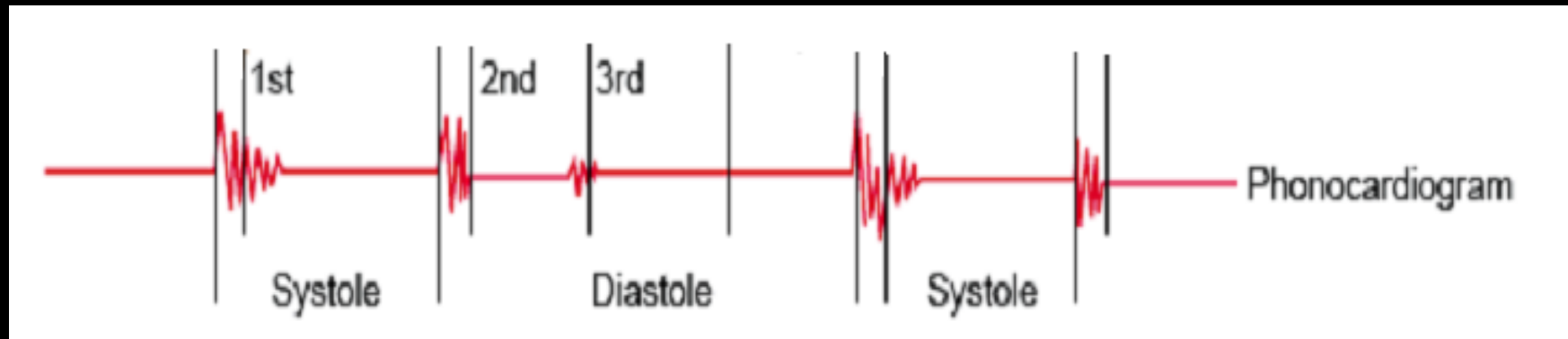


# CARDIO VASCULAR SYSTEM

Dr. Chetna Ramanuj



# HEART SOUNDS

## Definition:

These are the sounds of brief duration heard during cardiac cycle

## Methods:

- 1) Direct hearing : not so clear
- 2) Stethoscope : first two sounds are heard very well
- 3) Phono-cardiogram : all four heart sounds are heard

## Normal Heart Sounds :

Listening with a stethoscope to a normal heart, one hears a sound usually described as

**“ L-u-b-b, dub, L-u-b-b, dub, . . . . . ”**

The L-u-b-b- is associated with the closure of A-V valves at the beginning of the Systole

The “dub” is associated with the closure of Semilunar valves at the end of Systole

## Normal Heart Sounds :

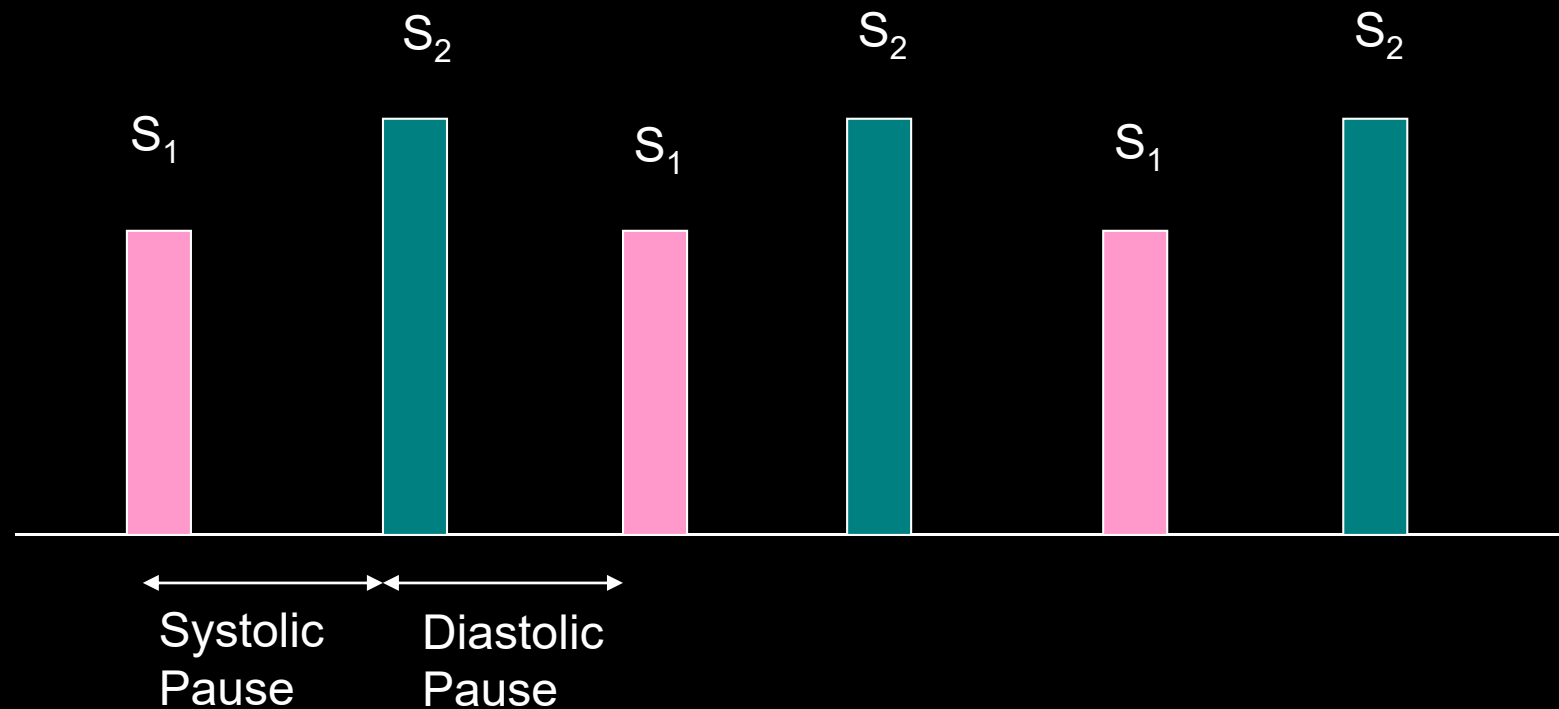
The L-u-b-b is the First Heart Sound ( $S_1$ )

The dub is the Second Heart Sound ( $S_2$ )

Because the normal cardiac cycle is considered to start with the beginning of systole when the A-V valves close.

