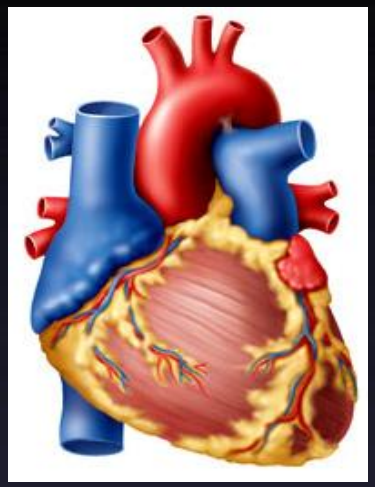
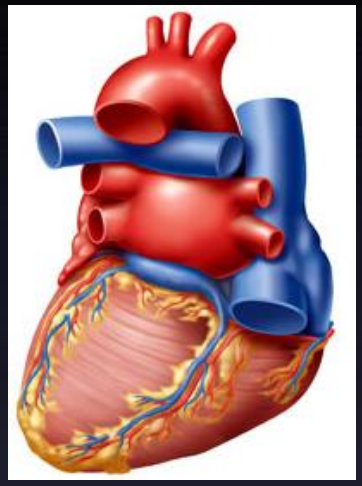
CARDIOVASCULAR SYSTEM

HEART SOUNDS





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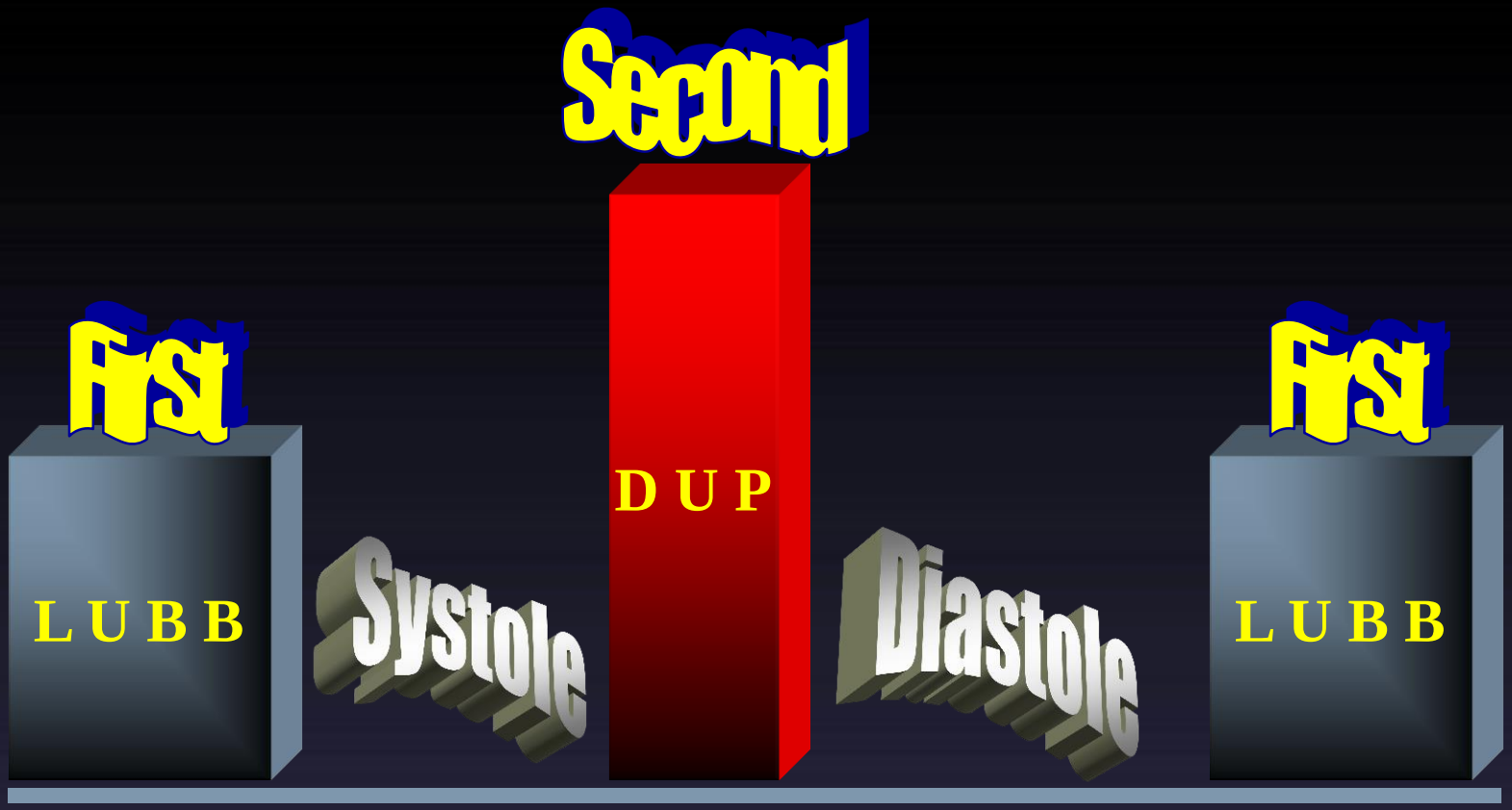
OBJECTIVES

- **At the end of the lecture you should be able to …..**

1. **Enumerate the different heart sounds**
2. **Describe the cause and characteristic features of first and second heart sound**
3. **Correlate the heart sounds with different phases of cardiac cycle**
4. **Define murmurs and their clinical importance**

