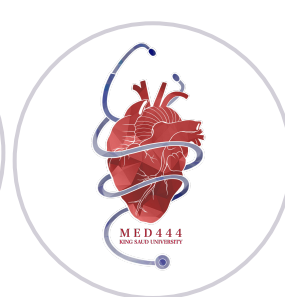




Physiology team



MED 444
KING SAUD UNIVERSITY



Heart sounds & murmurs

Editing File

Objectives:



Enumerate the different heart sound



Describe the **normal heart sound** ,causes & characteristic features of S₁ & S₂



Correlate the heart sound with different phases of cardiac cycle



Define / **describe** heart murmur and their clinical importance & **example**



Causes of abnormal heart sound



Recommended playlist by [Medzcool](#)

Recommended video by Ninja nerd ([Heart sound](#))

Recommended video by Ninja nerd ([Heart murmur](#))

Heart sounds



1

S₁ and S₂

1. Audible with stethoscope (Lub-dub)
2. Ventricular **systole** is between S₁ - S₂
3. Ventricular **diastole** is between S₂ - S₁
4. Detected by : auscultation(stethoscope) & phonocardiography (sound recording device)
5. The heart sound you hear when you first feel the pulse is S₁ & when the pulse disappears is S₂

2

S₃ and S₄

1. **Inaudible** in stethoscope under normal conditions because they are **low frequency** (pitch) sounds

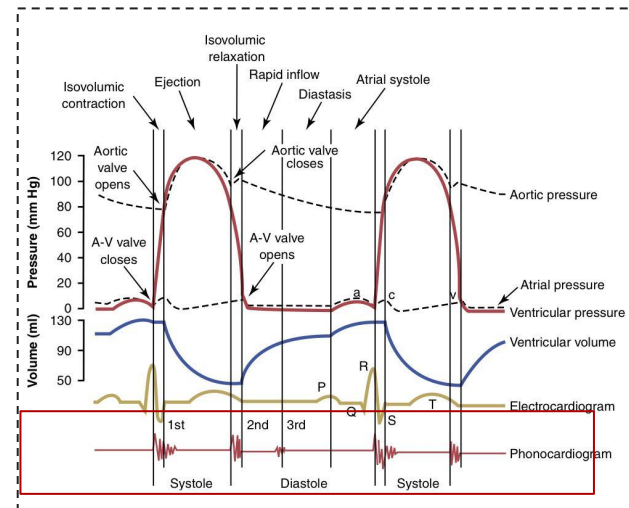
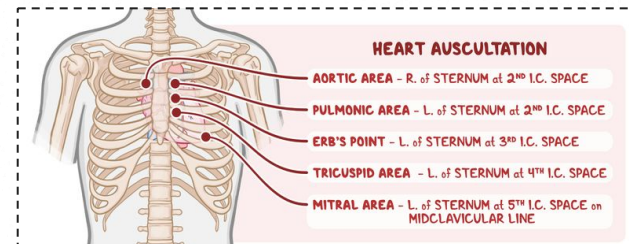
Heart sounds in order : S₄,S₁,S₂,S₃



Areas of Auscultation & Heart sounds during cardiac cycle



Phase of cardiac cycle	Major event	ECG	valve	Heart sounds
Atrial systole	Atria contract	-P wave -PR interval	—	Fourth heart sound
Isovolumetric ventricular contraction	-Ventricles contract -Ventricular pressure increases -Ventricular volume is constant (all valves are closed)	QRS complex	A-V valve close	First heart sound
Isovolumetric ventricular relaxation	-Ventricles relaxed -Ventricular pressure decreases -Ventricular volume is constant	—	Aortic & pulmonary valve close	Second heart sound
Rapid ventricular filling	-Ventricles relaxed -Ventricles fill passively with blood from atria -Ventricular volume increases -Ventricular pressure low and constant	—	A-V valve open	Third heart sound



Heart sounds



وَفِي أَنْفُسِكُمْ أَفَلَا تُبْصِرُونَ		S1 (first heart sound)	S2 (second heart sound) S-S-S-(Second-Short-Semilunar closure-Sharp)
Cause		Due to closure of A-V valves (Mitral & Tricuspid)	Due to closure of semilunar valve (Aortic & Pulmonary)
When is it recorded?		at the beginning of the 'isovolumetric contraction phase'	at the beginning of the 'isovolumetric relaxation phase'
What does it Mark (S1, S2)?		Marks the beginning of ventricular systole	the beginning of ventricular diastole , occurs at the end of systole
Sound, pitch		LUB (low pitch), Loud, heavier compared to S2.	DUB (high pitch), Soft, louder and sharp compared to S1.
Best heard at?		Mitral and Tricuspid areas	Aortic and Pulmonary areas
frequency		25-35/45 Hz	50 Hz (more)
duration		(0.15 sec) (longer)	shorter (0.12 sec)