## Cause of Production:

Vibrations of taut valves immediately after closure along with vibrations of adjacent blood, walls of the heart and major vessels around the heart.



## FIRST HEART SOUND (S<sub>1</sub>):

- 1) **Cause** : closure of A-V valves (Mitral & tricuspid)
- 2) **Timing** : Onset of ventricular Systole
- 3) **Pitch** : Low
- 4) **Quality** : Soft
- 5) **Duration** : 0.14 seconds (Long)
- 6) **Frequency** : 25 – 45 Hz
- 7) **ECG** : coincides with the peak of “R” wave

## FIRST HEART SOUND (S<sub>1</sub>):

- It can be identified by its long duration
- Best heard in mid-clavicular line of 5<sup>th</sup> intercostal space in left side
- It is coincide with apexbeat and carotid pulse
- It comes after long pause

## FIRST HEART SOUND (S<sub>1</sub>):

### Significance:

- It indicates the force of ventricular contraction
- Rough guide for commencement of ventricular systole
- It indicates the conditions of mitral and tricuspid valves
- In Mitral Stenosis & Tricuspid Stenosis } S<sub>1</sub> is Loud
- It also indicates the condition of myocardia.
- In Myocarditis : S<sub>1</sub> is weak



## SECOND HEART SOUND (S<sub>2</sub>):

- 1) **Cause** : closure of Semilunar valves (Aortic & Pulmonary)
- 2) **Timing** : Onset of ventricular Diastole
- 3) **Pitch** : High
- 4) **Quality** : Harsh
- 5) **Duration** : 0.1 seconds (Short and Snappy)
- 6) **Frequency** : 50 Hz
- 7) **ECG** : usually coincides with the end of “T” wave

## SECOND HEART SOUND (S<sub>2</sub>):

- Best heard in Right and Left 2<sup>nd</sup> intercostal space in Parasternal line
- It occurs after the apexbeat and carotid pulse
- It is followed by long pause

## SECOND HEART SOUND (S<sub>2</sub>):

### Significance:

- It indicates the end of ventricular systole and the onset of Ventricular diastole
- Two components of the S<sub>2</sub> [Aortic(A<sub>2</sub>) and Pulmonary(P<sub>2</sub>)] may be splitting physiologically during the inspiration

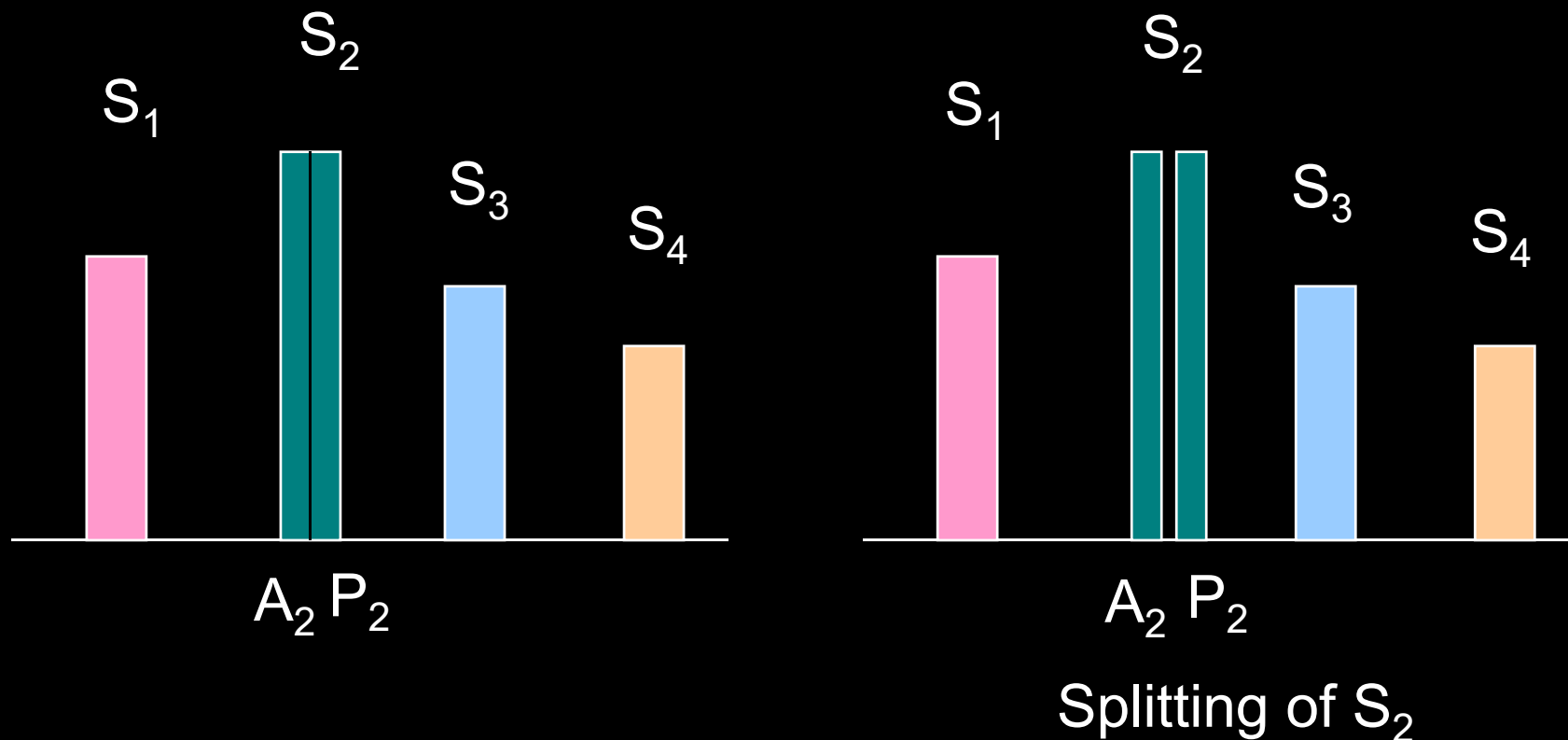
## SECOND HEART SOUND ( $S_2$ ):

