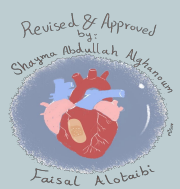
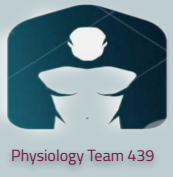
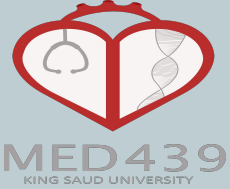
Heart sounds and murmurs







Black: in male / female slides

Red : important

Pink: in female slides only

Blue: in male slides only

Green: notes

Gray: extra information

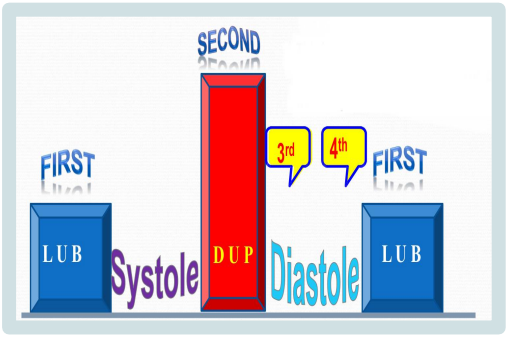
Editing File

Objectives

- Normal heart sounds, causes & characteristic features
- Causes of abnormal heart sounds
- Describe heart murmurs
- Different examples of heart murmurs

Heart sound

- 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 (pitch) sounds.
- Ventricular systole is between First and Second heart sound.
  Ventricular diastole is between Second and First heart sounds.
- The heart sound you hear when you first feel the pulse is S1, and when the pulse disappears is S2
  Third and Fourth heart sound are low pitched sounds, therefore not audible normally with stethoscope
  Heart sound detected by :
  1/Auscultation (Stethoscope)
  2/Phonocardiography (sound recording device)

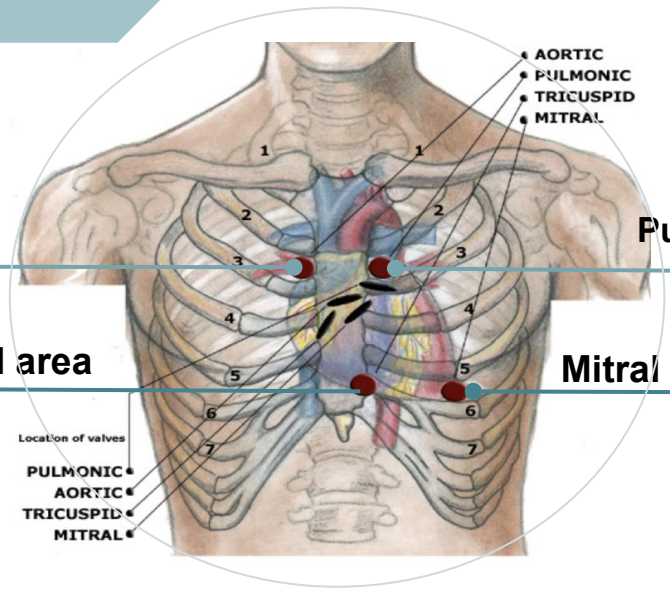


The bell portion of the stethoscope is used to hear low-pitched sounds , while the diaphragm used to hear high-pitched sounds ,like the first and second heart sound

Why is the heart sound not heard within the valves location? because the sound is transmitted within the direction of the blood flow.

Areas Of Auscultation

what are the 4 cardiac landmarks for auscultations ?



Aortic area

Location :2nd Rt costal cartilage

Sound : S2 dub

Pulmonary area

Location : 2nd left intercostal space

Sound : S2 dub

Tricuspid area

Location : lower part of sternum towards Rt side (4th intercostal space)

