Revised & Reviewed by: Abdulaziz & Bahammam
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MED441
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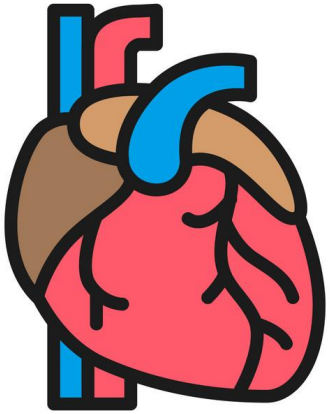


Heart sounds & Murmurs

Helpful video

Color Index:
- Main text
- Important
- Girls Slides
- Boys Slides
- Notes
- Extra

Editing File

Objectives

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

Heart sounds

➔ **There are 4 heart sounds**

S1 S2 S3 S4

Normally **audible** in stethoscope (Lub-dub)

Normally **inaudible** in stethoscope

Why? they are **low frequency** (pitch) sounds

➔ **2 ways to detect heart sounds**

Auscultation (stethoscope)

Phonocardiography (sound recording device)

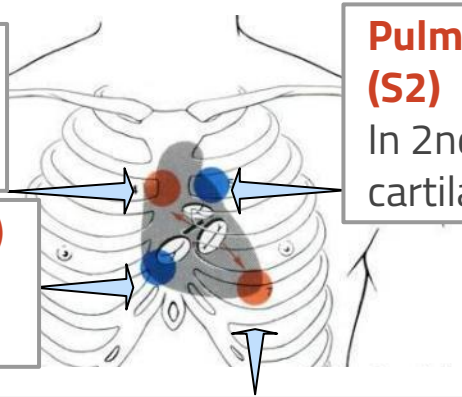
➔ Ventricular systole is between **S1 - S2**

➔ Ventricular diastole is between **S2 - S1**

➔ Auscultation areas

Aortic area (S2)
In 2nd right costal cartilage

Pulmonary area (S2)
In 2nd right costal cartilage

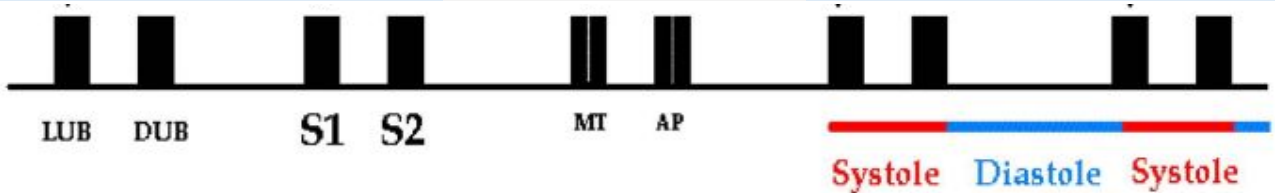


Tricuspid area (S1)
Right side, lower part of sternum

Mitral (bicuspid) area (S1)
5th left intercostal crossing mid-clavicular line, **or** 9 cm (2.5-3 inches) from sternum.

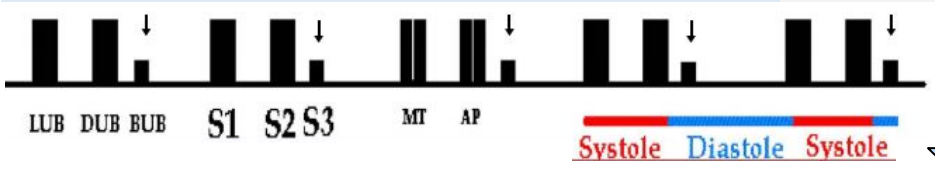
S1 (first heart sound)		S2 (second heart sound)
Due to closure of **A-V valves**	**Cause**	Due to closure of **semilunar valves**
at the beginning of the 'isovolumetric **contraction** phase'	**When is it recorded?**	at the beginning of the 'isovolumetric **relaxation** phase'
beginning of ventricular **systole**	**What does it mark?**	the beginning of ventricular **diastole**
LUB **(low pitch)**, Loud, heavier compared to S2. The sound you hear when you **first feel the pulse is S1**	**Sound, pitch**	DUB **(high pitch)**, Soft, louder and sharp compared to S1. when the **pulse disappears it is S2**
Mitral and **Tricuspid** areas	**Best heard at?**	**Aortic** and **Pulmonary** areas
25-35 Hz	**frequency**	50 Hz
(0.15 sec)	**duration**	**shorter** (0.12 sec)