### Significance:

- During deep inspiration, the venous return and the right ventricular filling is increased and its ejection time is prolonged, the appearance of  $P_2$  is therefore delayed.
- In Atrial Septal Disease (ASD) : there is wide and fixed splitting of  $S_2$

## SECOND HEART SOUND (S<sub>2</sub>):

In Atrial Septal Disease (ASD) : there is wide and fixed splitting of S<sub>2</sub>



## THIRD HEART SOUND (S<sub>3</sub>):

- 1) Cause : By vibrations of ventricular wall due to In-rushing of blood from the atria
- 2) Timing : heard at the beginning of the middle 1/3 of the diastole
- 3) Pitch : Low
- 4) Duration : 0.04 seconds
- 5) Frequency : very low
- 6) ECG : between "T" and "P" waves

## THIRD HEART SOUND (S<sub>3</sub>):

- It can be heard in those subjects who have a very good venous return (exercise), thin chest wall (Children)
- Best heard in the mitral area in upright position, with the bell of the stethoscope

## THIRD HEART SOUND (S<sub>3</sub>):

### Significance:

- S<sub>3</sub> in patients with a heart disease is usually a “*Grave Sign*”
- Presence of S<sub>3</sub> (Clear) suggests ventricular gallop sound/ gallop rhythm. This occurs in
  - LVF** : Left Ventricular Failure
  - RVF** : Right Ventricular Failure
  - CCF** : Congestive Cardiac Failure
  - Acute myocardial infection



## FOURTH HEART SOUND (S<sub>4</sub>):

- 1) Cause : By vibrations set up during atrial systole which coincides with last rapid filling phase of ventricular diastole
- 2) Pitch : Low
- 3) Duration : 0.03 seconds
- 4) Frequency : 3 Hz
- 5) ECG : between "P" and "Q" waves

## FOURTH HEART SOUND (S<sub>4</sub>):

### Significance:

When it is present it produces pathological *atrial gallop rhythm*.