Sound : S1 lub

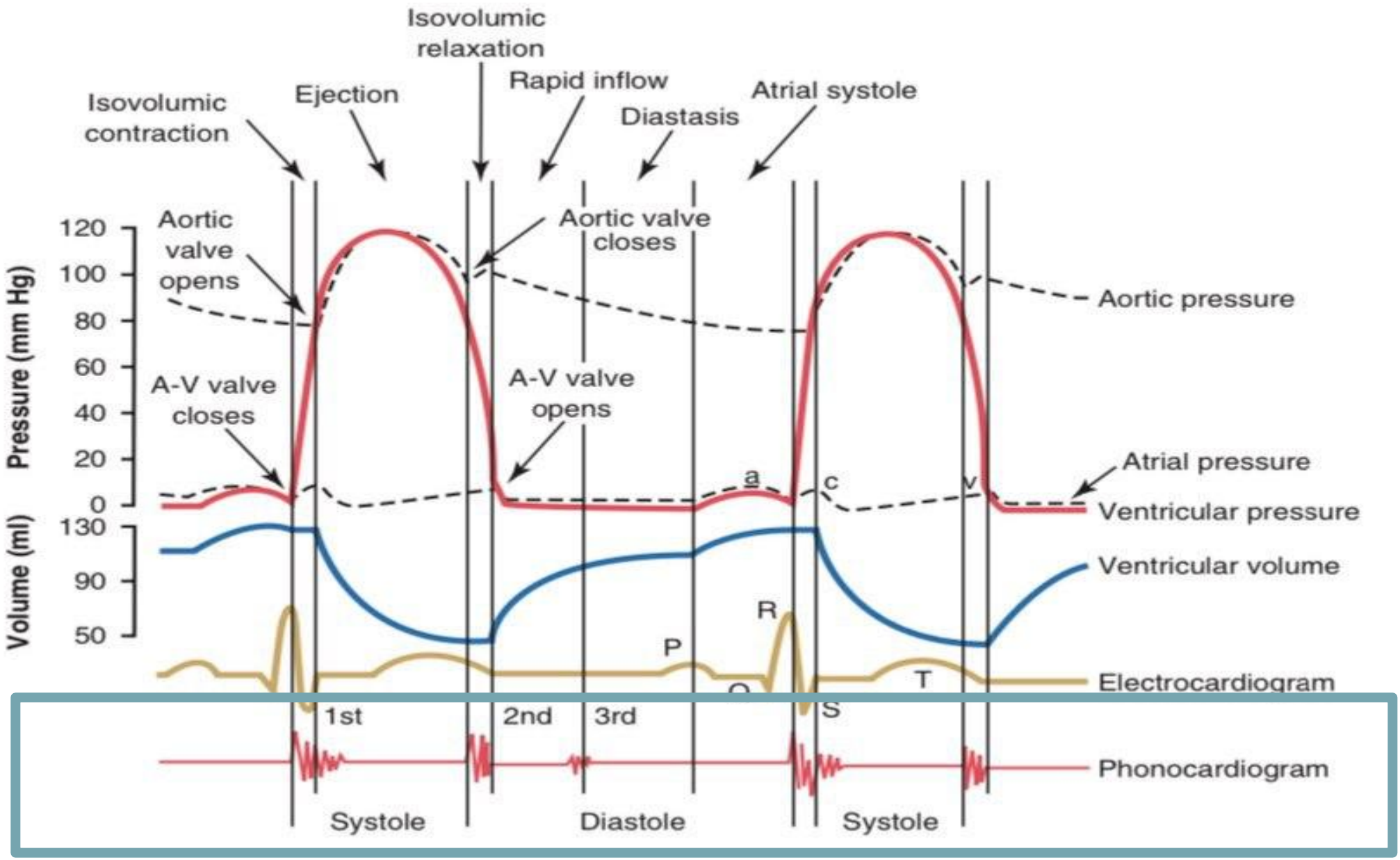
Mitral (bicuspid) area

Sound : S1 lub

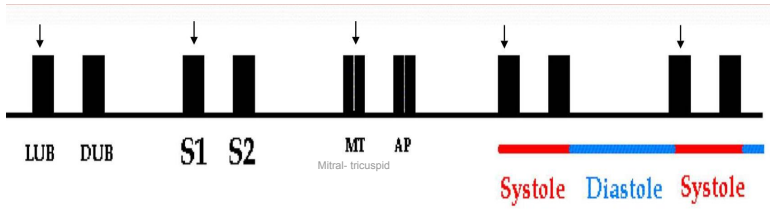
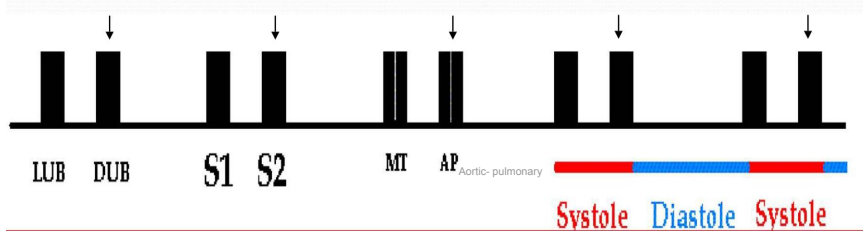
Location : 5th Lt intercostal space crossing mid-clavicular line, or 9 cm (2.5-3 inches) from sternum

