

# Practical Class 4

## **BLOOD SUPPLY TO THE TRUNK**

### OBJECTIVES

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

1. Identify the great vessels of the heart and understand their arrangement in the mediastinum.
2. Outline the 3 groups into which the branches of the descending aorta can be classified.
3. List in order and, on a suitable prosection, demonstrate the branches of the ascending aorta and aortic arch. Outline their general distribution.
4. List in order, and on suitable prosections, demonstrate the descending aorta and its major branches. Describe the general distribution of these branches.
5. Identify the 3 major veins of the thorax (superior vena cava, inferior vena cava and azygos vein) on suitable prosections. Give a general outline of the regions of the body which are drained by these vessels and their major tributaries.

## **LIVING ANATOMY OF THE HEART AND GREAT VESSELS**

### OBJECTIVES

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

1. Demonstrate the positions of the heart borders and heart valves on a living subject.
2. Identify the apex beat in a living subject by palpation.
3. Demonstrate the positions in which a stethoscope should be placed in order to listen to the apex beat and the sounds of the different valves.

### **Background reading**

Rogers: Chapter 7; The Cardiovascular System

37; The Heart and Pericardium

38; The Aorta and great Vessels

40; The Blood Supply of the Trunk



# INTRODUCTION

In today's class you will be looking at the vessels which distribute blood to the trunk via the great vessels from the heart.

## THE GREAT VESSELS

*List, in order, the branches of the ascending aorta and the arch of the aorta.*

Examine the great vessels as they lie within the superior mediastinum of a prosected specimen.

First identify the **arch of the aorta** and the **superior vena cava**.

*Then identify:*

**left & right brachiocephalic veins**

**brachiocephalic trunk**

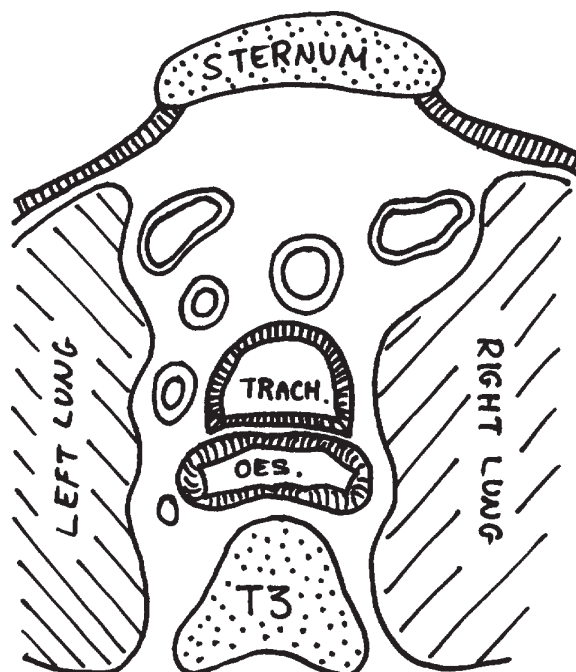
**left common carotid artery**

**left subclavian artery**

**thoracic duct**

Label these structures on the following diagram of a transverse section through the superior mediastinum at the level of the third thoracic vertebra. This is just superior to the point at which the two brachiocephalic veins unite to form the inferior vena cava.

*Draw in the left recurrent laryngeal nerve, the left and right vagus nerves and the left and right phrenic nerves*



## *Descending thoracic aorta*

The descending aorta is divisible into thoracic and abdominal portions, the thoracic aorta begins on the left of the lower border of T4 vertebra, approaching the midline as it descends.

