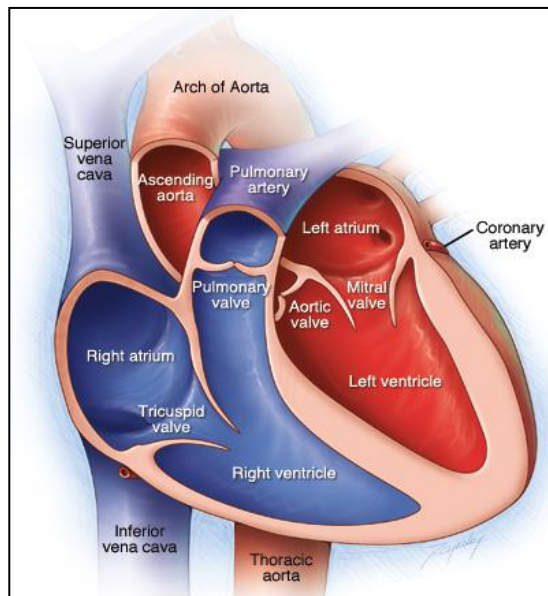


### 3- Heart sounds

#### Introduction:

Each side of the heart consists of two chambers, the atrium and the ventricle. Between atria and ventricles, there are mitral and tricuspid valves and between ventricles and aorta and pulmonary artery, there are aortic and pulmonary valves respectively (Figure 3.1).



**Figure 3.1** Anatomy of the heart

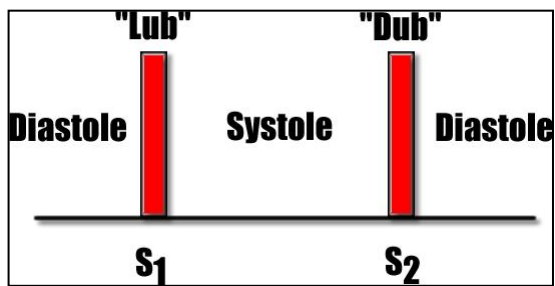
Heart sounds originate from the vibration associated with the closure of heart valves. The characteristic heart sound is lup-dup-pause-lup-dup-pause rhythm. Auscultation of the heart requires a stethoscope with a bell and diaphragm (Fig.3.2). The bell is best for listening to low-pitched sounds such as the murmur of mitral stenosis. The diaphragm filters out such sounds and helps to identify high-pitched sounds such as normal heart sounds. The most important features of stethoscope are the extraneous noises must be excluded as far as possible and that the condition of sound from the chest pieces should be as complete as possible. In order to achieve these, the ear pieces should be well fitting and there should be no leaks elsewhere. The tube should be of small diameter, relatively short, and with polished inner surface to reduce loss of conduction by friction. Plastic tubing is much more efficient in this capacity than rubber. Two heart sounds (S1, S2) are normally heard during cardiac cycle by stethoscope with or without additional heart sounds (S3, S4). Low frequency sounds are detected by phonocardiogram.



**Figure 3.2** Stethoscope

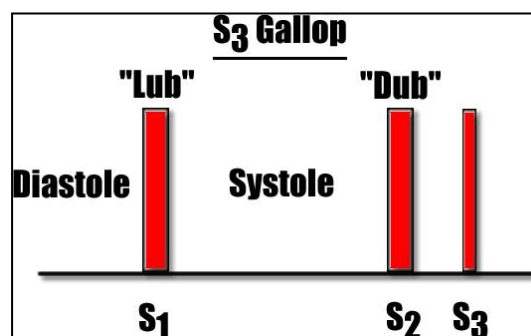
1-The **first heart sound (S1)** (**Fig. 3.3**) is low pitch (25 – 45 Hz), slightly prolonged (0.14 - 0.15 second), caused by vibration associated with the closure of the mitral and tricuspid valves at the start of ventricle systole. It is normally loudest at the apex area. Quiet S1 is heard in low cardiac output, poor left ventricular function and long PR interval. Loud S1 is heard in increased cardiac output, mitral valve stenosis and short PR interval

2-The **second heart sound (S2)** is shorter (0.12 second), high pitch (50 Hz), caused by vibration associated with the closure of the aortic and pulmonary valves just after the end of ventricular systole (**Fig. 3.3**). It is best heard at left sternal edge. The interval between the aortic and pulmonary valve closure during deep inspiration is long enough for the second sound to be reduplicated (physiological splitting). This is because left ventricular contraction slightly precedes right ventricular contraction and further delay is due to increased venous return and increased right ventricle filling. The aortic component of S2 is well heard in the aortic area while pulmonic component of S2 is usually heard in pulmonary area. Quiet S2 is heard in low cardiac output and aortic regurgitation. Loud S2 is heard in systemic and pulmonary hypertension.