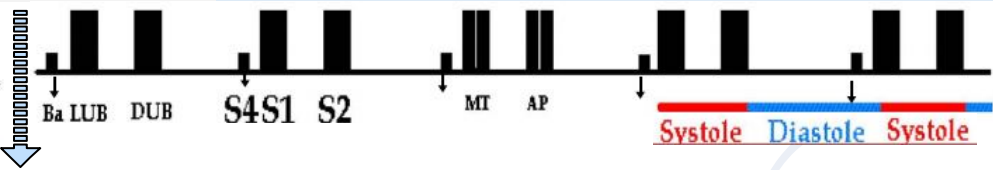
- MT= mitral, tricuspid



- AP= aortic, pulmonary

S3 (third heart sound)		S4 (fourth heart sound)
Rush of blood from **Atria to Ventricle** during rapid filling phase of Cardiac Cycle. It causes vibration in the blood	**Cause**	Due to **atrial systole** causing **rapid blood flow to ventricle**, vibration in the blood causing **ventricles oscillations** in atrial contraction. (Blood striking **left ventricle)**
during the 'rapid filling phase' at the beginning of middle third of diastole due to rush of blood from the atria into the ventricle.	**When is it recorded?**	**during atrial systole**, at the last one third of diastole.
Heard in children and young slim adults (pathological in old age)	**Where is it heard?**	may be **heard in elderly** but is usually pathologic in the young.
usually not audible **(very low pitch)**	**Sound, pitch**	usually not audible **(very low pitch)**
Mitral area	**Best heard at?**	**Mitral** area
20-30 Htz	**frequency**	< 20 Htz **low pitch**
(0.05 sec)	**duration**	(0.04 sec)

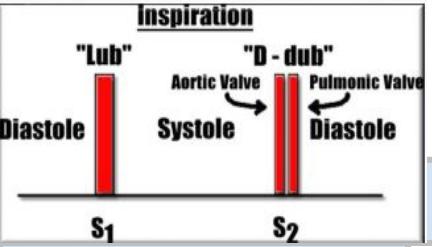




S2 splitting

➔ **There are 4 types of S2 splitting**

- **physiological** — Normal
- **fixed**, **wide**, **Paradoxical** — Pathological (discussed in the next slide)

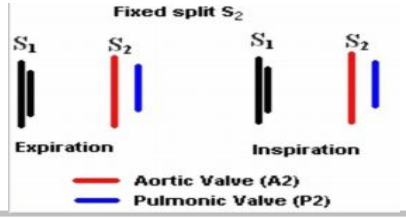
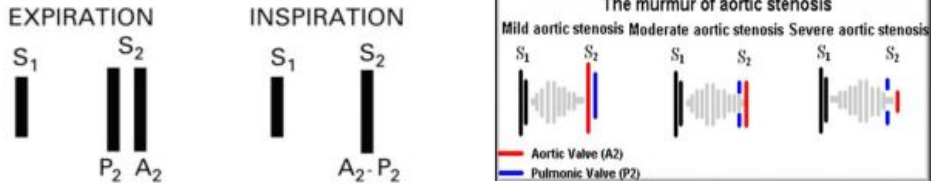
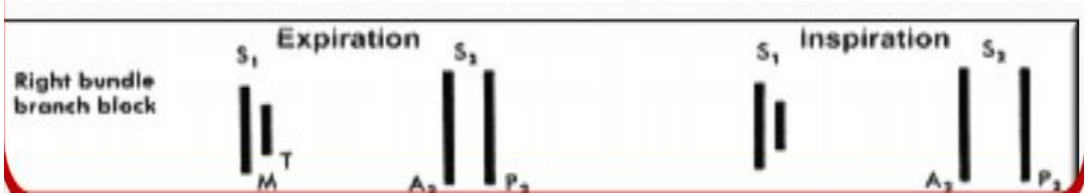


