Chapter

22 Examination of Cardiovascular System

First do a general examination with special emphasis to dyspnea, cyanosis, clubbing of fingers, edema and jugular venous pressure. Most patients with cardiovascular disease will present with difficulty in breathing, palpitation, and chest pain especially on exertion, raised JVP, cyanosis or edema. Clubbing is present in congenital cyanotic heart disease and infective endocarditis. Pitting edema in the dependent parts is a cardinal feature of congestive heart failure.

Examination of cardiovascular system is done under the following headings:

- Arterial pulse
- Recording of blood pressure
- Venous pulse
- Examination of precordium

EXAMINATION OF ARTERIAL PULSE

Arterial pulse is an expansile wave transmitted along the arteries due to ejection of blood from the left ventricle into the already full aorta, and which is transmitted along the vessel wall and is felt in the peripheral arteries. Usually the radial artery is examined.

The patient should be at complete physical and mental rest for at least 3 minutes before examining the pulse. The radial pulse on the right side should be examined. The pulse on the left side must also be examined in cardiac patients.

The right forearm of the subject is held in the semi-prone position with the wrist and elbow slightly flexed. The radial pulse should be felt against the head of radius with the tips of the middle three fingers of the examiner's left hand (Fig. 22.1). The following points should be noted.

1. Rate
2. Rhythm
3. Volume
4. Character
5. Symmetry (equality on both sides)
6. Condition of the vessel wall
7. Radio-femoral delay
8. Palpation of other peripheral pulses

Fig. 22.1: Palpation of radial pulse

Rate

The pulse is counted for complete one minute and is expressed in beats per minute. If it is counted for 15 sec and multiplied by 4 it may not be accurate because of sinus arrhythmia (heart rate is increased during inspiration and decreased during expiration). The normal pulse rate ranges between 60-100 beats/min (average 80/min). Increase in pulse rate above 100/min is **tachycardia** (seen in exercise, anxiety, excitement, fever, thyrotoxicosis, tachyarrhythmia and circulatory shock) and decrease in heart rate below 60/min is **bradycardia** (seen in athletes, myxedema and in heart blocks).

Rhythm

See whether the pulse beats at regular intervals. Comment as regular or irregular. If irregular, see whether it is **regularly irregular or irregularly irregular**. An irregular rhythm may be due to atrial fibrillation, frequent ectopic beats, or due to paroxysmal arrhythmias. Sinus arrhythmia is increase in the pulse rate during inspiration and decrease during expiration. It is a physiological phenomenon caused by a change in vagal tone affecting the sinoatrial node, during each respiratory cycle. The variation is markedly observed in children and during sleep.

If the pulse is irregular, look for **pulse deficit**. The examiner auscultates the heart rate while an assistant counts the pulse rate for the same minute. The difference between heart rate and pulse rate is called pulse deficit. Pulse deficit is seen in atrial and ventricular fibrillation.

Volume

Volume of the pulse is defined as the amplitude of expansion of the vessel wall produced by the pulse wave. Feeling the volume of the pulse can assess the pulse pressure. The pulse may have a normal, high or low volume. It is constant from beat to beat. The volume of the pulse is a measure of the amount of blood flowing through the artery during each beat. It is directly related to the stroke volume. Low volume pulse is felt in circulatory shock and heart failure. In circulatory shock pulse is referred to as weak and thready (low-volume). High volume pulse is felt during exercise, in old age and in aortic regurgitation. In aortic regurgitation the pulse is described as collapsing pulse. Pulses alternans and pulses paradoxes are volume abnormalities.

Character of the Pulse

Character describes the volume, tension and waveform of the pulse. Tension is the pressure required to obliterate the pulse and it can be normal, increased or decreased. Character of the pulse is usually evaluated at the right carotid artery or the radial artery. It can be better studied by sphygmography. An upstroke and a down stroke can be recorded for each pulse wave (Fig. 22.2). The normal pulse waveform is catacrotic. Abnormalities in pulse character include anacrotic pulse, dicrotic pulse, bisferiens pulse and collapsing pulse.

