

Practical class 3

THE HEART

OBJECTIVES

By the time you have completed this assignment and any necessary further reading or study you should be able to:-

1. Describe the fibrous pericardium and serous pericardium, identify them on a suitable prosection, and explain their function.
2. Describe the major gross features of an intact heart.
3. Demonstrate the major features of the interior of the right atrium.
4. Name and describe the main features of, and the differences between, the right and left ventricular interiors.
5. Identify the heart valves in appropriate prosections and outline their functions.
6. Describe the conducting system of the heart.
7. Summarise the nerve supply to the heart and describe briefly the neurological basis of referred pain from the heart.
8. Describe the origin, course and distribution of the coronary arteries and summarise the venous drainage of the heart.
9. List the main areas of myocardium affected by occlusion of the major coronary arteries.

Background reading

Rogers: Chapter 7; Cardiovascular System

37; The Heart and Pericardium

INTRODUCTION

The heart is a muscular organ found in the mediastinum between the two lungs. It is the driving force of the cardiovascular system, circulating blood through the pulmonary and systemic systems.

THE PERICARDIUM

The pericardium is a double layer of serous and fibrous tissue which serves to protect the heart and permit free movement during contraction. Look at a prosection in which the **fibrous pericardium** has been opened, locate the external attachments of the fibrous pericardium to the diaphragm and great vessels, then explore the extent of the **pericardial cavity**. Note that the endocardium of the heart is continuous with the **visceral serous pericardium**.

Between which two membranous layers does the pericardial cavity lie?

What is the function of: the fibrous pericardium?

the serous pericardium?

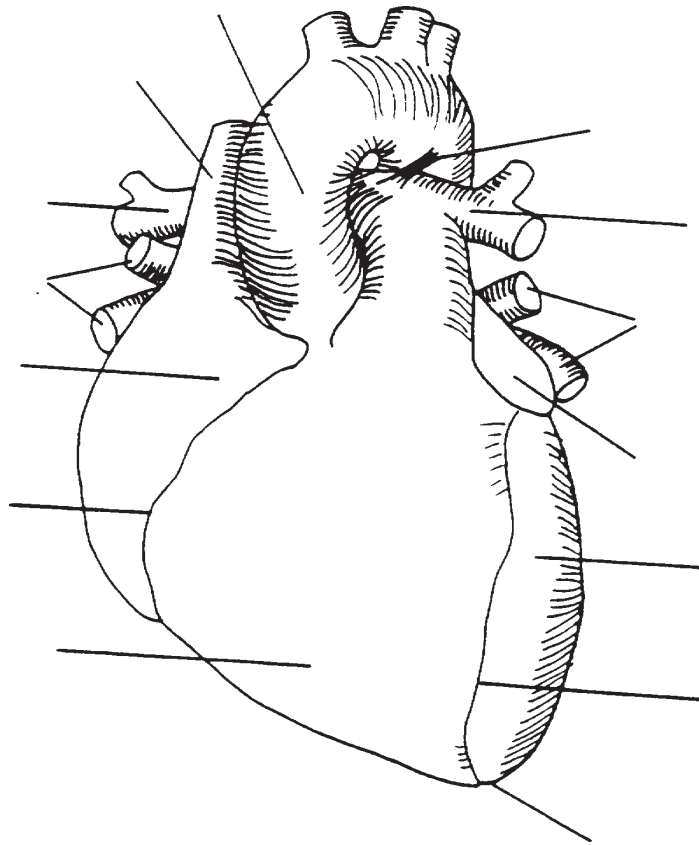
What is a pericardial effusion?

Sketch the arrangement of the serous and fibrous pericardia onto one of the following diagrams of the heart.

