



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

السلام عليكم ورحمة الله وبركاته

Cardiovascular System Block
Heart Sounds & Murmurs
(Physiology)

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Learning Objectives

1

Normal heart sounds and its leading causes

2

Causes of abnormal heart sounds

3

Describing abnormal heart sounds

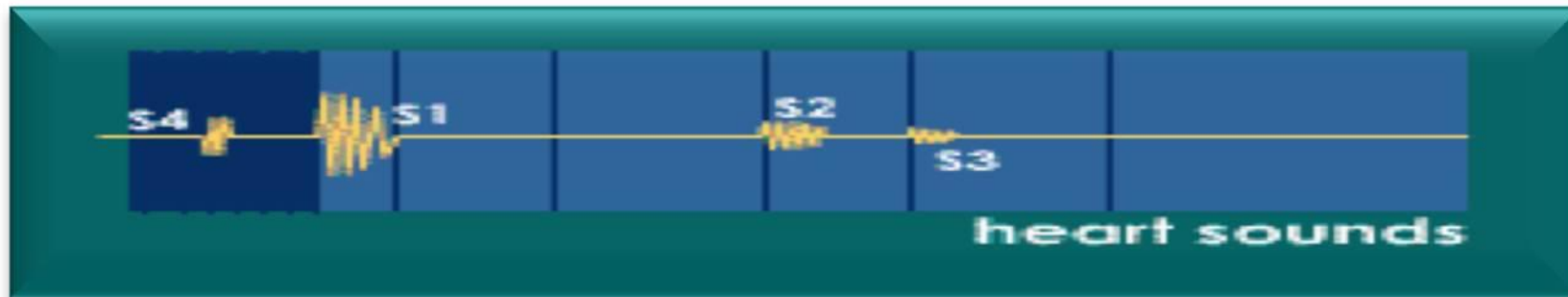
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Different examples of abnormal heart sounds

Heart Sounds

❖ Detected over anterior chest wall by 2 methods:-

- Auscultation.....(Stethoscope)
- Phonocardiography.....(sound recording device)



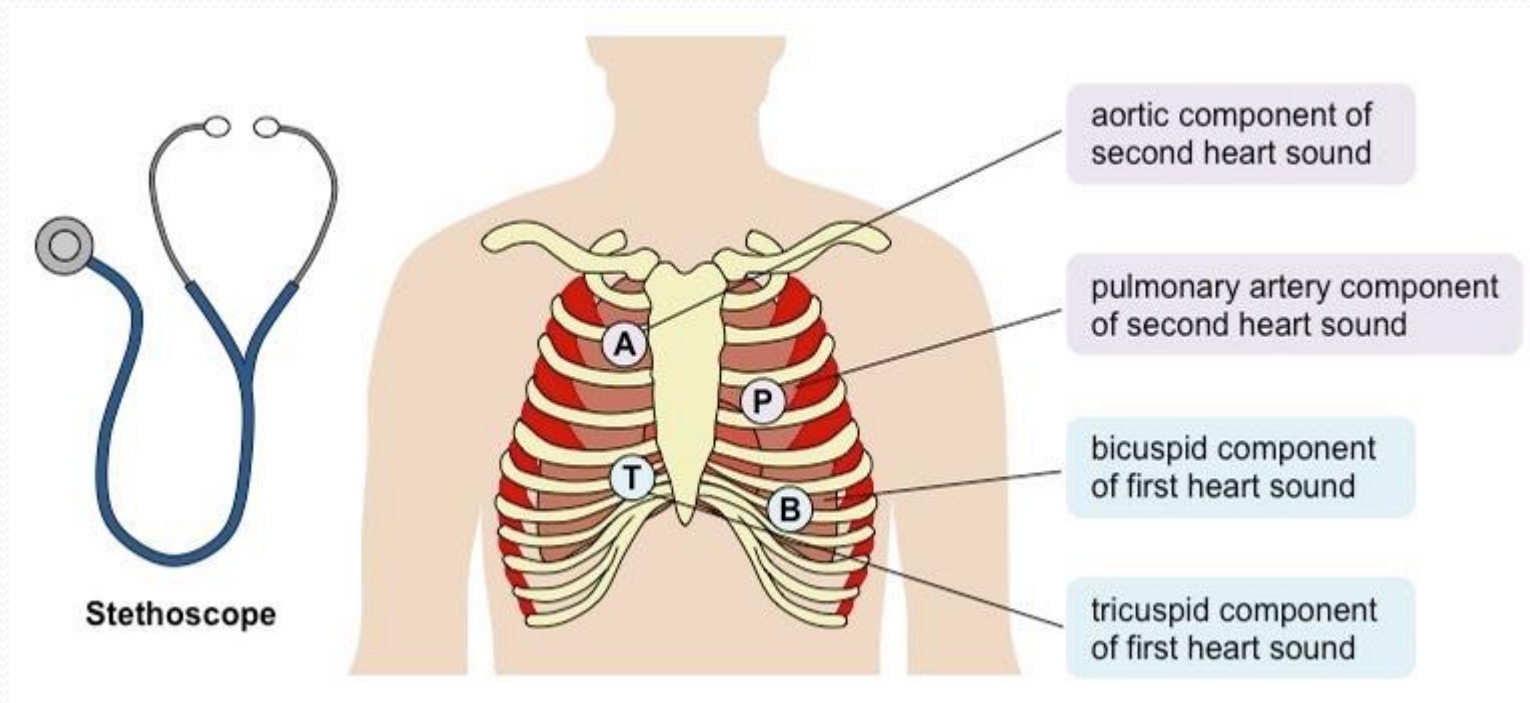
Heart Sounds

4 heart sounds can be detected:

- 1st & 2nd heart sounds ... (usually audible)
- 3rd & 4th heart sounds ... (sometimes detected)