Heart sound
During the Cardiac Cycle

Helpful video,click here



1st and 2 Heart Sound

list five differences between the 1st and 2nd heart sounds	1st Heart Sound =S1	2nd Heart Sound =S2 S-S-S-S(**s**econd- **s**hort duration -**s**emilunar closure- **s**harp)
Cause	-Produced due to closure of the A-V valves -Recorded at the beginning of the 'isovolumetric contraction phase	-Produced due to closure of semilunar valves -Recorded at the beginning of the 'isovolumetric relaxation phase'.
Mark	It marks beginning of ventricular systole	Marks the beginning of ventricular **d**iastole
pitch	Sounds like LUB (low pitch). Loud, heavier when compared to the 2nd heart sound	high pitch sounds like (**D**UB)
Areas Of Auscultation	Best heard at **Mitral & Tricuspid** areas Why ? Because of closure of AV valves (mitral & tricuspid)	Best heard at **Aortic & Pulmonary** areas Why? Because of closure of semilunar valves (Aortic & pulmonary)
Frequency	25-35 Hz	50 Hz
Duration	0.15 sec	It is shorter duration=0.12 sec
Sound	LUB	-DUB -the sound of S2 is Soft, louder and sharp compared to the 1st heart sound
	Helpful video,click here 	Helpful video,click here 

Physiological Splitting of the 2nd Heart Sound

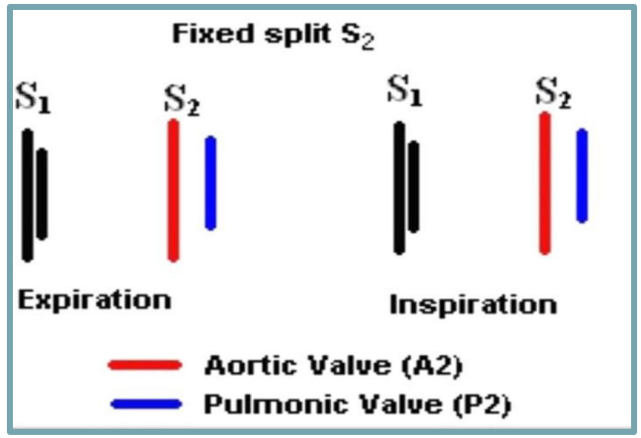
- During **inspiration**, the **aortic valve closes before** pulmonary valve → reduplication (splitting of S2). No splitting of the second heart sound is normally seen during expiration.
- The increased venous return to the right side of the heart delays closure of the pulmonary valve. The right ventricle has more blood than usual to eject and it thus takes more time.

What happens in normal splitting? aortic valve closes before pulmonary valve
Why does it happen? Due to an increase in venous return, so the right ventricle have more blood than usual to eject, therefore it will take more time.
When can it happen? During Inspiration

Pathological 1-Fixed Splitting of S2

the details are only in female slides

- Splitting of S2 is heard both during **inspiration and expiration**, with the **aortic valve closing before** the pulmonary valve.
- This is heard in cases of **Atrial Septal Defect.**



Pathological 2-Wide Splitting of S2

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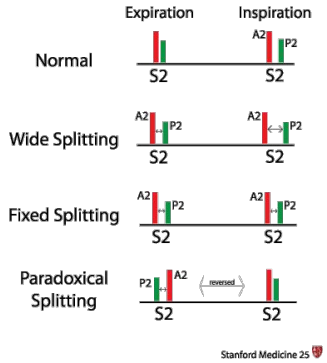


- A split in the second heart sound during inspiration may become wider and the split may also be seen during expiration due to :

- 1. 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 & contraction).