HEART SOUNDS

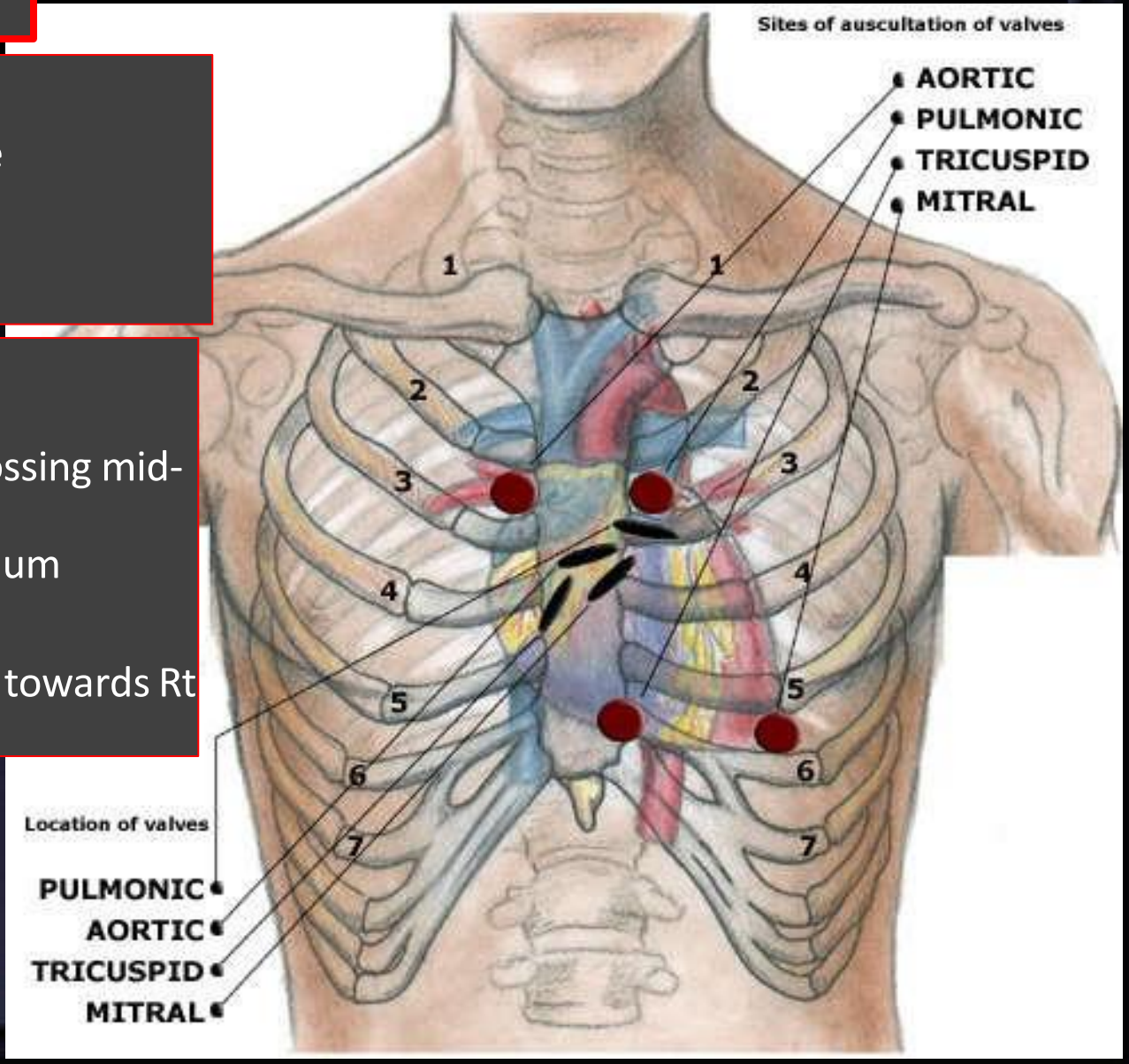


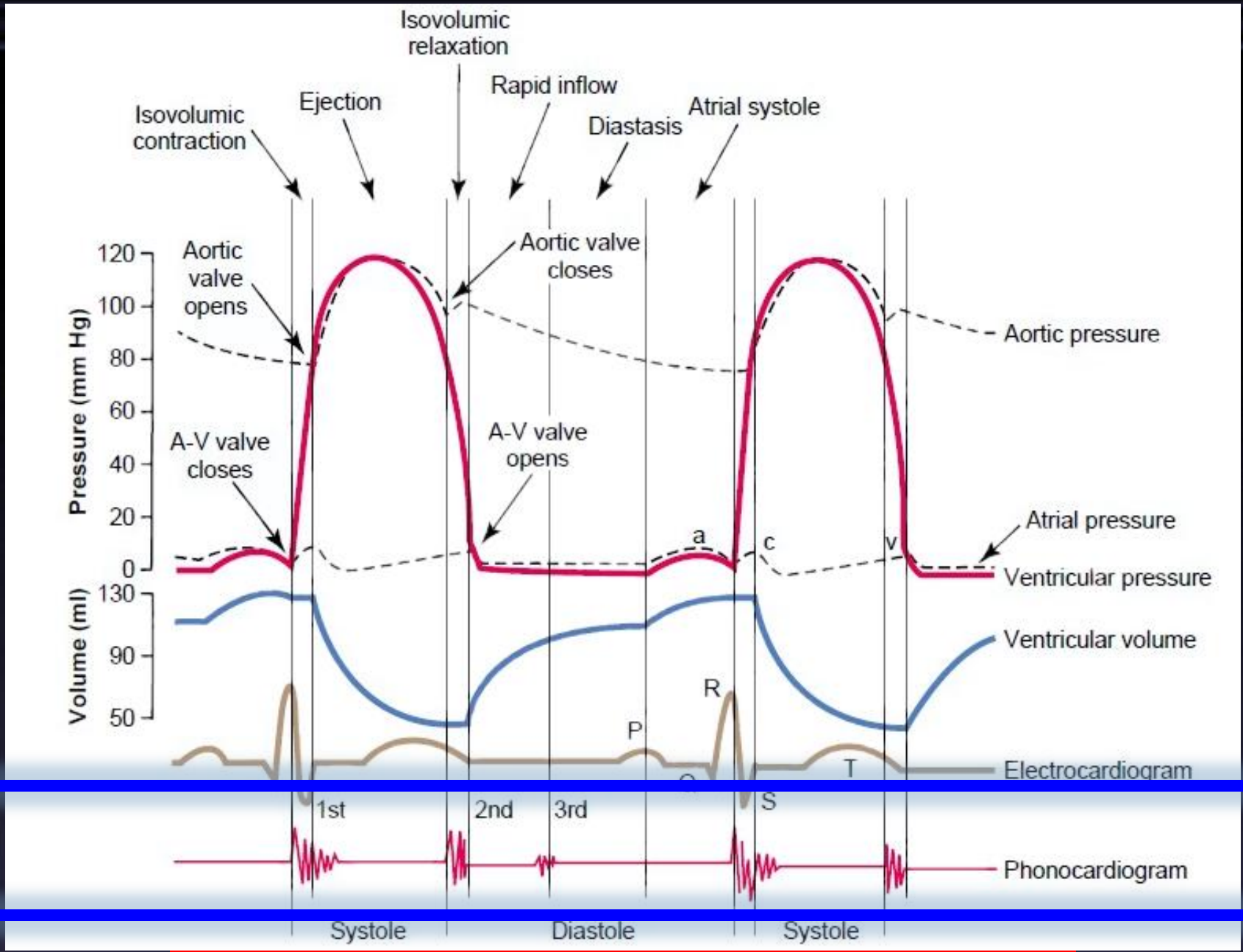
Heart sounds

AREAS OF AUSCULTATION

BEST HEARD AT 4 AREAS:

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





The Events of the Cardiac Cycle

PROF. HABIB 2018

HEART SOUNDS

- There are four heart sounds SI, S2, S3 & S4.
- Two heart sound are audible with stethoscope S1 & S2 (Lub - Dub).
- S3 & S4 are not audible with stethoscope Under normal conditions because they are low frequency sounds.
- Ventricular Systole is between First and second Heart sound.
- Ventricular diastole is between Second and First heart sounds.

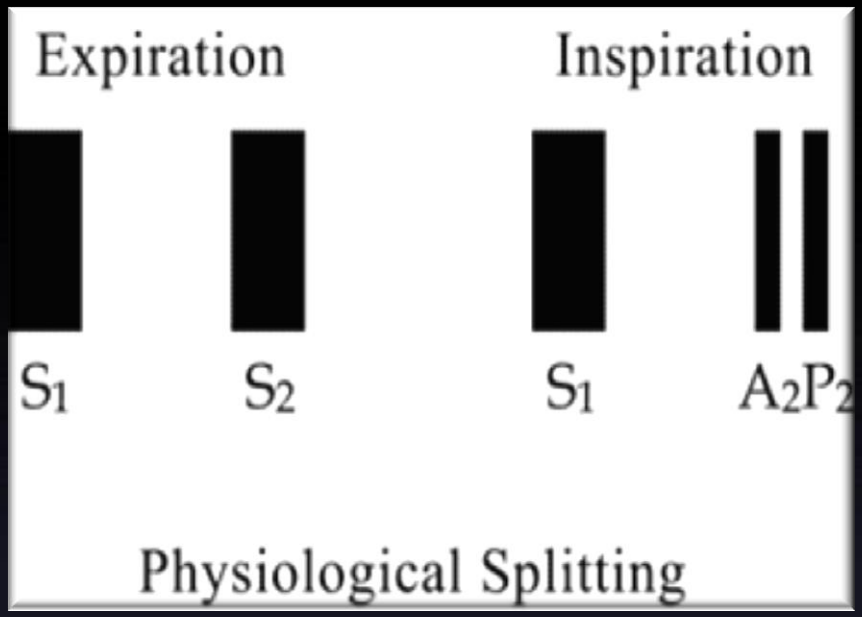
FIRST HEART SOUND (S1)

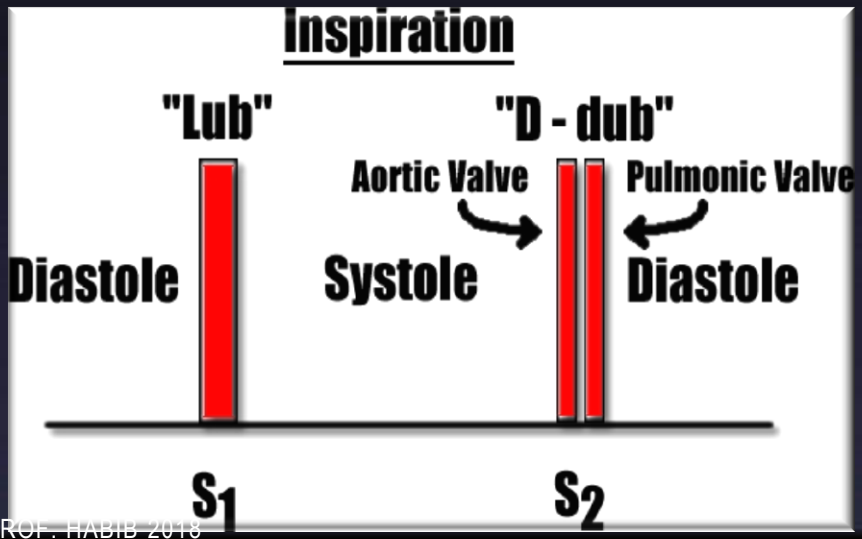
- It is produced due to the closure of Atrioventricular valves (Mitral & Tricuspid)
- It occurs at the beginning of the systole and sounds like LUB (beginning of the 'isometric contraction' phase)
- Frequency: 25-45 Hz
- Time: 0.15 sec
- Its is heavier when compared to the 2nd heart sound.

SECOND HEART SOUND (**S2**)

- **It is produced due to the closure of Semilunar valves (Aortic & Pulmonary)**
- **It occurs at the end of the systole and sounds like DUB (at the beginning of the 'isometric relaxation' phase of diastole)**
- **Frequency: 50 Hz**
- **Time: 0.12 sec**
- **It is short and sharp compared to the 1st hear sound**

