

HUMAN ANATOMY AND PHYSIOLOGY-1(BP101T)

UNIT: 5 CARDIOVASCULAR SYSTEM

CLASS: 3

TOPIC: ELEMENTS OF CONDUCTION SYSTEM OF HEART AND HEART BEAT, ITS REGULATION BY AUTONOMIC NERVOUS SYSTEM

HEART SOUNDS ➤ In all, there are four heart sounds. The first and the second heart sounds are audible to the stethoscope or lubb/lub and dub/dub. ➤ They are rhythmically at the beginning and end of the ventricular systole respectively. First Sound:- (I) ➤ It occurs at the beginning of ventricular systole due to the closure of AV valves of both the ventricles synchronously. ➤ The first sound is loud, low pitched and a longer duration. Second Sound (II) ➤ It occurs in the beginning of ventricular diastole due to closure of pulmonary valves of pulmonary trunk and aorta synchronously. ➤ The second sound is sharp, shrill and of short duration.

Elements of the Conduction System of the Heart

The heart has a **specialized conduction system** made up of **autorhythmic (pacemaker) cells** that generate and transmit electrical impulses, ensuring coordinated contractions.

✿ 1. Sinoatrial (SA) Node

- **Location:** Wall of right atrium near superior vena cava
- **Function:** Primary **pacemaker** of the heart
- **Rate:** ~70–100 impulses/minute (normal sinus rhythm)

- **Initiates** the impulse that starts each heartbeat

✱ 2. Atrioventricular (AV) Node

- **Location:** Interatrial septum near the tricuspid valve
- **Function:** Delays impulse (~0.1 sec) to allow atria to finish contraction before ventricles contract
- **Rate:** ~40–60 impulses/minute (backup pacemaker)

✱ 3. Bundle of His (AV Bundle)

- **Location:** Interventricular septum
- **Function:** Conducts impulse from AV node to bundle branches
- **Only electrical connection between atria and ventricles**

✱ 4. Right and Left Bundle Branches

- **Location:** Along interventricular septum
- **Function:** Conduct impulses to respective ventricles

✱ 5. Purkinje Fibers

- **Location:** Spread throughout the ventricular myocardium
- **Function:** Rapidly transmit impulses, causing **ventricular contraction**
- **Rate:** ~20–40 impulses/minute (final backup pacemaker)

Heartbeat and Cardiac Cycle

A heartbeat is **one complete cycle** of **contraction (systole)** and **relaxation (diastole)** of the atria and ventricles.

Sequence of Events

1. **SA node fires** → atrial contraction
2. **Impulse reaches AV node**, slight delay
3. **Travels through Bundle of His** → **bundle branches** → **Purkinje fibers**
4. **Ventricles contract** (systole)
5. **Relaxation** (diastole) follows

Regulation of Heartbeat by Autonomic Nervous System (ANS)

The **ANS modulates** the heart rate and force of contraction, but **does not initiate** the heartbeat (that's intrinsic to the SA node).

◆ Sympathetic Nervous System (SNS)

- **Neurotransmitter:** Norepinephrine (acts on β_1 -adrenergic receptors)
- **Effect:**
 - **Increases** heart rate (positive chronotropic effect)
 - **Increases** conduction velocity (positive dromotropic effect)
 - **Increases** force of contraction (positive inotropic effect)
- **Origin:** Thoracic spinal cord (T1–T5)

◆ Parasympathetic Nervous System (PNS)

- **Neurotransmitter:** Acetylcholine (acts on muscarinic receptors)
- **Effect:**
 - **Decreases** heart rate
 - **Slows** conduction at AV node
- **Origin:** Vagus nerve (cranial nerve X)

🩺 Clinical Relevance

- **Bradycardia:** Slow heart rate (<60 bpm), can result from increased vagal tone
- **Tachycardia:** Fast heart rate (>100 bpm), often due to sympathetic stimulation
- **Heart Block:** Disruption in AV conduction
- **Artificial Pacemakers:** Used when the SA node or AV node fails