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

3-Paradoxical (Reversed)splitting of S2

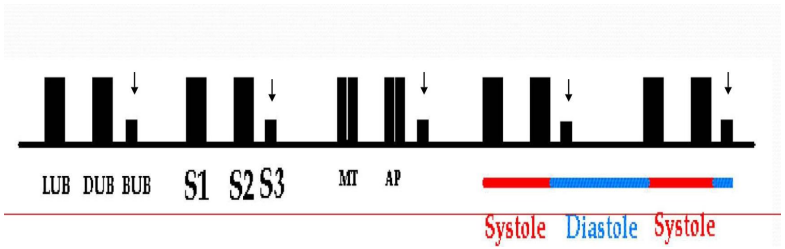
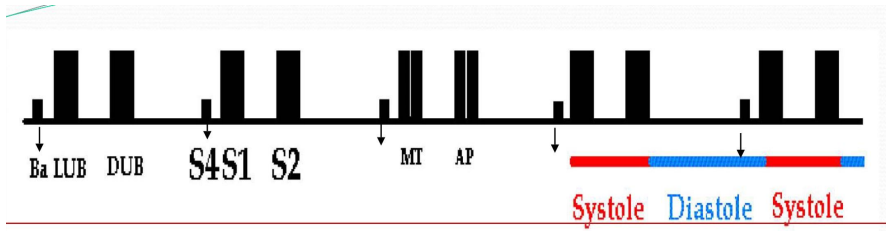
the details are only in female slides

- Reversed (paradoxical) splitting of the S2 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.

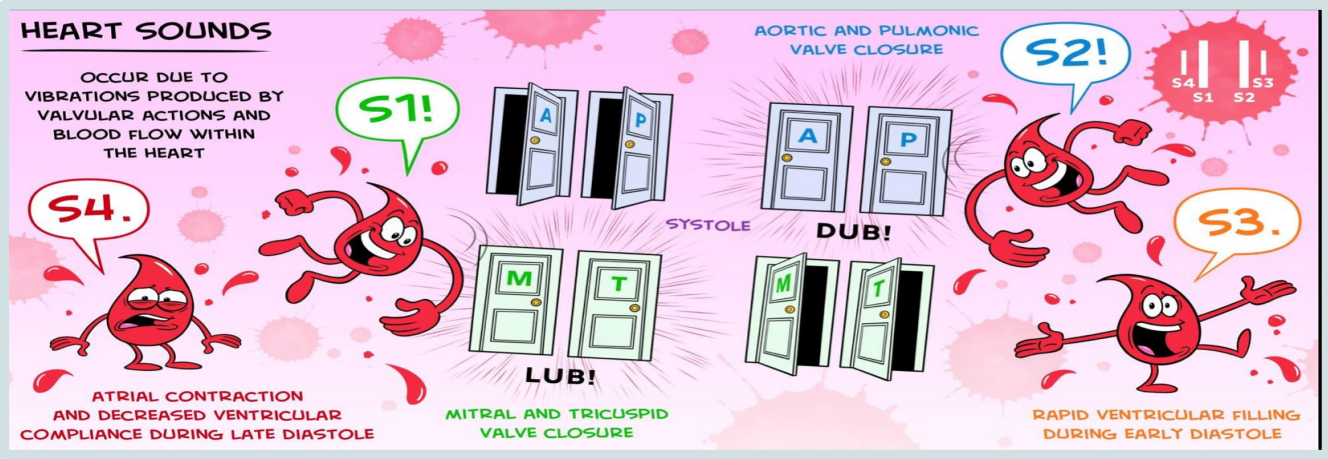
- This may be caused by the following:
  1/ Delayed onset of left ventricular systole (example: left bundle branch block).
  2/ Prolonged left ventricular systole (examples: aortic stenosis, severe hypertension, left-sided congestive heart failure).
  3/ Early onset of right ventricular systole(example: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

3st and 4 Heart Sound

	3rd Heart Sound =S3	4th Heart Sound =S4
Cause	-recorded during the 'rapid filling phase' at the beginning of middle third of diastole due t**o rush of blood from the atria into the ventricle**	-**Due to atrial systole** which causes rapid flow of blood to ventricle and vibration in the blood causing oscillations of the ventricles during atrial contraction. -Recorded during 'atrial systole, at the last one third of diastole.
pitch	S3 and S4 is usually not audible (very low pitch)	
Areas Of Auscultation	Best heard at Mitral area	
Frequency	20-30 Htz	< 20 Htz (low pitch)
Duration	0.05 sec	0.04 sec
Sound	Heard in **children** **and** **young slim adults** (pathological in **old age**)	S4 may be heard in **elderly** but is usually pathologic in the **young.**
		

Summary of heart sound

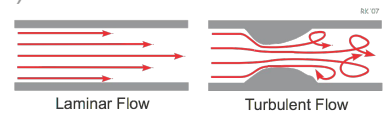
From male slides



what is **turbulent blood flow?

