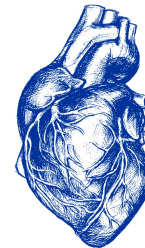


Lecture 6

Heart sounds

- **Red: important**
- **Black:** in male / female slides
- **Pink:** in female slides only
- **Blue:** in male slides only
- **Gray:** extra information

[Editing file](#)



Physiology
MED438



Heart Sounds

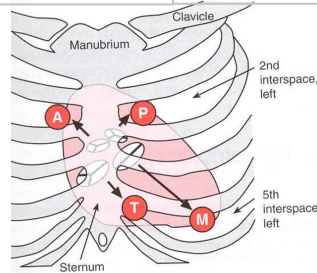
Listen to the
normal heart
Sound



Detected over the anterior chest wall by 2 methods:

Auscultation
(Stethoscope)

Phonocardiography



Pulmonary area:
2nd left intercostal space

Aortic area:
2nd right costal cartilage

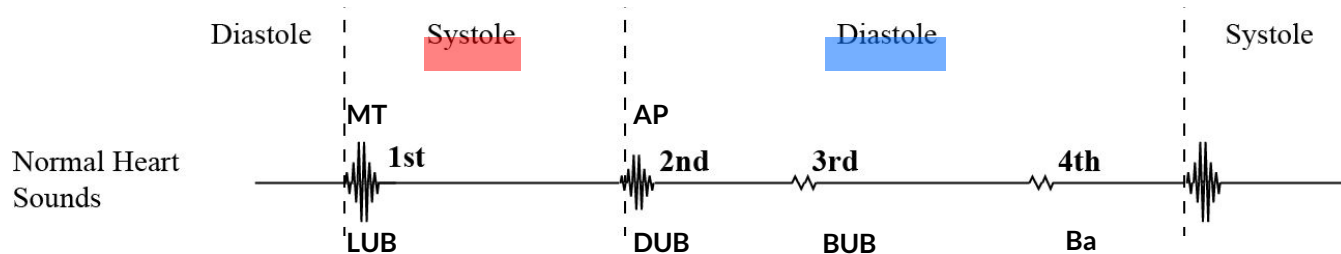
Mitral area:
5th left intercostal space,
crossing mid-clavicular line, 9cm
(2.5-3 in) from sternum

Tricuspid area:
lower part of
sternum towards the
right side

Heart Sounds



- There are four heart sounds **S1** , **S2** , **S3** & **S4**.
- Two heart sound are audible with a stethoscope **S1** & **S2** (Lub - Dub).
- **S3** & **S4** are not audible with a 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.
- The heart sound you hear when you first feel the pulse is S1, and when the pulse disappears is S2



Heart Sounds

S1

Heard at Mitral & Tricuspid

- **Cause:** AV valve closure
- Coincides with **isovolumetric contraction**
- **It marks beginning of Ventricular Systole**
- **Duration:** 0.15 sec
- **Low pitch** (LUB), Loud, 25-35Hz


S2

Heard at Aortic & Pulmonary

- **Cause:** semilunar valve closure
- Coincides with **isovolumetric relaxation**
- **It marks beginning of Ventricular Diastole**
- **Duration:** 0.11-0.12 sec (short)
- **High pitch** (DUB), soft , sharp, 50Hz

S3

Heard at mitral

- **Cause:** Rush of blood into ventricles
- Coincides with **rapid filling**
- **Duration:** 0.05 sec
- 20-30Hz 
- Pathologic in old age, Normal in children

S4

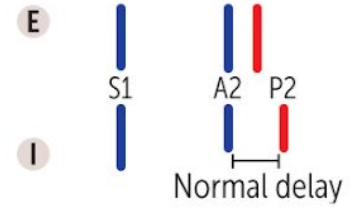
Heard at mitral

- **Cause:** when atrium contracts against a stiff ventricle and blood vibrates
- Coincides with **atrial systole**
- **Duration:** 0.04 sec
- <20Hz
- Pathologic in children, Normal in elderly

Splitting of S2

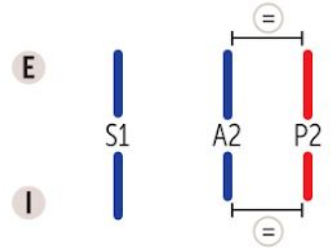
Physiological splitting

- During inspiration(not heard in expiration), there is an increase in venous return, eventually leading to increased right ventricular ejection time.
- This leads to a delay in the closure of the **pulmonic valve**.



