

# MASTERING THIRD AND FOURTH HEART SOUND

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S<sub>1</sub> – Onset of ventricular systole

S<sub>2</sub> – offset of ventricular systole

S<sub>3</sub> – produced due to ventricular vibrations produced as a result of rapid ventricular filling in distended/ taut ventricles

S<sub>4</sub> – produced due to pathologic conditions

## VENTRICULAR DIASTOLE AND PRODUCTION OF S<sub>3</sub> AND S<sub>4</sub>

In ventricular diastole, aortic and pulmonary valves are closed while mitral and tricuspid valves open

### Phases of Ventricular Diastole

#### **Phase 1: Rapid ventricular filling**

Before opening of mitral and tricuspid valves, ventricles have some volume of blood called **End Systolic Volume**. When ventricles begin to relax, mitral and tricuspid valves open and blood moves from atria to ventricles rapidly.

The early stage of ventricular diastole is called **Rapid Inflow Stage**. During this stage, as ventricles are being filled, they expand. By the end of rapid inflow phase, ventricles have reached maximum elasticity and cannot stretch further.

When ventricles cannot stretch further, further inflow of blood causes ventricular vibrations and these vibrations produces **third heart sound, S<sub>3</sub>**. This heart sound is very soft (low-pitch) so it can be heard with bell of stethoscope.

#### **Phase 2: Slow Ventricular filling/ Diastasis**

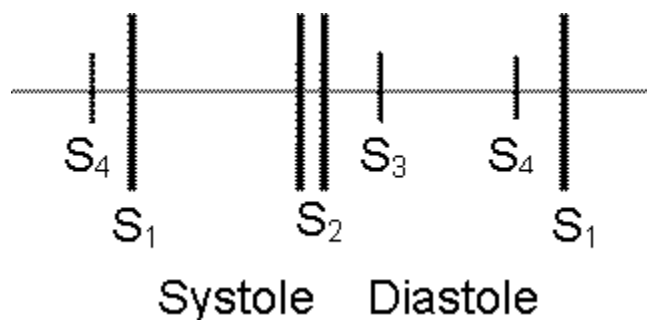
Venous return coming from lungs move directly to ventricles and here atria acts as transit route. As the blood is not being stored in atria, so in this phase slow ventricular filling takes place. This phase is called Diastasis.

### Phase 3: Last ventricular filling due to atrial contraction

Atria contract to do additional final filling of ventricles.

If the ventricles are stiff due to some pathologic conditions, atria has to contract more strongly to push the blood into ventricles which lead to ventricular vibrations these vibrations will produce **fourth heart sound, S<sub>4</sub>**. This stiffening of ventricles can be seen in left ventricular hypertrophy or in active myocardial ischemia. In active myocardial ischemia, the ischemic portion of myocardium cannot relax and contract properly. During diastole as it cannot relax properly it offers more resistance due to which atria has to contract stronger to pump blood into ventricles.

### AUSCULTATION OF S<sub>3</sub> AND S<sub>4</sub>



S<sub>3</sub> – Lub Dub Ta

S<sub>4</sub> – Ta Lub Dub

S<sub>3</sub> and S<sub>4</sub> (Quadruple Gallop) – Lub Dub Ta Ta

Quadruple Gallop with tachycardia – Lub Dub Taaa

To hear S<sub>3</sub> and S<sub>4</sub> sounds in left ventricle, the patient is asked to lie in **left lateral decubitus position**. Apex beat is palpated and bell of stethoscope is placed on apex beat and auscultated. To increase the intensity of S<sub>3</sub> and S<sub>4</sub> and hear the sound more audibly in left ventricle, the chest is auscultated during expiration. Because during expiration lungs move to the side and apex beat move closer to the chest, so sound is heard more clearly. Other reason to auscultate during expiration is that during expiration lungs are squeezed, pulmonary circulation is suppressed and as more blood goes to the left side hence, S<sub>3</sub> and S<sub>4</sub> are accentuated.

- ❑ Ask the patient to roll partly onto the left side into the left lateral decubitus position, bringing the left ventricle close to the chest wall
- ❑ This position accentuates or brings out a left-sided S<sub>3</sub> and S<sub>4</sub> and mitral murmurs, especially mitral stenosis. You may otherwise miss them.



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To hear S<sub>3</sub> and S<sub>4</sub> sound in right ventricle, the patient is asked to lie in supine position and bell is placed on fourth intercostal space in left parasternal position. To increase the intensity of S<sub>3</sub> and S<sub>4</sub> and hear the sound more audibly in right ventricle, the chest is auscultated during inspiration. As during inspiration, there is more venous return to the right side.

When both S<sub>3</sub> and S<sub>4</sub> can be auscultated, it is called **Quadruple Gallop**. Severe Tachycardia associated with Quadruple Gallop produces S<sub>3</sub> and S<sub>4</sub> so close together that they fuse together and form a single loud sound. This loud sound is called **Summation Gallop**. This summation gallop may be louder than S<sub>1</sub> and S<sub>2</sub>.

On auscultation, when we hear third heart sound and are confused if it's S<sub>2</sub> split or simply S<sub>3</sub>, the following procedure should be taken.

If double sound is heard through bell but not diaphragm, the sound is S<sub>3</sub>.

If double sound is heard through both bell and diaphragm, it indicates splitting of S<sub>2</sub>.

## CAUSES OF S<sub>3</sub>

S<sub>3</sub> may be due to normal physiologic process or it may be pathological.

- Physiologic Causes
  1. Heard in children and young people (upto age 30 – 40) due to pliable heart. In adults, heart become stiff and S<sub>3</sub> disappears.
  2. Heard in third trimester of pregnancy
  3. Heard normally in athletes
- Pathologic Causes
  1. Heart failure
  2. Mitral valve regurgitation
  3. Produced in conditions having hyperdynamic circulation e.g. in fever, severe anemia, thyrotoxicosis (raised levels of T<sub>3</sub> and T<sub>4</sub>)

## CAUSES OF S<sub>4</sub>

The causes of S<sub>4</sub> are always pathological, and is mainly due to conditions producing ventricular hypertrophy.

1. Aortic valve stenosis
2. Systemic hypertension
3. Active ventricular ischemia (e.g. due to recent MI)

## INTENSITY OF HEART SOUNDS

