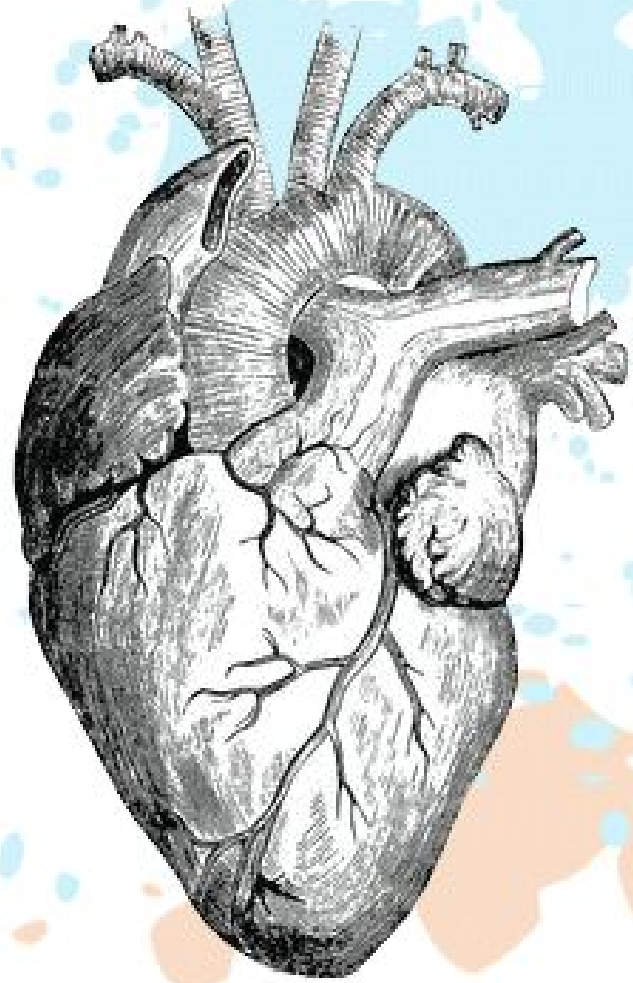


Physiology
OF THE CARDIOVASCULAR SYSTEM

Very important

Extra information

* Guyton corners, anything that is colored with grey is EXTRA explanation

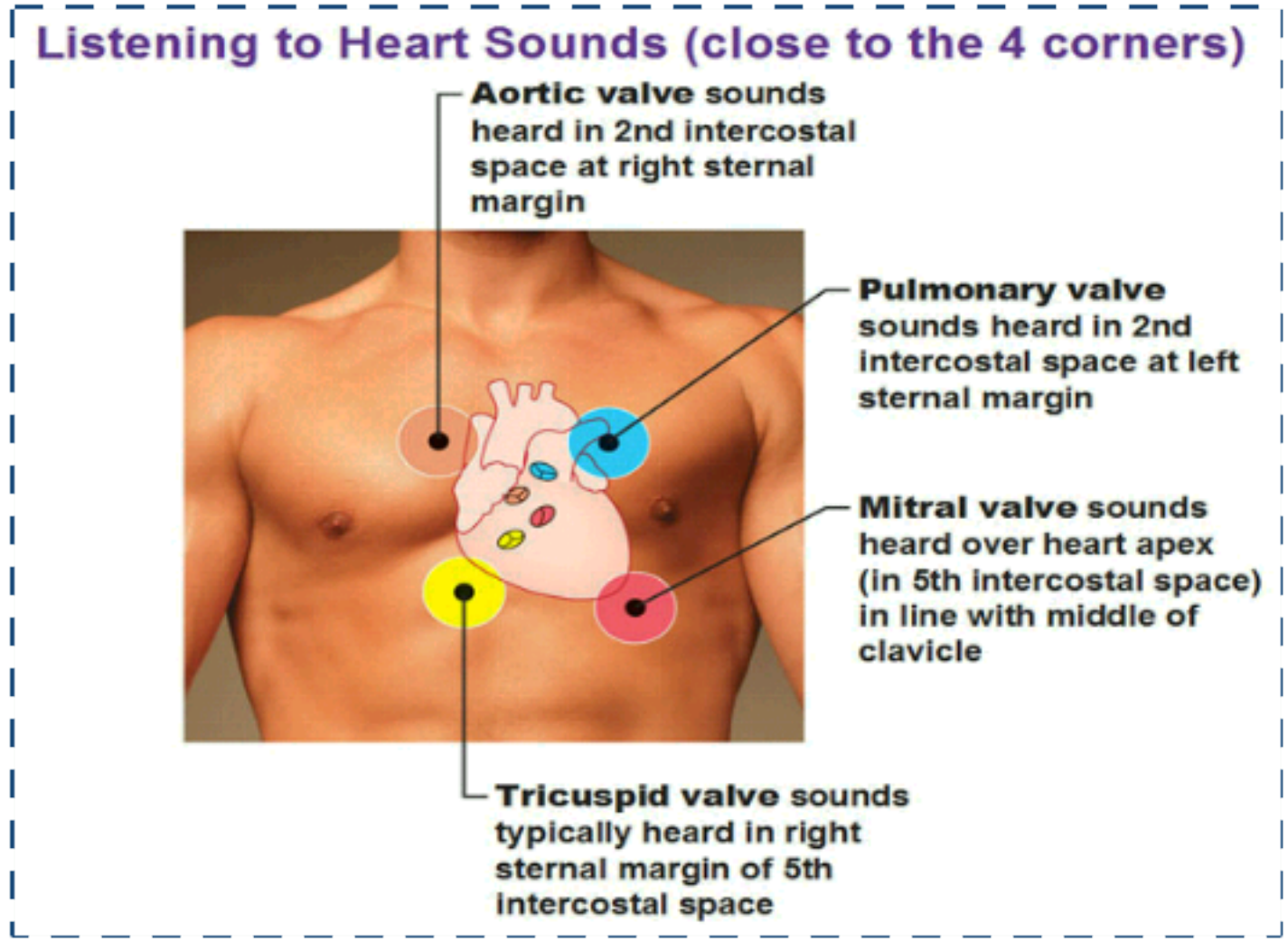
Heart sounds & Murmurs

Objectives :

- Enumerate the different heart sounds.
- Describe the cause and characteristic features of **first** and **second** heart sounds.
- Correlate the heart sounds with different **phases** of cardiac cycle.
- Define murmurs and their clinical importance.