Fixed splitting Male slides

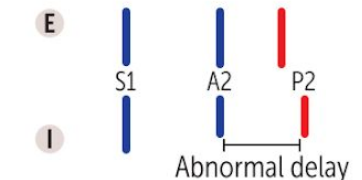
- Splitting of S2 is heard both during inspiration and expiration, with the aortic valve closing before the pulmonary valve.
- This is heard in cases of ASD (Atrial Septal Defect).



Wide splitting Male slides

This is seen in conditions that delay right ventricular emptying. For example:

1. There is a delay in the closing of the pulmonic valve (as would be seen in right bundle branch block)
2. The aortic valve closes earlier than normal (seen with either mitral regurgitation or ventricular septal defect).

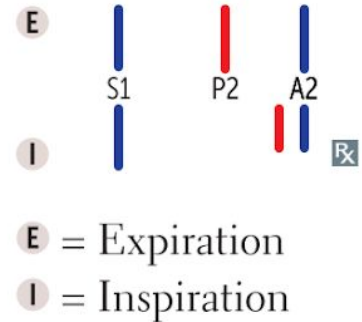


Splitting of S2

Paradoxical (reversed) splitting: Male slides

Heard in conditions that delay aortic valve closure, usually during expiration (In inspiration, the P2 and A2 are too close to each other to be differentiated). **It is caused by:**

1. **Delayed** onset of **left** ventricular systole (due to 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).



Murmurs

Physiological

- Caused by increased flow through normal valves.
- Can be seen in:
 - Anemia
 - Fever
 - children
 - Pregnancy
 - Hyperthyroidism

Pathological

- Caused by turbulent flow through abnormal valves or a septal defect
- Can be seen in stenosis, insufficiency or both.
- 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** valves.

Describing heart murmurs

01 Blowing, harsh, rumbling & musical.

02 Site where the murmur originates
e.g. Aortic, Pulmonary.

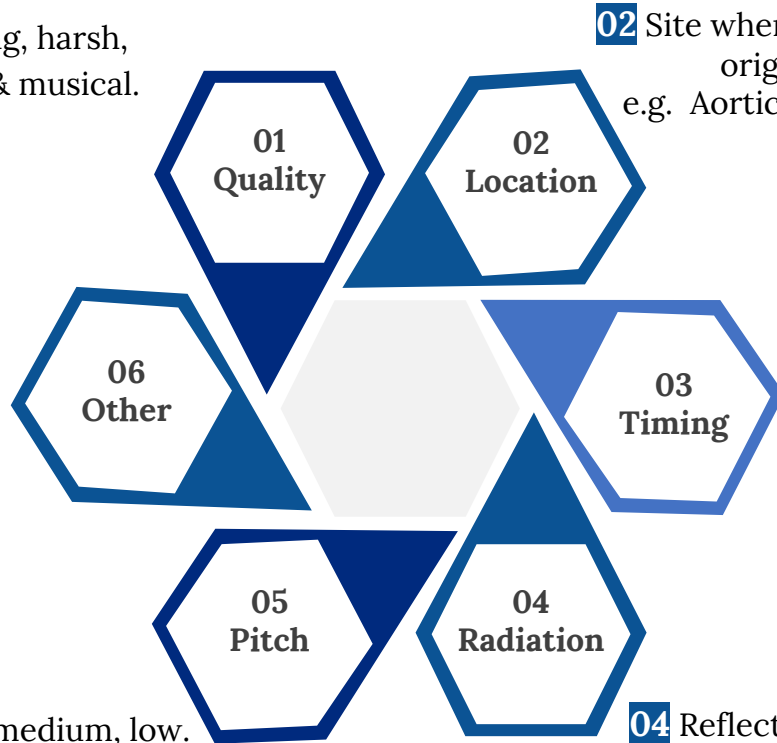
06 i. Variation with respiration:

Right sided murmurs change > left sided.

ii. Variation with position of patient.

iii. Variation with special maneuvers:

Valsalva murmurs decrease the duration & intensity of most murmurs.