1- physiological S2 splitting

When is it heard?	During **inspiration**, ***not normally seen in expiration***
What happens?	1- The **increased venous return** to the right side of the heart **delays closure of the pulmonary valve.** 2- During **inspiration**, the **aortic valve closes before pulmonary valve** → reduplication (splitting of S2). ❖ The **right ventricle** has more blood than usual to eject and it thus takes more time.

	2- fixed splitting	3- paradoxical splitting (reversed)	4- wide splitting
When is it heard?	**Inspiration** and **expiration**	**Expiration**, no splitting in inspiration *since the pulmonary valve is closing earlier (relative to the aortic valve) than normal.*	During **inspiration**, the split gets wider
What happens?	**aortic valve closes** before pulmonary valve	**pulmonary valve closes** before the aortic valve	-
Where is it heard?	In **Atrial Septal Defect.**	-	-
Causes	-	1- **Delayed onset of left ventricular systole** (ex: left bundle branch block) 2- **Prolonged left ventricular systole** (ex: aortic stenosis, severe hypertension, left-sided congestive heart failure) 3- **Early onset of right ventricular systole** (ex: Wolff-Parkinson White syndrome)	**The split may be seen during expiration if:** **1- Delay in closing of the pulmonic valve** (seen in right bundle branch block due to delay in right ventricular depolarization & contraction). **2- aortic valve closes earlier than normal** (seen with mitral regurgitation or ventricular septal defect

S2 splitting pictures

Fixed splitting	
Paradoxical splitting	
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**

	Heart murmurs
Definition	**abnormal, pathologic added heart sounds** produced due to abnormal flow of blood **(Turbulence)** and/or valvular abnormalities. They are heard during the heartbeat cycle **OR** Murmurs are pathologic and added heart sounds that are produced as a result of turbulent blood flow.
Types more in next slide)	1- physiological 2- pathological
Causes	1- Increased flow across **normal valves** (physiological) 2- Turbulent flow through an **abnormal valve** (pathological) 3- Turbulent flow through **septal defect** (pathological)
Duration	**longer** than heart sounds
abnormalities	**Stenosis insufficiency** in: 1) Aortic **or** pulmonary valves → timing of murmur is systolic **or** diastolic **(respectively)** 1) Mitral **or** tricuspid valves → timing of murmur is diastolic **or** systolic **(respectively)**

Physiological vs. pathological murmurs

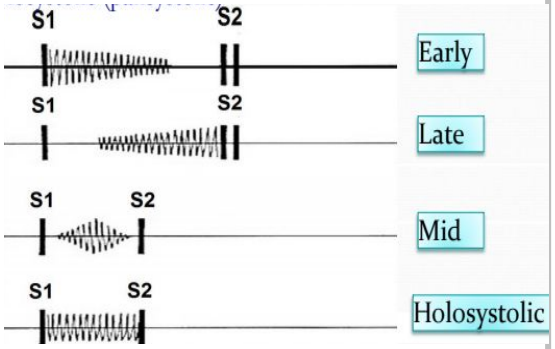
	Physiological murmurs	Pathological murmurs
Cause	Increased blood flow across **normal valves**	**turbulent flow** through **abnormal valves** or a septal Congenital defect
Seen in	1- pregnancy 2- hyperthyroidism 3- Anemia 4- Fever 5- Children	1- **stenosis** (Tight,narrowed valve): the **valve does not open properly** 2- **regurgitation** (leaky, incompetent, insufficiency valve), 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**