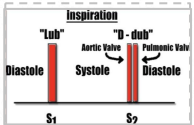
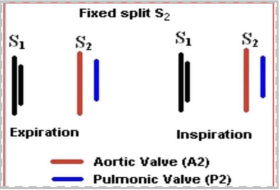
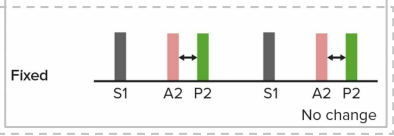
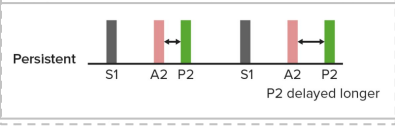
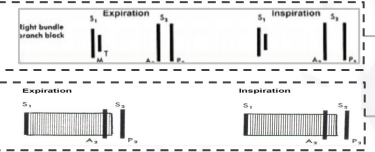
Heart sounds



<p>وَفِي أَنْفُسِكُمْ أَفَلَا تُبْصِرُونَ</p>	<p>S3 (third heart sound) Ventricular filling</p>	<p>S4 (fourth heart sound) Atrial sound</p>
<p>Cause</p>	<p>Rush of blood from Atria to Ventricle during rapid filling phase of CC. It causes vibration in the blood. CC= Cardiac cycle</p>	<p>Due to atrial systole causing rapid blood flow from atria to ventricle and vibration in the blood causing oscillations of ventricles during atrial contraction.</p>
<p>When is it recorded?</p>	<p>during the 'rapid filling phase' at the beginning of middle third of ventricular diastole</p>	<p>recorded during atrial systole, occurs at the last one third of ventricular diastole. (just before S1)</p>
<p>When does it heard(S3, S4) ?</p>	<p>Heard in children and young slim adults (less fat so, easier to hear) But usually (pathological in old age)</p>	<p>may be heard in elderly but is usually pathologic in the young. Can't be heard in healthy people but it can be heard with pathologic problems (diastolic heart failure caused by systemic HTN, aortic stenosis)</p>
<p>Sound, pitch</p>	<p>usually not audible (very low pitch)</p>	<p>Not audible (very low pitch)</p>
<p>Best heard at?</p>	<p>Mitral area</p>	<p>Mitral area</p>
<p>frequency</p>	<p>20-30 Hz</p>	<p>< 20 Hz (low pitch)</p>
<p>duration</p>	<p>(0.05 sec)</p>	<p>(0.04 sec)</p>



S2 Splitting

Physiological S2 Splitting (normal)	Fixed Splitting of S2 (Pathological)	Wide Splitting of S2 (Pathological)	Paradoxical (Reversed) splitting of S2
<p>1. During inspiration, the aortic valve closes before pulmonary valve → reduplication (splitting of S2).</p> <p>2. The increased venous return (VR) to the right side of the heart delays closure of the pulmonary valve. (during inspiration due to increase in pressure gradient* → more VR → more blood in RV)</p> <p>3. The right ventricle has more blood than usual to eject and it thus takes more time.</p> <p>4. No splitting of the second heart sound is normally seen during expiration</p> <p>*More explanation from DR: During inspiration → more negative pressure inside the thoracic cage → more pressure gradient between the lower veins and the chest veins → blood will move faster through IVC from the lower veins → more VR.</p> 	<p>1. Splitting of S2 is heard both during inspiration and expiration, with the aortic valve closing before the pulmonary valve.</p> <p>2. This is heard in cases of Atrial Septal Defect.</p>  	<p>1. A split in the second heart sound during inspiration may become wider</p> <p>2. the split may also be seen during expiration due to:</p> <ul style="list-style-type: none"> - 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 & contraction). - The aortic valve closes earlier (before pulmonary) than normal (this is seen with either mitral regurgitation or ventricular septal defect). <p>(in ventricular septal defect, less SV, because some of the blood will move from LV to RV → less blood in LV → easier to pump to aorta → earlier closure of the aortic valve)</p> 	<p>1. Typically heard during expiration, with the pulmonary valve closing before the aortic valve.</p> <p>2. No splitting is apparent during inspiration, since the pulmonary valve is closing earlier (relative to the aortic valve) than normal.</p> <p>3. This may be caused by the following:</p> <ul style="list-style-type: none"> - Delayed onset of left ventricular systole (ex: left bundle branch block). - Prolonged left ventricular systole (ex: aortic stenosis, severe hypertension, left-sided congestive heart failure). - Early onset of right ventricular systole (example: Wolff-Parkinson White syndrome "WPW"). 

