

CARDIOVASCULAR SYSTEM

HEART SOUNDS

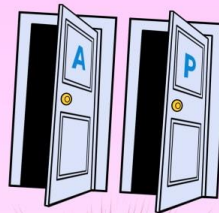
HEART SOUNDS

OCCUR DUE TO VIBRATIONS PRODUCED BY VALVULAR ACTIONS AND BLOOD FLOW WITHIN THE HEART

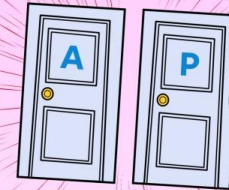
S4.

ATRIAL CONTRACTION AND DECREASED VENTRICULAR COMPLIANCE DURING LATE DIASTOLE

S1!



SYSTOLE



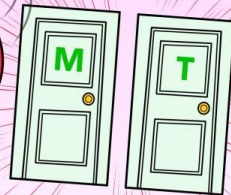
DUB!

S2!



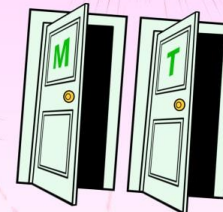
S3.

RAPID VENTRICULAR FILLING DURING EARLY DIASTOLE



LUB!

MITRAL AND TRICUSPID VALVE CLOSURE



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Heart Sounds.mov

PROF. HABIB 2020

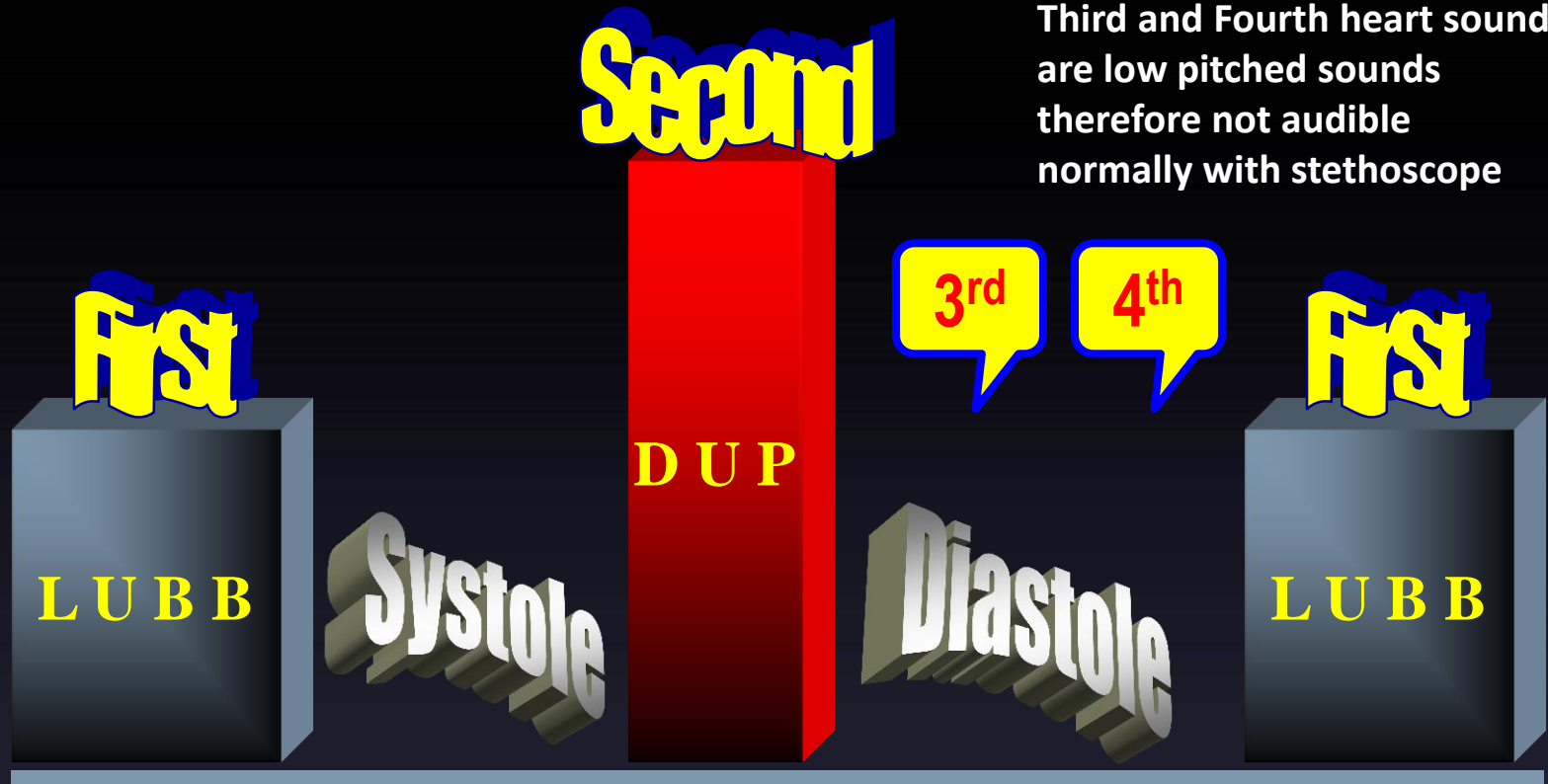
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OBJECTIVES