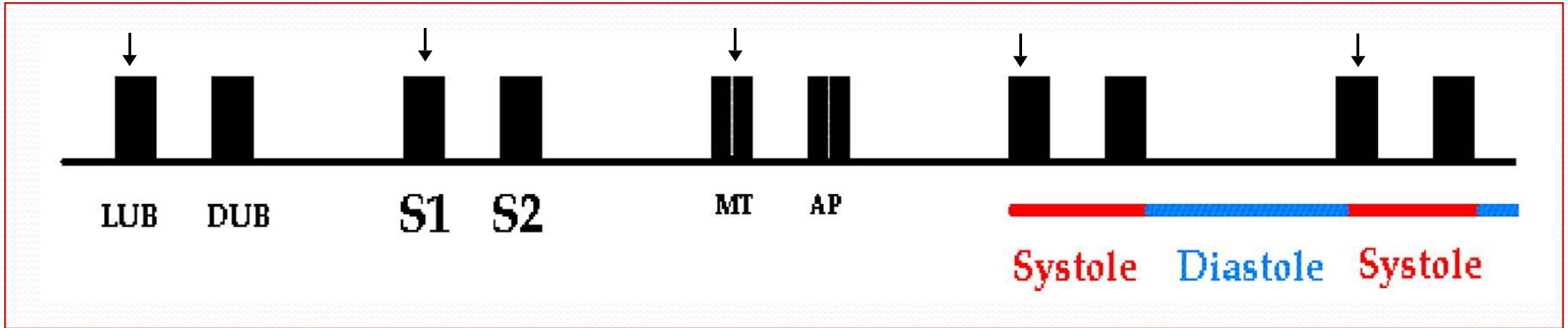


Heart Sounds Windows



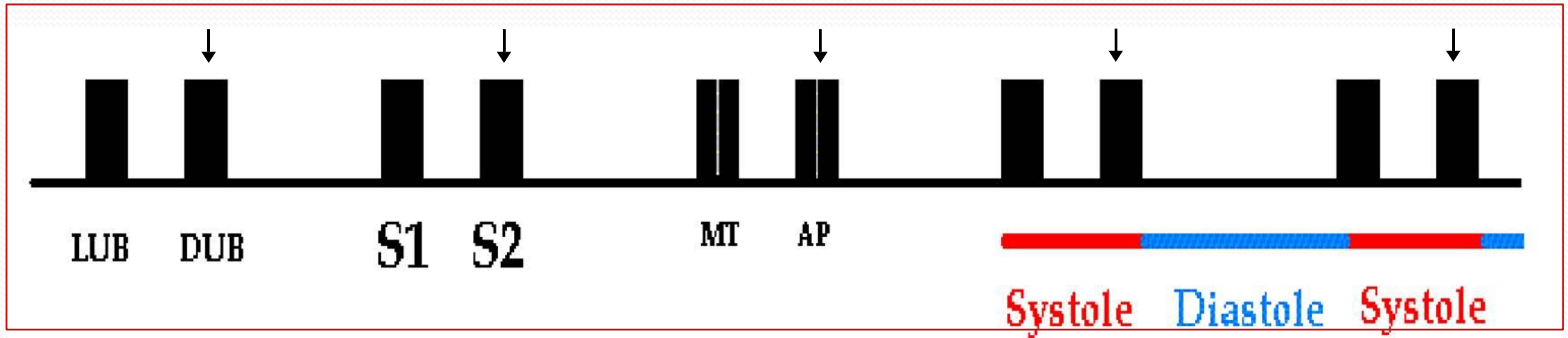
- ❖ **Aortic area:**
2nd Rt costal cartilage.
- ❖ **Pulmonary area:**
2nd Lt intercostal space.
- ❖ **Mitral (bicuspid) area:**
5th Lt intercostal space crossing mid-clavicular line, or 9 cm (2.5-3 inches) from sternum.
- ❖ **Tricuspid area:**
lower part of sternum towards Rt side.

1st Heart Sound = S1



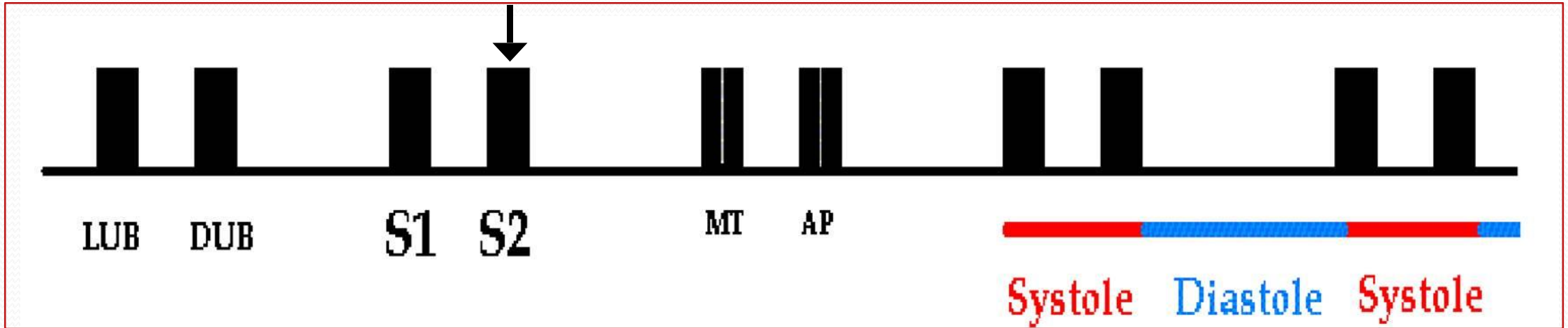
- Due to closure of the A-V valves.
- Recorded at the beginning of the ‘isovolumetric contraction phase.’
- It marks beginning of ventricular systole.
- Long in duration .. 0.15 sec. Of low pitch (LUB) .
- Loud.
- 25-35 Hz.
- Best heard at **Mitral & Tricuspid** areas.