Wide splitting in case of delay in closing of the pulmonic valve

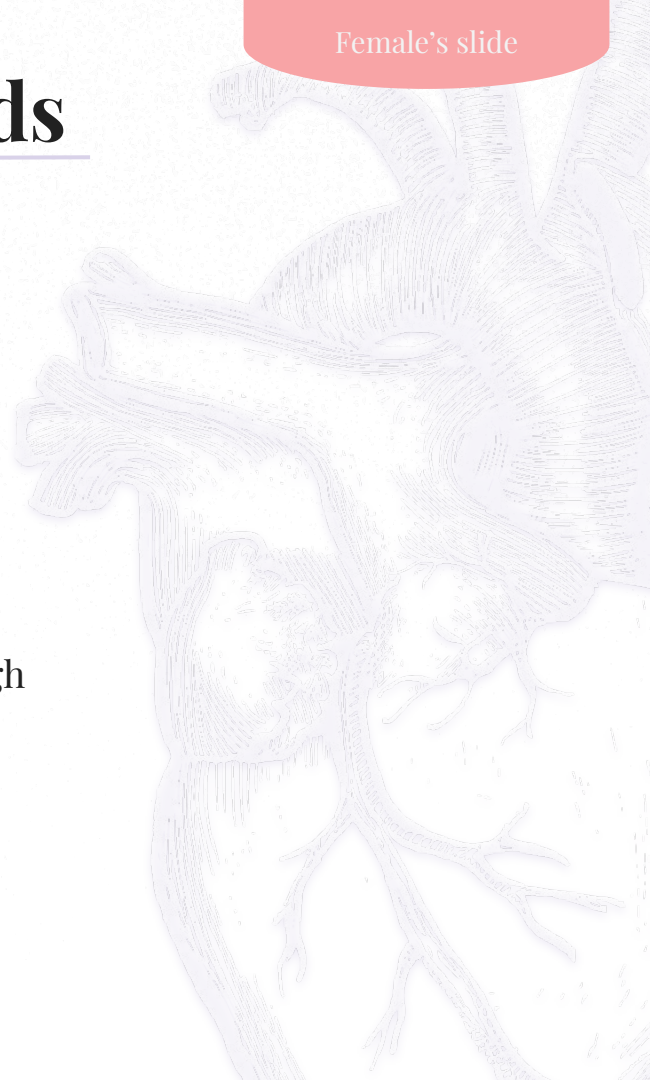
Wide splitting in case of aortic valve closes earlier than normal

Significance of Heart Sounds

Important for diagnosis of **Heart murmurs** :

- 1 **Abnormal extra heart sounds** heard during the heartbeat cycle
- 2 Produced by turbulence (abnormal patterns) of blood flow through the heart & it's valves
- 3 Murmurs are longer than normal heart sounds

S3, S4 not murmurs



Causes of Heart Sounds

1. Valves closure

Atrioventricular (Mitral & Tricuspid) **valves** = (S1)
Semilunar (Aortic & Pulmonary) **valves** = (S2)

2. Increased intracardiac Hemodynamics (murmurs)

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

} **Murmurs**

Types & causes of murmurs

Types

Physiological Murmurs (innocent murmur)

Caused by **increased blood flow across normal valves**, seen in:

- Pregnancy
- Hyperthyroidism
- Anemia
- Fever
- Children

Pathological murmurs :

Caused by **turbulent flow through abnormal valves** or a septal congenital defect & **Most common abnormalities of the valves are :**

- **stenosis** (**Tight, narrowed valve**): the valve does not open properly.
- **leaky/insufficiency** (**regurgitation, incompetent, 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**
- **Septal defect** (as ventricular septal defect)

Murmurs are abnormal, pathologic, added heart sounds produced due to abnormal flow of blood (turbulent blood flow and/or valvular abnormalities).