03 Described according to their position in the cardiac cycle:

- Systolic
- Between S1 & S2
- Classified as: **early, mid, late, holosystolic**
- Diastolic
- Between S2 & S1
- Classified as: **early, mid, late**
- Continuous

05 High, medium, low.

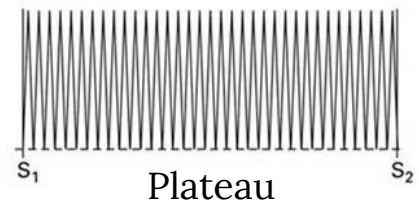
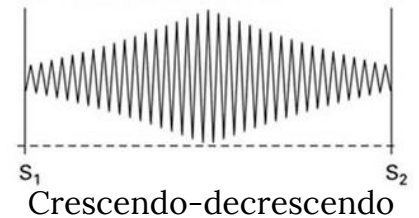
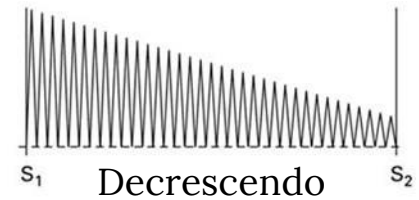
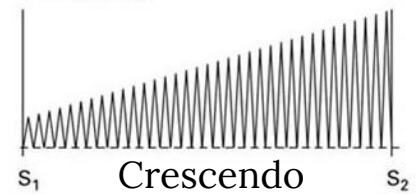
04 Reflects intensity of the murmur & direction of blood flow

07) Intensity

Graded on a (6) point according to Levine scale:

Grade	Intensity	Description
I	Lowest intensity	Very faint , need quiet room and trained ear to hear. (difficult to hear even by expert listeners)
II	Low intensity	Quiet but audible to anyone who listens attentively (usually audible by all listeners)
III	Medium intensity	Easy to hear even by inexperienced listeners, moderately loud but without a palpable thrill
IV	Medium intensity	Loud and palpable * produces a thrill (vibratory sensation felt on the skin overlying an area of turbulence)
V	High intensity	Audible with your stethoscope placed perpendicular to chest wall *Produces a thrill
VI	Highest intensity	Audible without a stethoscope *Produces a thrill

08) Shape

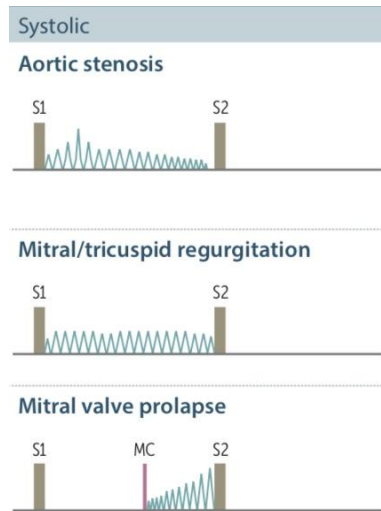


Systolic Murmur

- Between **S1 – S2**
- Derived from harsh & Increased turbulence in flow.

Associated with: Female slides

- Increased flow across normal valve.
- Increased flow into a dilated great vessel.
- Increased flow across an abnormal valve, or narrowed ventricular outflow tract e.g. **aortic/pulmonary stenosis**.
- Increased flow across an incompetent AV valve e.g. **mitral/tricuspid regurgitation**.
- Increased flow across the interventricular septum e.g. **VSD** (Ventricular Septal Defect)



Early Systolic

Mid Systolic
(ejection)

Late Systolic

Pansystolic
(holosystolic)




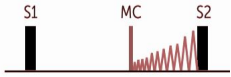
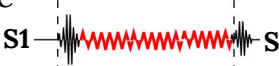
Common Systolic Murmurs and Timing

Mid-systolic (Ejection):

- Most common murmur, usually **crescendo-decrescendo**.
- They may be:
 1. **Innocent:** common in children
 2. **Physiological:** can be detected in hyper-dynamic states, e.g. anemia, pregnancy, fever & hyperthyroidism.
 3. **Pathological:** Secondary to structural CV abnormalities **i.e:** hypertrophy, semilunar valve stenosis & mitral prolapse.

Pansystolic:

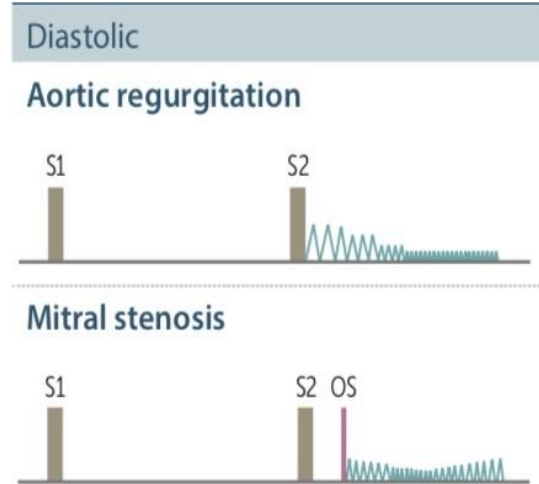
- Pathological murmur
- From S1 up to S2
- Heard with AV valve regurgitation and VSD.