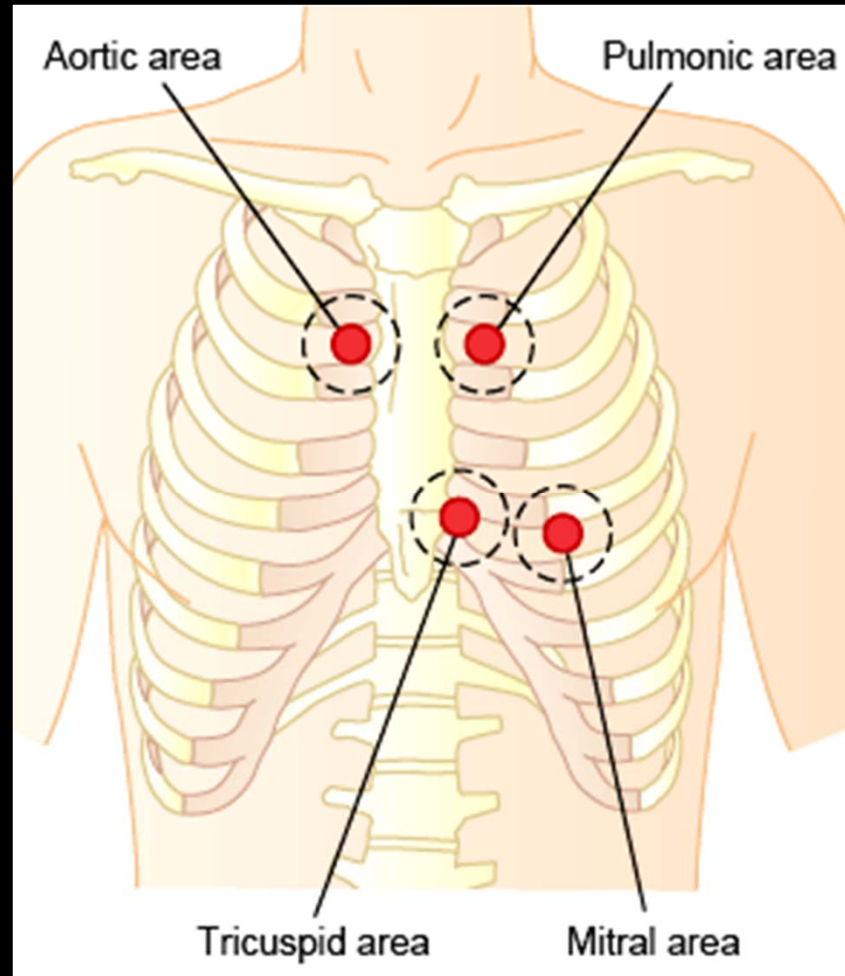
This occurs in

Acute Myocardial infection

Acute Myocarditis

# AREAS FOR AUSCULTATION OF HEART SOUNDS

Right 2<sup>nd</sup> I.C. space, right side of the sternum



Left 2<sup>nd</sup> I.C. space, left side of the sternum

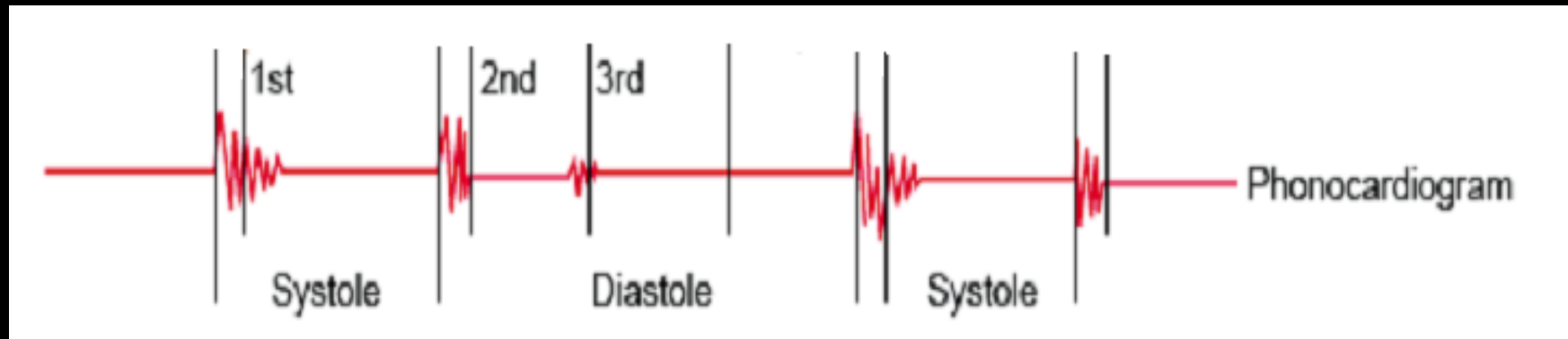
Lower end of sternum

5<sup>th</sup> I.C. space ½ inch inside the midclavicular line

## Phonocardiogram:-

The heart sounds are amplified and recorded by a high-speed recording apparatus

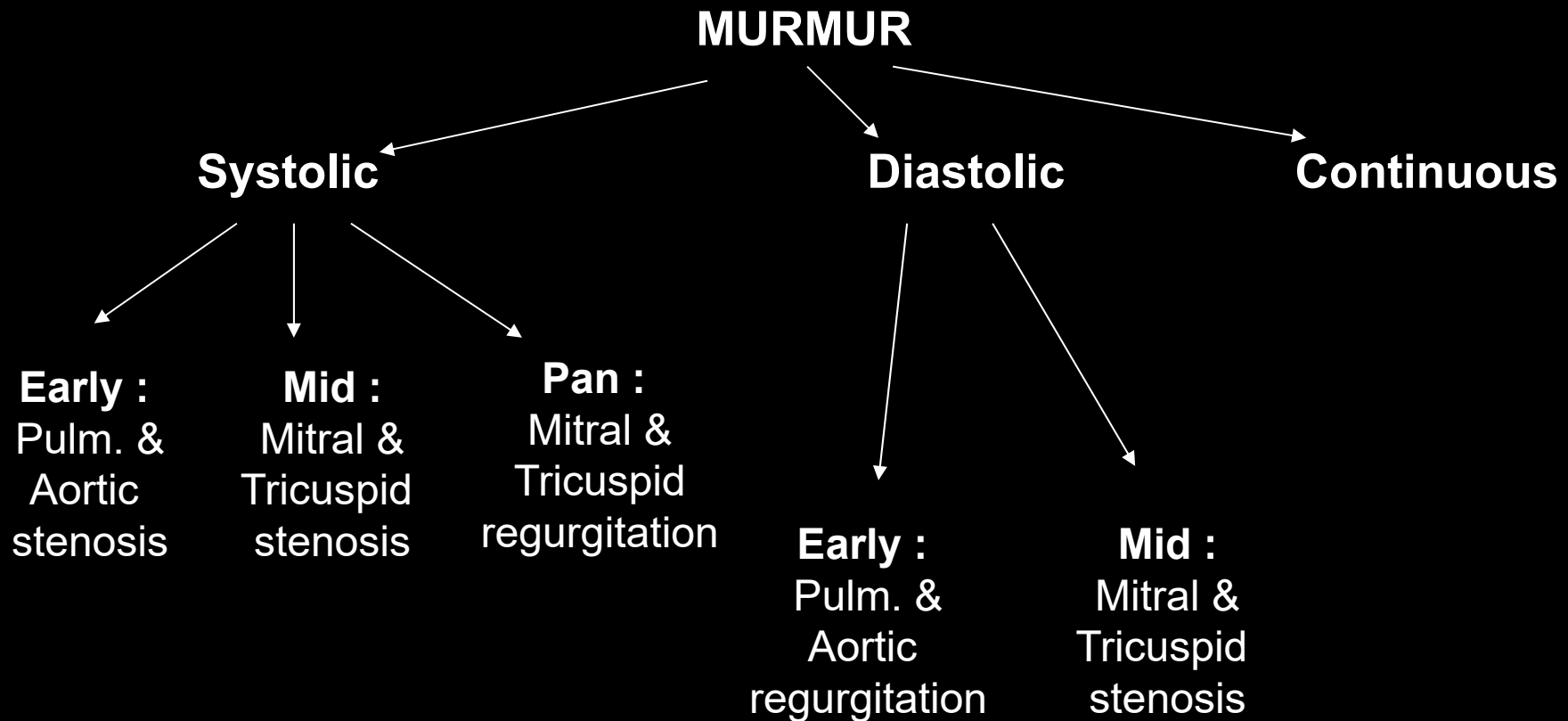
Specially designed to detect low frequency sounds



