HEART SOUNDS

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INTRODUCTION

- Heart sounds are the sounds produced by mechanical activities of heart during each cardiac cycle.
- Heart sounds are produced by:

1. Flow of blood through cardiac chambers
2. Contraction of cardiac muscle
3. Closure of valves of the heart

- Heart sounds are heard by placing the ear over the chest or by using a stethoscope or microphone.
- These sounds are also recorded graphically.

DIFFERENT HEART SOUNDS

- Four heart sounds are produced during each cardiac cycle:

1. First heart sound
2. Second heart sound
3. Third heart sound
4. Fourth heart sound.

- First and second heart sounds are called **classical heart sounds** and heard by using the stethoscope.
- These two sounds are more prominent and resemble the spoken words 'LUBB' (or LUB) and 'DUBB' (or DUP), respectively.
- Third heart sound is a mild sound and it is not heard by using stethoscope in normal conditions. But it can be heard by using a microphone.
- Fourth heart sound is an inaudible sound. It becomes audible in pathological conditions only.
- This sound is studied only by graphic registration, i.e. the phonocardiogram.

IMPORTANCE OF HEART SOUNDS

- Study of heart sounds has important diagnostic value in clinical practice because alteration in the heart sounds indicates cardiac diseases involving valves of the heart.

DESCRIPTION OF HEART SOUNDS

FIRST HEART SOUND

- First heart sound is produced during **isometric contraction** period and earlier part of **ejection period**.

CAUSES

- Major cause for first heart sound is the sudden and synchronous (simultaneous) closure of **atrioventricular valves.** However, some other factors are also involved.
- Four types of factors are responsible for the production of the first heart sound.

1. VALVULAR FACTOR

- Synchronous closure of atrioventricular valves set up the vibrations in the **valvular leaflets** and **chordae tendineae.** These vibrations are mainly responsible for the production of the first heart sound.

2. VASCULAR FACTOR

- **Rush of blood** from the ventricles into aorta and pulmonary artery during ejection period is also responsible for the production of the first heart sound.

3. MUSCULAR FACTOR

- **Myocardial tension** and the contraction of ventricular muscle during isometric contraction and the ejection periods also add to the production of the first heart sound.

4. ATRIAL FACTOR

- Vibrations produced by the atrial systole also play a role in the production of the first heart sound.

CHARACTERISTICS

- First heart sound is a long, soft and low-pitched sound.
- It resembles the spoken word **'LUBB'.**
- The duration of this sound is 0.10 to 0.17 second.
- Its frequency is 25 to 45 cycles/second.

APPLIED PHYSIOLOGY

1. REDUPLICATION OF FIRST HEART SOUND

- Reduplication means splitting of the heart sound.
- First heart sound is split when the atrioventricular valves do not close simultaneously **(asynchronous closure).**
- Splitting of first heart sound in normal conditions **(physiological splitting)** is rare.
- **Pathological splitting** of first heart sound occurs in stenosis of atrioventricular valves and atrial septal defect.

2. SOFT FIRST HEART SOUND

- Heart sound becomes soft when the intensity of sound decreases.
- A soft first heart sound is heard in low blood pressure, severe heart failure, myocardial infarction and myxedema.

3. LOUD OR ACCENTUATED FIRST HEART SOUND

- First heart sound becomes louder or accentuated (becoming prominent) in conditions like mitral stenosis,
- **Wolff-Parkinson-White syndrome** and acute rheumatic fever.
- It is loud in patients with thin chest wall also.

4. CANNON SOUND

- Cannon sound refers to the loud first heart sound that is heard intermittently.
- It is heard in ventricular tachycardia and complete atrioventricular block.

FIRST HEART SOUND AND ECG

- First heart sound coincides with peak of 'R' wave in ECG.

SECOND HEART SOUND

- Second heart sound is produced at the end of **protodiastolic period.**

CAUSE

- Second heart sound is produced due to the sudden and synchronous closure of the **semilunar valves.**

CHARACTERISTICS

- Second heart sound is a short, sharp and high-pitched sound.
- It resembles the spoken word **'DUBB'** (or DUP).
- Duration of second heart sound is 0.10 to 0.14 second.

APPLIED PHYSIOLOGY

1. REDUPLICATION OF SECOND HEART SOUND

- Splitting of second heart sound occurs due to asynchronous closure of semilunar valves.
- It may occur both in physiological and pathological conditions.

i. PHYSIOLOGICAL SPLITTING

- It occurs during deep inspiration.
- Interval between the two valves widens during inspiration and narrows during expiration.
- Increased negative intrathoracic pressure during deep inspiration increases lung expansion and venous return into right atrium.
- So, the pulmonary valve closes little later than the aortic valve causing splitting of second heart sound.

ii. PATHOLOGICAL SPLITTING:

- The splitting of second heart sound occurs during pulmonary stenosis, right bundle branch block and right ventricular hypertrophy.

2. LOUD OR ACCENTUATED SECOND HEART SOUND

- Loud or accentuated second heart sound is produced by the closure of either aortic valve or pulmonary valve.
- Aortic valve produces loud sound during systemic hypertension and **coarctation** (narrowing) of aorta.
- Pulmonary valve produces loud sound during pulmonary hypertension.