Normally in the body, blood flow is **laminar**. However, under certain conditions the blood start flowing in **all direction**, **mixing** different layers and start producing **sounds**. we call this type of blood flow

(turbulent)



Significance of Heart Sound

- Important for **diagnosis** of heart murmurs

Heart murmurs

- are abnormal, pathologic added heart sounds heard during the heartbeat cycle.
- Produced due to **abnormal pattern of blood flow** through the heart and its valve called (Turbulance**) and/or valvular abnormalities.
- They are **longer** than normal heart sounds
- Gallop: three or four sound are spaced to audibly resemble the pace of a horse, the extra sound occurs after S2

What Make Noise In The Heart

Causes Of Heart Sounds

- **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

Murmurs	
Physiological Murmurs	**Pathological Murmurs**
Caused by **increased flow** through normal valves	Caused by **turbulent flow** through **abnormal valves** or a septal Congenital defect
due to hyperdynamic circulation , and they disappear after these conditions is over. **seen in:** • Pregnancy • Hyperthyroidism • Anemia • Fever • Children	**seen in:** • **stenosis** (Tight,narrowed valve): the valve does not open properly. • **regurgitation** (leaky, incompetent, insufficiency valve), the valve fails to close completely, and hence causing backflow or leaks of the blood across the insufficient valve. • A **combination** of stenosis and insufficiency ★ If there is stenosis or insufficiency in the **semilunar** valves, the murmurs can be heard in systolic or diastolic, **respectively.** ★ the opposite can be said for **AV** valve. **(explained in detailed later)**

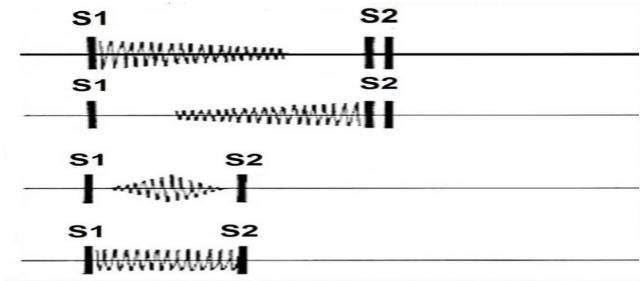
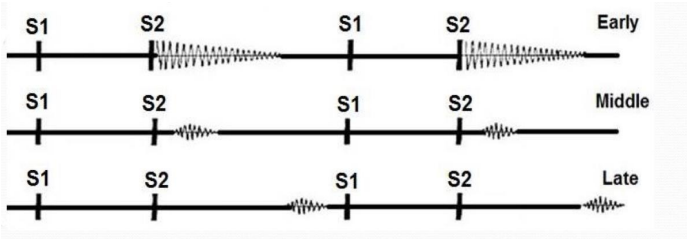
How to Describe Heart Murmurs

1-Timing (systolic or diastolic) **2-Shape** **3-Location** **4-Radiation**

5- Intensity **6- Pitch** **7-Quality**

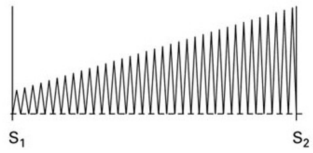
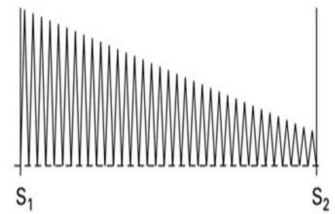
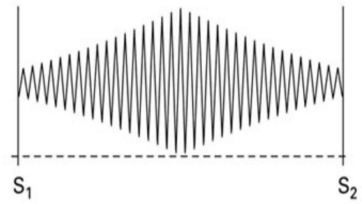
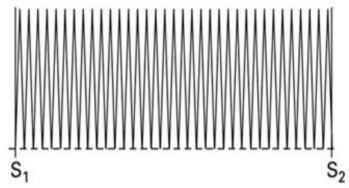
1- Timing:

described according to their position in the cardiac cycle: Systolic, Diastolic OR Continuous.

Systolic Murmurs	• Between S1 and S2 • Classified as: 1- early 2-mid (ejection systolic murmur ESM) 3- late 4-holosystolic (pansystolic) 
Diastolic Murmurs	• Between S2 & S1 • Classified as 1-early 2-mid 3- late. NO holosystolic 

2- Shape:

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

Crescendo (increasing intensity)	
Decrescendo (decreasing intensity)	
Crescendo-decrescendo (Diamond- shaped) (increasing then immediate decreasing intensity)	
Plateau (uniform) (The intensity of the murmur remains uniform)	

recorded using a phonocardiogram

3- Location of maximum intensity:

- Determined by the site where the murmur originates. Examples:

  -Aortic, Pulmonary, Tricuspid, & Mitral listening areas.