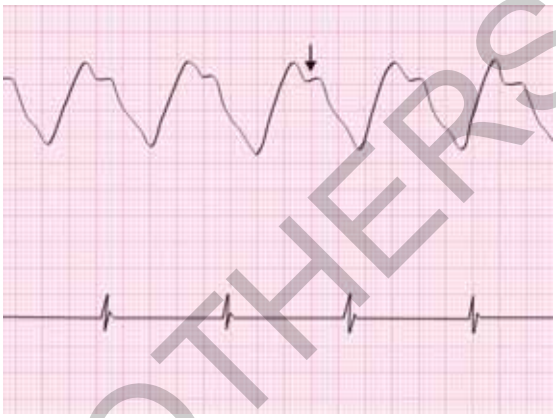

Fig. 22.2: Arterial pulse recorded in a physiograph from the finger (upstroke of each wave is the anacrotic limb, down stroke is the catacrotic limb. In the down stroke, note the dicrotic notch represented by the arrow)

Abnormal Pulses

- **Collapsing or water hammer or Corrigan's pulse** characterized by rapid upstroke and rapid down stroke of the pulse wave. It is a large volume pulse and is seen in aortic regurgitation and patent ductus arteriosus. For the examination of collapsing pulse, feel for the radial artery with the distal aspect of the examiner's right palm. The collapsing pulse can be exaggerated at the radial artery by lifting the arm. Elevate the limb vertically up to 90° swiftly, to feel for a thud or collapse.
- **Pulses paradoxes** are seen in large pericardial effusion and in constrictive pericarditis (at the end of deep inspiration, pulse becomes weaker or even disappears). It is called paradox because heart sounds may be heard on auscultation of the precordium at a time when no pulse is palpable at the site of radial artery.
- **Pulses alternans** where a high volume pulse is followed by a low volume pulse due to left ventricular failure (e.g. myocardial infarction of left ventricle).
- **Biphasic pulse or bisferiens pulse** with two peaks in systole. It is seen in mixed aortic valve disease.
- **Anacrotic pulse** is slow rising and late peaking pulse.
- **Dicrotic pulse**: Single pulse wave with one peak in systole and one peak in diastole.

Symmetry

Symmetry of the radial, brachial, carotid, femoral, popliteal, posterior tibial, and dorsalis pedis pulses should be confirmed. Reduced or absent pulse indicates obstruction proximally in the artery which can be caused by thromboembolism.

Condition of the Vessel Wall

The radial artery is palpated with the index, middle and ring finger of the right hand of the examiner. Compress the artery with the index finger or the proximal finger and empty the vessel by squeezing distally with the ring finger or the distal finger. The middle finger is pressed

sufficiently hard and the vessel is rolled against the bone beneath it, to feel for the texture of the vessel wall. In the young adults the vessel wall cannot be felt distinctly. In elderly people it may be distinctly felt as a cord as a result of thickening of the vessel wall due to atherosclerosis.

Radiofemoral Delay

Compare the radial pulse and the femoral pulse simultaneously. Palpate the right radial artery of the subject with the fingers of the left hand and palpate the right femoral artery with the right hand and feel for the delay. Normally the femoral pulse comes ahead of the radial pulse. Normal delay of pulse from the arch of aorta to the radial artery is 80 ms and to the femoral artery is 75 ms. Delay of the femoral pulse when compared with the radial pulse is seen in coarctation of aorta.

Palpation of Other Peripheral Vessels

Carotid artery: With the subject in the supine position, gently palpate the carotid artery with the thumb at the level of the thyroid cartilage against the transverse process of sixth cervical vertebra. To examine the left carotid use the right thumb and vice versa. Both the carotids should not be palpated simultaneously.

Femoral artery: Palpate the artery with three fingers or the thumb at the midpoint between anterior superior iliac spine and the pubic symphysis.

Popliteal artery: Flex the supine subject's knee at 120° and place the fingertips of both the hands of the examiner on the popliteal fossa with the thumbs resting on the subject's patella. Feel for the popliteal artery.

Posterior tibial artery: Palpate the artery at a distance of 1 cm behind the medial malleolus with the foot relaxed between plantar and dorsiflexion.

Dorsalis pedis artery: Palpate the artery against the tarsal bones in the first intermetatarsal space proximally.

MEASUREMENT OF ARTERIAL BLOOD PRESSURE

Blood pressure is the lateral force exerted by the blood column per unit area of vascular wall and is expressed in mm of mercury. It is recorded using a sphygmomanometer with the subject in the sitting or lying down posture. Both palpatory and auscultatory methods should be done. (Details given in Chapter 20).