3. SOFT SECOND HEART SOUND

- Second heart sound becomes soft in heart failure.

SECOND HEART SOUND AND ECG

- Second heart sound coincides with the 'T' wave in ECG.
- Sometimes, it may precede the 'T' wave or it may commence after the peak of 'T' wave.

THIRD HEART SOUND

- Third heart sound is a low-pitched sound that is produced during **rapid filling period** of the cardiac cycle.
- It is also called ventricular gallop or protodiastolic gallop, as it is produced during earlier part of diastole.
- Usually, the third heart sound is **inaudible** by stethoscope and it can be heard only by using microphone.

CAUSES

- Third heart sound is produced by the **rushing of blood** into ventricles and vibrations set up in the ventricular wall during rapid filling phase.
- It may also be due to vibrations set up in chordae tendineae.

CHARACTERISTICS

- Third heart sound is a short and low-pitched sound.
- Duration of this sound is 0.07 to 0.10 second.

CONDITIONS WHEN THIRD HEART SOUND BECOMES AUDIBLE BY STETHOSCOPE

- Third heart sound can be heard by stethoscope in children and athletes.
- Pathological conditions when third heart sound becomes loud and audible by stethoscope are aortic regurgitation, cardiac failure and cardiomyopathy with dilated ventricles.
- When third heart sound is heard by stethoscope, the condition is called **triple heart sound**.

THIRD HEART SOUND AND ECG

Third heart sound appears between 'T' and 'P' waves of ECG.

FOURTH HEART SOUND

- Normally, the fourth heart sound is an **inaudible** sound.
- It becomes audible only in pathological conditions.
- It is studied only by graphical recording, i.e. by phonocardiography.
- This sound is produced during **atrial systole** (late diastole) and it is considered as the physiologic atrial sound. It is also called **atrial gallop** or **presystolic gallop.**

CAUSES

- Fourth heart sound is produced by contraction of **atrial musculature** and vibrations are set up in atrial musculature, flaps of the atrioventricular valves during systole.
- It is also due to the vibrations set up in the ventricular myocardium because of ventricular distention during atrial systole.

CHARACTERISTICS

- Fourth heart sound is a short and low-pitched sound.
- Duration of this sound is 0.02 to 0.04 second.

CONDITIONS WHEN FOURTH HEART SOUND BECOMES AUDIBLE

- Fourth heart sound becomes audible by stethoscope when the ventricles become stiff.
- Ventricular stiffness occurs in conditions like ventricular hypertrophy, long standing hypertension and aortic stenosis.
- To overcome the ventricular stiffness, the atria contract forcefully, producing audible fourth heart sound. When fourth heart sound is heard by stethoscope, the condition is called **triple heart sound**.

FOURTH HEART SOUND AND ECG

- Fourth heart sound coincides with the interval between the end of 'P' wave and the onset of 'Q' wave.

TRIPLE AND QUADRUPLE HEART SOUNDS

TRIPLE HEART SOUND OR GALLOP RHYTHM

- Triple heart sound or **triple rhythm** is an **abnormal rhythm** of heart, characterized by three clear heart sounds during each heart beat.
- It is due to an abnormal third or fourth heart sound that is heard besides first and second heart sounds.
- It is also called **gallop rhythm,** since it resembles the sound of a horse's gallop.
- Usually, it is indicative of serious cardiovascular disease.

CONDITIONS WHEN TRIPLE HEART SOUND IS PRODUCED

- Triple heart sound is produced in conditions like myocardial infarction and severe hypertension.

QUADRUPLE HEART SOUND

- Quadruple heart sound is an abnormal rhythm of heart, characterized by four clear heart sounds during each heart beat. It is also called **quadruple rhythm.**
- It is due to third and fourth heart sounds that are heard besides first and second heart sounds.
- It is also called **quadruple gallop.**
- Quadruple heart sound is also indicative of serious cardiovascular disease.

CONDITIONS WHEN QUADRUPLE HEART SOUND IS PRODUCED

- Quadruple heart sound is produced in patients with congestive heart failure.