4- Radiation:

- Reflects **intensity** of the murmur & direction of blood flow. (if the murmur has a very high intensity-very strong- it may radiates to another part of the body for example: the neck)

5- Intensity

Graded on a six point according to Levine scale.
Classification of murmurs by loudness:

Grade	Intensity	Description
I	Lowest intensity	**Very faint** (soft murmur heard in quiet surroundings)
II	Low intensity	Quiet but heard immediately (soft murmur heard in noisy surroundings)
III	Medium intensity	Moderately loud (prominent heard murmurs)
IV	Medium intensity	Loud murmur with a ***thrill**
V	Loud intensity	Heard with stethoscope partly off the chest + **thrill**
VI	**Loudest intensity**	★ **No stethoscope is needed** + **thrill**

★ ***A thrill is a slight palpable vibration felt by the hand over the chest wall. Present in grades 4,5 and 6**

6- Pitch (tone): (High, medium,low.)

Drs : pitch is the (sharpness of the voice)

7- Quality:

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

8- Others:

i. 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.

ii. Variation with position of patient.

iii. Variation with special maneuvers:

Valsalva (forced expiration) decreases the intensity and duration of most murmurs.

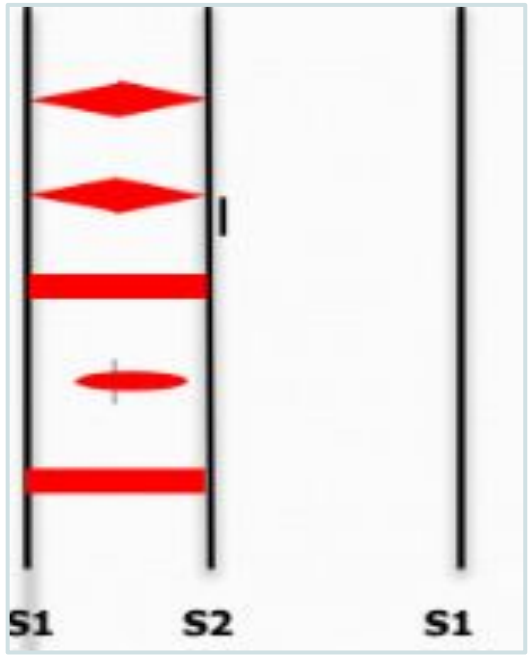
Valsalva maneuvers: a forceful attempt at expiration when the airway is closed.
I guess we all tried this when we were kids.

Systolic Murmurs

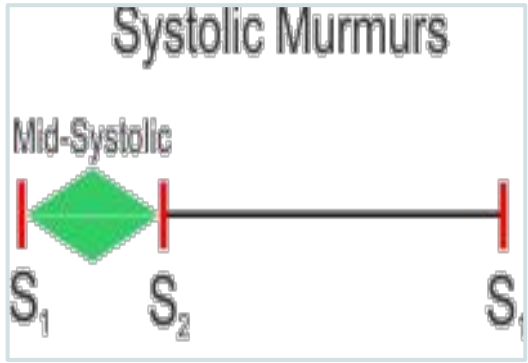
1- which of the following can cause holosystolic murmur ? 2- aortic stenosis produces which shape of murmur ?

Systolic Murmurs

Systolic Murmurs	Murmurs timing
Aortic stenosis	ejection murmur
Pulmonary stenosis	ejection murmur
Mitral/Tricuspid regurgitation	holosystolic
Mitral valve prolapse	mid-late systolic.
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 S2**
-Heard with:
- Mitral/tricuspid regurgitation.
- Ventricular septal defect (VSD).

Systolic Murmurs

	Aortic Stenosis	Mitral Prolapse	Holosystolic murmur.
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-late 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

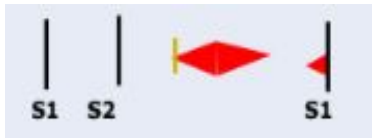
Diastolic Murmurs

Note: happens between S2-> S1

Almost always indicate **heart disease**.
Two basic types:

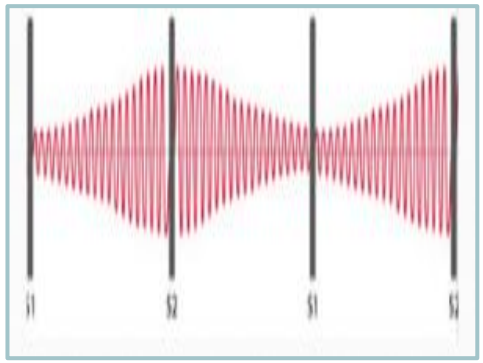
1. **Early decrescendo** diastolic murmurs: Signify regurgitant flow through an incompetent semilunar valve,
e.g. aortic/pulmonary regurgitation.

