CHAPTER

4 Surface Anatomy of Thorax

AN25.9: Demonstrate surface marking of lines of pleural reflection, lung borders and fissures, trachea, heart borders, apex beat and surface projection of valves of heart.

BONY AND SOFT TISSUE LANDMARKS (FIGS. 4.1 AND 4.2)

- ***Suprasternal notch*:** This is felt at the superior border of the sternum.
- ***Sternal angle*:** This is the joint between the manubrium sterni and the body of the sternum. This can be felt as a prominent ridge as we move from the suprasternal notch below over the manubrium sternum at the junction between manubrium and body of sternum. This joint also corresponds to the articulation of the 2nd costal cartilage to the sternum.
- ***Counting of ribs*:** This can be initiated by identifying the manubriosternal angle as this corresponds to the 2nd rib. Then continue counting ribs downwards and laterally.
- ***Costal margin*:** This is a continuous bony margin formed by the joining of the sternal end of the 7th to 10th ribs to one another via the costal cartilages.
- ***Subcostal angle*:** This is the angulation between the two costal margins (right and left).

Applied Anatomy

Sternum is divided in the midline from the suprasternal notch and the xiphoid process for open heart procedures. This is called midline sternotomy.

For access to the trachea, the 3rd intercostal space is used and for the esophagus and lower lobes of the lung, the 5th to 7th intercostal space is used as a landmark.

- ***Counting of ribs on the back*:** Feel for the spinous process of the 7th cervical vertebra (vertebra prominence). This is visible and palpable. Then start counting below. The spine of the scapula corresponds to spinous process of the T3 vertebra and the 7th thoracic vertebra to the inferior angle of the scapula.
- The suprasternal notch corresponds to the 2nd thoracic vertebra. The sternal angle corresponds to the 4th thoracic vertebra, the xiphisternal joint corresponds to the intervertebral disc between the 9th and the 10th vertebrae.
- Few lines can be drawn with reference to the bony landmarks for the thorax. These lines are very useful during invasive procedures, such as putting drainage insertion, anesthesia, needle decompression, etc., these include **(Figs. 4.2A and B):**
  - ***Midsternal line*:** Line drawn through the middle of the sternum.
  - ***Midclavicular line*:** Drawn through the midpoint of the medial and lateral ends of the clavicle. This usually passes through the nipple.

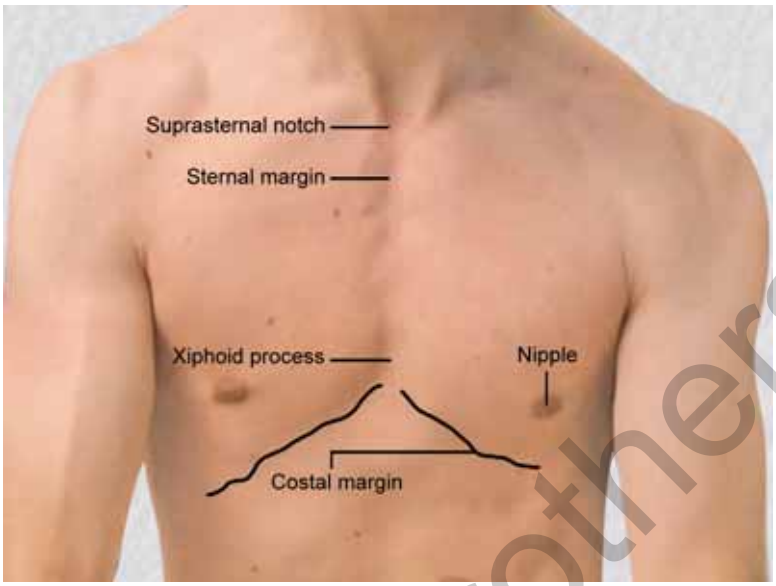

Fig. 4.1: Bony and soft tissue landmarks of the anterior thoracic wall.

Fig. 4.2A: Imaginary lines on the anterior thoracic wall.