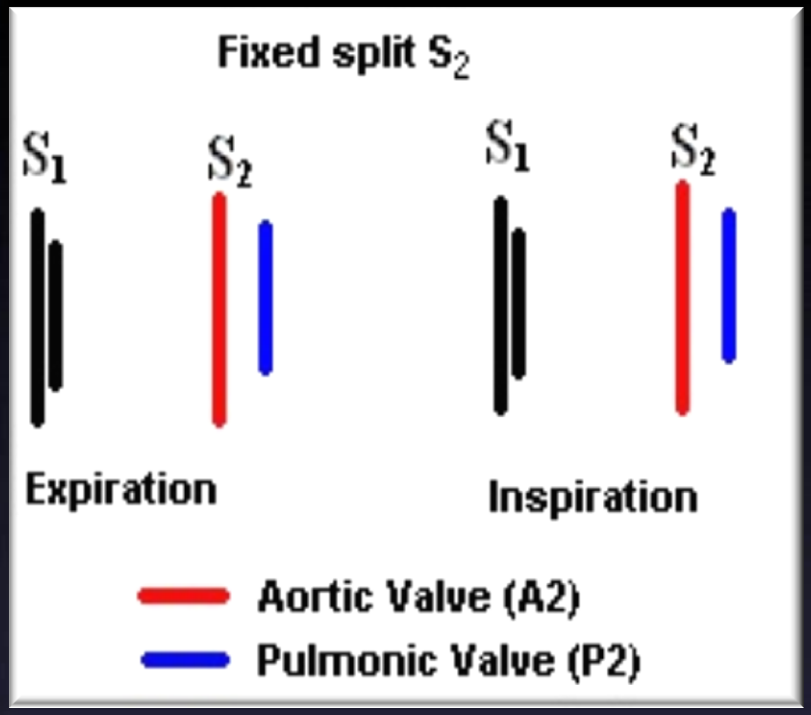
Physiological splitting of S_2





- During inspiration, the aortic valve closes before pulmonary valve → reduplication (physiologic splitting of S_2.
- The increased venous return to the right side of the heart delays closure of the pulmonary valve. The right ventricle has more blood than usual to eject and it thus takes more time.
- No splitting of the second heart sound is normally seen during expiration.

Fixed splitting of S_2



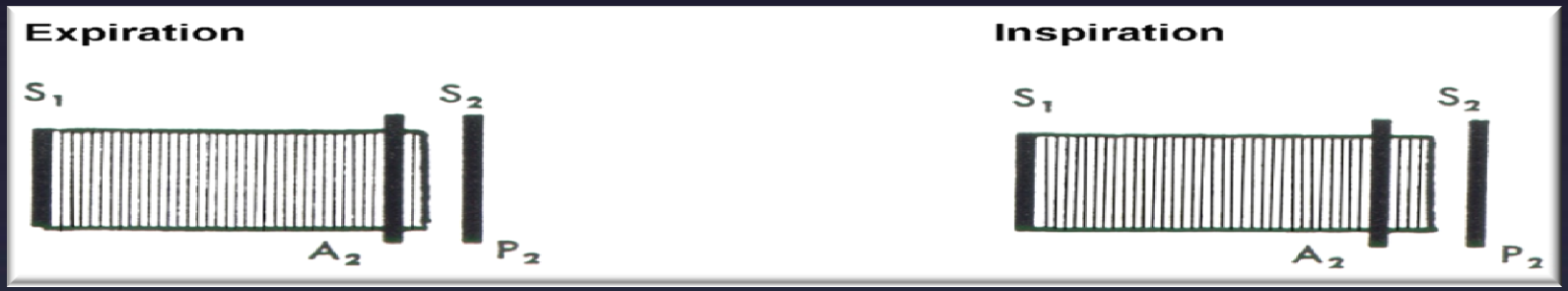
- Splitting of S_2 is heard both during inspiration and expiration, with the aortic valve closing before the pulmonary valve.
- This is heard in cases of ASD.

Wide splitting of S_2

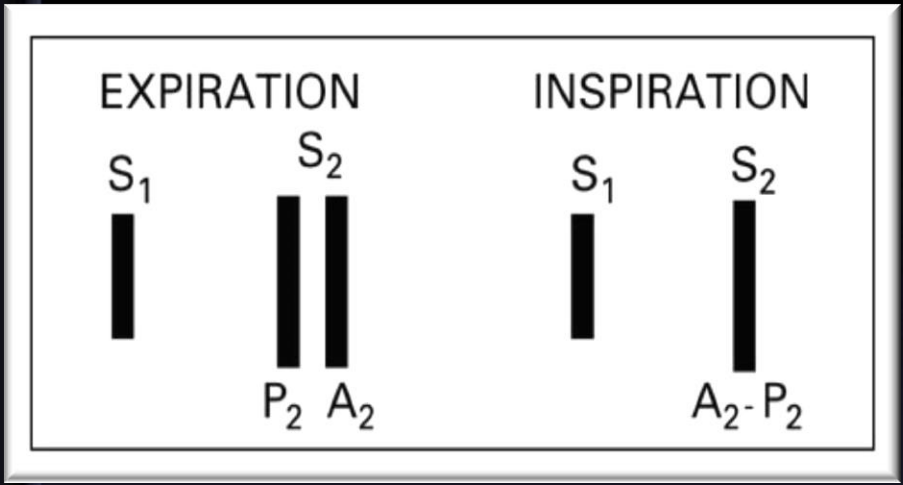
A split in the second heart sound during inspiration may become wider and the split may also be seen during expiration if:

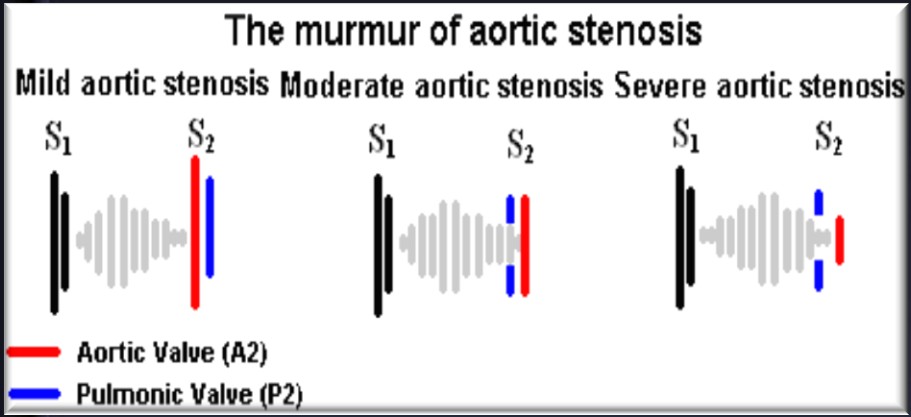
1. **There is a delay in the closing of the pulmonic valve (as would be seen in right bundle branch block due to delay in right ventricular depolarization and contraction).**

2. **The aortic valve closes earlier than normal (this is seen with either mitral regurgitation or ventricular septal defect).**



Paradoxical (reversed) splitting of S_2





- Reversed (*paradoxical*) splitting of the second heart sound is typically heard during expiration, with the pulmonary valve closing before the aortic valve. No splitting is apparent during inspiration, since the pulmonary valve is closing earlier (relative to the aortic valve) than normal.