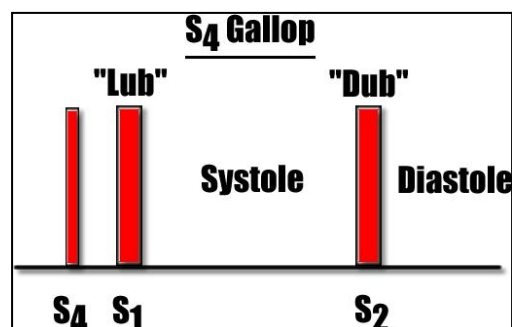
**Figure 3.3** First & Second heart sound

3-A soft (0.1 second), low pitched **third heart sound (S3)** is heard about one-third of way through diastole (Fig.3.4). It coincides with the period of rapid ventricular filling and due to vibration set up by inrush of blood. It is best heard at the apex. It can be physiological or pathological. Physiological causes include healthy young adult, athletes, pregnancy and fever. S3 is usually pathological after the age of 40 and is associated with heart failure. S3 accompanied by tachycardia in heart failure result in 'triple rhythm' or gallop rhythm resembling the sound of galloping horse. Normally S3 disappears completely when the patient sits or stands.



**Figure 3.4** Third heart sound

4- A **fourth heart sound (S4)** is a very soft, low-pitched sound that occurs just before the first sound (late diastole) when atrial pressure is high (Fig.3.5). It is pathological and caused by forceful atrial contraction. It is best heard with the bell of stethoscope at the apex. S4 is heard in conditions associated with left ventricular hypertrophy such as hypertension and aortic stenosis.



**Figure 3.5** Fourth heart sound

**Murmurs or bruits:-**

They are abnormal sounds heard in vascular system due to turbulent blood flow in the heart. Normally blood flow is laminar and non-turbulent so it is silent. Murmurs are caused either by abnormal heart valve function or arise from increased volume, or velocity of blood flowing through normal valve. Murmurs may occur in healthy heart when stroke volume is increased like e.g. during pregnancy and in athletes. Murmurs can be classified according to timing into systolic, diastolic or continuous murmurs.

**There are four sites** at which sound of murmurs arising from the four valves are best heard (Fig.3.6).

**1-The apex area (mitral area):-**

It is at 5<sup>th</sup> intercostal space, at mid-clavicular line, below left mammary.

**2- The tricuspid area:-**

It is at left lower end of sternum.

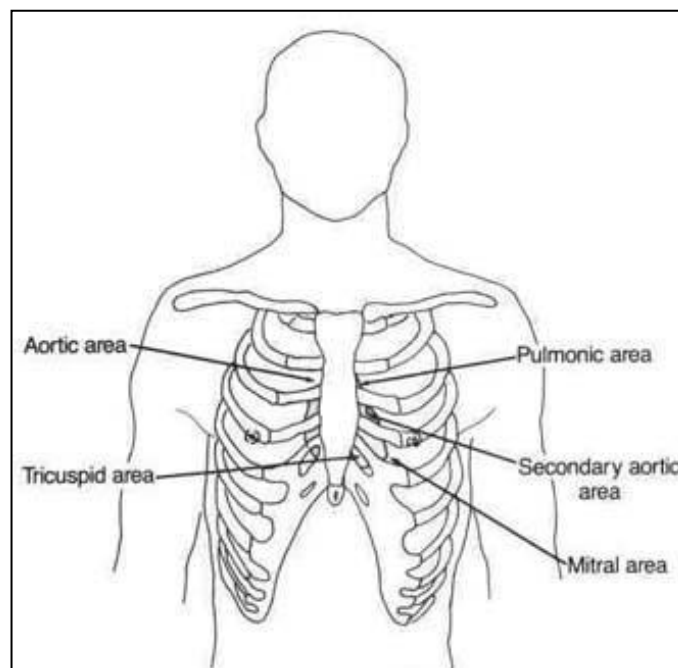
**3- The aortic area:-**

It is at right to sternum in 2<sup>nd</sup> intercostal space.

**4- The pulmonary area:-**

It is at left to sternum in 2<sup>nd</sup> intercostal space.

The murmurs arising from the four valves are best heard on these sites. It is advisable to have a fixed routine for auscultation. Most clinicians first auscultate at the apex then proceed to tricuspid, pulmonary and aortic area.



**Figure 3.6** Anatomical location of heart sounds auscultation areas

**Objective:-**

To hear heart sounds.

**Materials and instruments:-**

- 1- Subject.
- 2- Stethoscope.

**Procedures:-**

- 1- Put the bell or diaphragm of stethoscope on apex area to hear heart sounds and proceed to tricuspid, pulmonary and aortic areas.
- 2- If you heard murmur, move the stethoscope from one area to another, to hear the loudest sounds of murmur in different areas which are mentioned before.
- 3- It wise to palpate carotid artery during auscultation to avoid error of mistaking systole from diastole and vice versa.
- 4- Calculate the heart rate.

**Role of echocardiography in assessing heart disease (Fig.3.7):**

An echocardiography (echo=sound + card=heart + graphy=drawing) is an imaging technique test that uses ultrasound waves to produce moving real-time images of the heart. It provides information about the structure and function of the heart including heart valves assessment.



**Figure 3.7** Echocardiography