2nd Heart Sound = S2



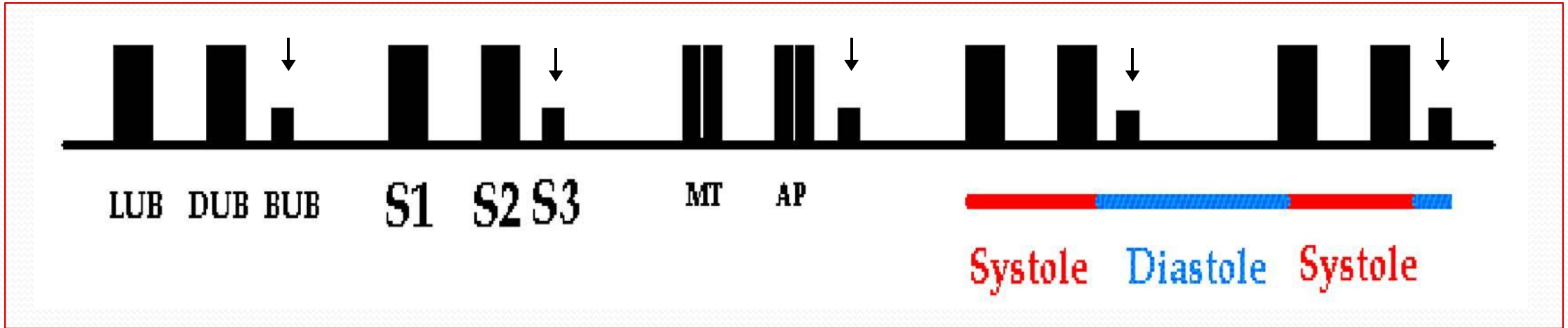
- Due to closure of semilunar valves.
- Recorded at the beginning of the ‘isovolumetric relaxation phase’.
- Marks the beginning of ventricular diastole.
- Short in duration .. 0.11-0.125 sec.
- Of high pitch (DUB) .
- Soft & Sharp.
- 50 Hz.
- Best heard at **Aortic & Pulmonary** areas.

Splitting of the 2nd Heart Sound



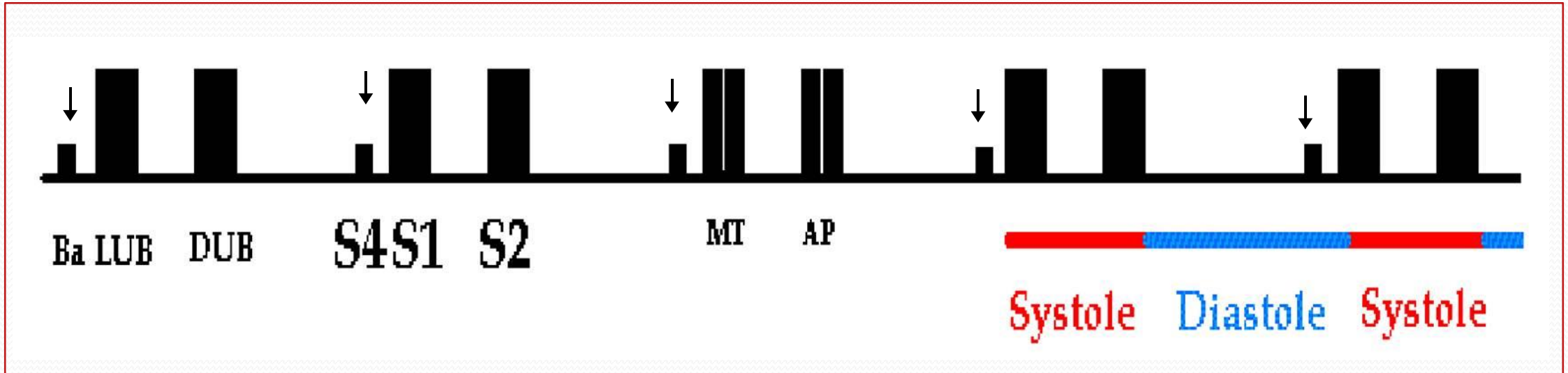
- S2 splits physiologically into 2 sounds during inspiration = Physiological Splitting.
- This splitting occurs due to delay closure of pulmonary valve.

3rd Heart Sound = S3



- Recorded during the ‘rapid filling phase’ due to rush of blood into the ventricle.
- S3 is usually not audible (very low pitch.)
- 0.05 sec.
- ? Heard in children.
- Best heard at **Mitral** area.

4th Heart Sound = S4



- Recorded during ‘atrial systole.’
- S4 is usually not audible (very low pitch.)
- 0.04 sec.
- ? Heard in elderly.
- Best heard at **Mitral** area.

Significance of Heart Sound

Important for diagnosis of heart murmurs.

Abnormal extra heart sounds heard during the heart beat cycle.

Produced by turbulence (abnormal patterns) of blood flow through the heart & its valves.

Murmurs are longer than heart sounds.

What make noise in the heart

❑ *Closure of valves of the heart*

- Atrio-ventricular (Mitral & Tricuspid) valves= (S1)
- Semilunar (Aortic & Pulmonary) valves= (S2)

❑ *Increased intra-cardiac hemodynamics*

- Blood striking the left ventricle = (S3, S4)
- Increased flow across normal valves.
- Turbulent flow through an abnormal valve.
- Turbulent flow through septal defect.