Contact us : Physiology435@gmail.com

Areas of Auscultation

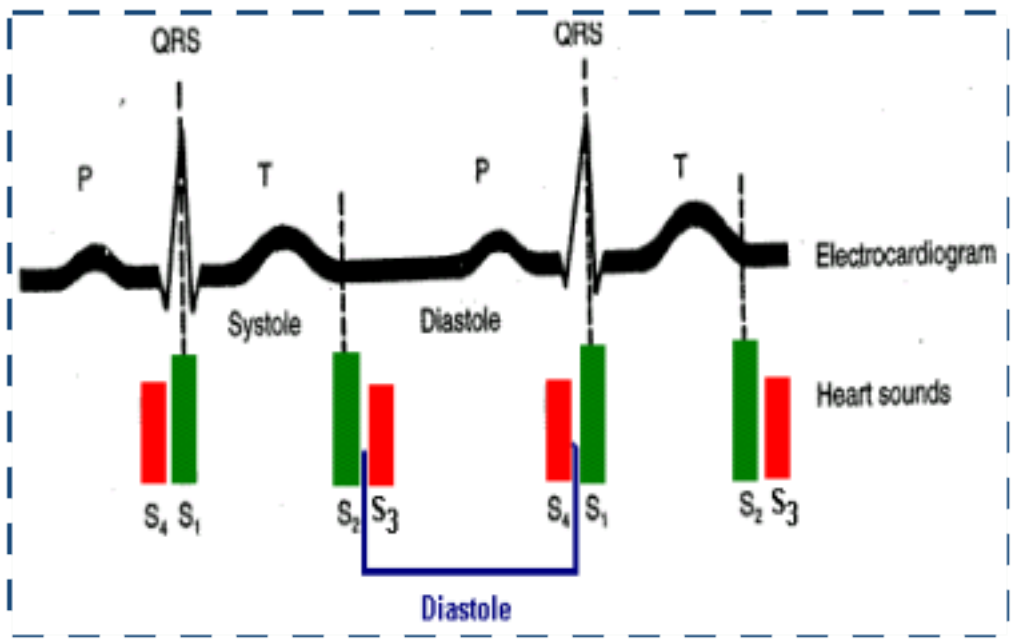


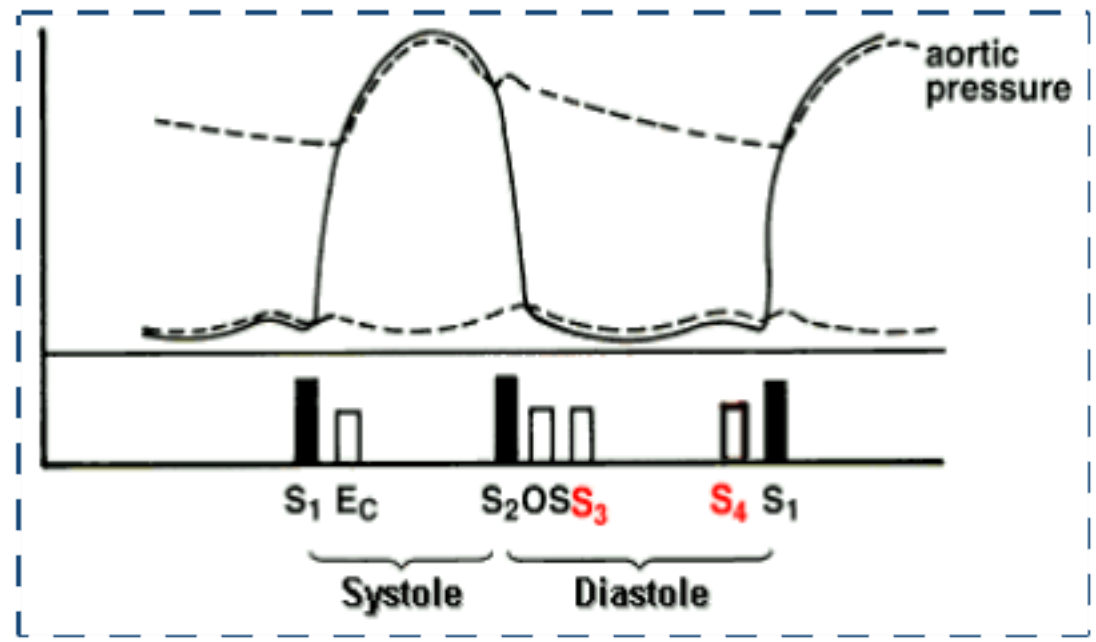
- Guyton corner : (Normal Heart Sounds) :

Listening with a stethoscope to a normal heart, one hears a sound usually described as "lub, dub, lub, dub." The "lub" is associated with closure of the atrioventricular (A-V) valves at the beginning of systole, and the "dub" is associated with closure of the semilunar (aortic and pulmonary) valves at the end of systole. The "lub" sound is called the first heart sound, and the "dub" is called the second heart sound, because the normal pumping cycle of the heart is considered to start when the A-V valves close at the onset of ventricular systole.