- ***Anterior axillary line*:** This line is drawn vertically at the plane of anterior axillary fold.
- ***Posterior axillary line*:** This line is drawn at the plane of the posterior axillary fold.
- ***Midaxillary line*:** This line passes from the apex of the axilla between the anterior and the posterior axillary folds.

Fig. 4.2B: Bony landmarks of the lateral thoracic wall.

Soft Tissue Landmarks (Fig. 4.1)

***Nipple*:** It is the projection of the breasts. It is dark due to pigmentation. This soft tissue is constant in position in males. It lies in the 4th intercostal space in the midclavicular line. The nipple is inconsistent in position in females because of the sagging breasts. It also depends on the size of the breasts.

Borders of the Heart (Fig. 4.3A)

The heart anatomically can be shown in four borders. They are the right, left, upper and lower margins. They can be drawn by identifying the following points:

- ***Point A*:** Marked on the right 3rd costal cartilage by the side of the right sternal margin.
- ***Point B*:** Marked on the left 2nd intercostal space by the side of the left sternal margin.
- ***Point C*:** Right 6th costal cartilage joining the sternum.
- ***Point D*:** Left 5th intercostal space just medial to the midclavicular line.
  - Upper border is formed by the joining of the points A and B.
  - Lower border is formed by the joining of the points C and D.
  - Right border is formed by the joining of the points A and C by a curved line. Convexity is maximum in the 4th intercostal space, about 3.7 cm to 4 cm from the midline. Left border is formed by the joining of the points B and D.

Anatomically, right border represents the right atrium. The left border represents the left ventricle. The lower border represents the right ventricle. The upper border represents the left atrium.

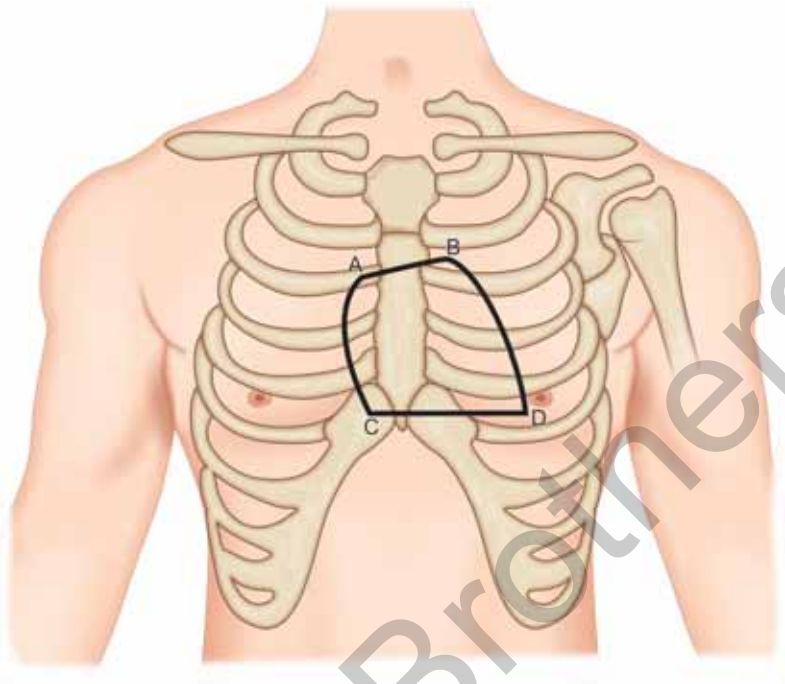

Fig. 4.3A: Borders of the heart.

Applied Anatomy

By drawing/identifying the borders of the heart, it is possible to percuss the borders and be able to identify the enlargement of the heart. This also helps in putting the leads of the electrocardiogram (ECG) and continuous cardiac monitoring.

The area bounded by the borders of the heart is called as the precordial area.

The apex of the heart and the right shoulder are in the same plane. When a line is drawn in the perpendicular plane, this represents the coronary sulcus or the atrioventricular groove. This groove lodges the coronary vessels. The plane differentiates the atria from the ventricles.