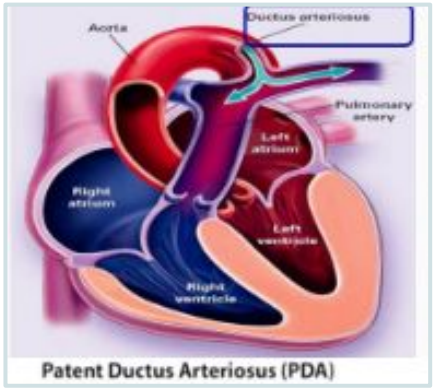
2. **Rumbling diastolic** murmurs in mid- or late diastole or (pre-systolic): Suggest stenosis of an AV valve
e.g. mitral/tricuspid stenosis.

	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.
Murmur image		

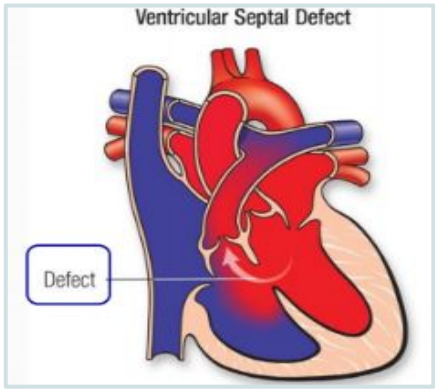
Continuous Murmurs:

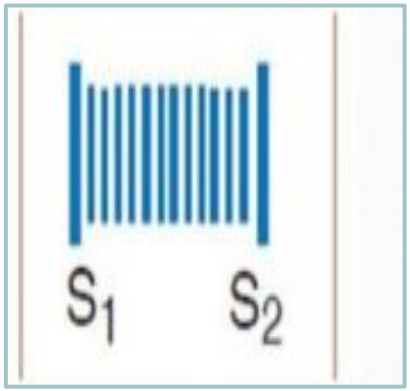
	Ventricular septal defect (Pansystolic)	Patent Ductus Arteriosus
Cause	A congenital condition associated with abnormal blood flow between the left ventricle and the right ventricle	Failure of closure of the duct between pulmonary artery & aorta
timing	Holosystolic murmur, may be diastolic murmur due 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.