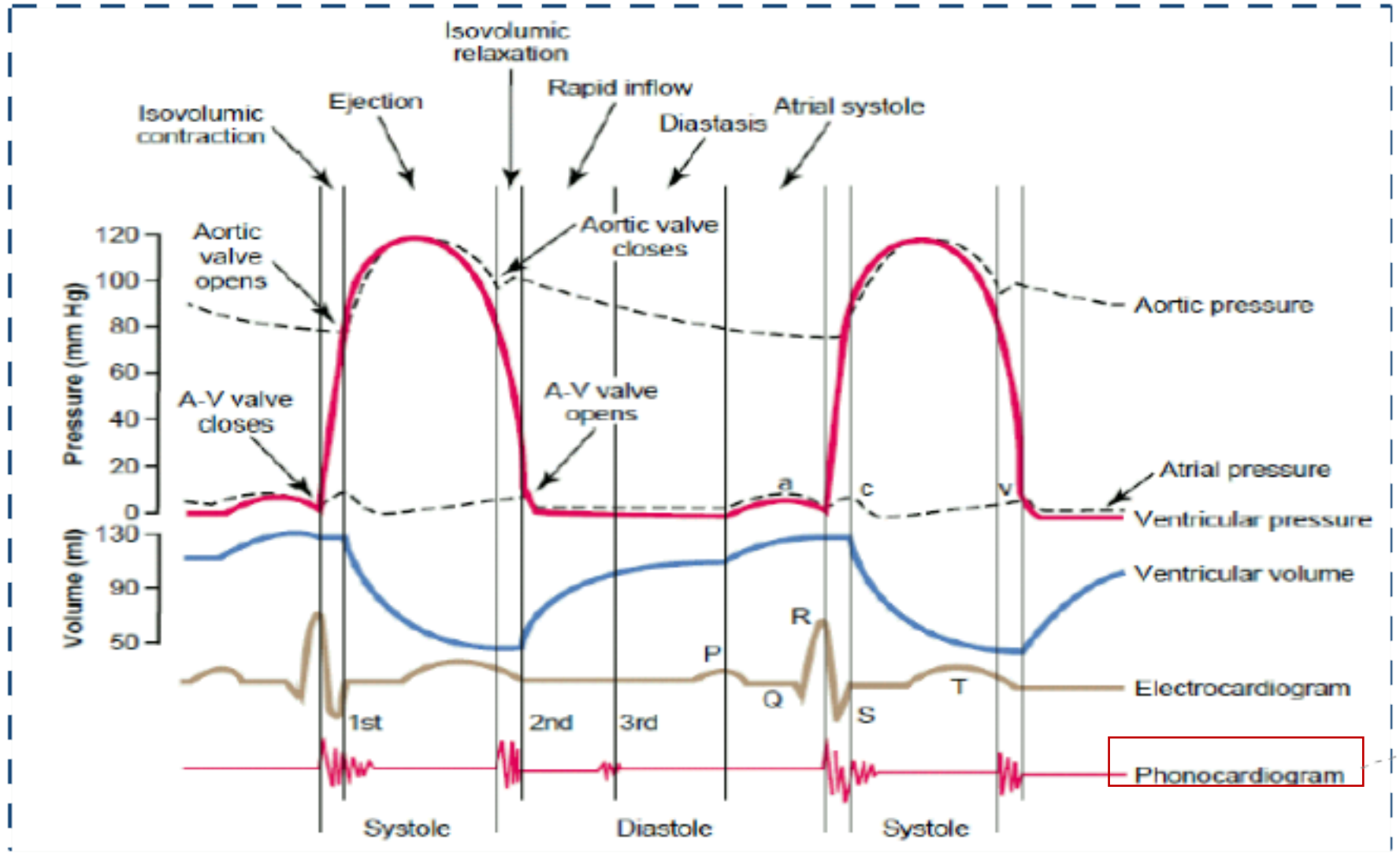
Heart Sounds

- 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 sounds.
- Ventricular Systole is between **First** and **second** Heart sound.
- Ventricular diastole is between **Second** and **First** heart sounds.





Heart Sounds



- Guyton corner : Phonocardiogram

If a microphone specially designed to detect low-frequency sound is placed on the chest, the heart sounds can be amplified and recorded by a high-speed recording apparatus. The recording is called a phonocardiogram, and the heart sounds appear as waves, as shown schematically . Recording A is an example of normal heart sounds, showing the vibrations of the first, second, and third heart sounds and even the very weak atrial sound. Note specifically that the third and atrial heart sounds are each a very low rumble. The third heart sound can be recorded in only one third to one half of all people, and the atrial heart sound can be recorded in perhaps one fourth of all people.

Heart Sounds

S4	S3	S2	S1	
at the last one third of Diastole (just before S1)	at the beginning of middle third of Diastole	due to the closure of Semilunar valves (Aortic & Pulmonary).	due to the closure of Atrioventricular valves (Mitral & Tricuspid).	**Causes**
Due to Atrial systole (rapid flow of blood from Atria to Ventricle and vibration in the blood)	Rush of blood from Atria to Ventricle during rapid filling phase of Cardiac Cycle. It causes vibration in the blood	at the end of the systole	at the beginning of the systole	**Cardiac cycle**
- Also called "Atrial sound" - low pitched sounds - may be heard in elderly - pathologic in the young	- heard in children and young slim adults - pathological in old age	- Sharp - Short - Sound like Dub	- heavier than S2 - Sound like Lub	**Characteristics**
< 20 Hz	20-30Hz	80-90 Hz	50-60 Hz	**Frequency**
	0.1sec	0.12 sec	0.15 sec	**Duration**

*Why does S2 have higher frequency than S1? See the next slide!