JUGULAR VENOUS PRESSURE (JVP)

Jugular venous pressure is defined as the height of the vertical column of blood in the internal jugular vein, above the sternal angle measured in centimeters. The right internal jugular vein is examined under good light with the subject reclined at an angle of about 45° with the horizontal. The head should rest on a pillow and chin should be in the midline. Elevate the chin slightly to stretch the skin over the lower neck and supraclavicular area. The internal jugular vein lies adjacent to the medial border of the sternocleidomastoid muscle.

The right internal jugular vein reflects the right atrial pressure (central venous pressure) as it is directly in line with the right atrium. In normal individuals jugular venous pulse (JVP) is

not visible in the neck in the above-mentioned position of the subject, because it is just below the clavicle. If visible, it indicates elevation of right atrial pressure. If visible, mainly two waves can be distinguished in the venous pulse 'a' and 'v' waves. The 'c' wave of jugular venous pulse tracing is a very small wave and it is not visible over the neck. JVP may be visible normally when the subject is in the supine position.

Since the jugular vein reflects right atrial pressure the **jugular pulse tracing** also has the same waves as that of atrial pressure changes, i.e., a, c, v which are positive waves and x and y descend (Fig. 22.3). The perpendicular level at which pulsation is obtained over the jugular vein depends on the hydrostatic pressure in the right atrium. Normally it corresponds to manubrium sterni in the erect posture. So it is not visible in the erect posture. When the person is reclined at an angle of 45°, the pulsation cannot be seen above the clavicle. If the pulsation is seen above the clavicle at this angle, then there is increase in the right atrial pressure and it indicates some pathology. Normal jugular venous pressure (central venous pressure) is 6 mm Hg.

View the jugular pulse waves and time the waves with the carotid pulse by simultaneously palpating the left carotid artery with the left hand, which is passed behind the subject's neck. The 'a' wave comes just before the carotid pulse while the 'v' wave comes with the carotid pulse or follows the carotid pulsation. The 'a' wave is produced by atrial systole. In atrial fibrillation, there is no 'a' wave and the JVP loses its double waveform.

Fig. 22.3: Waves of jugular venous pulse

Measurement of JVP

The jugular venous pressure is measured in centimeters vertically from the sternal angle to the upper level of the venous waveform. To measure the JVP, a scale is placed vertically from the sternal angle and a second scale is placed horizontally at the upper level of the vertical oscillating column of blood. The distance from the sternal angle to the horizontal scale is measured in cm (Fig. 22.4).

The normal upper limit is 4 cm. This is about 9 cm above the right atrium and corresponds to a pressure of 6 mm Hg. Elevation of JVP indicates a raised right atrial pressure or superior vena caval obstruction.

Hepatojugular Reflux

With the subject inclined at an angle of 45°, the examiner who is standing on the right side of the subject should apply firm pressure over the mid-abdomen for at least 30 seconds. In normal individuals the rise in jugular venous pressure will be less than 3 cm and it is not sustained,

Fig. 22.4: Measurement of JVP

returning to normal in less than 3 cardiac cycles. In right heart failure, a sustained rise in JVP more than 3 cm is obtained.

EXAMINATION OF PRECORDIUM

Inspection

Chest should be bare when the precordium is examined. Precordium is the part of the chest overlying the heart. The subject should lie relaxed on an examination couch in the supine position or at 45° to the horizontal. Look for the following:

1. Shape of precordium
2. Position of the apical impulse
3. Other visible pulsations over the chest

During inspection observe the shape of the precordium and see whether there is any bulging or depression of precordium or other deformities. See whether the apex beat is visible. Mention the position in relation to nipple in the male. In addition, look for pulsations outside the precordium like the carotid pulsations in the neck and the veins and venous pulsations in the neck. Look for pulsations in the supraclavicular, suprasternal, second intercostal spaces and the epigastrium. See whether there are dilated veins over the thorax and the abdomen.