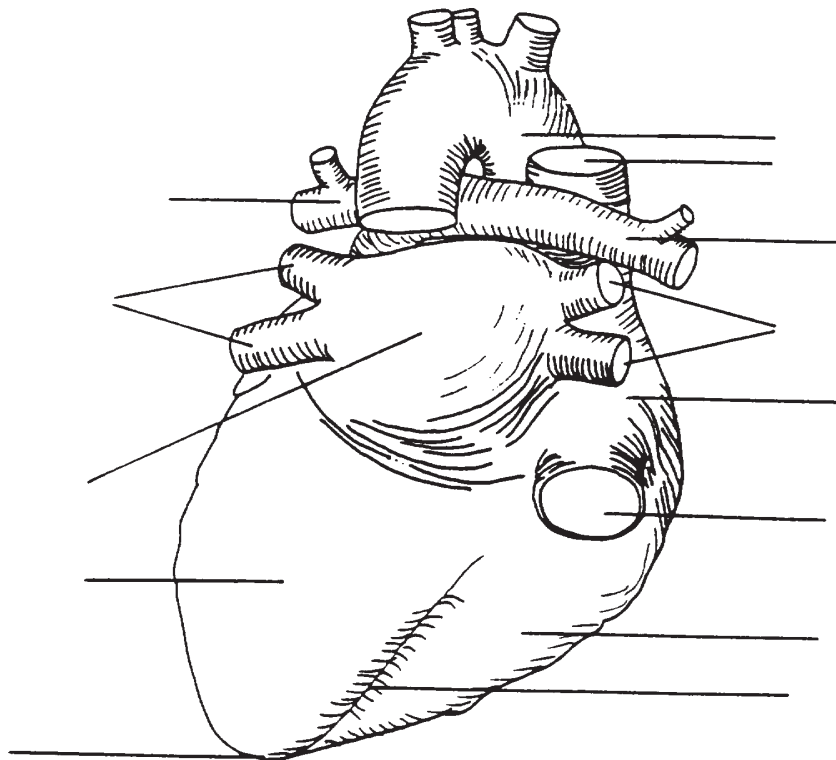
EXTERIOR OF THE HEART

Observe an isolated heart and orientate it in the anatomical position.

Examine the heart thoroughly, then label the following diagrams, ensuring that you can identify all the labelled structures on the specimen itself.



ANTERIOR



POSTERIOR

Which chambers of the heart form part of: the pulmonary circulation?

the systemic circulation?

Examine the roots of the great vessels and identify the aortic and pulmonary valves.

How would you describe these valves?

When do they close?

What are the aortic sinuses?

BLOOD SUPPLY TO THE HEART

Arterial supply

The arterial supply to the heart is provided by the **right** and **left coronary arteries**.

Where do the coronary arteries arise?

Identify the right and left coronary arteries and study the distribution of their branches on a prosected heart and on the resin cast of the coronary circulation.

Which coronary artery usually gives the greater supply to the specialised conducting tissue of the heart?

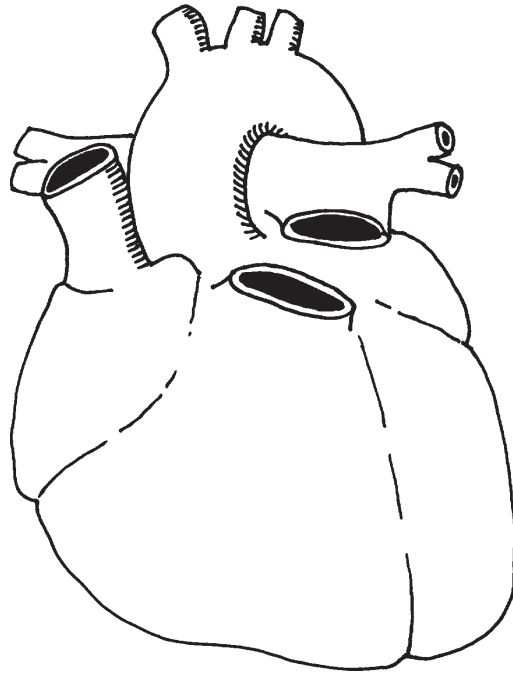
Draw and label the branches of the coronary arteries listed, on the following diagram (indicate those arteries running on the posterior surface of the heart by broken lines):

left and right coronary arteries

circumflex artery

anterior and posterior interventricular arteries

left and right marginal arteries



ANTERIOR

The small branches of the coronary arteries which pass into and supply the heart muscle are “functional end arteries”. Discuss the meaning of this term with a colleague and/or a tutor.