- This may be caused by the following:
  - Delayed onset of left ventricular systole (example: *left bundle branch block*).
  - Prolonged left ventricular systole (examples: *aortic stenosis*, *severe hypertension*, *left-sided congestive heart failure*).
  - Early onset of right ventricular systole (example: *Wolff-Parkinson White syndrome*).

THIRD HEART SOUND (**S3**)

- **It occurs at the beginning of middle third of Diastole**
- **Cause of 3rd sound – Rush of blood from Atria to Ventricle during rapid filling phase of Cardiac Cycle. It causes vibration in the blood**
- **Frequency:20-30 Htz**
- **Time: 0.05 sec**
- **S3 may be heard in children and young slim adults but usually pathological in old age.**

FOURTH HEART SOUND (S4) OR ATRIAL SOUND

- It occurs at the last one third of Diastole

  (just before S1)
- Cause of Fourth heart sound – Due to Atrial systole which causes rapid flow of blood from Atria to Ventricle and vibration in the blood causing oscillations of the ventricles during atrial contraction.
- Frequency: < 20 Htz
- Time: 0.04 sec

Note:

- Third and Fourth heart sound are low pitched sounds therefore not audible normally with stethoscope
- S4 may be heard in elderly but is usually pathologic in the young.

CAUSE OF HEART SOUNDS

Valves closure:

- Atrio-ventricular = (S1)
- Semilunar = (S2)

Increased intra-cardiac hemodynamics (Murmurs)

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

HEART MURMURS

- Murmurs are abnormal sounds produced due to abnormal flow of blood (Turbulance) and/or valvular abnormalities.

OR

- Murmurs are pathologic and added heart sounds that are produced as a result of turbulent blood flow

TABLE 30–2 Heart murmurs.

Valve	Abnormality	Timing of Murmur
Aortic or pulmonary	Stenosis	Systolic
	Insufficiency	Diastolic
Mitral or tricuspid	Stenosis	Diastolic
	Insufficiency	Systolic

Causes of murmurs

- Physiological murmurs:
  - Associate with increased blood flow across normal valves: e.g.
    - Pregnancy
    - Hyperthyroidism
    - Anemia
    - Fever
    - Children
- Pathological murmurs:
  - Turbulent flow through abnormal valves, or septal defect.. ? Congenital: e.g.
  - The most common abnormalities of the valves are:
    - Stenosis (narrowing): the valve does not open properly.
    - Insufficiency (the valve fails to close completely, and hence causing backflow or leaks of the blood across the insufficient valve. Valvular insufficiency is also known as Regurgitation or Incompetency).
    - A combination of Stenosis and Insufficiency.

Describing heart murmurs

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

Gallop:

Three or four sounds are spaced to audibly resemble the pace of a horse, the extra sounds occurs after S2.

1. Timing

Murmurs are described according to their position in the cardiac cycle

Systolic murmurs: are further classified into:

- Early systolic murmurs.
- Mid systolic murmurs (ejection systolic murmurs; ESM).
- Late systolic murmurs.
- Pansystolic (holosystolic murmurs).

Diastolic: are further classified into:

- Early diastolic murmurs.
- Mid diastolic murmurs.
- Late diastolic murmurs

- **Continuous: Both**

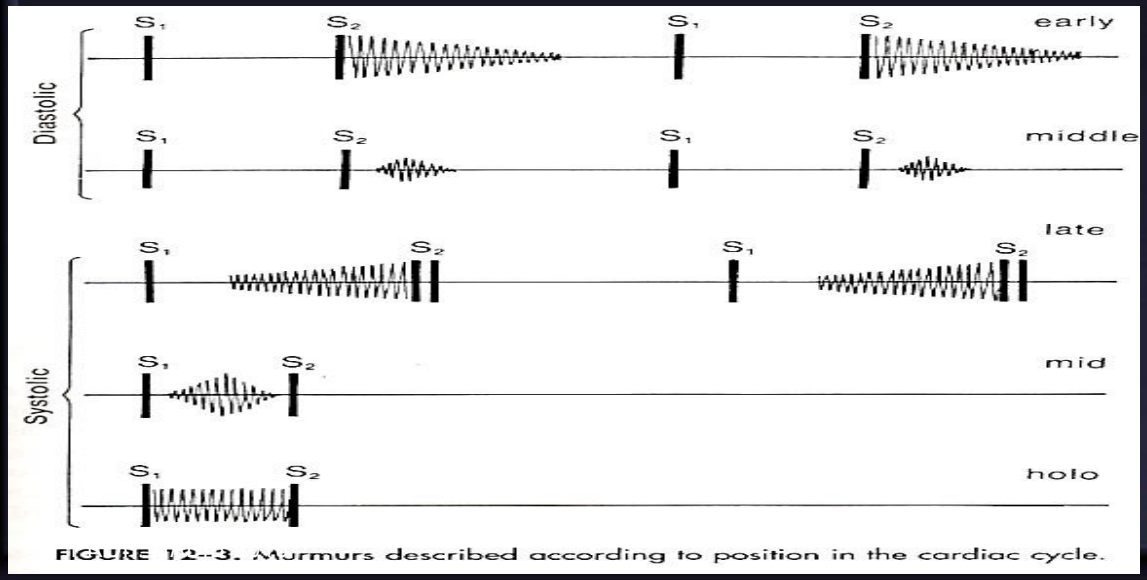
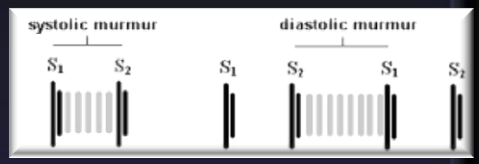
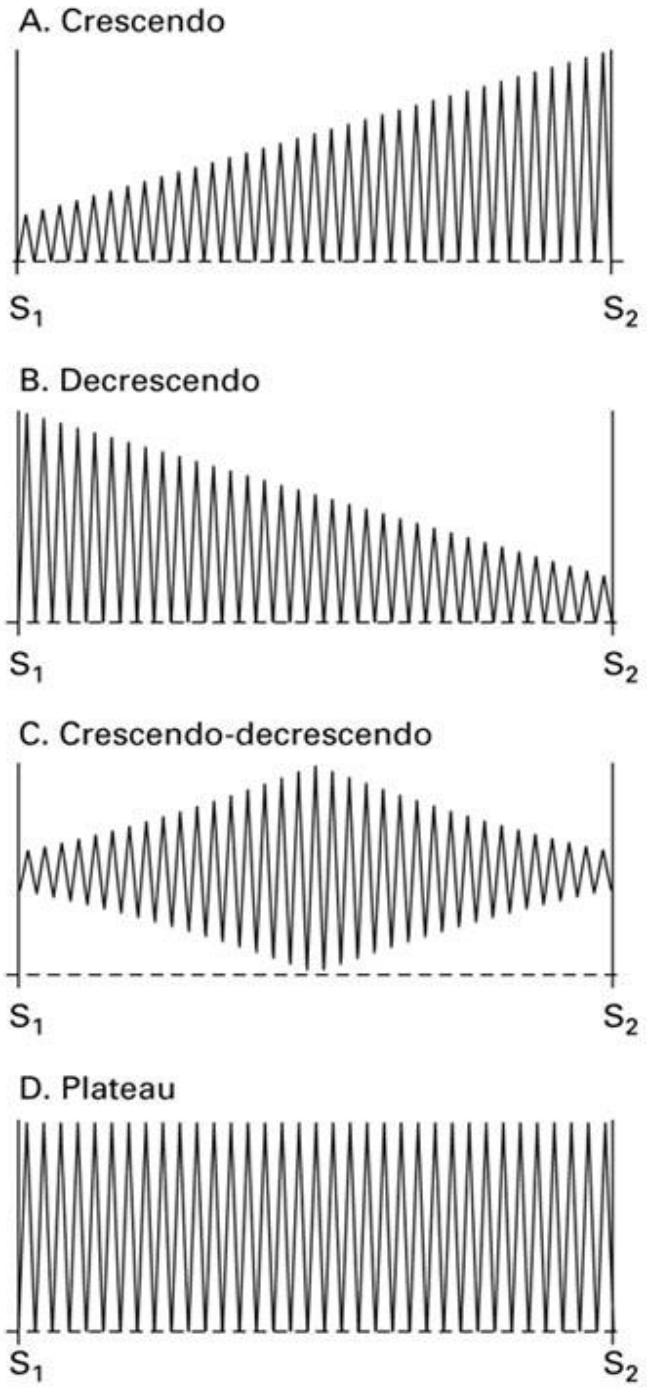