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

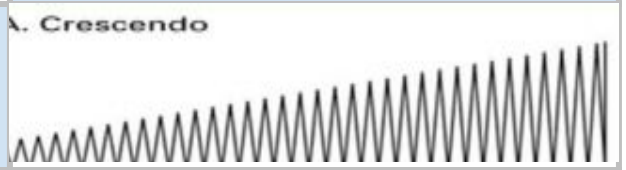
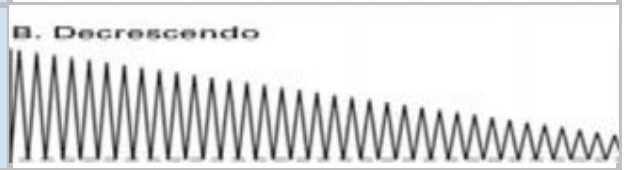
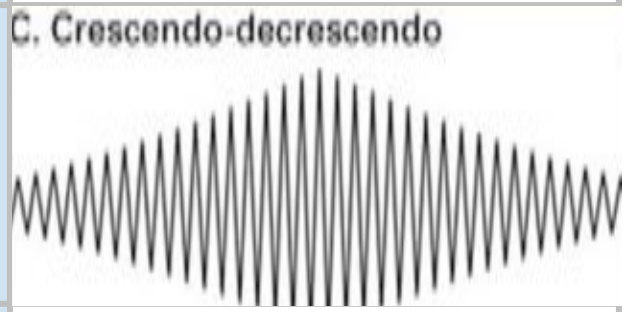
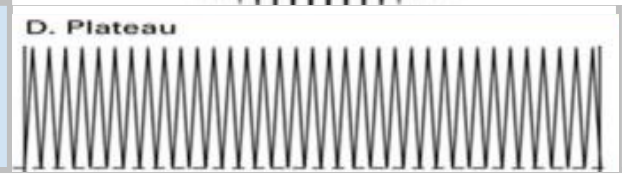
How to describe heart murmurs

1) Timing
2) Shape
3) Location
4) Radiation
5) Pitch
6) Quality
7) Intensity
8) Others

1- timing (described according to their **position in** the **cardiac cycle**)

Systolic (Between S1 - S2) (discussed in slide 15-17)	Classified as: 1) **early** 2) **mid** (ejection systolic murmur **ESM**) 3) **late** 4) **holosystolic** (pansystolic) 
Diastolic (Between S2 - S1) (discussed in slide 18-19)	Classified as: 1) **early** 2) **mid** 3) **late** 
Continuous	(discussed in detail in slide 20)

How to describe heart murmurs

	2- shape
Crescendo **increasing intensity**	
Decrescendo **decreasing intensity**	
Crescendo-decrescendo (Diamond- Shaped, increasing- immediate decreasing intensity)	
Plateau (uniform); the intensity remains uniform throughout	

3- Location maximum intensity	Determined by the **site where the murmur originates**; ex: Aortic, Pulmonary, Tricuspid, & Mitral listening areas.
4- Radiation	Reflects **intensity** of the murmur and **direction of blood flow**
5- Pitch	High, medium,low
6- Quality	Blowing, harsh (hard) ,resonant (rumbling) & musical

How to describe heart murmurs

7- intensity (graded according to Levine scale)		
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**

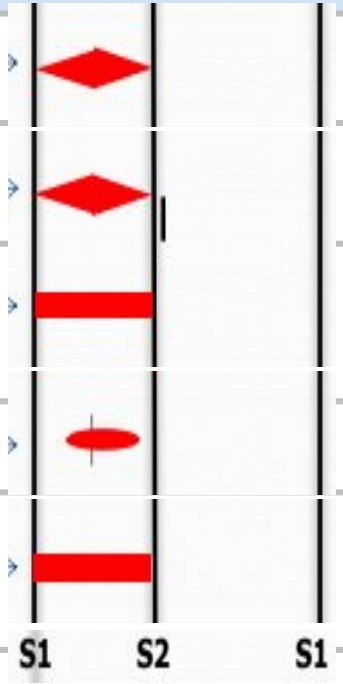
8- Others	1) Variation with **respiration** 2) Variation with **position** of patient 3) Variation with special **maneuvers**: Valsalva (forced expiration) decreases the intensity and duration of most murmurs