} (Murmurs)

Physiological VS Pathological Murmurs

1- Physiological Murmurs:

↑ blood flow across normal valves:

e.g.:-

- Pregnancy
- Hyperthyroidism
- Anemia
- Fever
- Children

2- Pathological Murmurs:

Turbulent flow through abnormal valves, or septal defect.....Congenital?

e.g:-

- Tight valve (stenosis)
- Leaky valve (regurgitation or insufficiency)

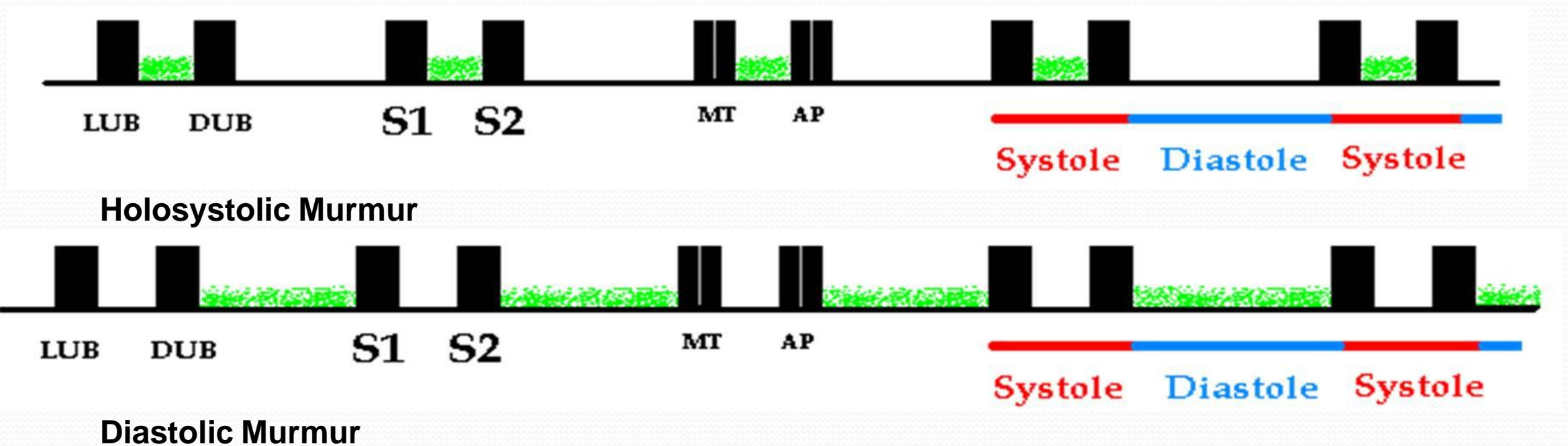
How to Describe Heart Murmurs

- Timing (systolic or diastolic)
- Shape
- Location
- Radiation
- Intensity
- Pitch
- Quality

1- Timing

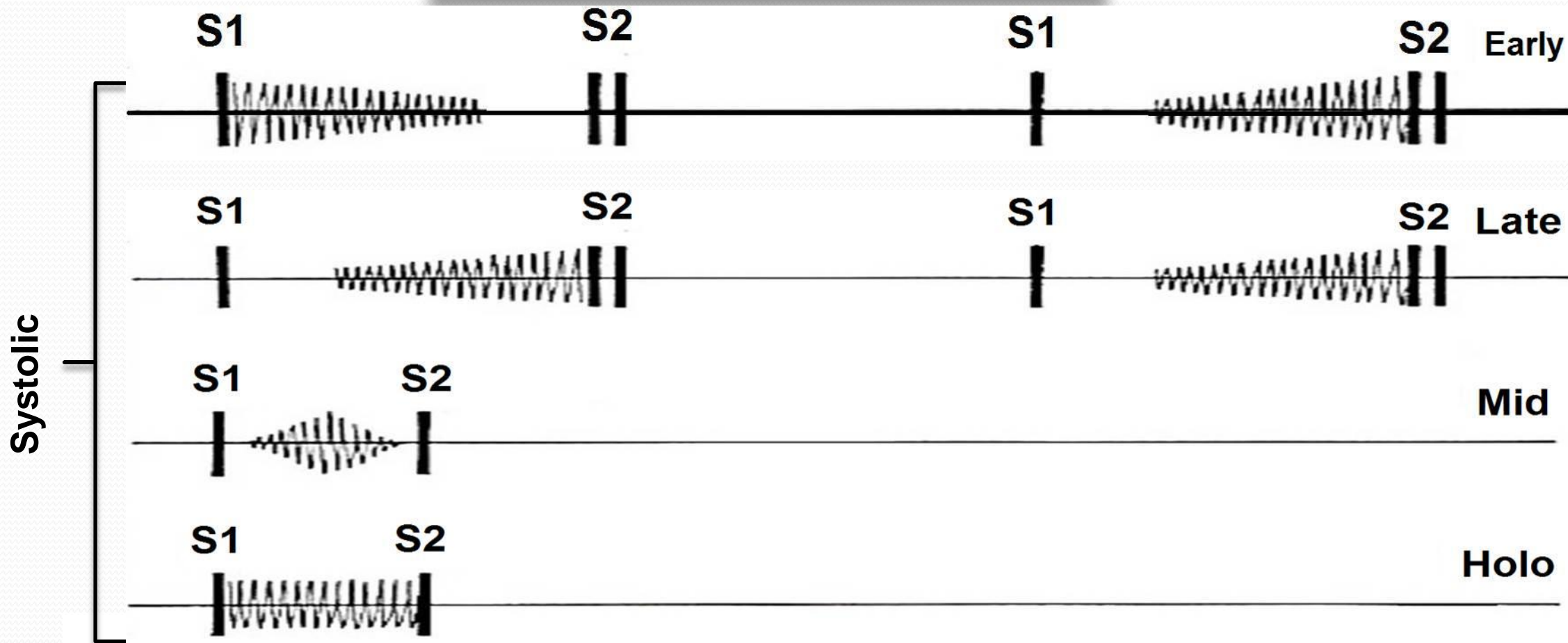
Murmurs are described according to their position in the cardiac cycle:

- Systolic.
- Diastolic.
- Continuous.