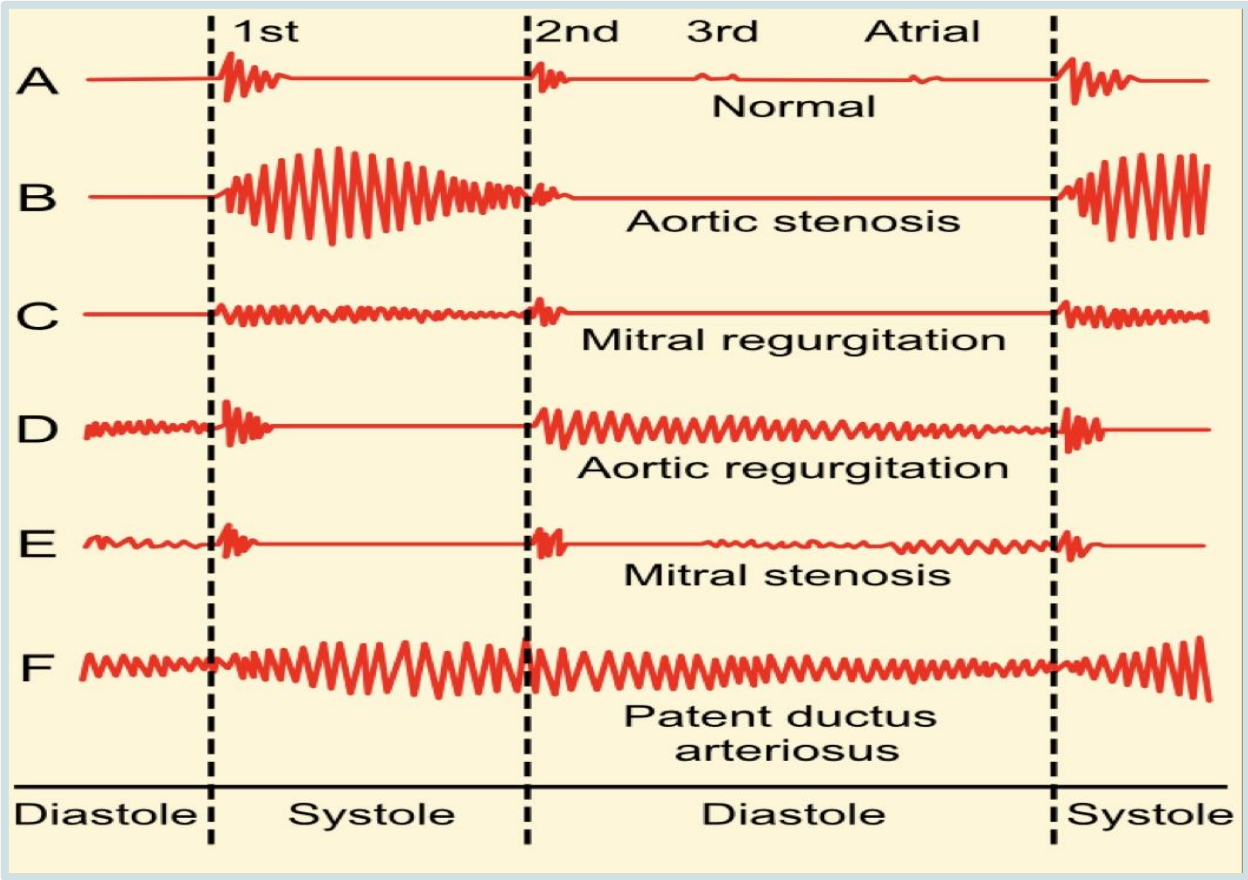




Patent Ductus Arteriosus (PDA)







the image may come and ask you for what does this pattern present
or
what murmur has a Holosystolic shape
or
gives you the name of the murmur and asks you the shape.
so memorise every murmur inside out

Quiz:

1-Which of following locations can S1 be heard?
A) Mitral area only
B) Auortic and pulmonary areas
C) Mitral and Tricuspid areas
D) Aortic and Pulmonary areas

2-Which of the following heart sounds is produced when AV valves closed?
A) S1
B) S2
C) S3
D) S4

3-Which type of splitting is heard in both inspiration and expiration?
A) Physiological
B) Fixed
C) wide
D) None of the above

4-Which of the following is associated with the second heart sound?
A) In rushing of blood into the ventricles due to atrial contraction.
B) Closing of the A-V valve.
C)Closing of the pulmonary valve.
D) In rushing of blood into the ventricles in the early to middle part of diastole.

5-Which of the following heart sound heard during systole?
A) Aortic valve regurgitation
B) pulmonary valve regurgitation
C) patent ductus arteriosus
D) mitral valve stenosis

6-Radiation of a murmur depends on ?
A) Timing
B) Shape
C) Quality
D) Intensity

7-what grade of heart murmur are associated with thrill?
A) one
B) four
C) three
D) two

8-left heart murmurs are best heard during expiration T or F?
A) true
B) false

9-Which heart sound has long duration:
A) S1
B) S2
C) S3
D) S4

10-In a patient with mitral stenosis one would expect to hear:
A) a systolic murmur loudest over the apex of heart
B) a systolic murmur loudest over the base of heart
C) a diastolic murmur loudest over the apex of heart
D. a diastolic murmur loudest over the base of heart

Answer Key: 1C - 2A- 3B - 4C - 5C
6D - 7B- 8A - 9A - 10C

Quiz:

1- mention three examples of the pathological murmur ?

2- Define Aortic regurgitation?

3- what is a thrill?

4- what is grade six murmur?

5- List 4 differences between first and second heart sound?

A1: 1/Tight valve, narrowing (stenosis): the valve does not open properly.
2/Leaky, (regurgitation or incompetency), the valve fails to close completely, and hence causing backflow or leaks of the blood across the insufficient valve.
3/A combination of Stenosis and Insufficiency.

A2:
Retrograde flow from aorta into LV Obstruction of flow from LA to LV because through incompetent aortic cusps

A3: A thrill is a slight palpable vibration felt by the hand over the chest wall.

A4: loudest intensity. no stethoscope is needed and associated with thrill.

A5: Slide 5

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