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

Thanks to 439

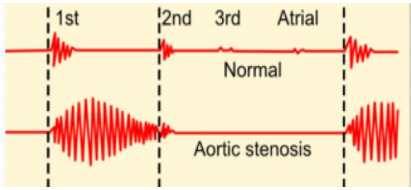
Systolic murmurs

Common systolic murmurs	timing	picture
Aortic stenosis	Ejection murmur	
Pulmonary stenosis	Ejection murmur	
mitral/tricuspid regurgitation	holosystolic	
Mitral valve prolapse	mid-late systolic	
Ventricular septal defect (VSD)	holosystolic	



SYSTOLIC MURMURS

1) Ejection (mid-systolic) murmurs:



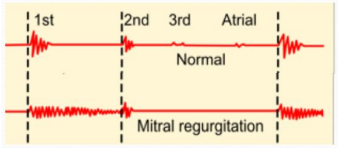
- **Most common** kind of heart murmur
- Usually **crescendo-decrescendo**
- **Types:**

1) innocent: common in children and young adults

2) physiological: detected in hyper-dynamic states, ex: anemia,pregnancy, fever, hyperthyroidism.

3) pathological: Secondary to structural CV abnormalities, ex: Aortic/pulmonary stenosis, Hypertrophic cardiomyopathy, mitral prolapse.

2) Pan- Systolic (Holosystolic) Murmurs:



- **Pathological** murmur
- Begins immediately with S1, continues up to S2
- **Heard with:**

1) Mitral/tricuspid regurgitation

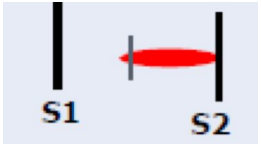
2) Ventricular septal defect (VSD)

Systolic murmurs

Thanks to 439

Male slides

	3) Aortic stenosis	4) Mitral prolapse	5) 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
Best heard	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
Associations	Old age, bicuspid aortic valve, rheumatic fever.	~5% normal population, asymptomatic, ? Sudden death. -MV prolapse, or myxomatous degeneration, rheumatic heart disease, endocarditis	MV prolapse, or myxomatous degeneration, rheumatic heart disease, endocarditis



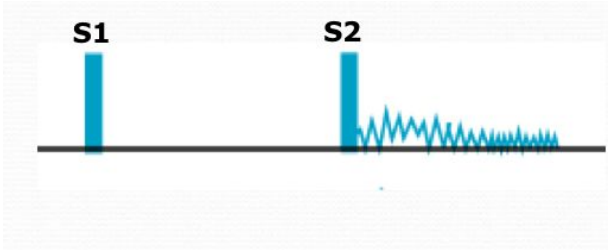
Diastolic murmurs

➔ **Almost always indicate heart disease, it has two basic types:**

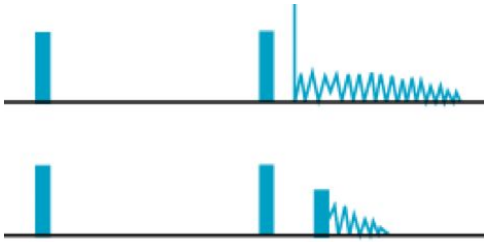
Types

- Early decrescendo
- Rumbling diastolic

- ❖ Signify regurgitant flow through an incompetent semilunar valve
- ❖ Ex: **aortic/pulmonary regurgitation**

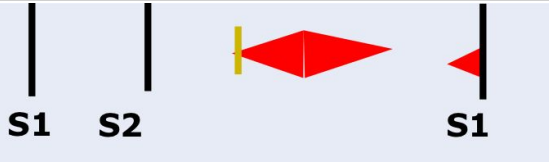


- ❖ mid- or late diastole or (pre-systolic): Suggest stenosis of an AV valve
- ❖ Ex: **mitral/tricuspid stenosis**