❖ **At the end of the lecture you should be able to**

- 1. Enumerate the normal heart sounds & list their causes**
- 2. Describe the causes and characteristic features of the four heart sounds**
- 3. Correlate the heart sounds with different phases of cardiac cycle**
- 4. Describe & classify murmurs with examples**

HEART SOUNDS



Third and Fourth heart sound are low pitched sounds therefore not audible normally with stethoscope

Detected by

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

The heart sound you hear when you first feel the pulse is S1, and when the pulse disappears is S2

BEST HEARD AT 4 AREAS:

■ Pulmonary area:

- 2nd Lt intercostal space

■ Aortic area:

- 2nd Rt costal cartilage

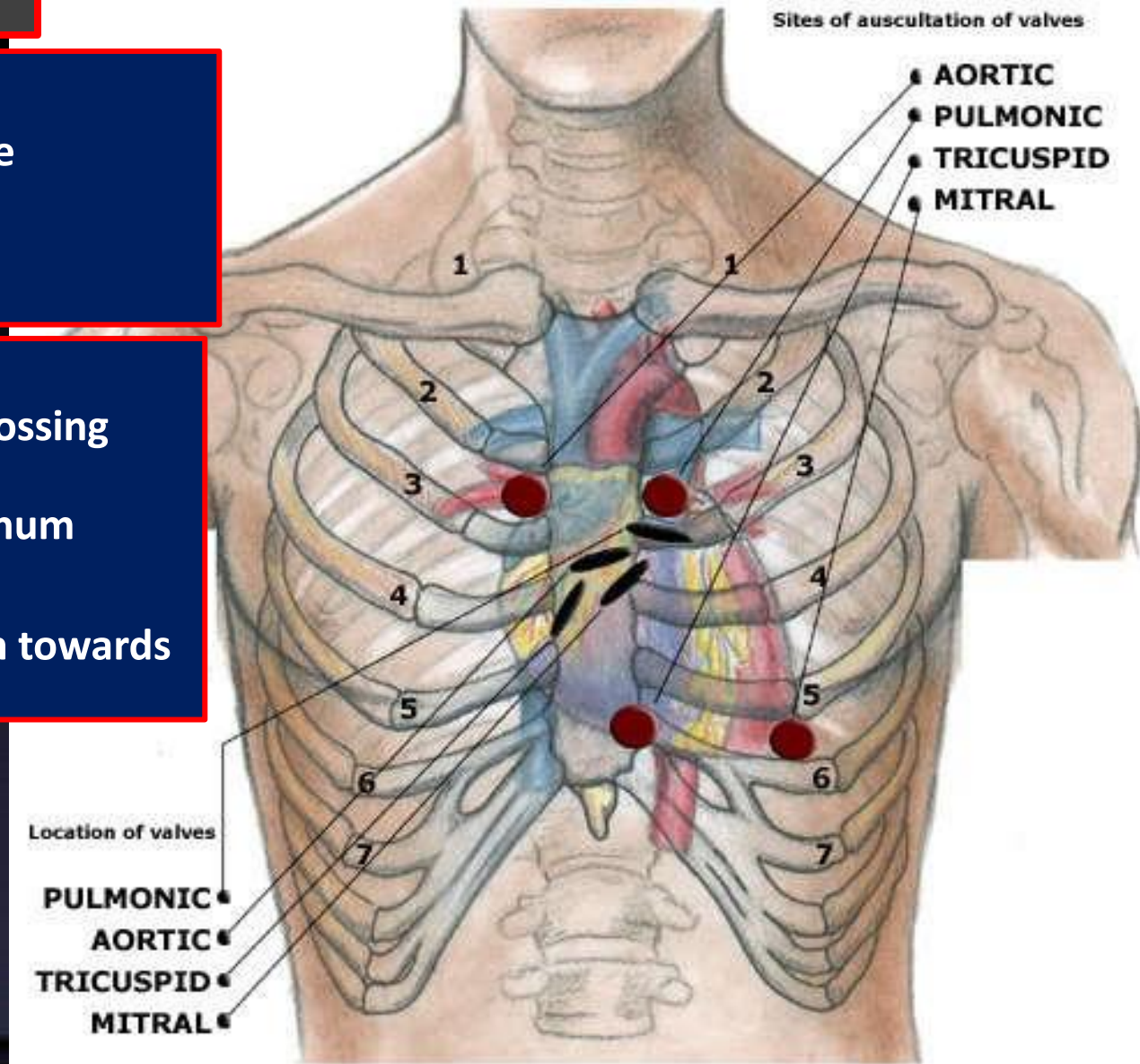
■ Mitral area:

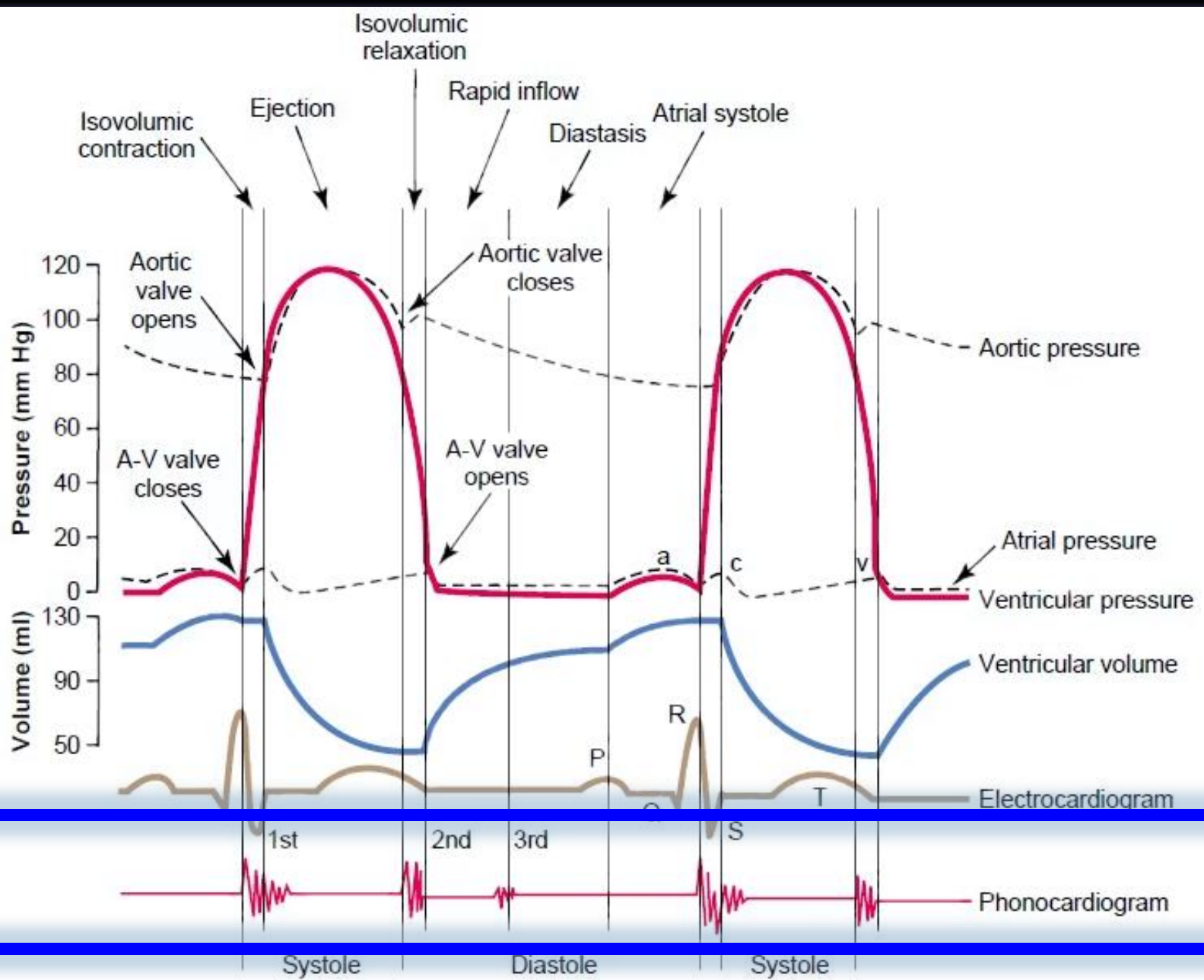
- 5th Lt intercostal space crossing mid- clavicular line, or
- 9cm (2.5-3 in) from sternum

■ Tricuspid area:

- lower part of sternum towards Lt side

AREAS OF AUSCULTATION





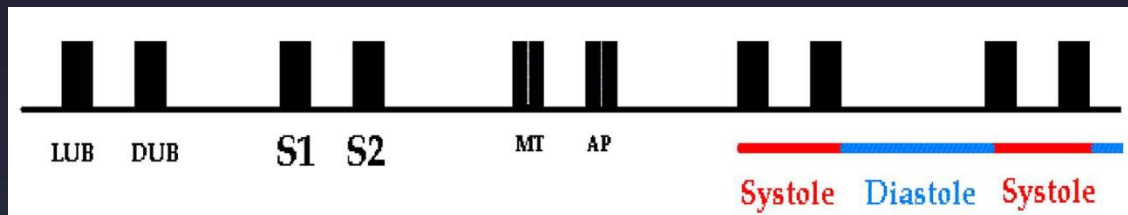
The Events of the Cardiac Cycle

HEART SOUNDS

- There are four heart sounds S1, 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.

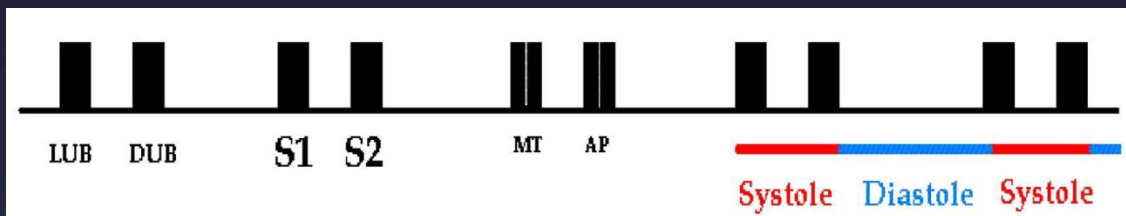
FIRST HEART SOUND (S1)

- It is produced due to the closure of Atrioventricular valves It occurs at the beginning of the systole and ('isometric contraction' phase)
- Sounds like LUB (low pitch) heavier when compared to the 2nd heart sound
- Frequency: 25-35 Hz
- Time: 0.15 sec
- Best heard at Mitral & Tricuspid areas