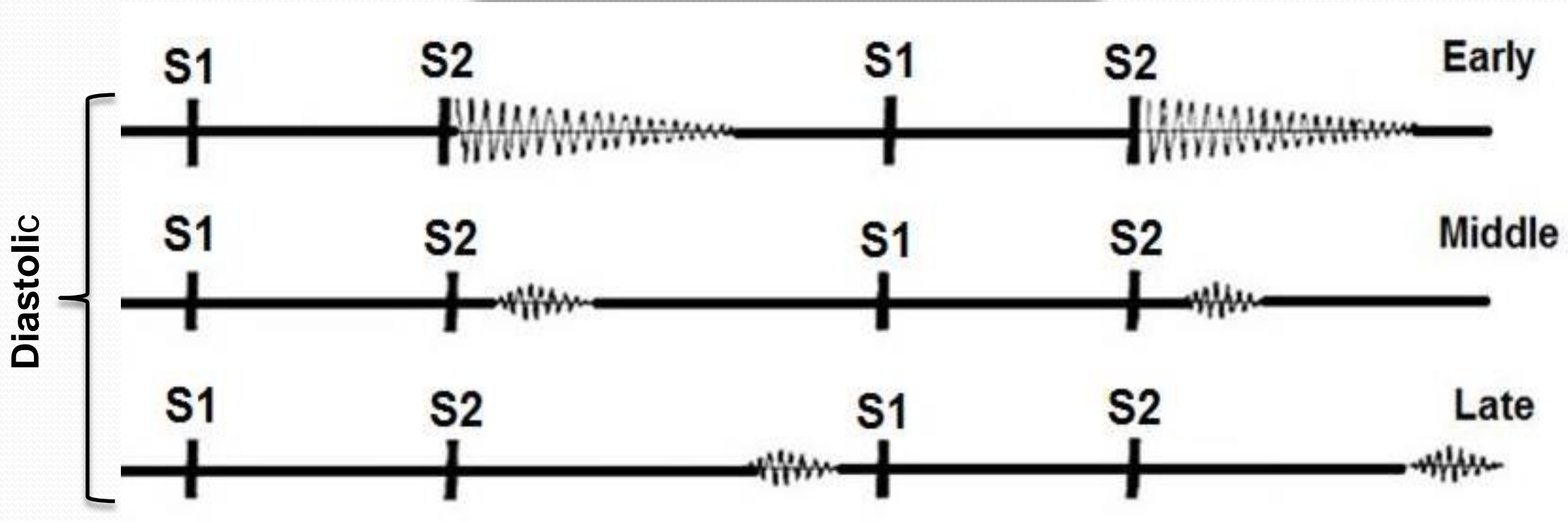
Systolic Murmurs

- Between S_1 & S_2
- Classified as early, mid, late, holosystolic



Diastolic Murmurs

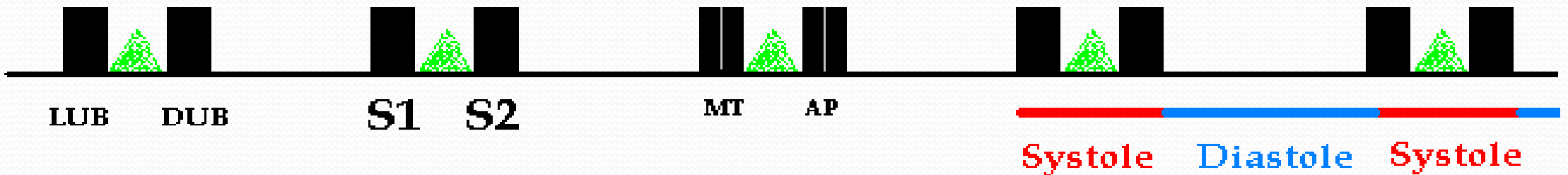
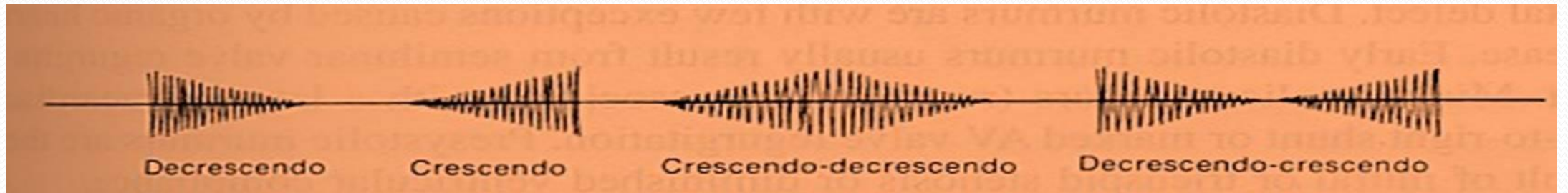
- Between S_2 & S_1
- Classified as early, mid, late



2- Shape

Murmurs are described according to the waxing & waning of the sound

- Crescendo (grows louder)
- Decrescendo
- Plateau
- Crescendo-decrescendo (Diamond-shaped)
- Decrescend-crescendo



Diamond-shaped Murmur

Describing a Heart Murmurs.....Cont

3- Radiation

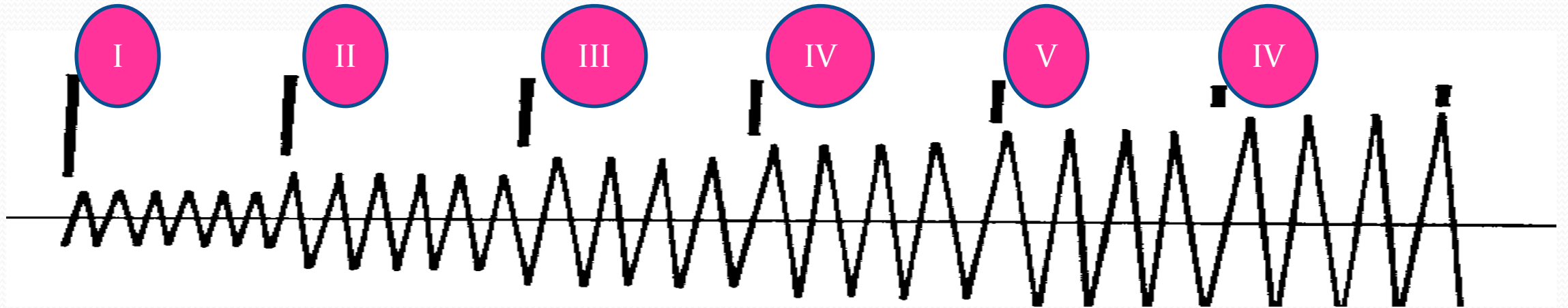
Reflects intensity of the murmur & direction of blood flow.