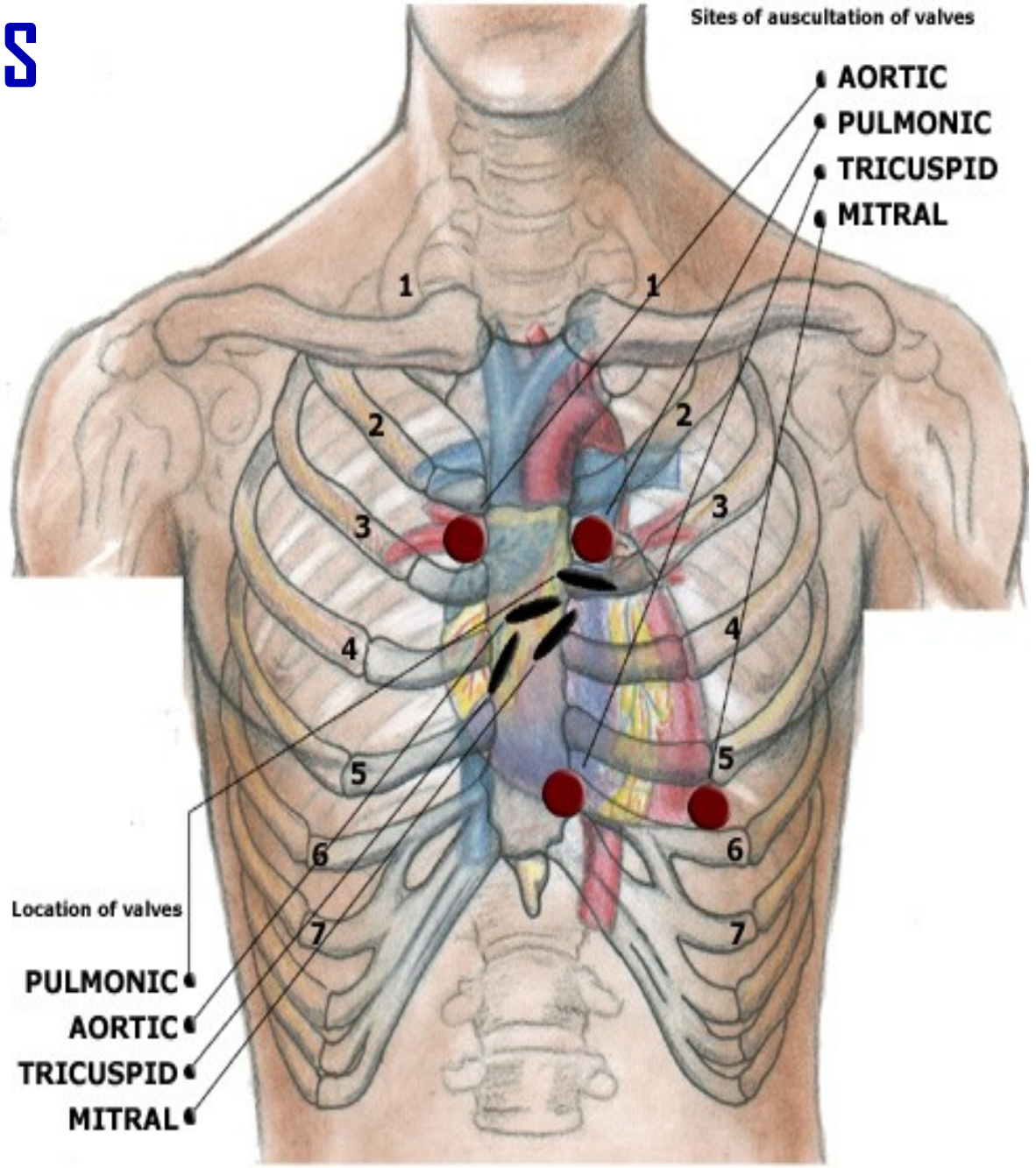
METHODS OF STUDY OF HEART SOUNDS

- Heart sounds are studied by three methods:

1. By using stethoscope
2. By using microphone
3. By using phonocardiogram

BY STETHOSCOPE

- First and second heart sounds are heard on the auscultation areas, by using the stethoscope.
- The chest piece of the stethoscope is placed over four areas on the chest, which are called auscultation areas.



AUSCULTATION AREAS

I. MITRAL AREA (BICUSPID AREA)

- Mitral area is in the left 5th intercostal space, about 10 cm away from the midline (midclavicular line).
- Sound produced by the closure of mitral valve (first heart sound) is transmitted well into this area.
- It is also called **apex beat area** because apex beat is felt in this area.
- Apex beat is the thrust of the apex of ventricles, against the chest wall during systole.

II. TRICUSPID AREA

- Tricuspid area is on the xiphoid process.
- Sound produced by the closure of tricuspid valve (first heart sound) is transmitted well into this area.

III. PULMONARY AREA

- Pulmonary area is on the left 2nd intercostal space, close to sternum.
- Sound produced by the closure of pulmonary valve (second heart sound) is heard well on this area.

IV. AORTIC AREA

- Aortic area is over the right 2nd intercostal space, close to the sternum.
- On this area, the sound produced by the closure of aortic valve (second heart sound) is heard well.

- First heart sound is best heard in mitral and tricuspid areas.
- However, it is heard in other areas also but the intensity is less.
- Similarly, the second heart sound is best heard in pulmonary and aortic areas.
- It is also heard in other areas with less intensity.

BY MICROPHONE

- A highly sensitive microphone is placed over the chest.
- The heart sounds are amplified by means of an **amplifier** and heard by using a **loudspeaker.**
- First, second and third heart sounds are heard by this method.

BY PHONOCARDIOGRAM

- Phonocardiography is the technique used to record the heart sounds.
- Phonocardiogram is the graphical record of heart sounds.
- It is done by placing an electronic **sound transducer** over the chest.
- All the four heart sounds can be recorded in phonocardiogram.

Phonocardiograph

THANK YOU