FIGURE 12--3. Murmurs described according to position in the cardiac cycle.



2. Shape

- **Crescendo (**increasing intensity**).**
- **Decrescendo** (decreasing intensity**).**
- **Crescendo-decrescendo (Diamond-shaped);** (increasing then immediate decreasing intensity**).**
- **Plateau (uniform); the intensity of the murmur remains uniform throughout.**



3. Location

of maximum intensity of heart murmurs

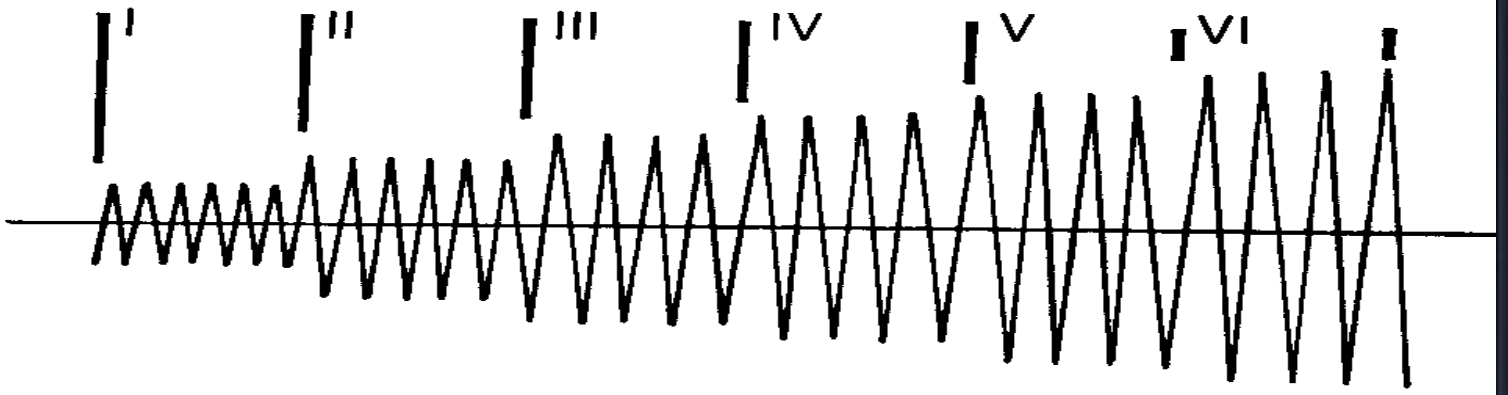
Determined by the site where the murmur originates e.g. A, P, T, M listening areas

4. Radiation

Reflects intensity of the murmur & direction of blood flow

5. Intensity

GRADED ON A (6) POINT ACCORDING TO LEVINE SCALE:

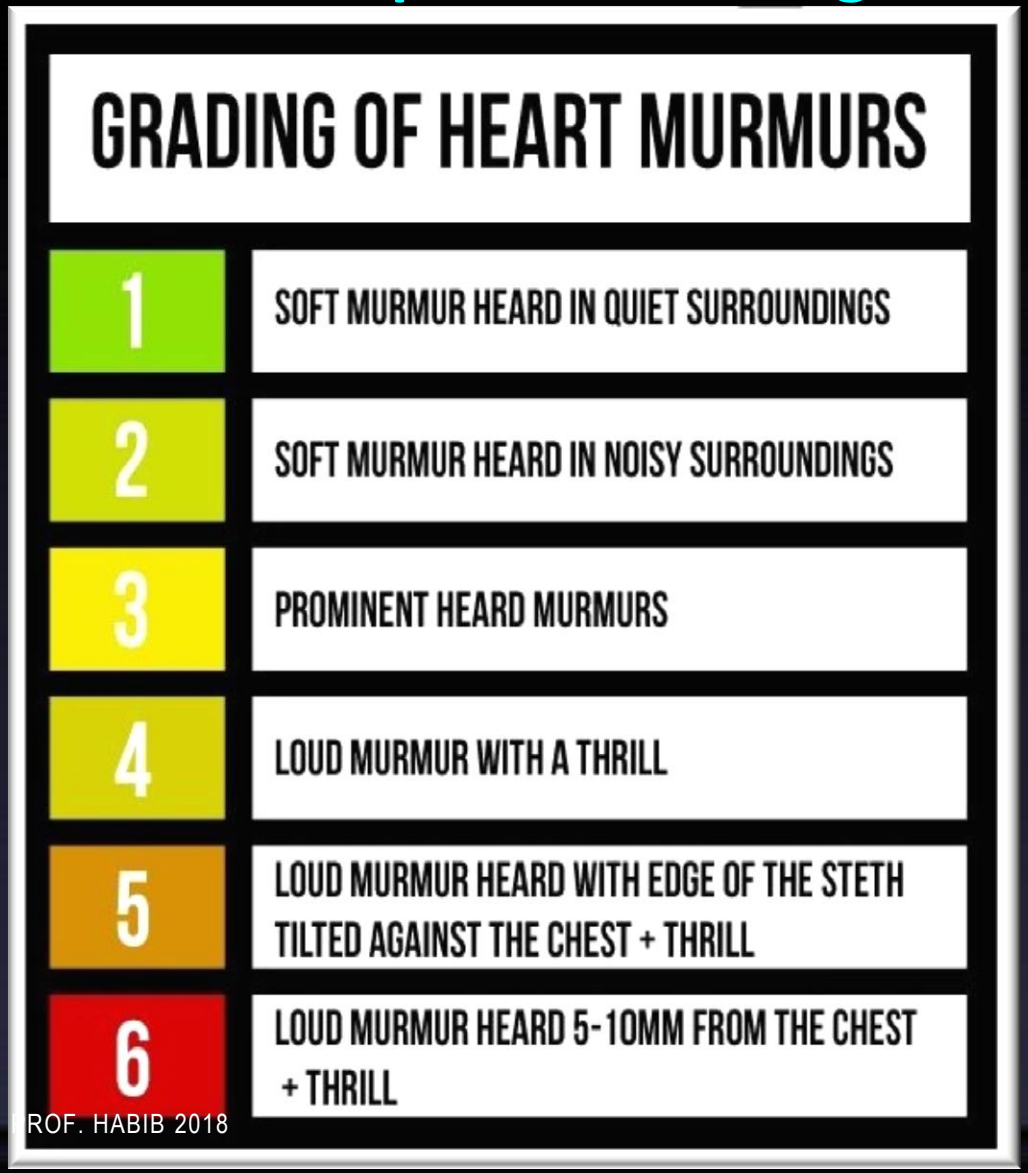


Classification of murmurs by loudness

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
• Lowest intensity • Very faint	• Low intensity • Quiet but heard immediately	• Medium intensity • Moderately loud	• Medium intensity • Loud • Thrills	• Loud intensity • Heard with stethoscope partly off the chest • Thrills	• Loudest intensity • No stethoscope needed • Thrills

5. Intensity (grades) of heart murmurs

Graded on a 6 point according to Levine scale:



A thrill is a slight palpable vibration felt by the hand over the chest wall

6. Pitch (frequency) of heart murmurs

High, medium, low

7. Quality of heart murmurs

Blowing, harsh, rumbling, musical

8. Others

- Variation with respiration
  - Murmurs increasing with expiration originate with left side (aortic or mitral) valves, while murmurs increasing in intensity with inspiration originate with tricuspid or pulmonary valves.
- Variation with position of patient
- Variation with special maneuvers
  - Valsalva maneuver decreases the intensity and duraion of most murmurs.

SYSTOLIC MURMURS

1. Aortic stenosis – ejection murmur.
2. Pulmonary stenosis – ejection murmur +S2 Split.
3. Mitral / Tricuspid regurgitation – holosystolic.
4. Mitral valve prolapse – mid-late systole.
5. Ventricular septal defect (VSD) – holosystolic.

DIASTOLIC MURMURS

ALMOST ALWAYS INDICATE HEART DISEASE.

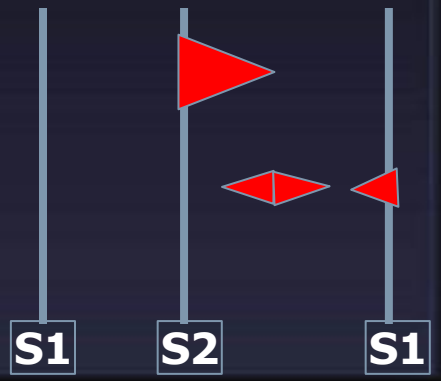
Two basic types:

Early decrescendo diastolic murmurs:
Signify regurgitant flow through an incompetent semilunar valve,e.g. aortic/pulmonary regurgitation.

Rumbling diastolic murmurs in mid- or late diastole:
Suggest stenosis of an AV valve, e.g. mitral/tricuspid stenosis.