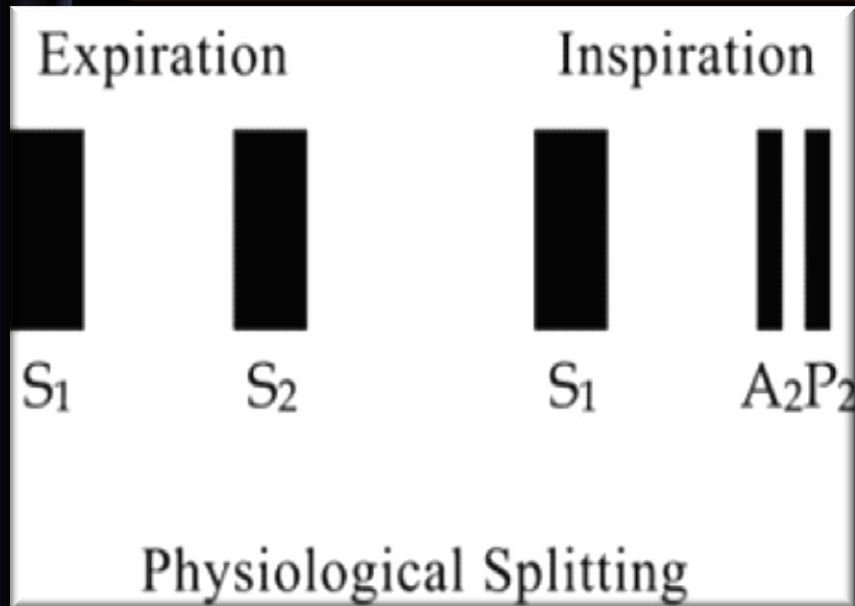


SECOND HEART SOUND (S2)

- It is produced due to the closure of Semilunar valves It occurs at the end of the systole and sounds like DUB ('isometric relaxation' phase of diastole)
- Frequency: 50 Hz
- It is shorter (duration=0.12 sec), louder and sharp compared to the 1st hear sound
- Best heard at Aortic & Pulmonary areas



Physiological splitting of S_2

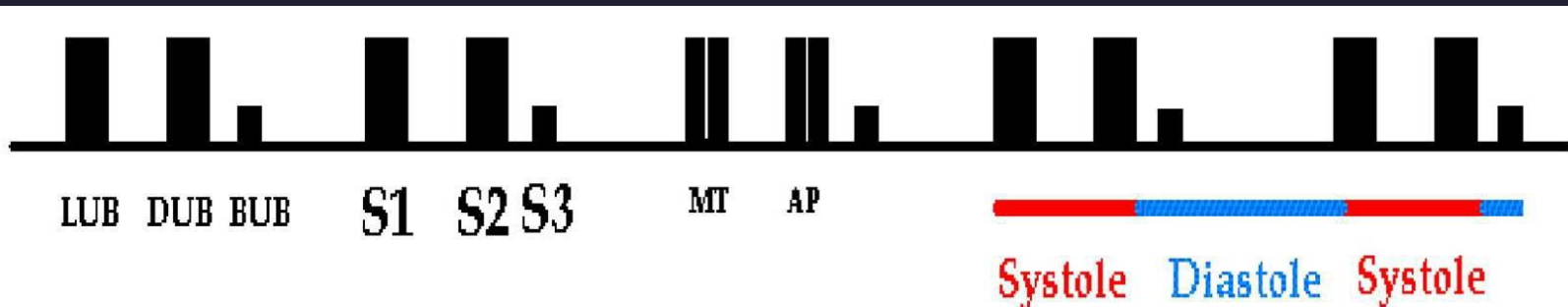


- During inspiration, the aortic valve closes before pulmonary valve → reduplication (physiologic splitting of S_2).
- The increased venous return to the right side of the heart delays closure of the pulmonary valve. The right ventricle has more blood than usual to eject and it thus takes more time.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

- Fixed splitting of S_2 is heard in cases of ASD
- Wide splitting of S_2 occurs in right bundle branch block
- Paradoxical (reversed) splitting of S_2 in left bundle branch block

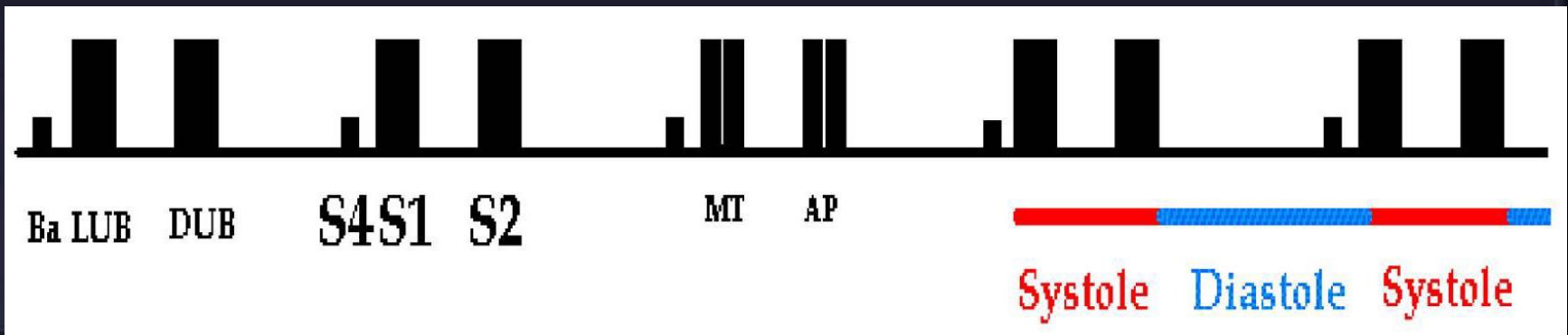
THIRD HEART SOUND (S3)

- It occurs at the beginning of middle third of Diastole (during rapid filling phase)
- 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.
- Best heard at mitral area



FOURTH HEART SOUND (S4) OR ATRIAL SOUND

- It occurs at the last one third of Diastole (Atrial systole)
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 (low pitch)
- Time: 0.04 sec
- S4 may be heard in elderly but is usually pathologic in the young.