Heart Sounds- EXTRA

Why does S2 have higher frequency than S1?

- Guyton corner :

The second heart sound normally has a higher frequency than the first heart sound for two reasons: (1) the tautness of the semilunar valves in comparison with the much less taut A-V valves, and (2) the greater elastic coefficient of the taut arterial walls that provide the principal vibrating chambers for the second sound, in comparison with the much looser, less elastic ventricular chambers that provide the vibrating system for the first heart sound. The clinician uses these differences to distinguish special characteristics of the two respective sounds.

Read more about S3 & S4 :

- Guyton corner :
  - Third Heart Sound.

Occasionally a weak, rumbling third heart sound is heard at the beginning of the middle third of diastole. A logical but unproved explanation of this sound is oscillation of blood back and forth between the walls of the ventricles initiated by inrushing blood from the atria. This is analogous to running water from a faucet into a paper sack, the inrushing water reverberating back and forth between the walls of the sack to cause vibrations in its walls. The reason the third heart sound does not occur until the middle third of diastole is believed to be that in the early part of diastole, the ventricles are not filled sufficiently to create even the small amount of elastic tension necessary for reverberation. The frequency of this sound is usually so low that the ear cannot hear it, yet it can often be recorded in the phonocardiogram.

  - Atrial Heart Sound (Fourth Heart Sound).

An atrial heart sound can sometimes be recorded in the phonocardiogram, but it can almost never be heard with a stethoscope because of its weakness and very low frequency—usually 20 cycles/sec or less. This sound occurs when the atria contract, and presumably, it is caused by the inrush of blood into the ventricles, which initiates vibrations similar to those of the third heart sound.