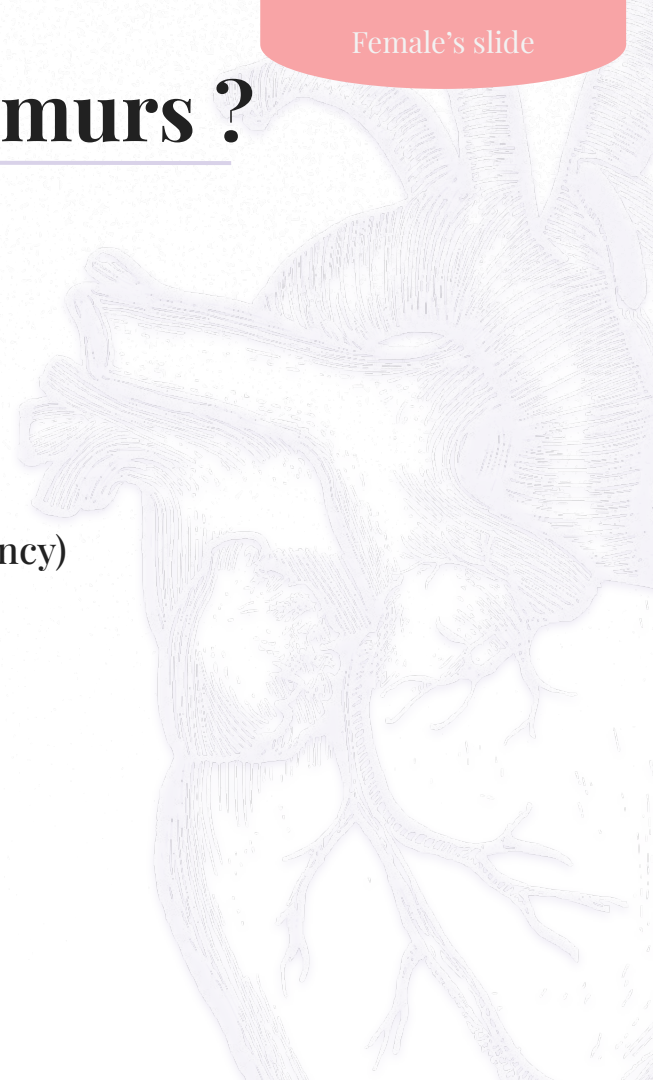


How to describe Heart Murmurs ?

These are all the points that we will be discussed about in next slides

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

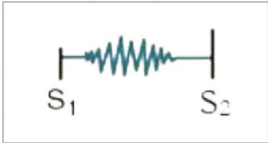
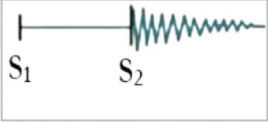
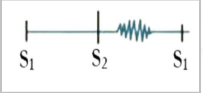

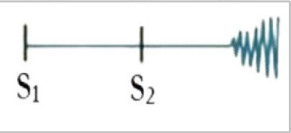

- 1 Quality
- 2 Pitch (Frequency)
- 3 Intensity
- 4 Others



How to describe Heart Murmurs? continued

Timing

Murmurs are described according to their position in the cardiac cycle: systolic, diastolic, continuous

Systolic Murmurs Between S ₁ and S ₂		Diastolic Murmurs Between S ₂ and S ₁	
Mid systolic murmurs (ejection systolic murmur (ESM) (Aortic & Pulmonary stenosis or Mitral & Tricuspid regurgitation)		Early diastolic (A or P regurgitation)	
Holosystolic (pansystolic) (M&T regurgitation or VSD)	Pan = entire 	Mid diastolic	
Early systolic		Late diastolic (presystolic) (M and T stenosis)	
Late systolic (M and T regurgitation)			

How to describe Heart Murmurs? continued



Heart murmur shape

Shape	Murmurs are described according to the waxing & waning of the sound :	1. Crescendo (increasing intensity)	
		2. Decrescendo (decreasing intensity)	
		3. Crescendo-decrescendo (Diamond-shaped): (increasing then immediate decreasing intensity)	
		4. Plateau (uniform): the intensity of the murmur remains uniform throughout.	
Variation with	-	1. 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. (increased pressure of LA and decrease pressure RA)
		2. position of patient	(Standing decreases venous return)
		3. special maneuvers	Valsalva (forced expiration) decreases the intensity and duration of most murmurs. (Decrease venous return)