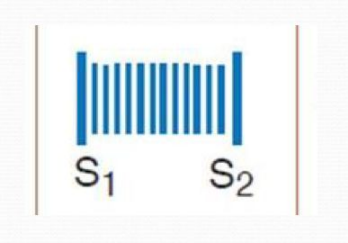
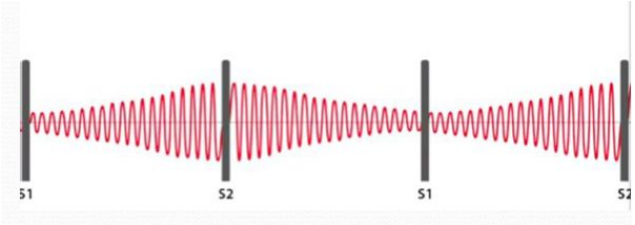


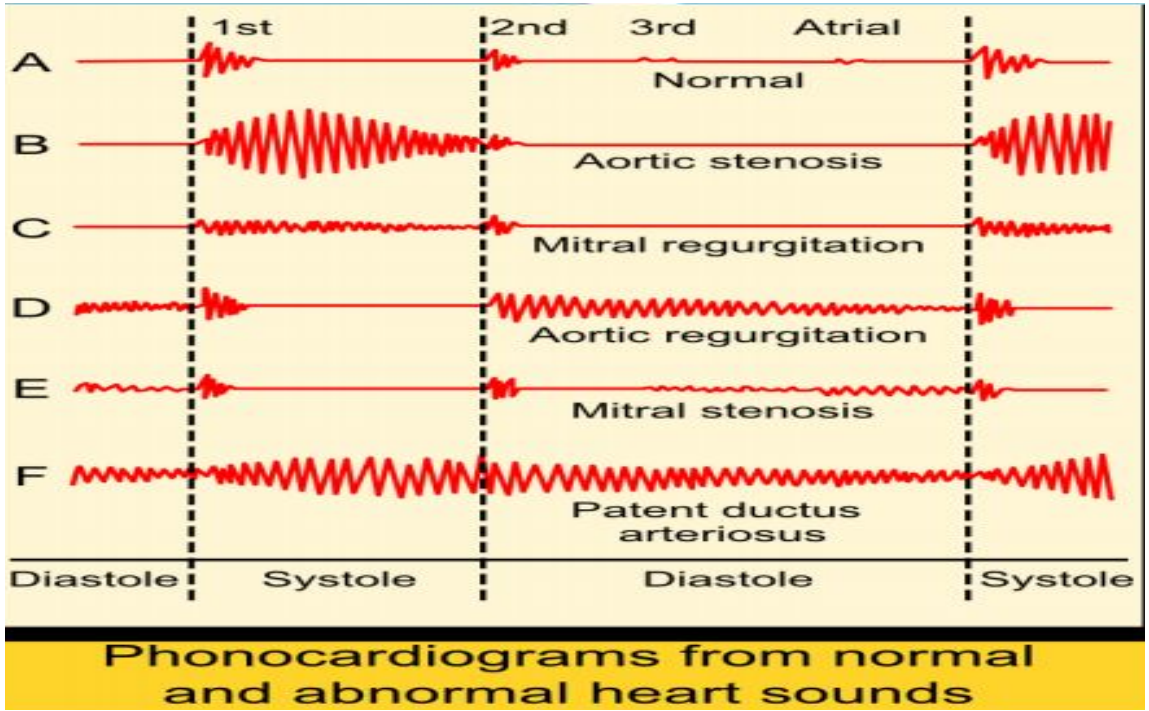
Diastolic murmurs

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



Continuous murmurs

	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 duct between pulmonary artery & aorta
Timing	**Holosystolic** murmur, may be diastolic murmur due to turbulent flow through mitral valve	**Continuous** murmur
Best heard	at **tricuspid area**	at **upper left sternal border.**
Character	**medium pitched** murmur fills all of systole	**Machine-like**
Associations	Volume **overload** of right ventricle	Left to right **shunt**, **cyanosis**
Pictures		



Phonocardiograms from normal and abnormal heart sounds

439: very important for SAQ
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

Team Leaders

QBank Team

Rand aldajani

Nawaf Alshehri

Sub Leader

Samiah AlQutub

Team Members

Rahmah Alzahrani

Abdullah Abdulrazaq