- Cardiac impulse refers to the diffuse movements occurring in the precordium due to the impact of heart against the chest wall during ventricular systole. Apex beat is seen as forceful, repetitive, rhythmic bulging movement in the left and lower part of the area of cardiac impulse. The rate will be same as that of the pulse rate. It may not be visible because of obesity, thick muscular chest wall, if the apex beat lies behind a rib, in scoliosis and after deep inspiration when the lungs cover the heart. It may not be visible on the left side if the heart is on the right side (dextrocardia).
- When the cardiac impulse is not visible, the subject should be examined in the sitting position while bending forward or while lying down on his left side. The impulse is normally seen in the fifth left intercostal space about half an inch medial to the mid-clavicular line.

In children, it is usually in the 4th intercostal space; and in persons with long, narrow chest it may be in the 6th space. It will be very prominent in thin individuals.

- The carotid pulsations are visible on either side in the anterior triangle of the neck by the side of the sternomastoid muscles especially in thin individuals. They synchronize with the cardiac impulse in rate and rhythm.
- The external jugular veins are seen on the surface in the posterior triangle of the neck. They are seen when they are full with blood. The height of the column of blood in these veins can be regarded as a measure of the venous blood pressure.
- The venous pulsations are seen over the jugular veins better on the right side. The pulsations are prominent at the lowest level in the supraclavicular fossa where the veins enter the deeper tissues to join the superior vena cava. The pulsations are more marked if the veins are full. In the erect posture the column sinks to the level of the manubrium sterni and venous pulsations are hardly seen. Only the carotid pulsations are visible in this position. In the supine recumbent position with the neck slightly flexed and turned a little to the left, the venous pulsations are seen prominently.
- The carotid pulsations are normally seen in thin individuals and in anxiety. Pathologically carotid pulsations will be prominent in conditions like thyrotoxicosis, aortic regurgitation and in aneurysms of aorta.
- Pulsations in the suprasternal notch may indicate unfolding or aneurysms of arch of aorta.
- Prominent veins are not normally seen on the thorax and abdominal wall. If dilated veins are seen it is abnormal e.g. portal hypertension, intrathoracic growth obstructing venous return and inferior vena caval obstruction. Thin and tiny veins might be visible in people with fair skin.

Palpation

- Confirm the findings obtained by inspection.
- If apex beat is palpable, locate its exact position using the pulp of the fingers with the subject preferably in the supine position. Palpation should be started from the axillary region, using whole of the palm (Fig. 22.5A). Once a definite impulse is felt, the apex beat should be located carefully using the index or middle finger (Fig. 22.5B). If the apex beat is not

Figs. 22.5A and B: Locating the apex beat

felt try it at the end of expiration or in the left lateral position. If it is not felt on the left side look on the right side. The cardiac impulse may be felt forcefully, moderately or feebly. It is felt as a tap coming from inside the chest towards the anterior wall. The junction of the manubrium with the body of the sternum is called sternal angle or angle of Louis. The second costal cartilage articulates with the sternum at the sternal angle. The intercostal space immediately below this rib is the second intercostal space. Vertical line drawn from the center of the clavicle downwards is the midclavicular line.

Fig. 22.6: Looking for left parasternal heave

- Place the ulnar border of the right hand parallel to the left sternal border and see whether there is a left parasternal heave (Fig. 22.6). Right ventricular enlargement produces a systolic thrust (heave) in the left parasternal area. There will be systolic elevation of left costochondral junction. Subject should be in supine position.
- Place the palm flat over the precordium and feel for any vibrations and thrills. The turbulent flow responsible for murmurs may produce palpable vibrations on the chest wall called thrills. Thrills are palpable murmurs. These should not be present in health. It is felt prominently in aortic stenosis, ventricular septal defect and patent ductus arteriosus.
- Feel for the carotid pulsations, which are felt as expansile waves. Venous pulsations in the neck are clearly seen than felt. By emptying the vein and compressing it at either end it may be confirmed that it fills from the head end towards the chest.
- Look for other palpable pulsations in the precordium, intercostal spaces and epigastrium. Epigastric pulsations are felt in aneurysms of abdominal aorta and in heart failure due to pulsatile liver. It may be felt normally in very thin individuals.
- If there are dilated veins over the chest and abdomen find out the direction of flow of blood.

Percussion

Percussion can define the borders of the heart mainly the right and left borders. Gross enlargement or shift in the position of the heart can be made out. Percussion is also useful to identify pericardial effusion and right atrial enlargement. While percussing the heart, a moderate force should be used.

