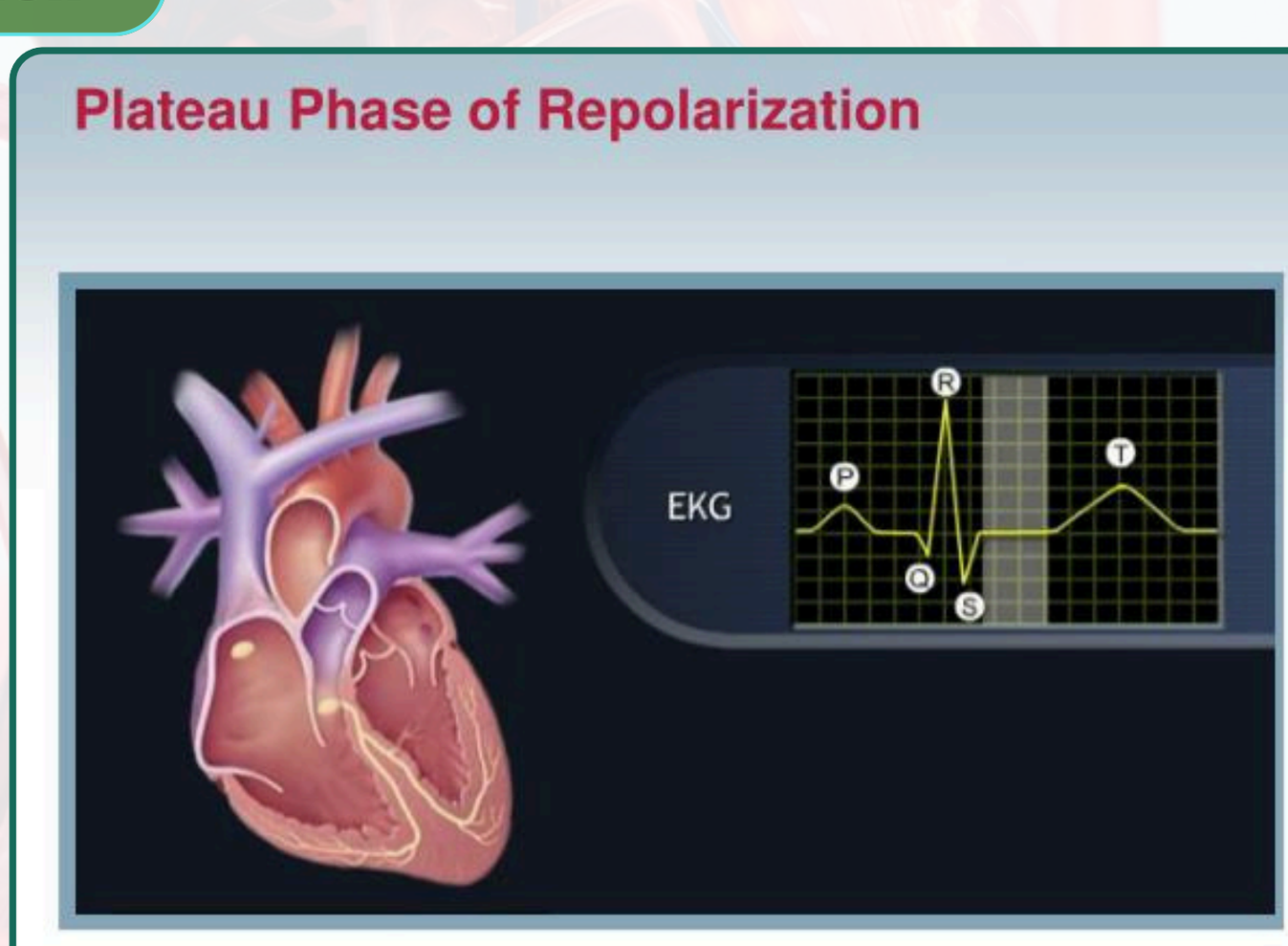
Ventricular Depolarization

- The impulse passes quickly through the bundle of His, the left and right bundle branches, and the Purkinje fibers, leading to depolarization and contraction of the ventricles.
- The QRS complex on the EKG represents the depolarization of the ventricular muscle mass.