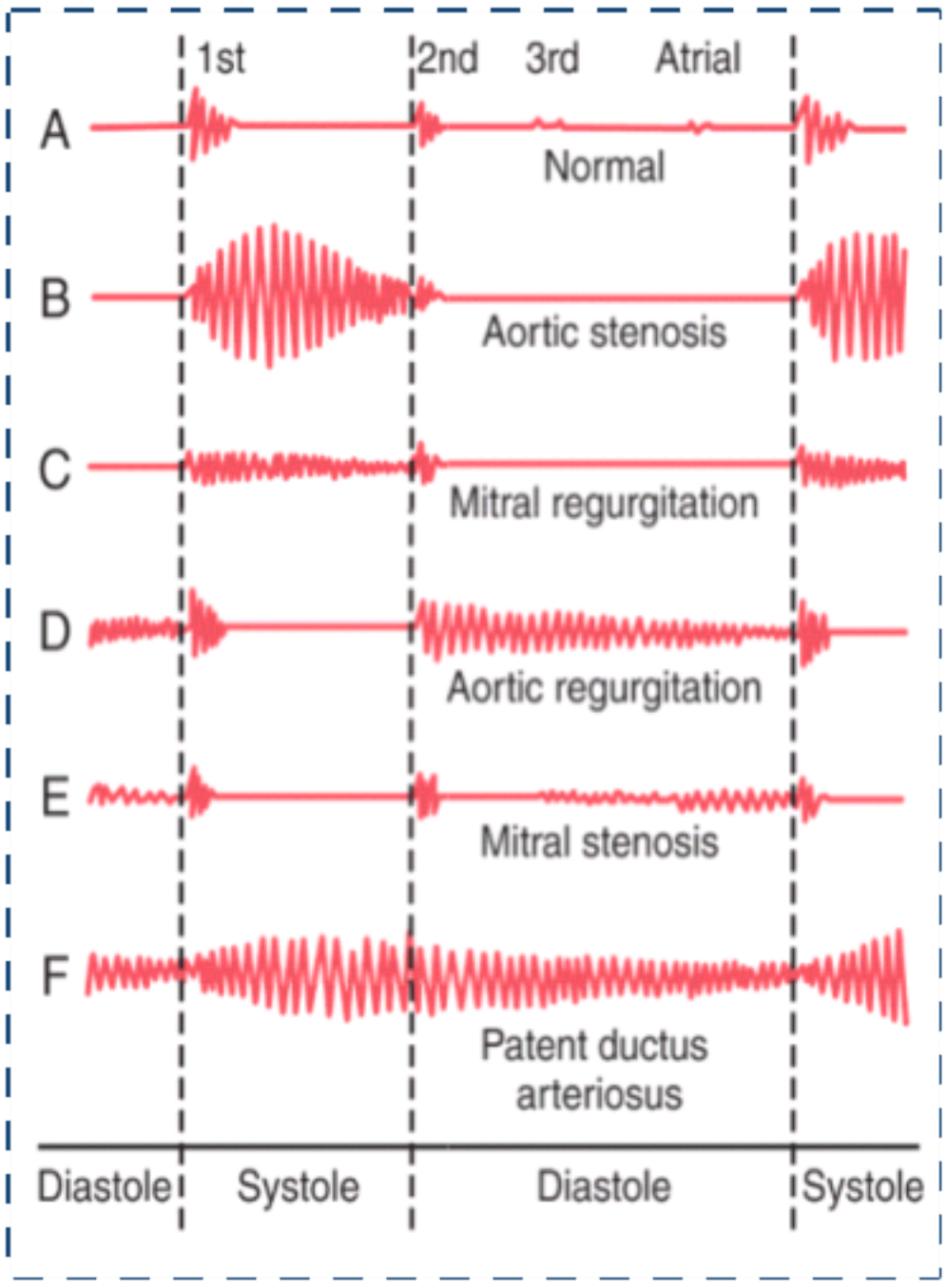
Heart Murmurs

Definition:

- Murmurs are abnormal sounds produced due to abnormal flow of blood.
- Murmurs are pathologic and added heart sounds that are produced as a result of turbulent blood flow.

Valve	Abnormality	Timing of Murmur
Aortic or pulmonary	Stenosis	Systolic
	Insufficiency	Diastolic
Mitral or tricuspid	Stenosis	Diastolic
	Insufficiency	Systolic

Heart Murmurs



- Guyton corner :
  - Systolic Murmur of Aortic Stenosis.

In aortic stenosis, blood is ejected from the left ventricle through only a small fibrous opening of the aortic valve. Because of the resistance to ejection, sometimes the blood pressure in the left ventricle rises as high as 300 mm Hg, while the pressure in the aorta is still normal. Thus, a nozzle effect is created during systole, with blood jetting at tremendous velocity through the small opening of the valve. This causes severe turbulence of the blood in the root of the aorta. The turbulent blood impinging against the aortic walls causes intense vibration, and a loud murmur (see recording B,) occurs during systole and is transmitted throughout the superior thoracic aorta and even into the large arteries of the neck. This sound is harsh and in severe stenosis may be so loud that it can be heard several feet away from the patient. Also, the sound vibrations can often be felt with the hand on the upper chest and lower neck, a phenomenon known as a "thrill."

  - Diastolic Murmur of Aortic Regurgitation.

In aortic regurgitation, no abnormal sound is heard during systole, but during diastole, blood flows backward from the high-pressure aorta into the left ventricle, causing a "blowing" murmur of relatively high pitch with a swishing quality heard maximally over the left ventricle (see recording D, This murmur results from turbulence of blood jetting backward into the blood already in the low-pressure diastolic left ventricle.

  - Systolic Murmur of Mitral Regurgitation.