4- Location of maximum intensity

Determined by the site where the murmur originates;
e.g. Aortic, Pulmonary, Tricuspid, & Mitral listening areas.

5- Intensity

- Graded on a (6) point according to Levine scale:



Classification of murmurs by loudness

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
<ul style="list-style-type: none">• Lowest intensity• Very faint	<ul style="list-style-type: none">• Low intensity• Quiet but heard immediately	<ul style="list-style-type: none">• Medium intensity• Moderately loud	<ul style="list-style-type: none">• Medium intensity• Loud• Thrill	<ul style="list-style-type: none">• Loud intensity• Heard with stethoscope partly off the chest• Thrills	<ul style="list-style-type: none">• Loudest intensity• No stethoscope needed• Thrills

Heart Murmurs Intensity

I / VI	Need quiet room and trained ear to hear. (difficult to hear even by expert listeners)
II / VI	Audible to anyone who listens attentively (usually audible by all listeners)
III / VI	Loud, but not palpable (easy to hear even by inexperienced listeners, but without a palpable thrill)
IV / VI	Loud and palpable: it produces a precordial thrill
V / VI	Audible with your stethoscope placed perpendicular to chest wall
VI / VI	Audible without a stethoscope

Describing a Heart Murmurs.....Cont

6. Pitch

High, medium, low.

7. Quality

Blowing, harsh (hard) ,resonant (rumbling) & musical.

8. Others:

i. **Variation with respiration:**

ii. **Variation with position of patient.**

iii. **Variation with special maneuvers:**

Valsalva (forced expiration) \Rightarrow Murmurs \downarrow in length & intensity.

Systolic Murmurs

Early Systolic

Mid Systolic

Late Systolic

Pansystolic (holosystolic)

Systolic Murmurs

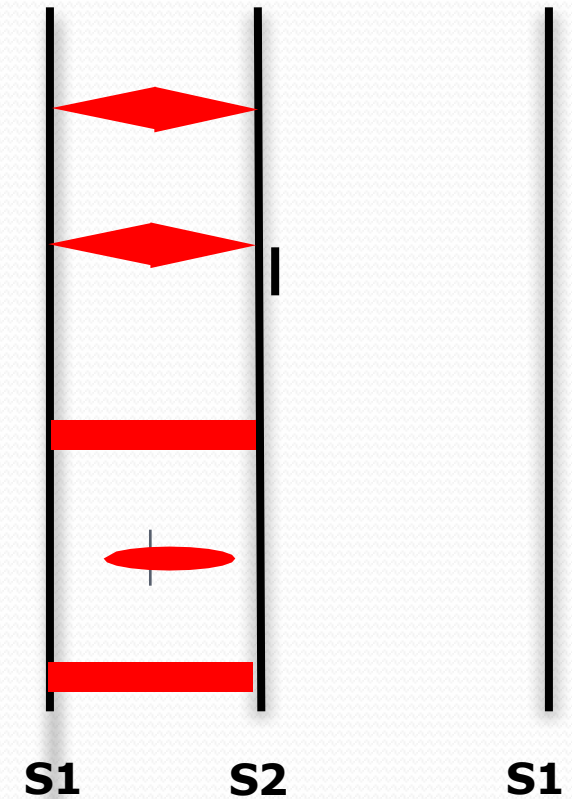
Derived from harsh & turbulence in blood flow.

Associated with:

1. ↑ flow across normal valve.
2. ↑ flow into a dilated great vessel.
3. ↑ flow across an abnormal valve, or narrowed ventricular outflow tract - e.g. aortic /pulmonary stenosis.
4. ↑ flow across an incompetent AV valve- e.g. mitral/tricuspid regurgitation.
5. ↑ flow across the inter-ventricular septum - e.g. VSD.

Common Systolic Murmurs and Timing

1. Aortic stenosis – ejection murmur.
2. Pulmonary stenosis – ejection murmur
3. Mitral / Tricuspid regurgitation – holosystolic.
4. Mitral valve prolapse – mid-late systole.
5. Ventricular septal defect (VSD) – holosystolic.



Ejection (Mid- Systolic) Murmurs

Most common kind of heart murmur.

Usually crescendo-decrescendo.

They may be:

- 1. Innocent**

Common in children & young adults.

- 2. Physiological**

Can be detected in hyper-dynamic states,
e.g. anemia, pregnancy, fever & hyperthyroidism.

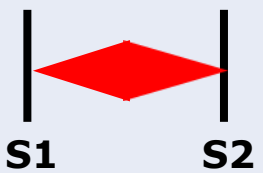
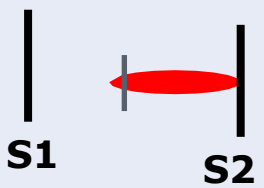

- 3. Pathological**

Secondary to structural CV abnormalities,
e.g. Aortic/pulmonary stenosis, Hypertrophic
cardiomyopathy & mitral prolapse.

Pan- Systolic (Holosystolic) Murmurs

- Pathological murmur.
- Begins immediately with S1 & continues up to S.2
- Heard with:
 - Mitral/tricuspid regurgitation.
 - Ventricular septal defect (VSD).