CAUSES & SIGNIFICANCE OF HEART SOUNDS

Valves closure:

- ❑ Atrio-ventricular = (S1)
- ❑ Semilunar = (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.

**Produce
Murmurs**

HEART MURMURS

- Murmurs are abnormal sounds produced due to abnormal flow of blood (Turbulence) 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:

Associated 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**

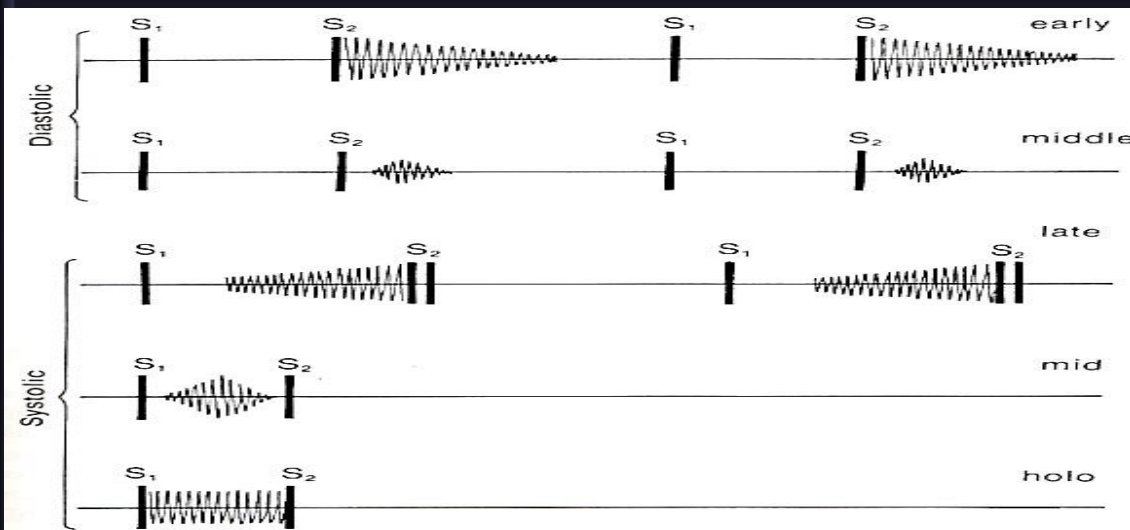
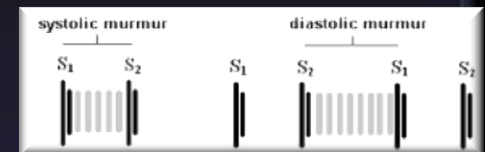


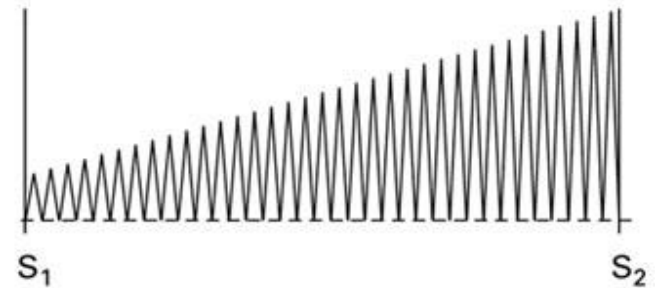
FIGURE 12-3. Murmurs described according to position in the cardiac cycle.



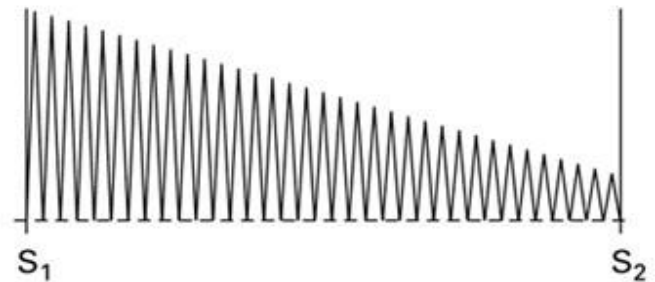
2. Shape

- ❑ **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.

