SURFACE ANATOMY AND FEATURES OF THE HEART AND THE PERICARDIUM

THE PERICARDIUM:

DEFINITION / DESCRIPTION (Fig 1):
The pericardium is a double-walled, truncated, cone-shaped fibroserous sac, which encloses the heart within the middle mediastinum. Its main function is to prevent sudden overfilling of the heart. It also secretes serous fluid, which prevents friction between its inner surface and the outer surface of the heart while the latter contracts and relaxes.

Figure 1

SUBDIVISIONS OF THE PERICARDIAL WALL: (See Fig 1 above)
The pericardium (Pericardial wall) is subdivided into two parts viz.

a. **Fibrous pericardium:**
   This is the outer, tough, conical shaped part of the pericardium. The truncated apex is located superiorly at the level of the manubrosternal junction, while the almost flat base is located inferiorly and attached to the central tendon of the thoracoabdominal diaphragm by the **Pericardiacophrenic ligament.**
   The truncated apex is pierced by the ascending aorta, the pulmonary trunk and the superior vena cava. The posterior surface is also pierced by the four pulmonary veins while the right aspect of the base is pierced by the inferior vena cava.
   The anterior surface is attached to the sternum by the **Sternopericardial ligaments.**
   The internal surface is lined by the parietal layer of the serous pericardium.
The fibrous pericardium is partly separated on either side from the sternum and 2nd to 6th costal cartilages by the lungs and pleural membrane.

b. **Serous pericardium (Fig: 2):**

This is the serous, double-layered, fluid-secreting part of the pericardium, which lines the pericardial cavity that encloses the heart. Its outer (parietal) layer is adherent to the internal surface of the fibrous pericardium, while its inner (visceral) layer surrounds the heart and the roots of the great vessels. The two layers enclose the pericardial sac. (Fig 1)

The reflection of the visceral layer around the roots of the vessels to continue with the parietal layer results in the formation of the pericardial sinuses, viz. The oblique and transverse pericardial sinuses.

1. **The oblique pericardial sinus:** This is the inverted j-shaped recess of the pericardial cavity which lies posterior to the left atrium and is bounded by the orifices of the four pulmonary veins and the inferior vena cava (see Fig 2).

2. **The transverse pericardial sinus:** This is the transversely running serous opening that lies between the ascending aorta and the pulmonary trunk anteriorly and the Superior vena cava posteriorly. (Fig. 2)

The upper borders of the atria also lie posteroinferior to the transverse sinus. The transverse pericardial sinus is actually the remnant of an aperture in the dorsal mesentery of the embryonic heart, separating the venous and arterial ends of the heart tube.

Figure: 2
**Blood Supply and innervation of the Pericardium**

The pericardium is supplied by the following vessels:

a. Pericardiacophrenic arteries.
b. Musculophrenic arteries
c. Pericardial branches of the bronchial, oesophageal and superior phrenic arteries
d. The coronary arteries

Pericardial veins drain into the azygos, internal thoracic and cardiac veins.

**Nerve Supply:**
The pericardium is innervated by the Vagi, Phrenic and sympathetic trunks.

**THE HEART (Fig: 3):**
The heart is a hollow, fibromuscular, thick-walled organ located in the middle mediastinum of the thorax. It is also a double, self-adjusting muscular pump, which receives oxygenated blood from the pulmonary circulation and propels blood through the systemic circulation to all the tissues of the body.

A little bit larger than the closed fist of the owner, the heart has an average weight range of 280 – 340gm (♂) and 230 – 280gm (♀).

It is conical in shape and possesses a base, three surfaces, six borders and an apex as follows:
Base (Vertebral or Posterior surface): (Fig. 6)
This is directed posterosuperiorly and to the right, and lies opposite T5-T8 or T6-T9. It is formed by the two atria. This surface also contains the posterior part of the coronary sulcus (Atrioventricular sulcus).
The ascending aorta and the pulmonary trunk emerge from the heart from the upper border of this surface while the superior vena cava enters the heart through the same border. This surface also receives the four pulmonary veins and the inferior vena cava.

Diaphragmatic (Inferior) Surface:
This surface is directed inferiorly and related to the central tendon of the diaphragm. It accommodates the posterior interventricular sulcus and is pierced by the inferior vena cava. It is also formed by the two ventricles (1/3 right and 2/3 left).

Sternocostal (Anterior) Surface (Fig. 3):
This surface lies directly behind the sternum and the 3rd to 6th right and left costal cartilages. It is formed by the two ventricles (2/3 right and 1/3 left). It contains the anterior part of the coronary sulcus and the anterior interventricular sulcus.