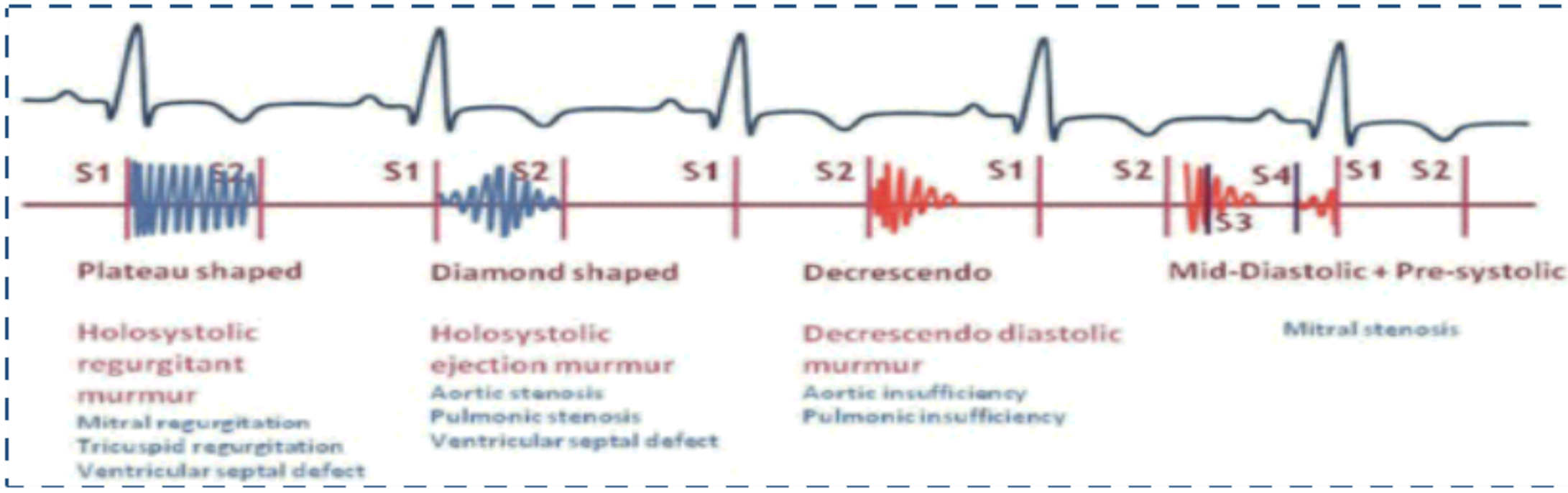
In mitral regurgitation, blood flows backward through the mitral valve into the left atrium during systole. This also causes a high-frequency "blowing," swishing sound (see recording C) similar to that of aortic regurgitation but occurring during systole rather than diastole. It is transmitted most strongly into the left atrium. However, the left atrium is so deep within the chest that it is difficult to hear this sound directly over the atrium. As a result, the sound of mitral regurgitation is transmitted to the chest wall mainly through the left ventricle to the apex of the heart.

  - Diastolic Murmur of Mitral Stenosis.

In mitral stenosis, blood passes with difficulty through the stenosed mitral valve from the left atrium into the left ventricle, and because the pressure in the left atrium seldom rises above 30 mm Hg, a large pressure differential forcing blood from the left atrium into the left ventricle does not develop. Consequently, the abnormal sounds heard in mitral stenosis (see recording E) are usually weak and of very low frequency, so most of the sound spectrum is below the low-frequency end of human hearing.

During the early part of diastole, a left ventricle with a stenotic mitral valve has so little blood in it and its walls are so flabby that blood does not reverberate back and forth between the walls of the ventricle. For this reason, even in severe mitral stenosis, no murmur may be heard during the first third of diastole. Then, after partial filling, the ventricle has stretched enough for blood to reverberate and a low rumbling murmur begins.

Heart Murmurs



How to remember heart murmurs ? [Timing] :

- Systolic : *ASMR* "أسمر" :
  - AS : Aortic Stenosis
  - MR : Mitral Regurgitation
- *ASMR = Systolic, so the rest are Diastolic*
- *NOTE :* Regurgitation = *Insufficiency*

Physiology
OF THE CARDIOVASCULAR SYSTEM

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- Elham Alzahrani
- Johara Almalki
- Lojain alsiwat
- Malak Alsharif
- Monirah Alsalouli
- Nora AlRomaih
- Nurah Alqahtani
- Nouf Alabdulkarim
- Nora Albusayes
- Nora Alsomali
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- Reem Alageel
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- Adel Alshehri
- Abdulaziz Alghanaym
- Abdulmajeed Alotaibi
- Khalil Alduraibi
- Hassan Albeladi
- Omar Alshehri
- Saleh Alshawi
- Abdulaziz Alhammad
- Faisal Alabdulatif
- Abdulnasser Alwabel
- Saad Almutairy