SOFT, BLOWING, GURGLE

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



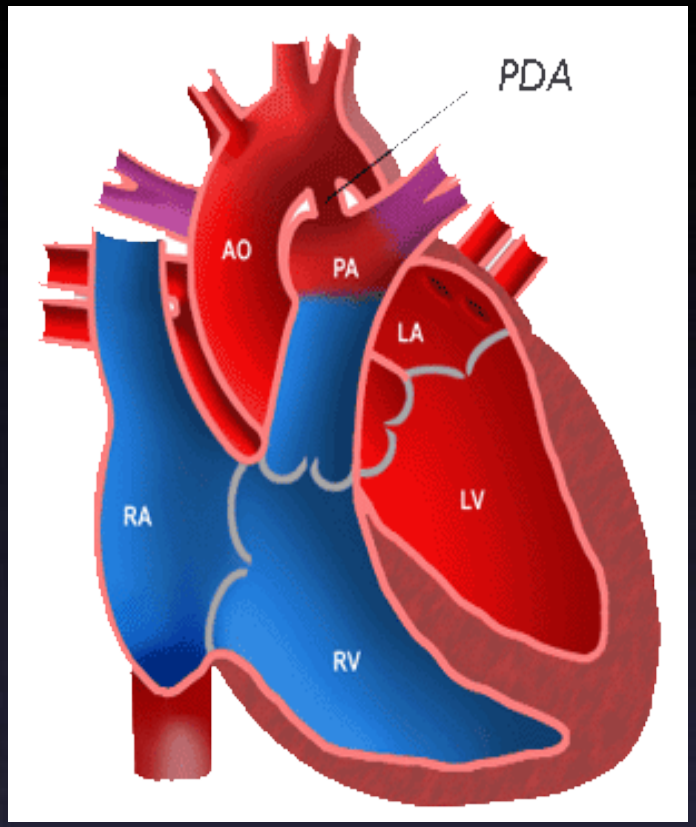
Continuous murmurs

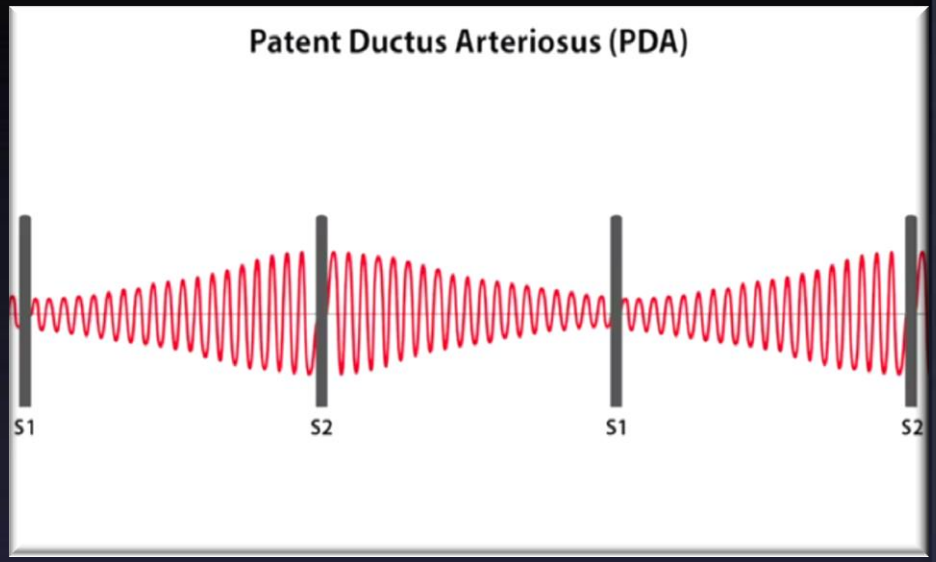
Patent ductus arteriosus; PDA

- Failure of closure of the ductus arteriosus between pulmonary artery & aorta results in a continuous murmur.

- Best heard at upper left sternal border.
- Machine-like.
- May be associated with left to right shunt, cyanosis.

Continuous murmurs of PDA





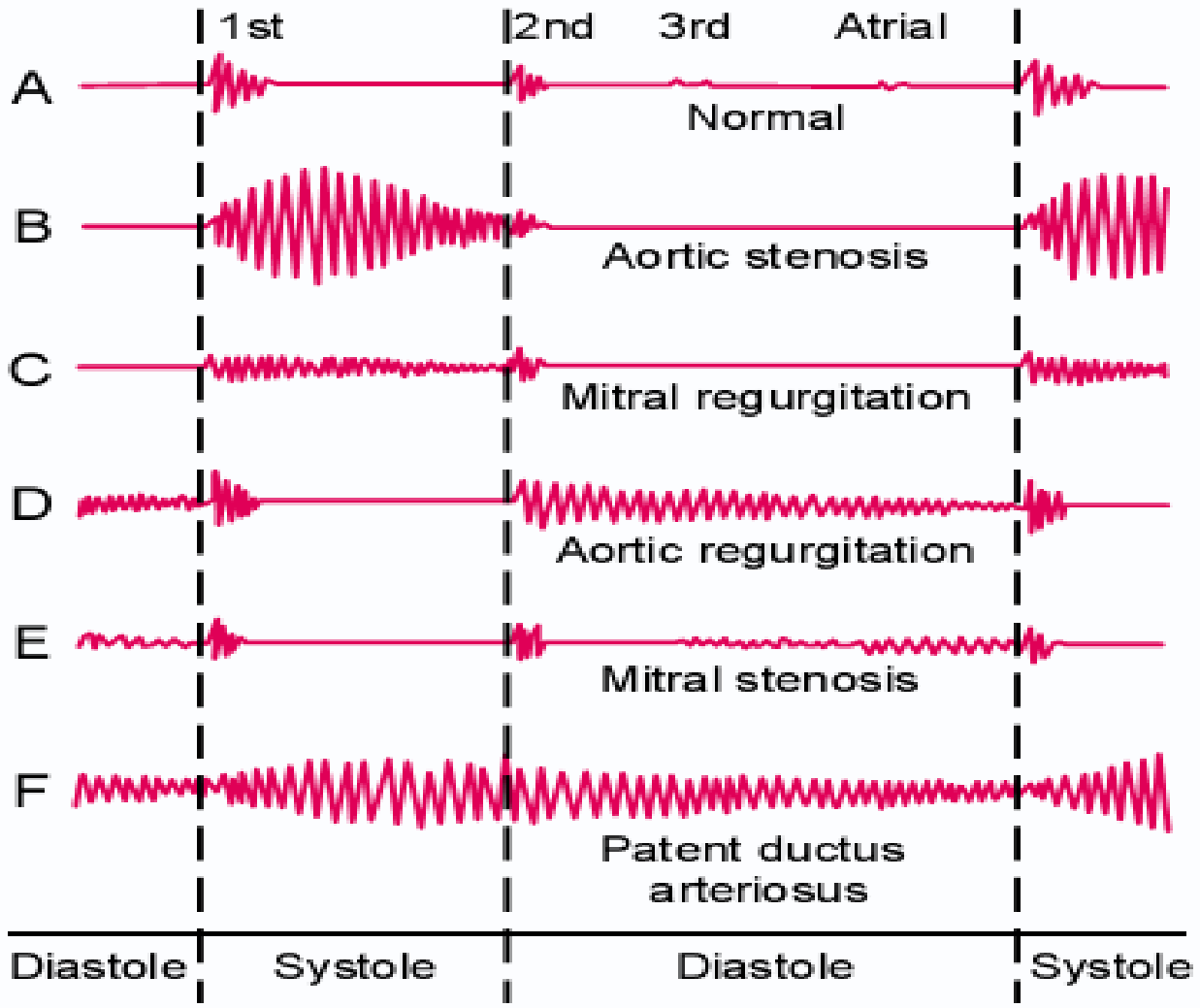


Figure 23–3

Phonocardiograms from normal and abnormal hearts.


THANKS