In most tissues peak blood flow occurs during systole and decreases during diastole. In heart tissue the opposite is true and peak blood flow occurs during diastole.

Explain why this difference occurs.

The myocardium has a very rich capillary supply with each myofibril being near a capillary. In the myocardium at maximum dilation there may be up to 3,000 capillaries per mm^3 . In skeletal muscle there are some 300 capillaries per mm^3 . Thus cardiac muscle has approximately ten times the capillary density of skeletal muscle.

List three pathological factors which could limit the coronary blood supply to the myocardium and which would cause ischaemia in the coronary bed.

List the main areas of the heart (i.e. atria, ventricles, conducting tissue etc.) which would be affected by occlusion of: the right coronary artery

the circumflex artery

the anterior interventricular artery

What is: coronary thrombosis?

myocardial infarction?

angina pectoris?

VENOUS DRAINAGE OF THE HEART

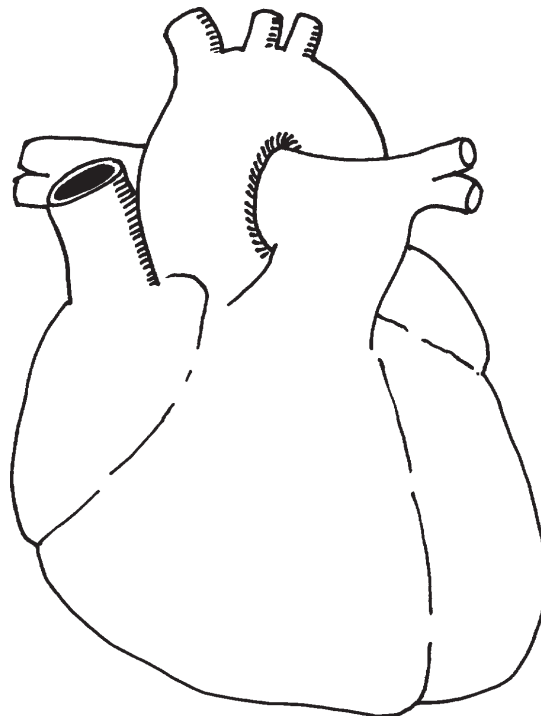
All the major arterial branches of the coronary circulation are accompanied by veins. Most eventually drain into the large **coronary sinus**, which lies in the **atrioventricular groove** on the posterior surface of the heart and opens into the **right atrium**.

Look for:

great, middle, small and anterior cardiac veins

marginal vein

Draw and label these vessels which drain the heart on the following diagram, again indicate those on the posterior surface by dotted lines.



ANTERIOR

NERVE SUPPLY OF THE HEART

Nerve fibres reach the heart from the **cardiac autonomic plexus**, which lies beneath the arch of the aorta.

Where do the fibres to the cardiac plexus arise?

Fibres are distributed from the **cardiac plexus** to the **sinu-atrial** and **atrio-ventricular nodes**, the myocardium and the coronary arteries.

How is the action of the heart affected by: sympathetic stimulation?

parasympathetic stimulation?

Pain from the heart e.g in angina pectoris, is commonly experienced over the left side of the chest and medial aspect of the left arm. Classical angina (literally choking) is like a belt tightening around the chest and radiating to the left arm. It is often triggered by an increase in the heart rate with critical coronary artery stenosis usually about 75% occlusion.

How is the pattern of “cardiac referred pain” accounted for?

INTERIOR OF THE HEART

Study a prosected heart which has flaps cut in the walls of its chambers.

Use the following table to indicate the flow of blood through the heart.