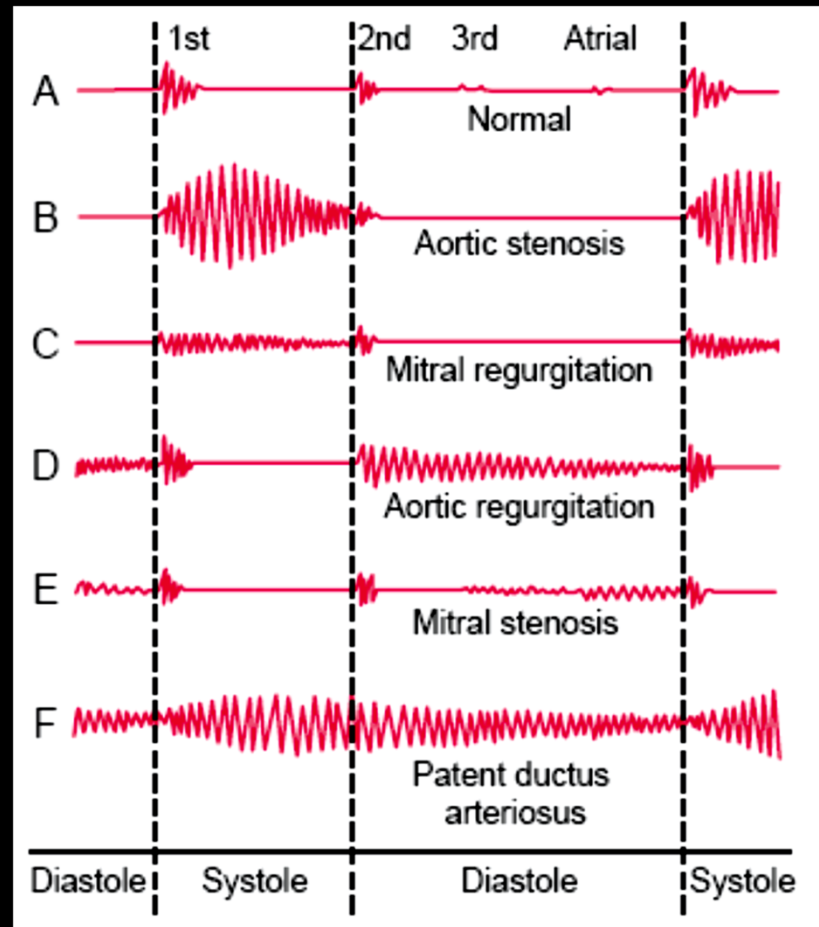
# HEART SOUNDS

## APPLIED PHYSIOLOGY:

❖ Murmurs : murmurs are the sound of long duration heard during the cardiac cycle. They are classified as :



# HEART SOUNDS



# HEART SOUNDS

## APPLIED PHYSIOLOGY:

### ❖ Murmurs :

#### Clinical significance:

- ❖ They always suggest some pathological condition of heart
- ❖ Depending upon its location, cardiological murmur is extremely helpful in diagnosis of various vascular lesions

# HEART SOUNDS

## APPLIED PHYSIOLOGY:

❖ Gallop rhythm:

The 3<sup>rd</sup> heart sound is heard in LVF, RVF, CCF,  
Acute myocardial infection



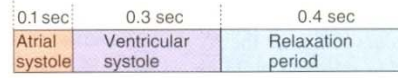
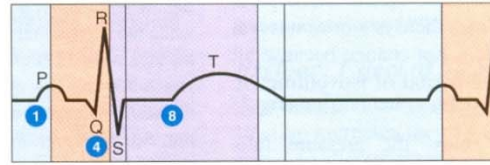
# HEART SOUNDS

## APPLIED PHYSIOLOGY:

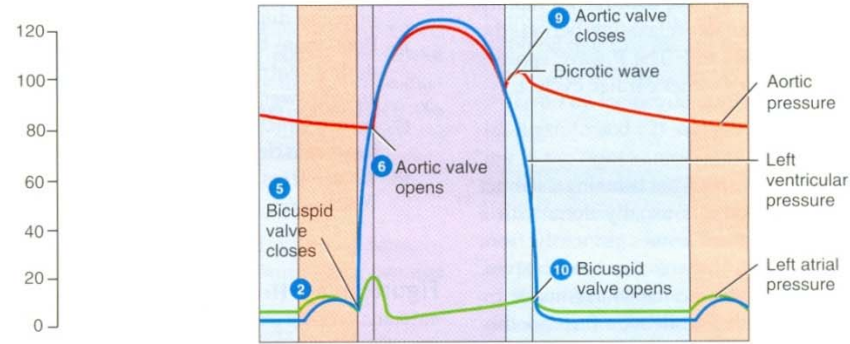
### ❖ Adventitious Sounds

- **Opening Snap:** in Mitral stenosis, a stiff valve snaps into the left ventricle in early diastole
- **Ejection:** high pitched sounds occurring in stenosis of aortic or pulmonary valve.
  - Occurs in systole
- **Prosthetic Valve Sound:** opening of prosthetic valve can be heard