How to describe Heart Murmurs? continued



Grading of heart murmurs

1

Soft Murmur heard in quiet surroundings & trained ear to hear (Difficult to hear even by expert listeners)

2

Soft Murmur heard in noisy surroundings, Audible to anyone who listens attentively

3

Prominent heard murmur, Loud but not palpable (Easy to hear even by inexperienced listeners, but without a palpable thrill)

4

Loud and palpable murmur with a precordial thrill
(A thrill is a slight palpable vibration felt by the Hand over the chest wall)

5

Loud murmur heard with edge of steth tilted against the chest + thrill (audible with your stethoscope placed perpendicular to chest wall)

6

Loud murmur heard 5-10 mm from the chest + thrill, audible without a stethoscope

Location of maximum intensity

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

Radiation

Reflects intensity of the murmur and direction of blood flow

Pitch (Frequency)

High, medium, low

Quality

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

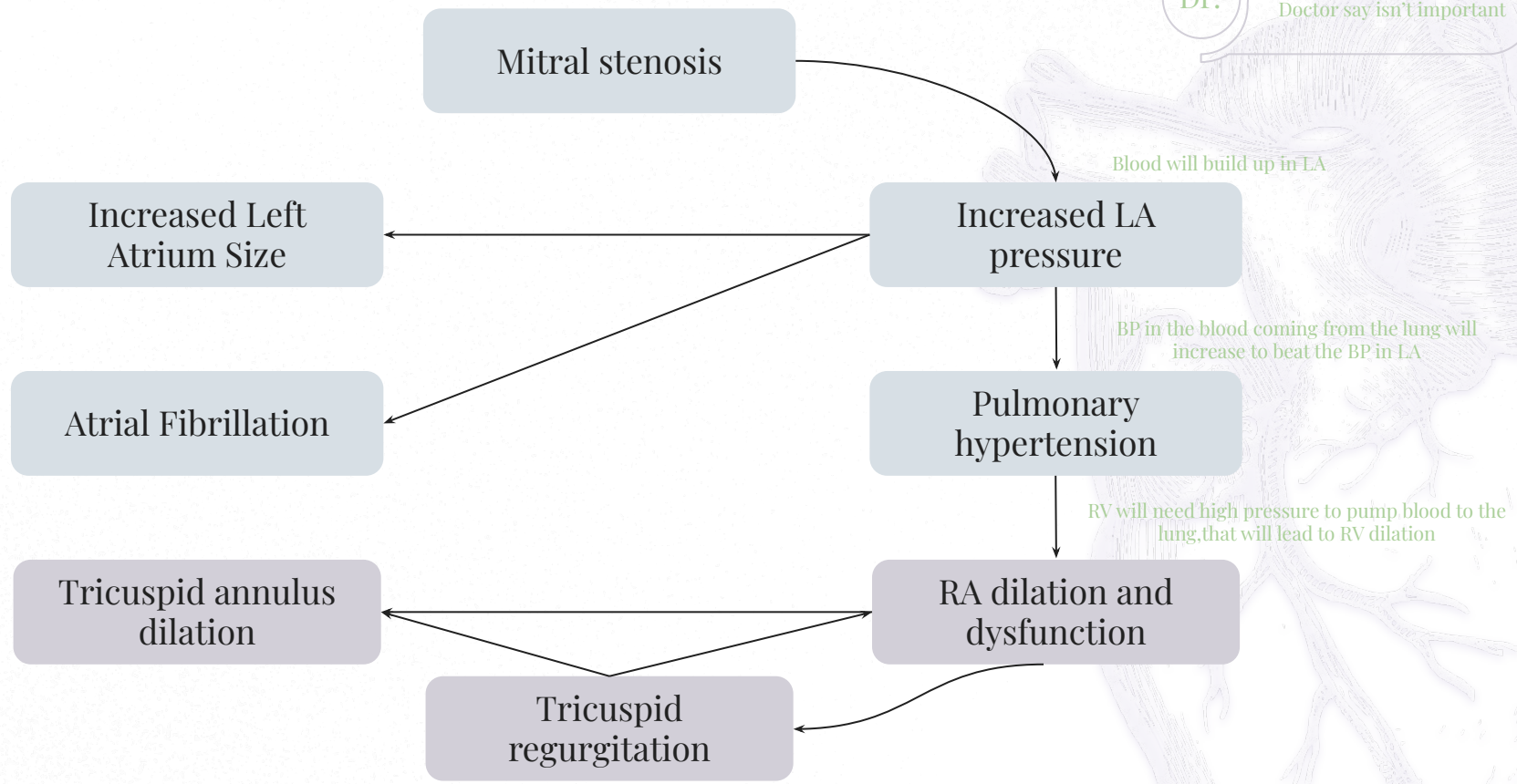
Intensity

Graded on a (6) points according to Levine scale

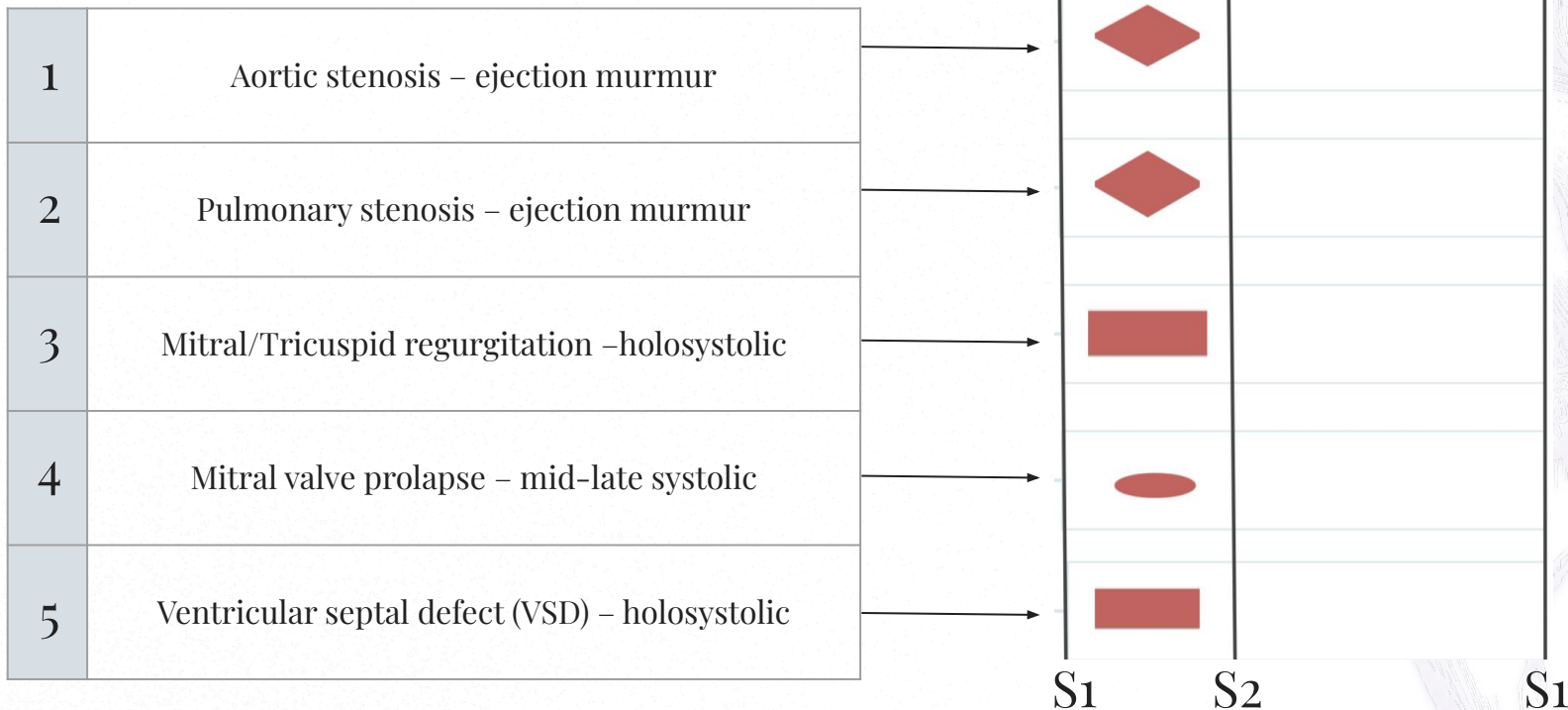
Pathophysiology

Dr:

Doctor say isn't important



Common Systolic Murmurs and Timing



Systolic murmurs



Derived from harsh and turbulence
in blood flow

Associated with increase in :