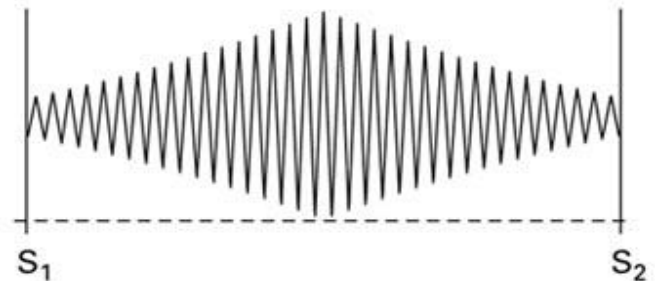
A. Crescendo



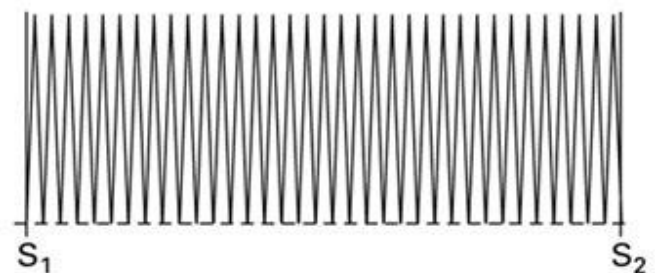
B. Decrescendo



C. Crescendo-decrescendo



D. Plateau



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 (grades) of heart murmurs

Graded on a 6 point according to Levine scale:

GRADING OF HEART MURMURS	
1	SOFT MURMUR HEARD IN QUIET SURROUNDINGS
2	SOFT MURMUR HEARD IN NOISY SURROUNDINGS
3	PROMINENT HEARD MURMURS
4	LOUD MURMUR WITH A THRILL
5	LOUD MURMUR HEARD WITH EDGE OF THE STETH TILTED AGAINST THE CHEST + THRILL
6	LOUD MURMUR HEARD 5-10MM FROM THE CHEST + THRILL

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 (resonant) , musical

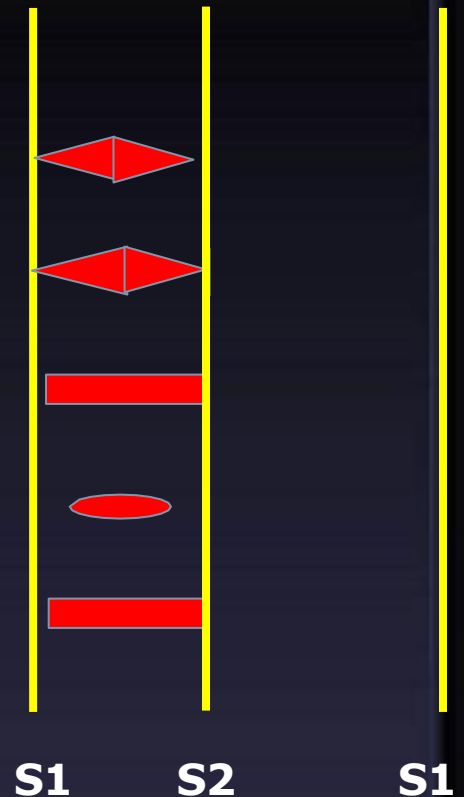
8. Others

- 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 duration of most murmurs.

SYSTOLIC MURMURS

- Early Systolic
- Mid Systolic
- Late Systolic
- Pansystolic (Holosystolic)

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.



Ejection (Mid-Systolic) Murmurs

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 (Holo-Systolic) Murmurs

Pathological murmur.

- Begins immediately with S1 & continues up to S2 .**
- Heard with:**
 - Mitral/tricuspid regurgitation.**
 - Ventricular septal defect (VSD).**

DIASTOLIC MURMURS

- Early Systolic
- Mid Systolic
- Late Systolic

ALMOST ALWAYS INDICATE HEART DISEASE

Two basic types:

Early decrescendo diastolic murmurs:

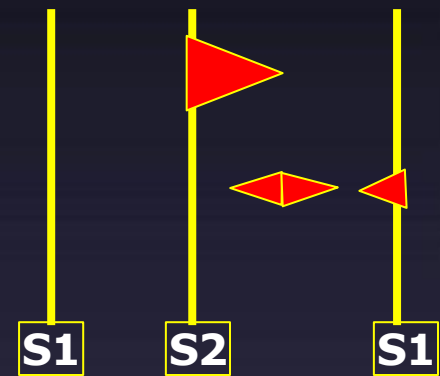
Signify regurgitant flow through an incompetent semilunar valve, e.g. aortic/pulmonary regurgitation.

Rumbling diastolic murmurs in mid- or late diastole:

Suggest stenosis of an AV valve, e.g. mitral/tricuspid stenosis.

SOFT, BLOWING, GURGLE

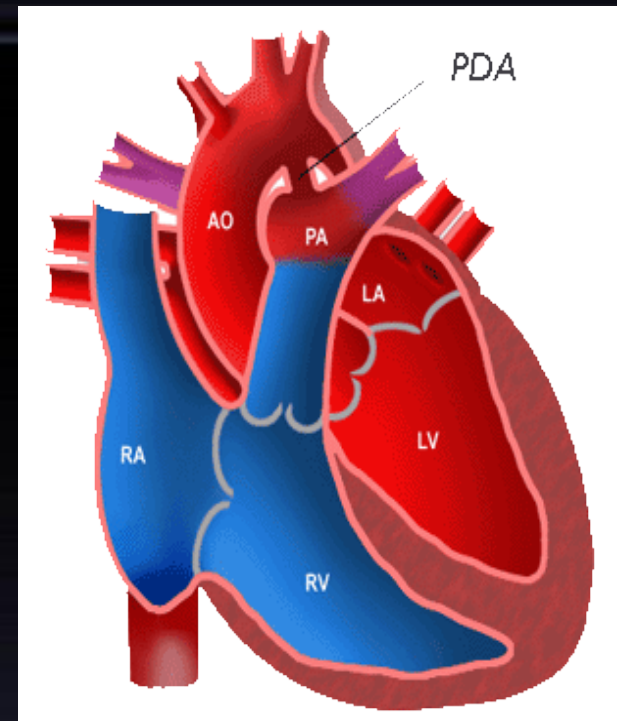
1. Aortic regurgitation - early diastole
2. Mitral stenosis - mid to late (pre-systolic) diastole