- The subject should be in the supine position.
- The left border of the heart is percussed first.
- Start percussing in the 5th left intercostal space from the mid-axillary line (vertical line descending from the center of axilla).
- Place the pleximeter finger in the space parallel to the ribs and percuss. A resonant note is heard normally.
- Continue percussing shifting the pleximeter finger towards the right by 1 cm.

- When the area of cardiac impulse is reached a dull note will be heard. The heart tissue gives a dull note. Mark the point with ink.
- Now repeat the same procedure on the 4th intercostal space. Mark the point where the dull note is heard.
- Repeat the procedure in the 3rd space and then on the 2nd space, till the clavicle is reached. Join the points to draw a line. It defines the left border of the heart. It begins in the third intercostal space 2 to 3 cm to the left of the midsternal line and extends 7 to 8 cm to the left of the midsternal line and ends just medial to the midclavicular line in the fifth intercostal space.
- To mark out the right border of the heart place the pleximeter finger on the right side of the chest in the 2nd intercostal space 4 to 5 cm away from the sternum. Percuss. A resonant note is obtained.
- Percuss in the same vertical line in each lower intercostal space. Listen to the note.
- In the 5th space a dull note is heard. This is due to liver.
- Find out the lowest space where a resonant note is heard. From this space, start percussing towards the left, while listening to the percussion note produced. A resonant note is heard till the sternum is reached.
- Repeat the percussion over each space above till the sternum is reached. The resonant note is heard all over till the sternum is reached.
- The right border of the heart corresponds to the right sternal border.
  Percussion cannot define the upper border and the inferior border of the heart accurately. The upper border cannot be percussed out accurately as the dullness of the heart tissue continues with the dullness of the great vessels. Joining the lower point of the left and right borders and the upper points in the same gives the upper and lower borders of the heart.
  Percussion of the great arteries should be carried out medially from the midclavicular line on either side along the second intercostal space. Both the second intercostal spaces are always resonant. Dullness here is a sign of disease.

Auscultation

By auscultation we listen to the heart sounds, i.e. the sounds produced in the heart and the great vessels. The sounds are produced mainly due to the closure of the heart valves and are heard all over the precordium. Ideally auscultation should be done in a sound proof room with a good stethoscope.

Clinically the chest is auscultated to hear the sounds clearly over four main areas. These areas are called the valvular areas of auscultation. These areas do not correspond to the anatomical location of the respective valves. The sound produced by each valve of the heart is heard best in each of these areas.

The areas are (Figs. 22.7A to D):

1. The mitral area overlying the apex-beat.
2. The tricuspid area lies just to the left of the lower end of the sternum in the fifth intercostal space.
3. The aortic area at the right 2nd intercostal space close to the sternal border.
4. The pulmonary area in the left 2nd intercostal space near the sternal border.
   - On auscultation, two sounds are heard all over the chest. There occurs a pause after the occurrence of the two sounds and again they are repeated.

- The sound that occurs first is the first heart sound, which can be mimicked as 'lubb' and the one that follows it in rapid succession, is the second heart sound, which is mimicked as 'dup'. It occurs as 'lubb dup', 'lubb dup' in succession.
- In children, a short and faint 3rd heart sound may sometimes be audible in mitral area, which immediately follows the second sound.
- Abnormal sounds heard over the precordium include murmur and friction rub or pericardial rub. A friction rub occurs in pericarditis. Murmurs are caused by turbulent flow within the heart and great vessels. Murmurs may also indicate valve disease or abnormal communications between the right and left sides of the heart (e.g. septal defects).
- Heart murmurs are defined by four characteristics: loudness, quality, location and timing. Loudness reflects the degree of turbulence. This relates to its frequency and is described as low, medium or high-pitched. The location of the murmur on the chest wall depends on its site of origin. Murmurs are timed according to the phase of systole or diastole during which they are audible. Systolic murmurs are ejection systolic, midsystolic, pansystolic or late systolic; diastolic murmurs are either early diastolic, mid-diastolic or late diastolic (presystolic) in timing. Continuous murmurs are heard

Figs. 22.7A to D: Areas for auscultation (A) mitral area over the apex beat, (B) tricuspid area at the lower end of sternum on the left side, (C) aortic area in the second right intercostal space near the sternal border, (D) pulmonary area in the second left intercostal space near the sternal border

both during systole and diastole of the cardiac cycle as in the case of patent ductus arteriosus.