(a) ECG



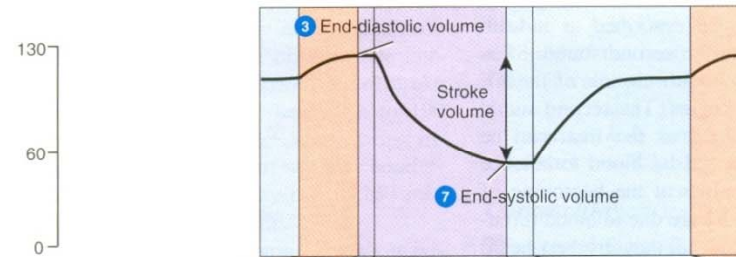
(b) Pressure (mmHg)



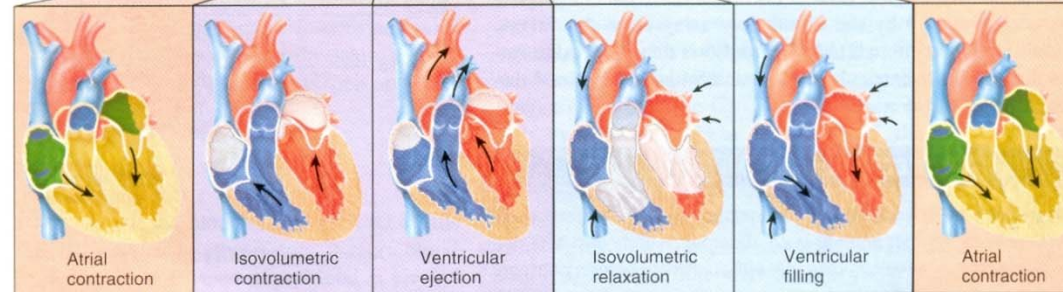
(c) Heart sounds



(d) Volume in ventricle (mL)



(e) Phases of the cardiac cycle



## **JUGULAR VENOUS PULSE:**

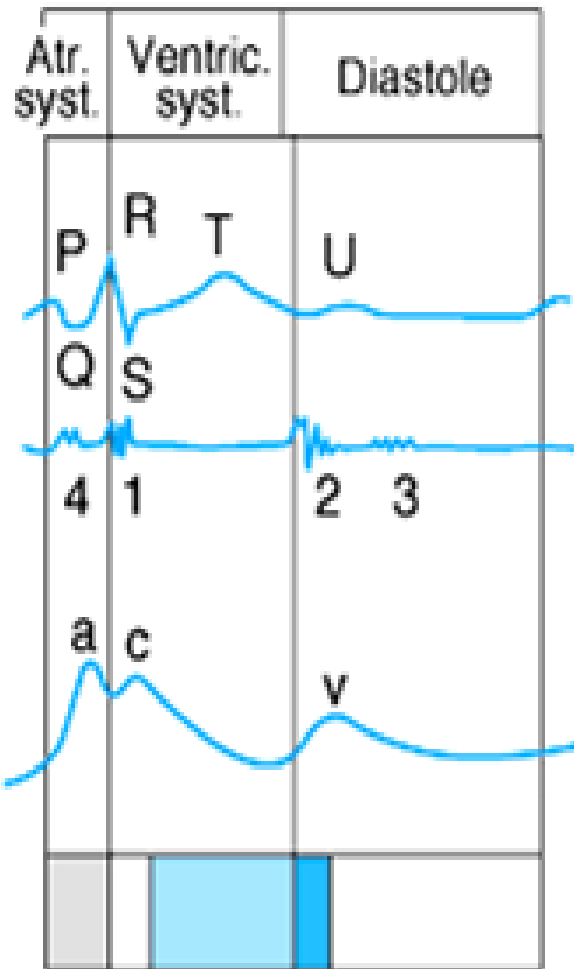
- ❖ The venous pulsation visible in neck is due to external and internal jugular vein.
- ❖ It can be recorded by “Mackencie’s polygraph machine” or by “Phlabogram”
- ❖ It is recorded best in internal jugular vein which is in line with right atrium.

## JUGULAR VENOUS PULSE:

- ❖ It can also be seen by throwing patient's head backwards and turn towards the side where in wave like movement is seen in the region of jugular bulb.
- ❖ Graphical record consist of 3 waves : a, c and v

0 0.2 0.4 0.6 0.8

Time (s)



Electrocardiogram

Heart sounds  
(phonocardiogram)