*Where does the thoracic aorta traverse the diaphragm?*

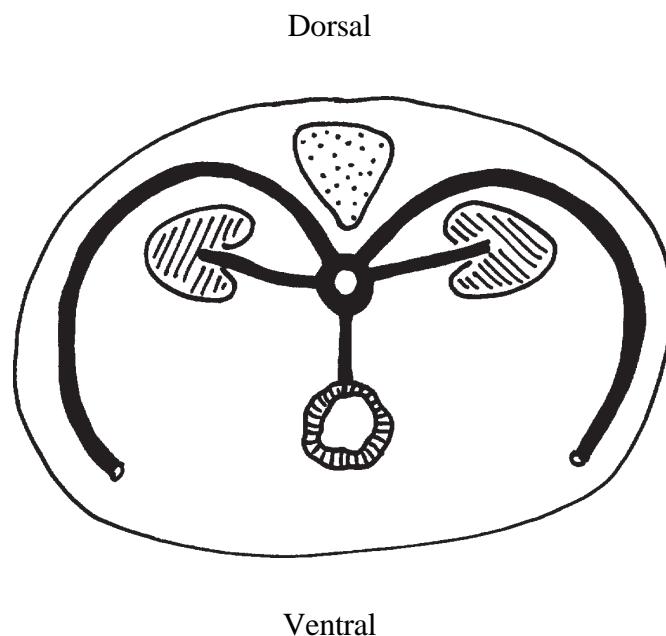
*How is the aorta affected by contraction of the diaphragm?*

*At which vertebral level does the abdominal aorta divide to form the two common iliac arteries?*

*Why does the wall of the aorta contain large amounts of elastic tissue?*

Identify the descending aorta in a suitable prosection. Note that the diameter of the vessel decreases considerably as it descends.

The branches of the **descending aorta** (shown as a central "doughnut" below) can be classified into three groups, as illustrated in the schematic diagram below:



They are:

**paired, segmental arteries supplying the body wall.**

**lateral arteries supplying paired viscera.**

**midline, unpaired arteries to the gut and its derivatives.**

*Label these accordingly in the previous diagram.*

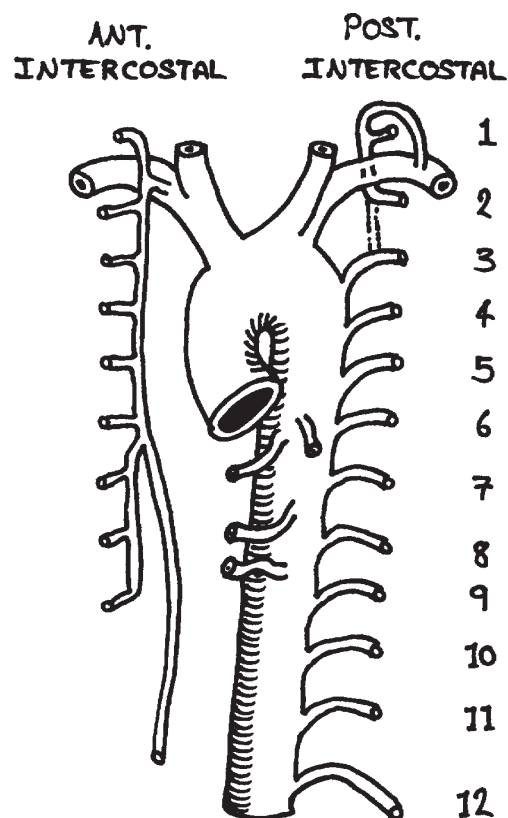
The branches of the descending aorta which supply the body wall are:

- nine pairs of intercostal arteries
- the paired subcostal arteries
- four or five pairs of lumbar arteries
- median sacral artery (unpaired!)

*Which regions of the body wall do each of these vessels supply?*

*Identify as many of these body wall vessels as you can on appropriate prosections.*

In the following diagram the branches of the anterior and posterior intercostal arteries are shown on the (bodies) right and left respectively.



Note that the third to the eleventh intercostal spaces are supplied by lateral branches of the thoracic aorta posteriorly, while the first and second are supplied by branches of the **superior (supreme) intercostal artery** arising from the subclavian artery.

The **internal thoracic artery** however, arises from the subclavian artery to provide **anterior intercostal branches** to the first 6 intercostal spaces prior to dividing into **superior epigastric** and **musculophrenic branches**. The latter supplies the seventh to the ninth intercostal spaces.

Finally paired lateral **subcostal** branches run inferior to the twelfth rib.