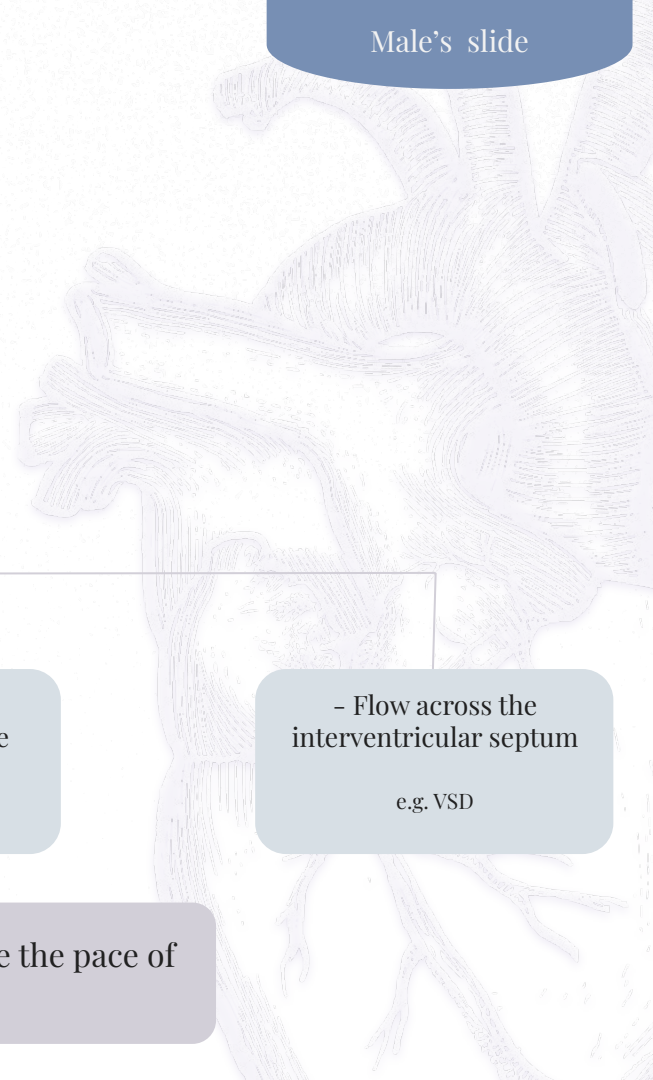
Flow across normal valves
- Flow into a dilated great vessel

- Flow across abnormal valve, or narrowed ventricular outflow tract
e.g. Aortic/Pulmonary stenosis

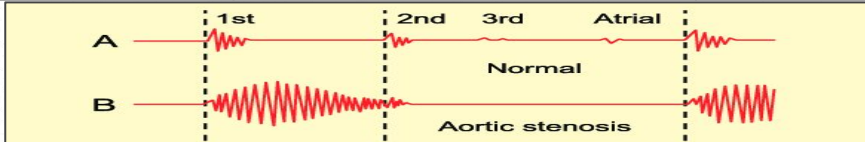
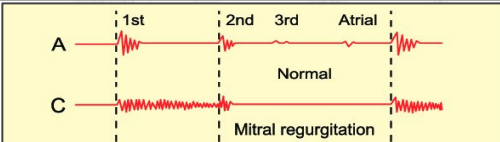
- Flow across an incompetent AV valve
e.g. M/T regurgitation

- Flow across the interventricular septum
e.g. VSD

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






Systolic murmurs

Ejection (Mid- Systolic) Murmurs			Pan- Systolic (Holosystolic) Murmurs
Most common kind of heart murmur. Usually crescendo-decrescendo They may be:			Pathological murmur
1- Innocent	2- Hyperdynamic states	3- Pathological	Begins immediately with S1 & continues up to S2
Common in children & young adults,	e.g. pregnancy, anemia, fever & hyperthyroidism.	Secondary to structural abnormalities e.g. Aortic/pulmonary stenosis, hypertrophic Cardiomyopathy & mitral prolapse	Heard with: <ul style="list-style-type: none"> • Mitral/tricuspid regurgitation • Ventricular septal defect(VSD)
			

Systolic murmurs



Systolic and diastolic murmurs

 سُبْحَانَ رَبِّكَ رَبِّ الْعَزَّةِ	Aortic Stenosis	Mitral Regurgitation
Cause	Obstruction of flow from LV into ascending aorta	Retrograde flow from LV into LA through an incompetent mitral valve
Timing	Mid-systolic murmur	Holosystolic (plateau shaped) murmur
Location	Best heard on aortic area, radiates along carotid arteries	Best heard at apex, radiates to left axilla
Character	Harsh, loud, may have associated with thrill, "ejection click"	Soft, high-pitched, blowing
Association	Old age, bicuspid aortic valve, rheumatic fever	MV prolapse, or myxomatous degeneration, rheumatic heart disease, endocarditis
Pictures	 Click here to hear	 Click here to hear