Jugular venous pressure,  
showing a, c, and v waves

1 2 3 4 5  
Phases of cardiac cycle

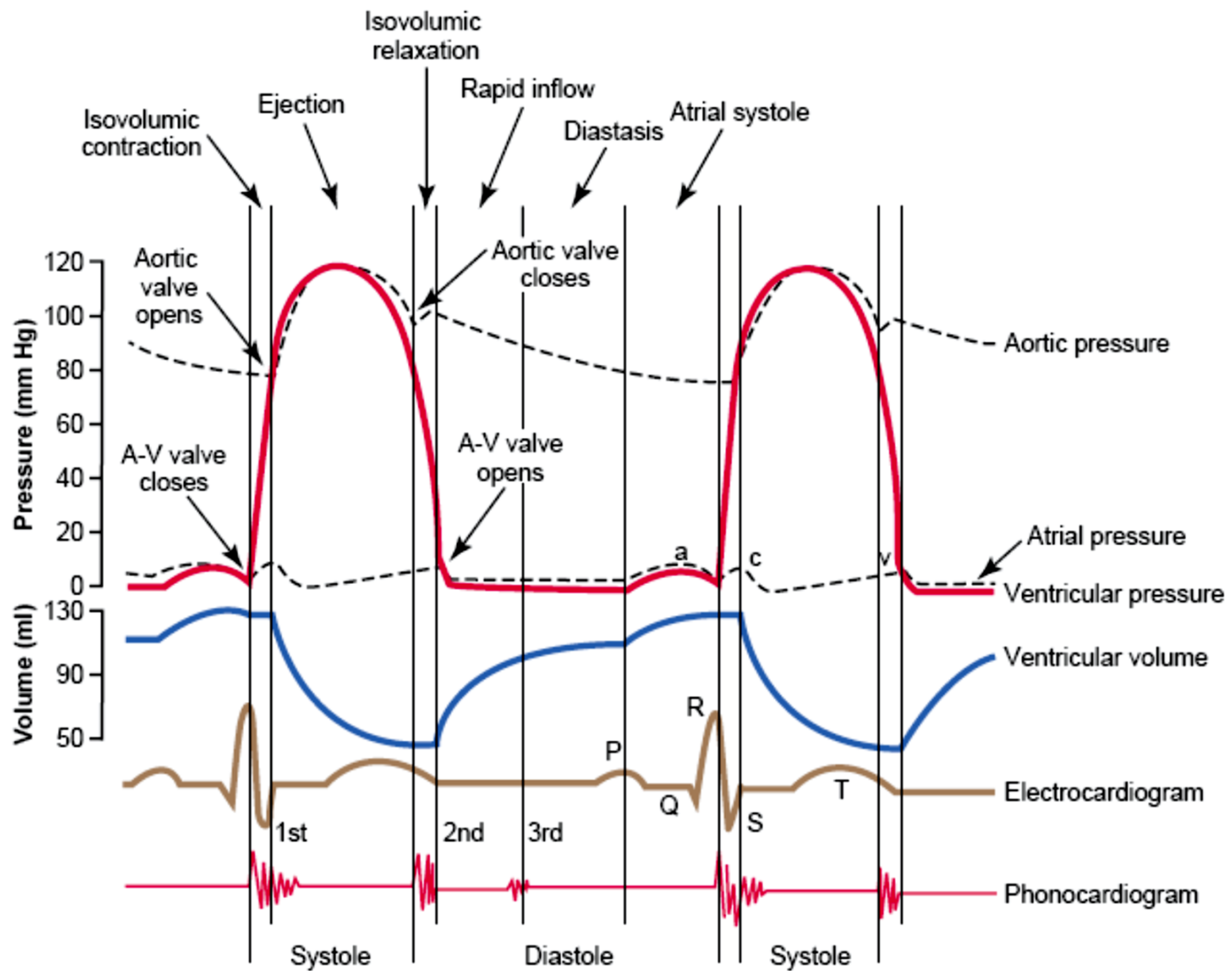
**a** : it is due to atrial systole and narrowing of the cavity

**c** : it is due to isometric contraction of ventricles and bulging of AV valves in to atria

**v** : it is due to gradual filling of atria during isometric relaxation phase

**x** : it is due to the fall of pressure during a dynamic phase of atrial systole

**y** : it is due to the opening of AV valves and blood from atria enters in to ventricles



# PULSE

The pressure wave expands the arterial walls as it travels, and expansion is palpable as the *PULSE*

Velocity of transmission of pulse wave:

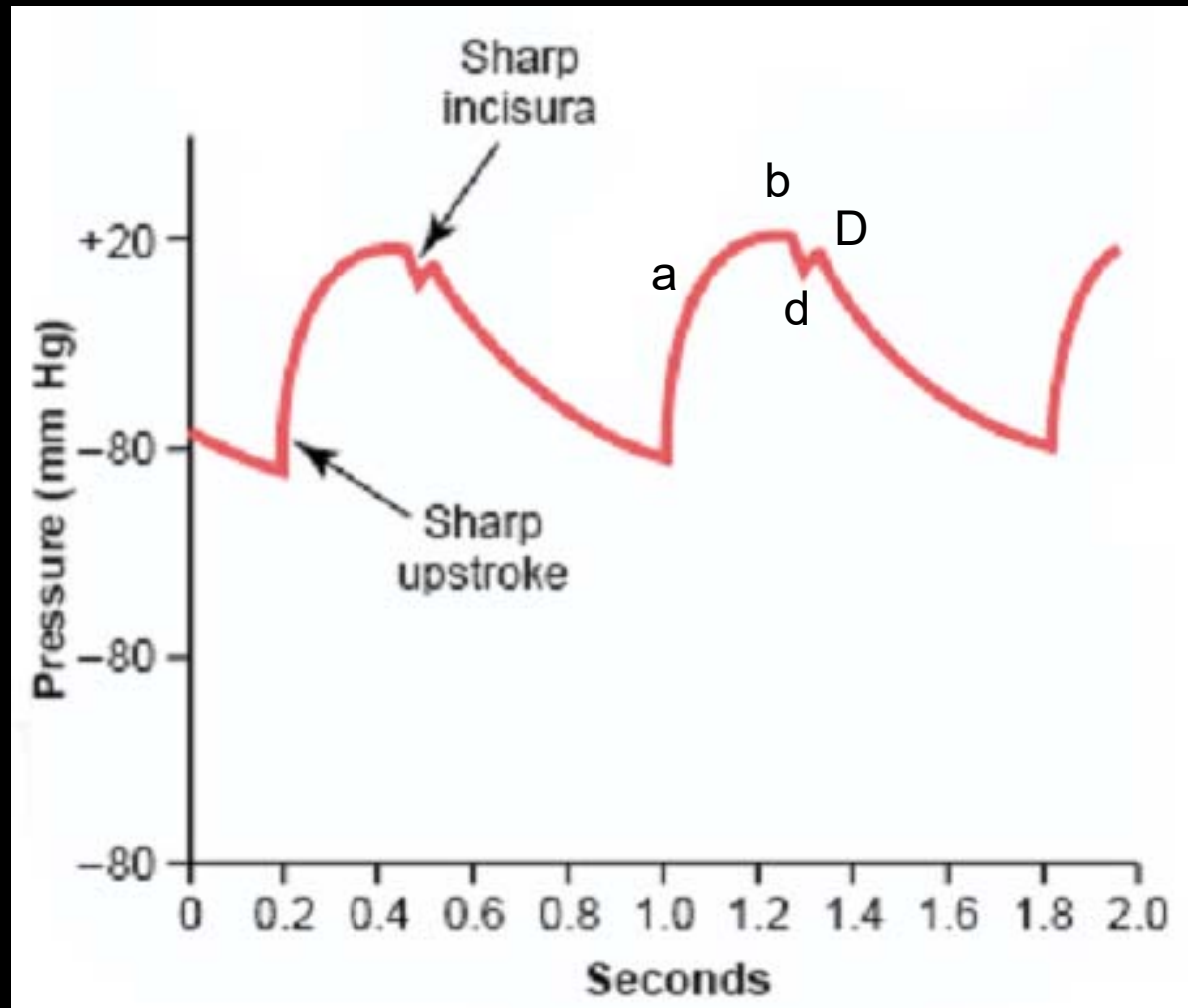
- Aorta : 4 mt. / sec.
- Large arteries : 8 mt. / sec.
- Small arteries : 16 mt. / sec.