The sternocostal surface represents most of the right ventricle. The right atrium and the right ventricle are more anteriorly placed than the left atrium and left ventricle in a 3-dimensional orientation **(Fig. 4.3B)**.

Apex Beat (Fig. 4.4)

This is the farthest point of the heart. This is positioned at the left 5th intercostal space, just medial to the midclavicular line.

This is approximately 9 cm from the midsternal line.

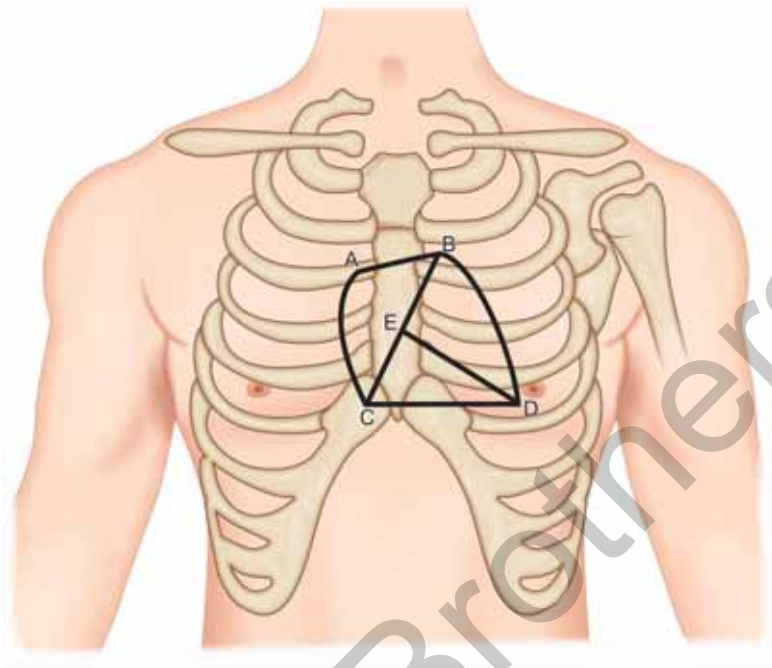

Fig. 4.3B: Coronary sulcus (CB) and anterior interventricular groove (ED).

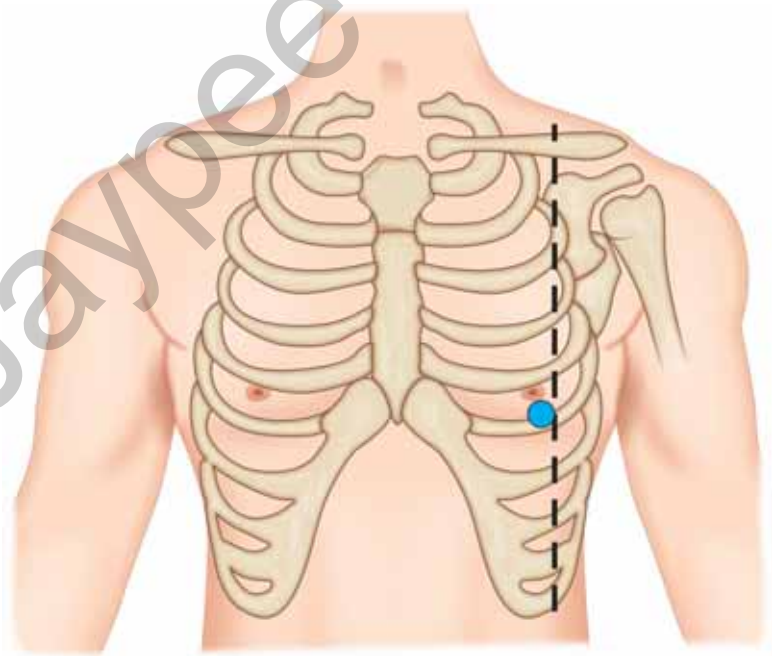

Fig. 4.4: Apex of the heart.