Diastolic murmurs



لقد خلقنا الإنسان في أحسن
تقويم

1

Almost always indicate heart disease

2

Soft, blowing, rumbling, gurgle

3

Two basic types: 

1

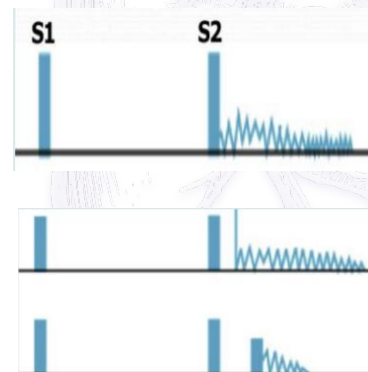
Early decrescendo diastolic murmurs:

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



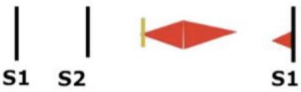
2

Mid-or late (pre-systolic) diastolic murmurs:



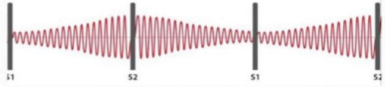
Suggest stenosis of **mitral or tricuspid valves**



Diastolic murmurs

 سُبْحَانَ رَبِّكَ رَبِّ الْعِزَّةِ	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 Retrograde 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
Pictures	 <p>Click here to hear</p>	 <p>Click here to hear</p>

Continuous murmurs

 سُبْحَانَ رَبِّكَ رَبِّ الْعِزَّةِ	Ventricular septal defect	Patent ductus arteriosus Normal event in fetus
Cause	A congenital condition associated with abnormal blood flow between the left ventricle and the right ventricle	Failure of closure of 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
Pictures	 <p>Click here to hear</p>	 <p>Click here to hear</p>

**Check here for our summary
Highly recommended !!!!!**



Sorry but if you will not check it راحت عليكم المليون

MCQs:



Answers

For more question check our summary file!

1/A
2/D
3/A

1 Which of the following heart sounds is associated with QRS complex?

A	First	B	Second	C	Third	D	Fourth
---	-------	---	--------	---	-------	---	--------

2 Which of these heart sounds coincide with the p wave in ECG?

A	S ₁	B	S ₂	C	S ₃	D	S ₄
---	----------------	---	----------------	---	----------------	---	----------------

3 Which of the following heart sounds is produced when AV valves closed?

A	S ₁	B	S ₂	C	S ₃	D	S ₄
---	----------------	---	----------------	---	----------------	---	----------------

MCQs:



Answers

For more question check our summary file!

4/A
5/B
6/C

4 Which heart murmur is only heard during diastole?

A	Mitral stenosis	B	Aortic stenosis	C	Tricuspid valve regurgitation	D	All of the above
---	-----------------	---	-----------------	---	-------------------------------	---	------------------

5 While listening to the heart sounds of a premature infant you heard a continuous machine-like murmur. What is the most likely cause of this murmur?

A	Mitral stenosis	B	Patent ductus arteriosus	C	Ventricular septal defect	D	Mitral regurgitation
---	-----------------	---	--------------------------	---	---------------------------	---	----------------------

6 Which of the following causes fixed splitting of S2?

A	Mitral stenosis	B	Aortic stenosis	C	Atrial septal defect	D	Tricuspid valve regurgitation
---	-----------------	---	-----------------	---	----------------------	---	-------------------------------



SAQ

List 5 differences between first and second heart sounds?

Slide 5

A murmur heard in patient with aortic stenosis. Describe the murmur mentioning the character, time, location?

Slide 18

A murmur heard in patient with Patent ductus arteriosus . Describe the murmur mentioning the character, time, location?

Slide 22

Finally you have arrived , we have been waiting for you !!

Meet our team !

Team leaders

Rimaz Alhammad

Noreen Almaraba

Rayan Alshehri

Omar Albaqami

Aljoharah Alyahya



Heroes of the lecture :



Rakan Alarifi

Farah Aldriweesh

Did you like the lecture ? we mean our work :)



Contact with us! physiology.444ksu@gmail.com