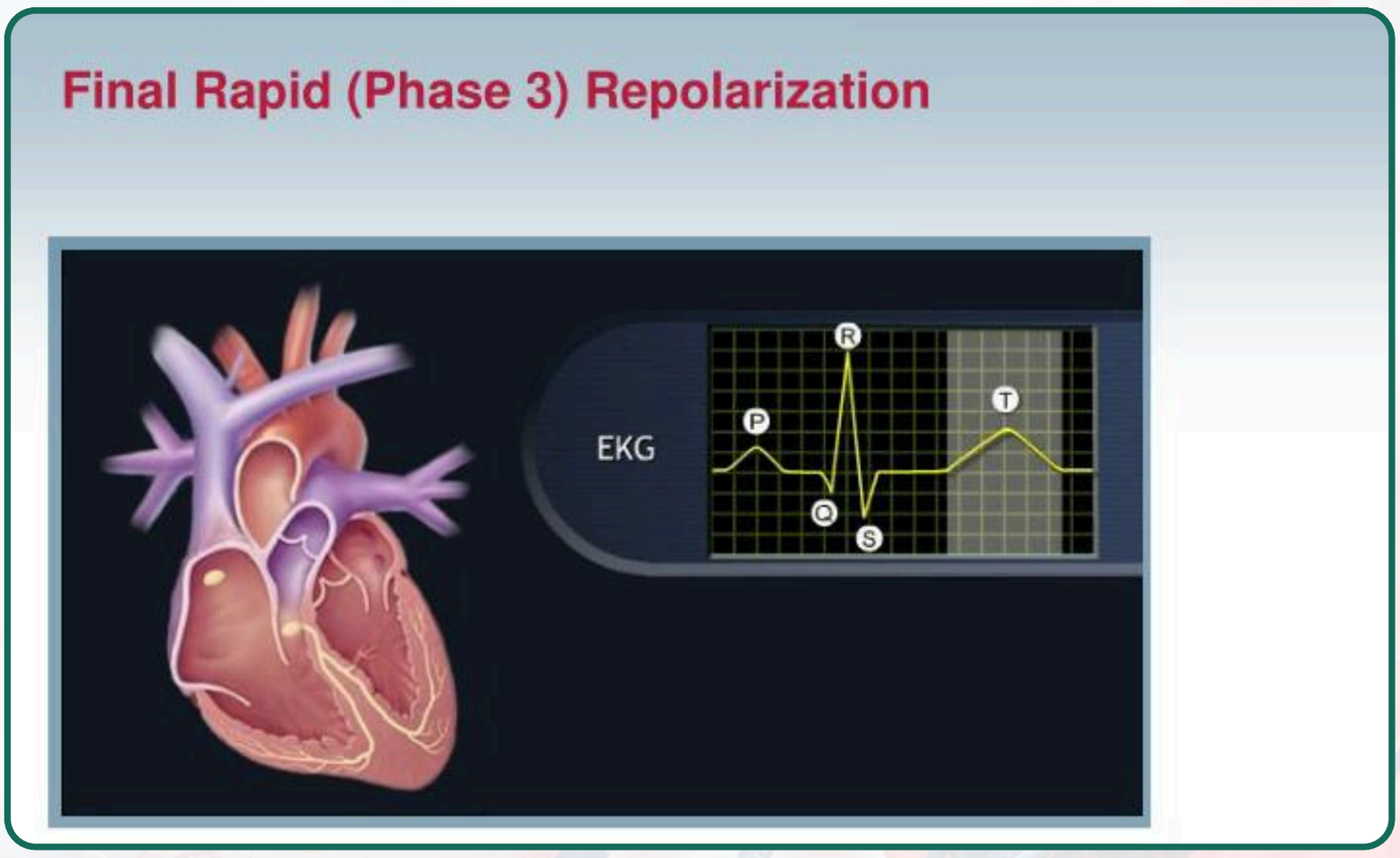


Plateau Phase of Repolarization

- The Plateau Phase lasts up to several hundred milliseconds.



Final Rapid (Phase 3) Repolarization



- **Repolarization of the ventricles generates a current in the body fluids and produces a T-wave. This takes place slowly, and generates a wide wave.**

Normal EKG Activation