# ARTERIAL PULSE TRACING

Radial pulse is recorded with the help of  
“Dudgon’s Sphignogram”

The components are:

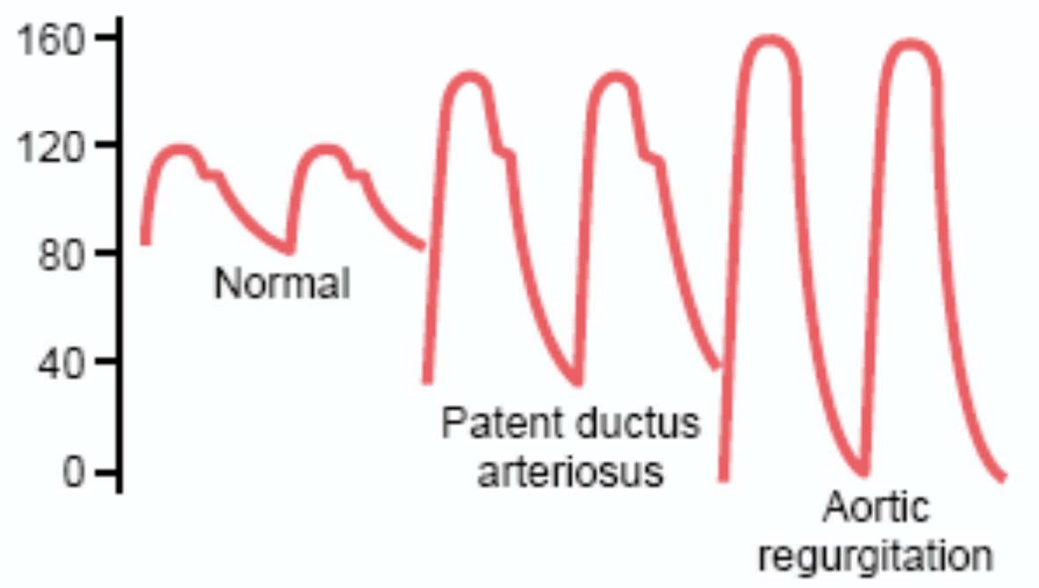
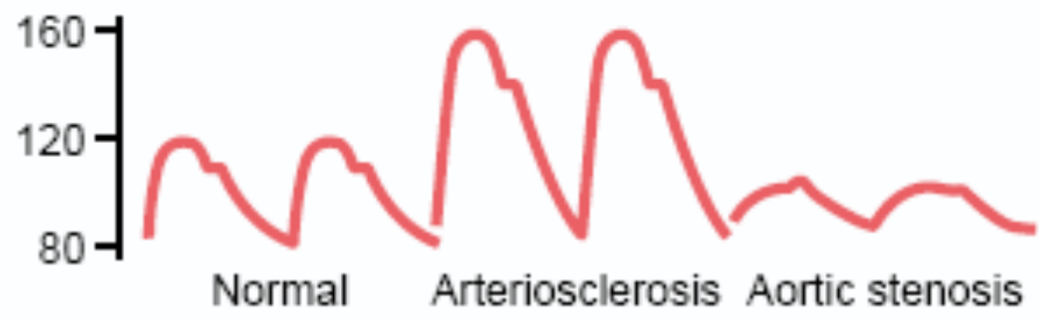


**a:** it is called the “anacrotic wave” or ascending wave. It is due to the ventricular systole

**b:** it is the initial part of descending wave. It is due to the fall of pressure in ventricles in later part of ventricular systole.

**d:** after “b”, pressure continues to fall in ventricles and during relaxation phase, blood column in pulmonary artery and aorta tries to fall back towards the ventricle which causes “d” or “diacrotic notch”

**D:** as the semilunar valves are closed, the blood is reflected back in aorta and pulmonary artery causing “D” or post-diacrotic wave. After that, pressure continues to fall.



# DISCLAIMER

- All figures are taken from Guyton and Hall Textbook of Medical Physiology, 12<sup>th</sup> Edition.