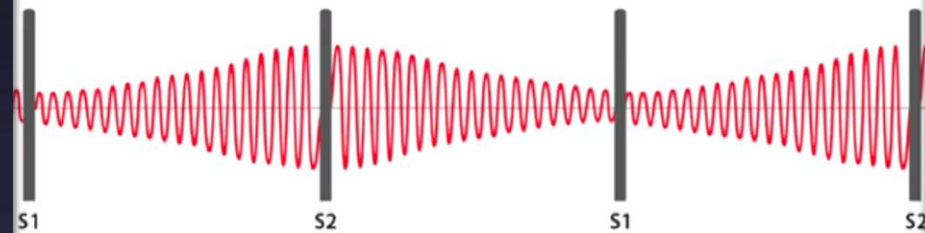
Continuous murmurs

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.

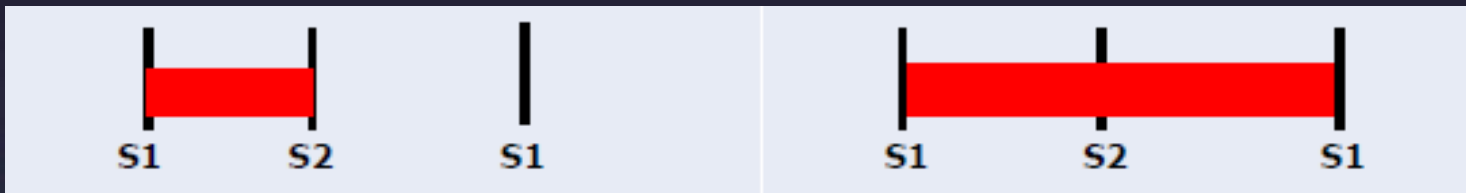


Patent Ductus Arteriosus (PDA)



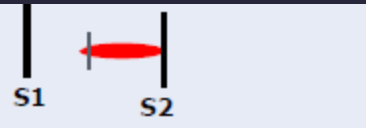
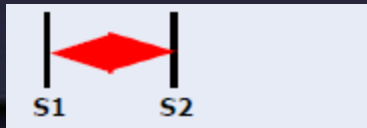
MURMURS OF VSD & PDA

	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.



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

	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 of stethoscope
Association	Aortic root degeneration, rheumatic heart disease, VSD with aortic valve prolapse (kids)	Rheumatic fever.