	Receives blood from	Pumps blood to
Right atrium		
Right ventricle		
Left atrium		
Left ventricle		

Examine first the right atrium and use your textbooks to help you identify:

openings of the venae cavae and the coronary sinus

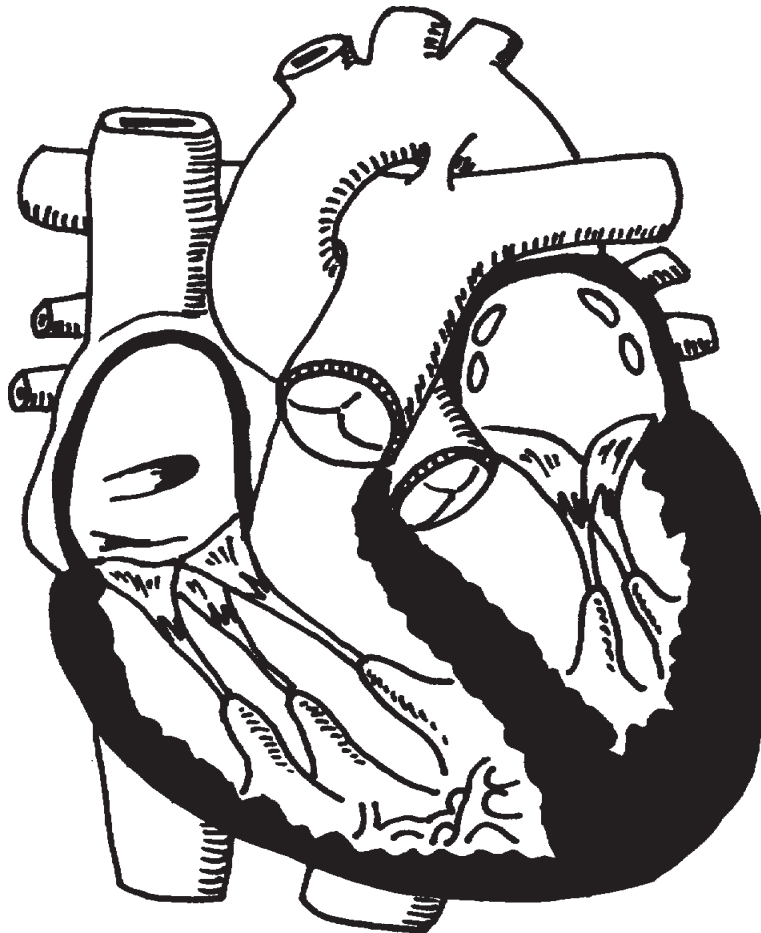
musculi pectinati

crista terminalis

fossa ovalis

tricuspid valve

Label as many of these structures as possible on the following diagram.



Indicate the direction of flow of blood between the vessels and chambers, using red for oxygenated and blue for deoxygenated blood.

Which regions of the body are drained by: the superior vena cava?

the inferior vena cava?

What is the auricle of the atrium?

The **fossa ovalis** marks the position of the foetal foramen ovale.

What was the function of this foramen?

When in life does it close?

If you examine all the prosected hearts which are available you may find a specimen in which a small opening persists in the upper part of the fossa ovalis.

Do you think that such a defect is functionally significant?

Why?

Now examine the right ventricle.

Identify the following structures:

tricuspid valve

chordae tendinae

papillary muscles

trabeculae carnae

moderator band

Label these structures on the previous diagram where possible.

What is the function of the moderator band?

Read an account of the conducting system of the heart, then write a summary of this information in the space below.

Ventricular contraction begins at the apex and progresses towards the outflow vessels.

What is the functional advantage of this arrangement?

What is the function of the chordae tendinae?

Congenital malformation or disease may lead to incomplete closure (**incompetence**) or incomplete opening (**stenosis**) of the heart valves.

What would be the effect on the right atrium of tricuspid valve incompetence?

How might this defect manifest itself clinically?

How is regurgitation of blood from the atria to the venous system prevented?

Compare the left and right ventricles.

Describe and comment on any differences in: the thickness of their walls

the atrioventricular valves.

In which direction would blood tend to flow through a ventricular septal defect?

How does such a defect arise?

What would be the consequences of incompetence of the left atrioventricular valve?

Why might an X-ray of a “barium swallow” be one of the techniques used in the clinical investigation of suspected mitral valve stenosis?

Replacing the heart in the thoracic cavity and studying its relations should help you answer this question.

The cusps of the heart valves are attached at their bases to the “skeleton of the heart” which surrounds the atrioventricular canals and pulmonary trunks.

What is the cardiac skeleton made of?

List two other functions of the cardiac skeleton.

Review this class and ensure that you can address the objectives set out at the beginning of the section.