	Aortic stenosis 	Mitral prolapse	Mitral regurgitation 
What happens?	Narrowing of aortic outflow tract causing obstruction of flow from LV into ascending aorta	Bulging of one or both mitral valve leaflets into LA during LV systole	Retrograde flow from LV into LA through an incompetent mitral valve
Timing	Mid systolic (ejection) 	Mid-late systolic murmur 	Holosystolic murmur. 
Location (Best heard)	Aortic area, radiates along carotid arteries	Apex	Apex, radiates to left axilla
Character	Harsh, loud, may have associated thrill, “ ejection click ”	Mid systolic click	Soft, high-pitched, blowing
Association	Older age, bicuspid aortic valve, rheumatic fever.	5% normal population, asymptomatic, sudden death.	MV prolapse, MV myxomatous degeneration, MI, rheumatic heart disease, cardiomyopathy, endocarditis.

Diastolic Murmurs

- Between **S2** and **S1**.
- Often indicates heart disease.
- Characterized by a soft, blowing gurgle.
- **Two main types:**

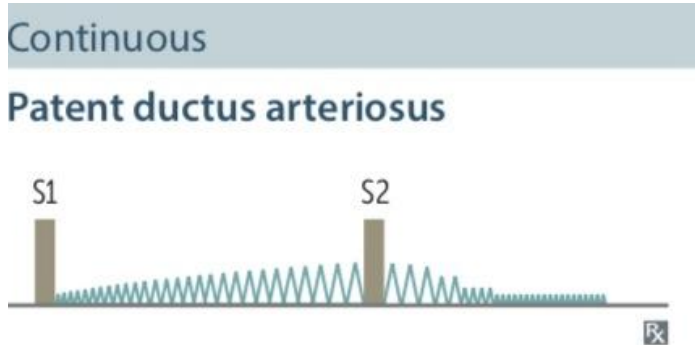
- 1- **Early** diastolic is usually seen in semilunar valve **regurgitation**.
- 2- **Mid-late** diastolic (pre-systolic) is seen in AV valve **stenosis**.