Applied Anatomy

This is the most commonly accessed part of the heart during clinical examination. The heart beat is felt in this position. The apex beat which can be palpated and auscultated by using a stethoscope is due to the vortex like motion of the left ventricle.

Applied Anatomy

The region of the chest wall bounded by the borders of the heart is called the precordial area. The borders of the heart can be identified by percussion (though not in use nowadays).

***Method of assessing the heart borders*:**

1. The apical impulse is first localized by inspection and then palpation. Any shift indicates cardiomegaly (enlargement of the heart)—mainly involving the left ventricle as can be seen secondary to severe mitral regurgitation, severe coronary artery disease. The apical impulse and thus the heart may be pushed laterally sometimes because of lung pathologies like large pleural effusion on the right side, pneumothorax on the right, etc. In pericardial effusion though the apex is shifted outward by percussion, the apical impulse is not visible or palpable and may sound muffled or absent on auscultation due to presence of fluid in the pericardium.
2. The left 2nd parasternal (intercostal) space is percussed for dullness as well as pulsations. Presence of both is indicative of pulmonary arterial hypertension or dilatation.
3. The right heart border is determined by percussing from lateral to medial from the midclavicular line in the 4th intercostal space to determine the lateral most point of dullness which corresponds to the right atrium. It is normally within 4 cm from the midline and any value beyond this indicates a dilated right atrium (as in severe tricuspid valvular stenosis, tricuspid regurgitation, etc.).
4. The 2nd intercostal space on the right is also similarly percussed from laterally up to the sternal margin. Any dullness lateral to the parasternal area in this space could be due to lymph nodes, thymus, etc.

Orifices of the Heart (Fig. 4.5)

These are mainly the valvular openings of the heart. They are the tricuspid, mitral, pulmonic and the aortic valvular areas.

- The ***tricuspid valve*** is situated behind the sternum in a vertical plane extending from the 4th to the 5th intercostal space. It is 4 cm long and vertically placed (T).
- The ***mitral valve*** is situated behind the left margin of the sternum at the level of the 4th costal cartilage (M).
- The ***pulmonary valve*** orifice is situated at the level of the left 3rd costal cartilage and partly behind the sternum. It is horizontally placed and is 2.5 cm long (P).
- The ***aortic valve*** is very close to the ***pulmonary valve***. It is situated in the 3rd intercostal space behind the left half of the sternum with an inclination downwards and medially (A).

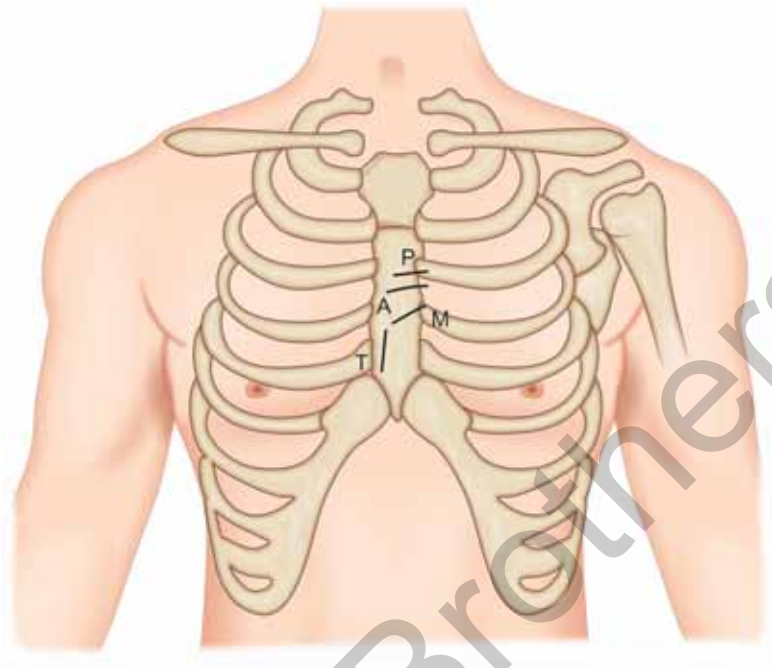

Fig. 4.5: Orifices of the heart.