Pulmonary (Left) Surface:
This is the surface in contact with the cardiac notch of the left lung. It is formed by the left ventricle.

Apex (Fig. 3)
The apex of the heart is formed by the left ventricle and directed inferolaterally to the left. It is located in the left 5th intercostal, 9cm from the midline, slightly medial to the midclavicular line and below the left nipple.

BORDERS OF THE HEART (Fig. 3 & 5)
In actual clinical practice, the borders of the heart refer to the borders of its sternocostal (Anterior) surface. It is these same borders that project to the anterior chest wall as the surface projection of the heart. The borders are:
1. **Right border:** This is slightly convex to the right. It is formed by the right atrium.
2. **Left border:** This is formed by the left ventricle and the left auricle.
3. **Superior border:** This is formed by the two auricles and the root of the pulmonary trunk also called the infundibulum.
4. **Inferior border:** This is formed by the right and left ventricles in ratio 2/3 to 1/3. It is sometimes referred to as the diaphragmatic border.

SURFACE ANATOMY OF THE HEART (Fig. 4)
This is the surface projection of the four borders of the sternocostal surface of the heart to the anterior chest wall. Reference to the alphabets in the DIAGRAM:

**AB:** This represents the upper border. A is located at the upper border of the right 3rd costal cartilage, about 2cm from the midline. B is located at the lower border of the left 2nd costal cartilage 2 to 3 cm from the midline.

**BC:** This represents the left border of the heart. C is located at the left 5th intercostals space about 9cm from the midline.

**CD:** This represents the inferior border of the heart. D is located behind the right 6th
costal cartilage about 2cm from the midline.

DA: This represents the right border of the heart.

**SURFACE ANATOMY OF THE HEART VALVES (Fig. 4)**

This is the surface projection of the orifices between the atria and the ventricles as well as those between the ventricles and the roots of the great vessels (Ascending aorta and the Pulmonary trunk).

With the aid of the DIAGRAM:
The valves are aligned in an oblique plane, which lies parallel to and on the left aspect of the anterior part of the coronary sulcus.

- **P** is the pulmonary orifice. It is located behind the sternal end of the left 3rd costal cartilage. This valve is auscultated at the sternal end of the 2nd left intercostal space.
- **A** is the aortic orifice. It is located at the sternal edge of the left 3rd intercostal space. This valve is auscultated at the sternal end of the 2nd right intercostal space.
- **M** is the mitral (Left atrioventricular or bicuspid) orifice. It is located behind the left half of the sternum at the level of the 4th costal cartilage. This valve is auscultated in the left 5th intercostal space 9cm from the midline. This is also called the apex beat of the heart.
- **T** is the Tricuspid (Right atrioventricular) orifice. It is located behind the middle of the sternum at the level of the 4th intercostal space. This valve is auscultated at the midpoint of the sternum at the level of the 5th intercostal space.
Surface Anatomy of the Heart
OTHER SURFACE FEATURES OF THE HEART

The Coronary Sulcus (Groove): This is the surface projection of the atrioventricular septum. It is filled with fat and blood vessels. The anterior part contains the right coronary artery. The posterior part contains the coronary sinus and the circumflex branch of the left coronary artery. The inferior part contains the small cardiac vein and a branch of the right coronary artery.

The Interventricular sulcus (Groove): This is the surface projection of the interventricular septum. The anterior part contains the anterior interventricular branch of the left coronary artery and the great cardiac vein. The diaphragmatic part contains the posterior interventricular branch of the right coronary artery and the middle cardiac vein.

The Sulcus Terminalis: This is the shallow vertical groove on the posterior aspect of the right atrium. It separates the two different embryological derivatives of the right atrium. Deep to this groove in the cavity of the right atrium lies the cristal terminalis.

**Figure: 5**

Heart and the Anterior Chest wall
Figure: 6

A. Base or posterior surface of the heart removed from the specimen shown in Fig. 1-46. Note that the left atrium forms the greater part of the base of the heart. B. Posteroventricular view of the heart showing the cardiac veins.
Figure 7. Interior of left atrium and ventricle of heart. A. The features of the internal aspects of the left atrium and the inflow tract of the left ventricle are shown. AV, atrioventricular. B. The pattern of blood flow through the left side of the heart is demonstrated. C. The heart in parts A and B was incised vertically along its left border and then transversely across the superior part of its base, passing between the superior and the inferior left pulmonary veins.