Systolic Murmurs

	Aortic Stenosis	Mitral Prolapse	Mitral Regurgitation
Cause	Obstruction of flow from LV into ascending aorta	Bulging of 1 or 2 mitral valve leaflets into LA during LV systole	Retrograde flow from LV into LA through an incompetent mitral valve
Timing	mid-systolic murmur	Mid- late systolic murmur.	Holosystolic murmur.
Location	Best heard on aortic area, radiates along carotid arteries.	Best heard at the apex.	Best heard at apex, radiates to left axilla.
Character	Harsh, loud, may have associated with thrill, “ejection click.”	Mid systolic click.	Soft, high-pitched, blowing
Association	Old age, bicuspid aortic valve, rheumatic fever.	~5% normal population, asymptomatic, ? Sudden death.	MV prolapse, or myxomatous degeneration, rheumatic heart disease, endocarditis
			

Diastolic Murmurs

Early Systolic

Mid Systolic

Late Systolic

Diastolic Murmurs

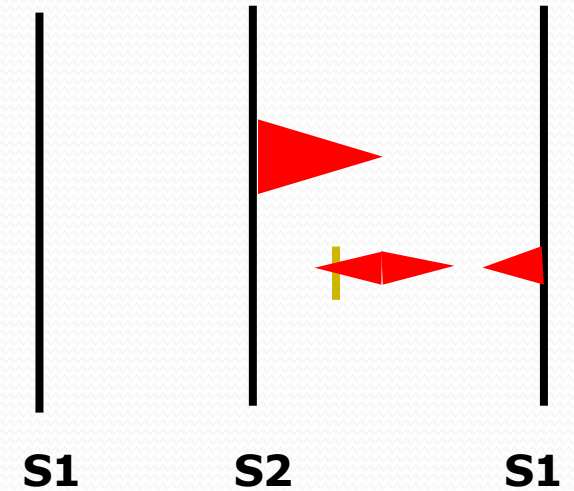
- Almost always indicate heart disease.
- Two basic types:
 1. **Early decrescendo diastolic murmurs:**
Signify regurgitant flow through an incompetent semilunar valve, e.g. aortic/pulmonary regurgitation.
 2. **Rumbling diastolic murmurs in mid- or late diastole:**
Suggest stenosis of an AV valve, e.g. mitral/tricuspid stenosis.

In Summary

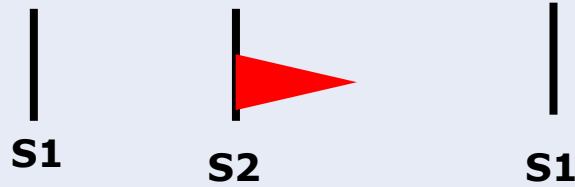
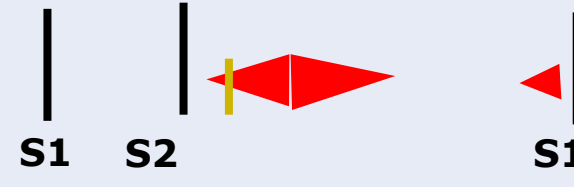
Common Diastolic Murmurs & Timing

Soft, blowing, gurgle

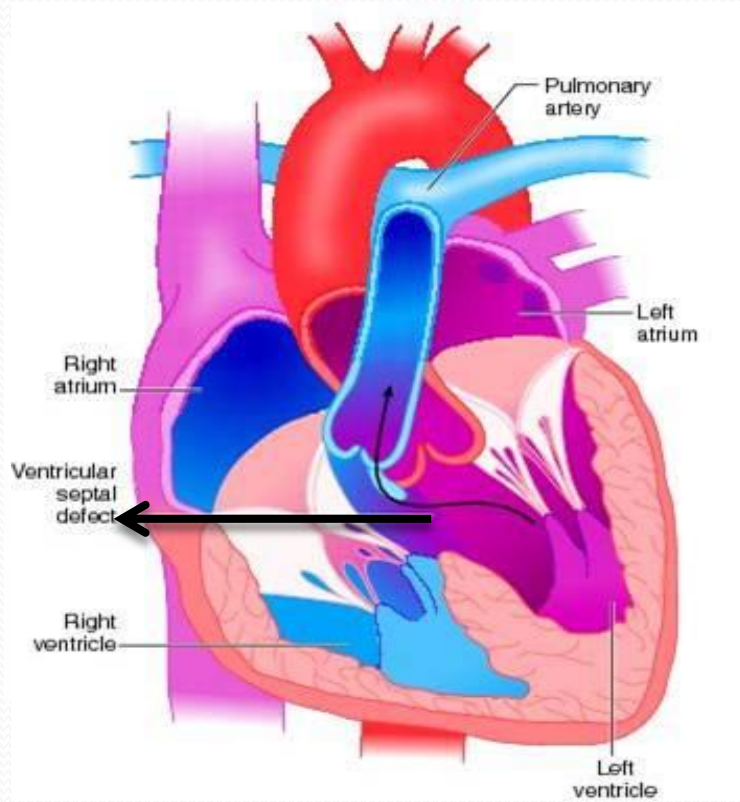
1. Aortic regurgitation - early diastole
2. Mitral stenosis - mid to late (pre-systolic) diastole