Thus the valves are more or less situated behind the sternum and closely placed. But the area of auscultation for these valves is a farther away from the valvular orifices. This is because the murmurs or the sound created by these valve closures are best heard in these areas as they are not covered by the sternum and they are in the direction of blood flow from the valvular orifices.

Auscultatory Areas of the Heart (Fig. 4.6)

There are mainly four valves of the heart. They are the mitral, tricuspid, aortic and the pulmonary valve.

1. The tricuspid valve can be heard at the left lower part of the sternum in the 5th intercostal space (T).
2. The mitral valve can be heard in the left 5th intercostal space near the apex beat (M).
3. The pulmonary valve is in the left 2nd intercostal space near the lateral end of the sternum (P).
4. The aortic valve is in the right 2nd intercostal space near lateral end of the sternum (A).
5. The left 3rd intercostal space near the lateral border of the sternum is also called the **neo aortic or 2nd aortic (A2) area** as, some aortic valvular pathologies such as the murmur of aortic valve incompetence is better heard here.

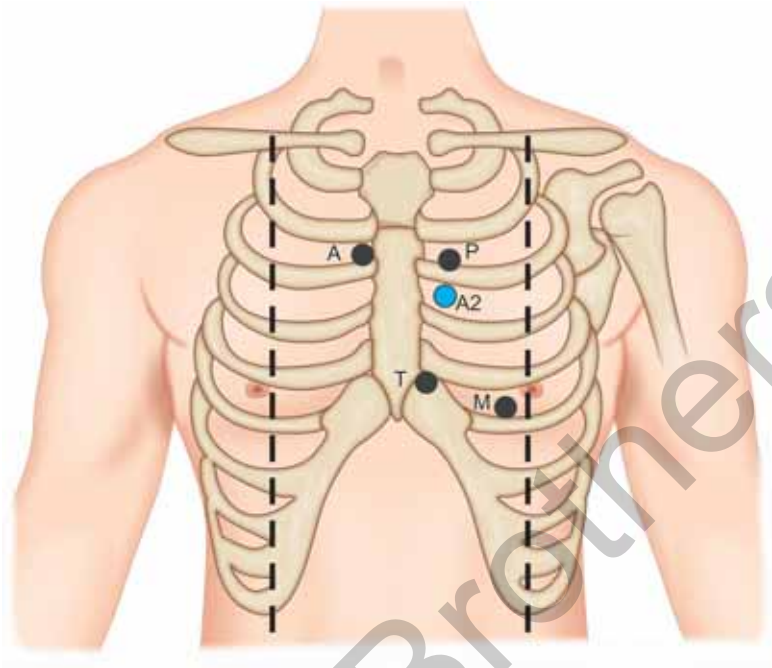

Fig. 4.6: Auscultatory areas of the heart.

Applied Anatomy

Learning to identify the auscultatory areas is important as we regularly auscultate these areas to confirm the normal heart sounds and be able to diagnose the different murmurs created due to the valvular abnormalities such as mitral valve regurgitation, aortic stenosis, etc. The auscultatory areas might differ in their position in rare cases as dextrocardia and lung diseases which push the heart toward the opposite side.

The best position to auscultate the heart is in the sitting position. This is because the heart is closer to the anterior thoracic wall and the sounds will be heard clearly than in supine position as the heart falls away from the thoracic wall.

***Pericardiocentesis*:** This is a procedure to aspirate the excess pericardial fluid in cases of pericardial effusion and cardiac tamponade. Here the pericardial cavity is accessed in three ways.

1. ***Subxiphoid approach*:** This is the most commonly used approach. The angle between the xiphoid process and the left costal margin is identified. With a sagittal angulation of 30–45°, the cannula is pushed forward pointing toward the left shoulder to reach the pericardial cavity.
2. The ***parasternal approach*** is an alternative method of performing emergency pericardiocentesis. The needle is inserted perpendicular to the chest wall in the 5th intercostal space, just lateral to the sternum.