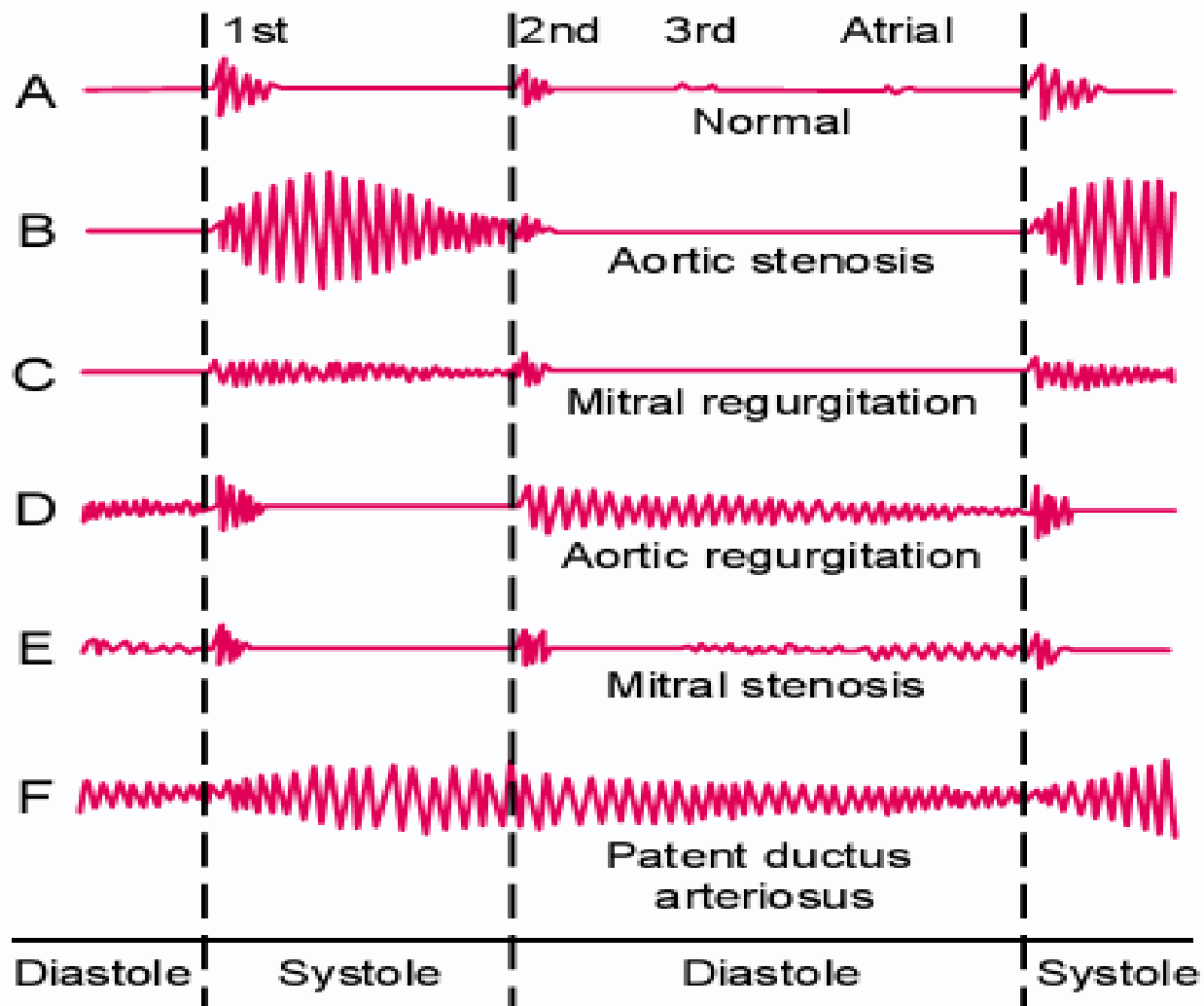
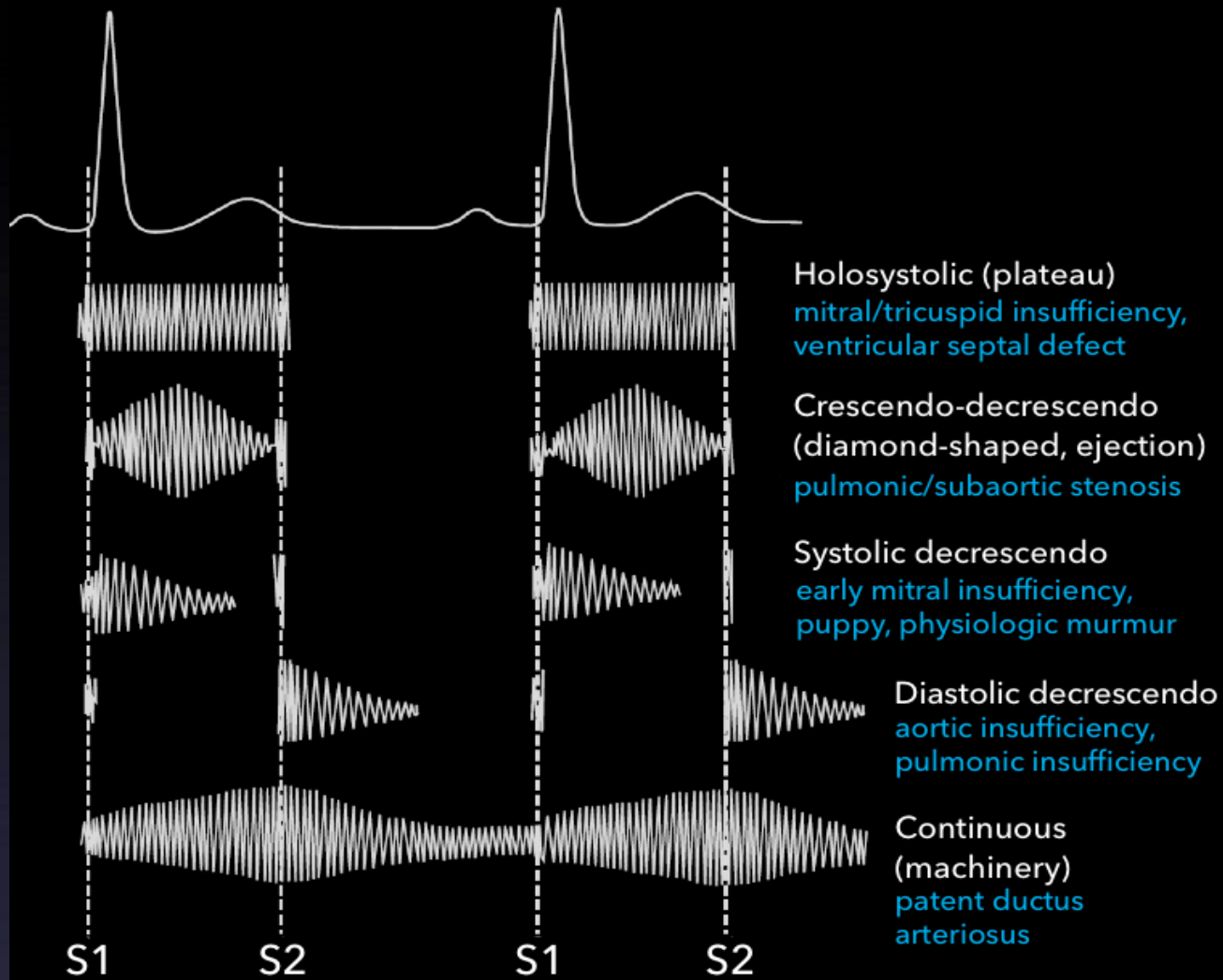


Figure 23-3

Phonocardiograms from normal and abnormal hearts.

HEART MURMURS



Depiction of the (phonocardiographic) configuration and timing of various cardiac murmurs