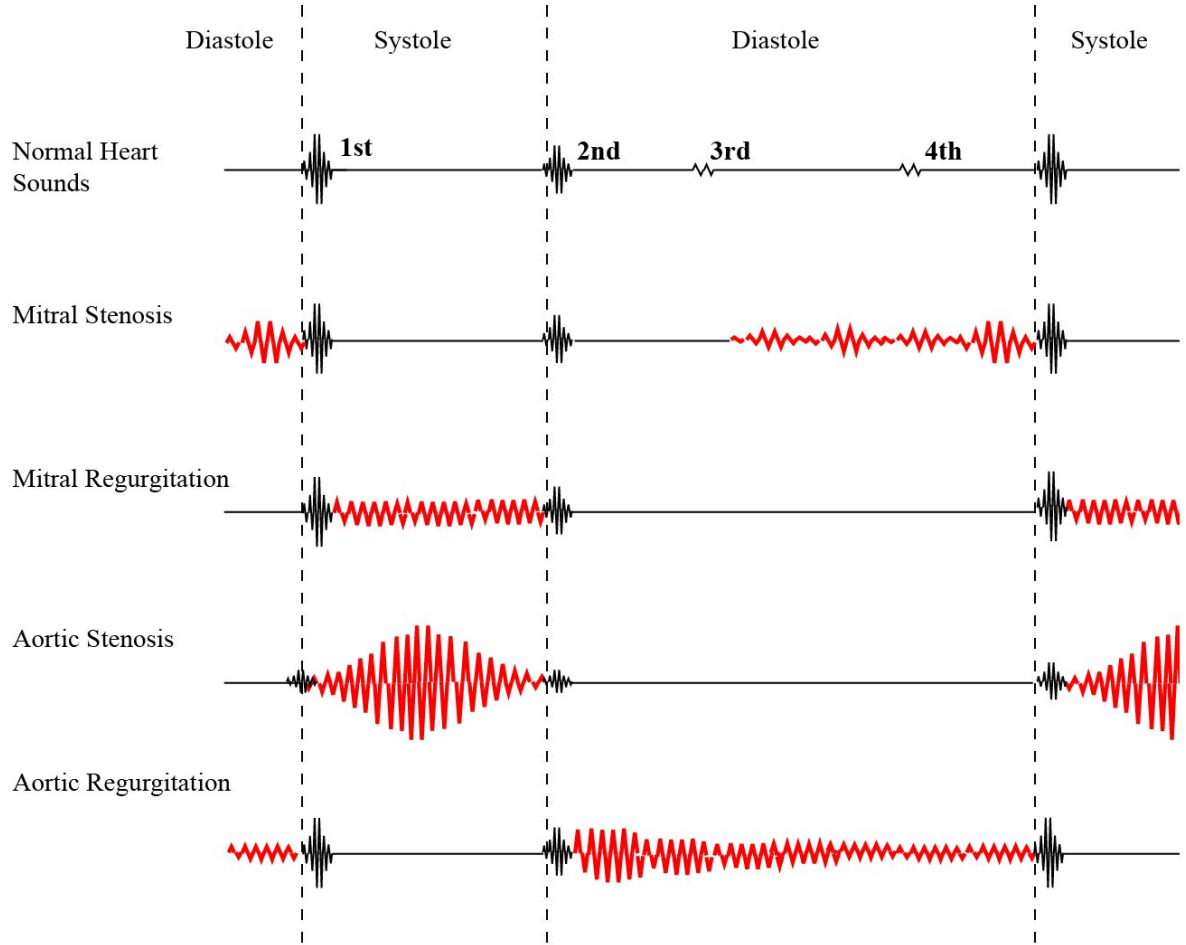
Aortic regurgitation 		Mitral stenosis 
What happens?	Retrograde flow from aorta into LV through incompetent aortic cusps	Obstruction of flow from LA to LV because of a narrowed mitral orifice (Valve becomes thickened & calcified)
Timing	diastolic (early) murmur 	diastolic (mid-diastolic, or pre-systolic) murmur with 'opening snap' after closure of aortic valve. 
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 w/aortic valve prolapse (kids.)	rheumatic fever.

Continuous Murmurs

- Begins in systole (near S2) and continues into all or a part of diastole.
- **Heard in:**
 - Patent Ductus Arteriosus (PDA)
 - Ventricular Septal Defect (VSD)



Patent ductus arteriosus (PDA) 	
What happens?	Failure of closure of the duct between pulmonary artery & aorta
Timing	Continuous murmur
Location	Best heard at upper left sternal border
Character	Machine-like
Association	Left to right shunt, cyanosis



Quiz

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

- A. S1
- B. S2
- C. S3
- D. S4

2. Which of following locations can S3 be heard?

- A. Aortic Area
- B. Pulmonary Area
- C. Tricuspid Area
- D. Mitral Area

3. Diastolic murmur happens between?

- A. S1-S2
- B. S2-S3
- C. S3-S4
- D. S2-S1

4. which of the following causes a mid-late systolic murmur?

- A. Aortic regurgitation
- B. Aortic stenosis
- C. Mitral regurgitation
- D. Mitral prolapse

5. Which type of splitting is heard in both inspiration and expiration?

- A. Physiological
- B. Fixed
- C. wide
- D. None of the above

SAQ:

1- Mention 3 characteristics to describe heart sounds

Quality, Timing, Shape

2- Define Aortic regurgitation

Slide 13

Leaders

Sedra Elsirawani

Abdulrahman Alhawas

Members

- Lama AlZamil
- Arwa AlEmam
- Noura AlTurki
- **Ghada AlSadhan**
- Nouf AlShammari
- Nouf AlHumaidhi
- Taibah AlZaid
- Ajeed AlRashoud
- Reem AlGarni
- Raghad AlKhashan
- Leen AlMazroa
- Nouran Arnous
- Maha AlNahdi
- Badr Almuhana
- Abdulrahman Almezaini
- Omar Aldosari
- Omar Alghadir
- Ibrahim Alshaqrawi
- Abdullah Aldawood
- Abdullah Shadid
- Meshari Alzeer
- **Mohammed Alhamad**
- Abdullah Alassaf
- Khalid Alkhani
- Amjad Albaroudi
- Mohammed Alhuqbani

Thank you!