- Finally auscultate for carotid and femoral arterial bruits. Bruits are vibrating sounds that can be heard while auscultating over arteries in which there is turbulent blood flow. It may be due to arterial narrowing.

REPORT PATTERN

Name:

Age:

Sex:

Occupation and address:

General Examination

Normally built and nourished; no pallor, icterus, cyanosis, edema, dyspnea, clubbing or lymphadenopathy.
Body temperature: 37°C
Respiratory rate: 16/min, regular, abdominothoracic
Pulse: 70/min, regular, normal in volume and character, no thickening of vessel wall, no radio-femoral/brachiofemoral delay. All other peripheral pulsations are felt equally on both sides.

Blood pressure in the right upper limb in supine position:
Palpatory method – 116 mm Hg
Auscultatory method – 120/80 mm Hg

Cardiovascular System Examination

Inspection

Shape of chest: Normal
Apex beat: Not visible
JVP: Not raised
No visible pulsations over the chest and no dilated veins over the chest and abdomen.

Palpation

Trachea: Centrally placed
Apex beat felt in the fifth left intercostal space half an inch medial to the midclavicular line
No thrills, no parasternal heave.

Percussion

Heart borders are within normal limits.

Auscultation

First and second heart sounds normally heard in the mitral, tricuspid, aortic and pulmonary areas. No murmur or other abnormal sounds. No carotid or femoral arterial bruits.

Impression

The cardiovascular system of the subject appears to be normal.

VIVA QUESTIONS

1. **What are the causes of first heart sound?**
   - Closure of the mitral and the tricuspid valves
   - Contraction of the ventricular musculature
   - Vibrations set up in the mediastinum.
2. **What are the causes of second heart sound?**
   - Closure of the aortic and the pulmonary valves
   - Vibrations of blood vessels
   - Turbulence produced in the blood column
3. **What are the causes for third and fourth heart sounds? Give the conditions in which it is audible.**
   - The third heart sound is due to gushing of blood into the ventricles during the diastole at the end of the isovolumetric relaxation phase. It is heard in children and young adults. It also occurs in high output states caused by exercise, anemia, fever, pregnancy and thyrotoxicosis.
   - The fourth heart sound is due to the atrial systole. It is not an audible heart sound. It can only be recorded by phonocardiography. In the elderly, S4 is sometimes physiological. Pathological S4 occurs in hypertension, aortic stenosis, and hypertrophic cardiomyopathy.
4. **How will you distinguish between first and second heart sounds?**
   - The first heart sound is almost synchronous with the carotid pulsation or the apex beat while the second sound follows it. Thus the sounds can be recognized as the first and the second sound.
   - The first sound is referred to as systolic sound because it is associated with the ventricular systole. The first heart sound is longer in duration when compared to the second and louder. But it is low pitched. The first sound is heard well in the mitral and tricuspid areas.
   - The second is called diastolic sound because it indicates the beginning of the diastole. The second sound is high pitched, of short duration and less in loudness. The second sound is heard well in the pulmonary and aortic areas.
5. **What are the variations in pulse rate with age and sex?**

   When the pulse rate is decreased the condition is called bradycardia. A rapid pulse rate is called tachycardia.

   Age: The pulse rate varies with age. In the fetus, the heart rate is about 140 per minute. In a newly born infant it is about 130, at the age of five it is about 90, at the age of 10 years 80, at the age of 15 years 75, and at the age of 20 it comes to about 70–72 per minute. It remains constant throughout the life after this age.

   Sex: The pulse rate is about five beats more in the adult woman than in the adult man. Athletes show a rate of 50–60/min due to well-developed vagal tone.

6. Name the conditions where JVP is elevated.

- Tricuspid valve stenosis
- Congestive cardiac failure
- Constrictive pericarditis
- Cardiac tamponade
- Superior vena cava obstruction
- Right ventricular infarction
- Pulmonary embolism

In constrictive pericarditis and in cardiac tamponade, inspiration produces a paradoxical rise in the JVP referred to as Kussmaul's sign. This is because the increased venous return that occurs during inspiration cannot be accommodated within the constrained right side of the heart.