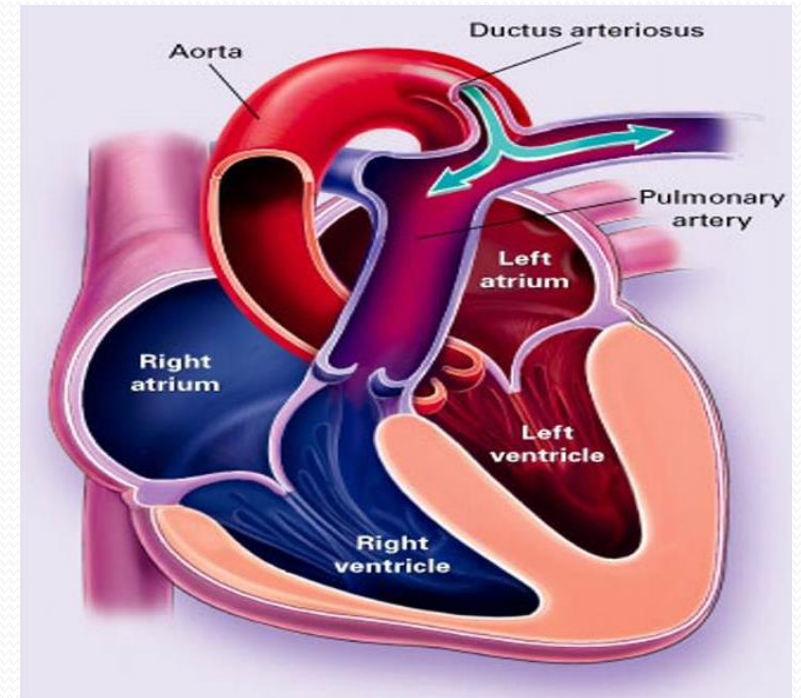
Diastolic Murmurs

	Aortic Regurgitation	Mitral Stenosis
Cause	Retrograde flow from aorta into LV through incompetent aortic cusps	Obstruction of flow from LA to LV (Valve becomes narrowed, thickened & calcified)
Timing	Diastolic (early) murmur.	Diastolic (mid-diastolic, or pre-systolic) murmur
Location	Best heard at 2nd-4th left intercostal spaces.	Best heard at apex.
Character	High-pitched, blowing, decrescendo	Low pitched (heard with bell)
Association	Aortic root degeneration, rheumatic heart disease, VSD with aortic valve prolapse (kids).	Rheumatic fever.
		

Murmurs of Ventricular Septal Defect & Patent Ductus Arteriosus

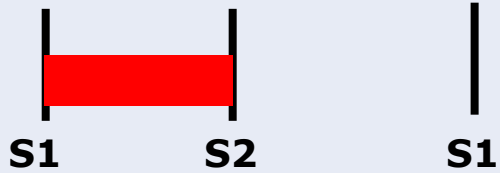
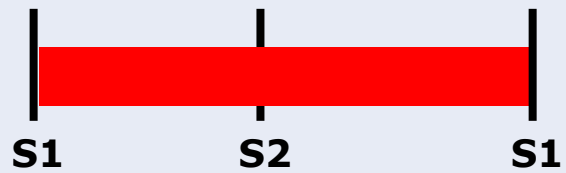


Ventricular Septal Defect

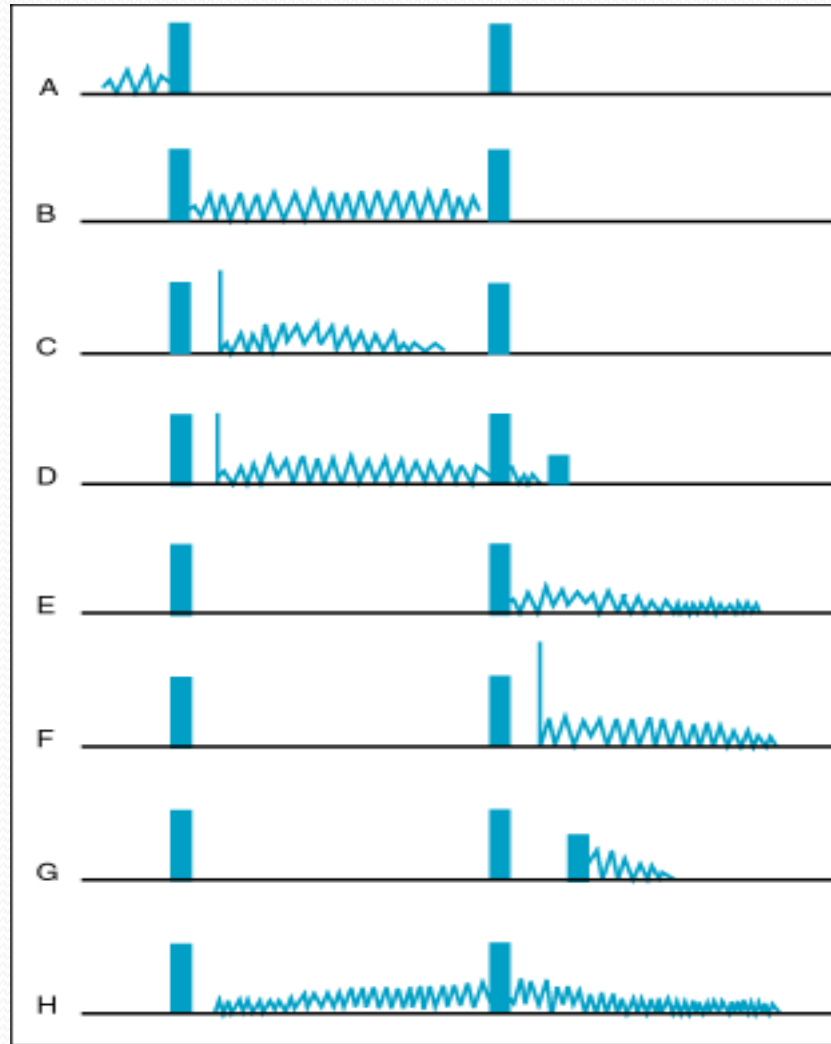


Patent ductus arteriosus

Murmurs of Ventricular Septal Defect VS Patent Ductus Arteriosus

	Ventricular septal defect	Patent ductus arteriosus
Cause	A congenital condition associated with abnormal blood flow between the left ventricle and the right ventricle	Failure of closure of the duct between pulmonary artery & aorta
Timing	Holosystolic murmur, may be diastolic murmur due to turbulent flow through mitral valve	Continuous murmur.
Location	Best heard at tricuspid area.	Best heard at upper left sternal border.
Character	A medium pitched murmur fills all of systole	Machine-like.
Association	Volume overload of right ventricle	Left to right shunt, cyanosis.
		

Summary



A. Presystolic murmur

- **Mitral/Tricuspid stenosis**

B. Mitral/Tricuspid regurgite.

C. Aortic ejection murmur

D. Pulmonic stenosis (spilling through S2)

E. Aortic/Pulm. diastolic murmur

F. Mitral stenosis w/ Opening snap

G. Mid-diastolic inflow murmur

H. Continuous murmur of PDA

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استغفرك وأتوب إليك