7. What are the abnormalities seen in the waveform of JVP?

- Giant 'a' wave occurs in forceful atrial contraction against a stenosed tricuspid valve or a non-compliant hypertrophied right ventricle.
- Cannon 'a' wave is caused by atrial systole against a closed tricuspid valve. It occurs in complete heart block and in ventricular tachycardia.
- Giant 'v' wave is seen in tricuspid regurgitation.
- Prominent 'x' and 'y' descents occur in constrictive pericarditis.

8. How will you distinguish between arterial and venous pulse?

- Venous pulse is better seen than felt whereas arterial pulse is better felt than seen.
- Venous pulse has a definite upper level, which falls during inspiration.
- Venous pulse varies with posture.
- Hepatojugular reflux is seen in venous pulse. When moderate pressure is applied over the right hypochondrium, there will be a slight increase in the JVP due to increased venous return.
- The double wave form of JVP is not seen in arterial pulse.

9. Why is external jugular vein not selected to assess venous pressure?

- Valves are present in the course of external jugular vein and so it may not reflect the exact right atrial pressure.
- External jugular vein passes through more fascial planes and so, it is subjected to external compression as it passes under the clavicle.

10. Define apex beat. Give its normal location.

Apex beat is the lowermost and outermost point over the precordium where a definite cardiac impulse is seen or felt. It is normally felt in the fifth left intercostal space ½ an inch medial to the midclavicular line.

11. Mention the conditions where the apex beat is displaced from the normal site.

Apex beat may be on the right side in dextrocardia. Shift to left of apex beat is seen in left ventricular hypertrophy. Chest wall deformities such as pectus excavatum may compress the heart and displace the apex to the left and this can be mistaken for cardiac enlargement. Shift of apex beat can also be due to push or pull due to diseases of the surrounding viscera. Pushing can be due to pleural effusion or pneumothorax. Pulling of the apex beat can be due to pulmonary fibrosis or collapse of the lung.

12. What is the difference between thrill, murmur and bruit? What are the types of murmur?

Palpable murmur over the precordium is called thrill. Murmur is an abnormal sound auscultated over the precordium. The types of murmurs are systolic murmurs, diastolic and pan systolic murmur. Bruit is a vibrating sound heard over arteries on auscultation.

13. What does physiological splitting mean? What is the reason for the physiological split of second heart sound? What is the reason for its widening in deep inspiration?

Aortic valve close first because the pressure difference is more on the aortic side. Pulmonary vascular resistance is 1/10th that of systemic resistance. So, the right ventricular ejection starts earlier and is completed slightly later than left ventricular ejection. So, the pulmonary valve closes after the closure of aortic valve. The splitting of the second sound (aortic and pulmonary components) is normal and is called **physiological splitting** and it is present during inspiration.

If the person takes a deep inspiration, the splitting widens, i.e., A_2 appears earlier and P_2 occurs a little late than normal. This is because of increase in the negativity of intrathoracic pressure and the resulting increase in the venous return to the right atrium. End-diastolic volume in the right ventricle is increased leading to an increase in the ejection period. Thus, P_2 will be a little delayed from normal, i.e., it is postponed. On the left side, increased negativity of intrathoracic pressure causes increase in the volume of left atrium leading to a decrease in the pressure in the left atrium. The pressure gradient becomes less between atrium and ventricle on the left. This leads to decrease in ventricular filling and there will be a reduction in the ventricular ejection time and so, A_2 is preponed than that of normal. During forced expiration, opposite of the above changes occur and the splitting becomes narrow. Exaggerated splitting is seen in right bundle branch block. Reversed splitting (splitting is seen during expiration and not during inspiration) occurs in left bundle branch block.

14. Define arterial pulse. Mention three abnormal pulses.

Definition (Page 143)

- Collapsing pulse in aortic regurgitation.
- Pulsus alternans or alternating pulse is seen in severe left ventricular failure.
- Biphasic pulse with two systolic peaks is seen in mixed aortic valve disease.

15. What is the reason for high volume pulse in old age?

In old age, due to atherosclerosis the systolic pressure increases. There is not much increase in the diastolic pressure normally. So, the pulse pressure increases. This results in high volume pulse.

16. What is Hepatojugular reflux?

Refer to page no. 147.