*Label all of the vessels mentioned on the previous diagram.*

*Also label the bronchial and oesophageal branches.*

*Why are there posterior branches to 11, but anterior branches to only 9 intercostal spaces?*

*What do the bronchial arteries supply?*

The superior epigastric artery forms an important anastomosis with the **inferior epigastric artery**.

*Where does the inferior epigastric artery arise?*

*Following what clinical condition would this anastomosis be important?*

The paired visceral branches of the thoracic aorta are the **bronchial arteries** which form part of the systemic circulation to the lungs (remind yourself of the distinction between the pulmonary and systemic circulations). In a previous practical you should have identified the bronchial arteries as they entered the lung root. Ensure that you can still do this. The origins of these vessels from the thoracic aorta are very difficult to locate.

The midline, unpaired vessels to the gut and its derivatives are the **oesophageal** branches of the thoracic aorta and the **coeliac, superior mesenteric** and **inferior mesenteric** branches of the **abdominal aorta**.

*The oesophageal branches of the thoracic aorta supply the middle third of the oesophagus.*

*Where do the arteries supplying the upper and lower regions of the oesophagus arise?*

Use your textbooks to help you locate the coeliac, superior mesenteric and inferior mesenteric arteries both in dissections from which the gut has been removed and in dissections where all or part of the gut remains in situ. In the latter specimens, attempt to trace the branches of these arteries towards the organs they supply. Blood supply to the abdomen will be covered in greater detail during the lectures on the gastrointestinal system.

The following diagram shows the major branches of the abdominal aorta.

*Label:*

**4 paired lumbar branches**

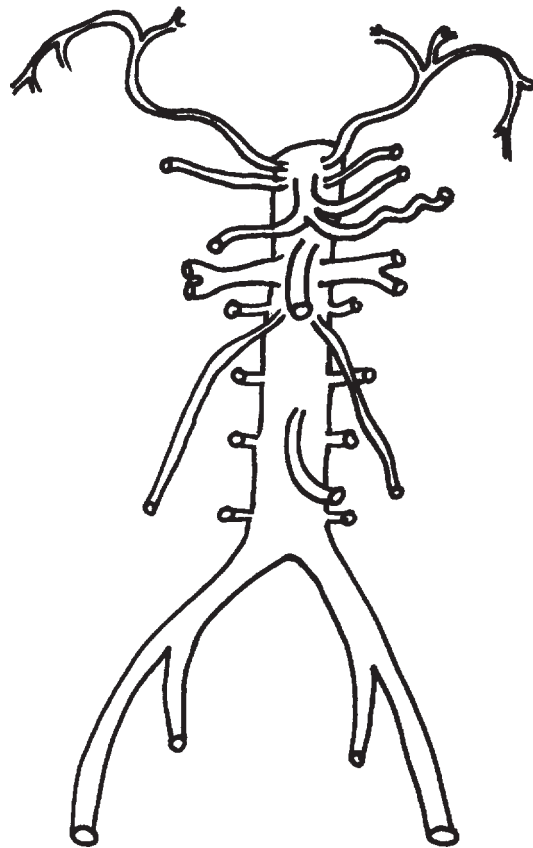
**2 lateral inferior phrenic**

**2 lateral suprarenal**

**2 lateral renal**

**2 lateral gonadal**

**3 midline visceral**



The abdominal aorta terminates by bifurcating into two common iliac vessels.

*Which vessels provide the arterial supply to the pelvic viscera?*

### *Venous drainage of the thorax and abdomen*

The veins from all parts of the body converge into two major vessels that empty into the right atrium: the superior vena cava and the inferior vena cava. You have already identified these vessels, as well as the great veins of the superior mediastinum (which unite to form the superior vena cava), in the previous practical.

*Which body regions are drained by the brachiocephalic veins?*

The other major veins of the thorax are those of the azygos venous system, which you should now examine.

On a suitable prosection identify the **azygos vein** as it ascends in the posterior mediastinum lying on the right side of the bodies of the lower 8 thoracic vertebrae posterior to the oesophagus.

*On the following diagram label:*

**azygos vein**

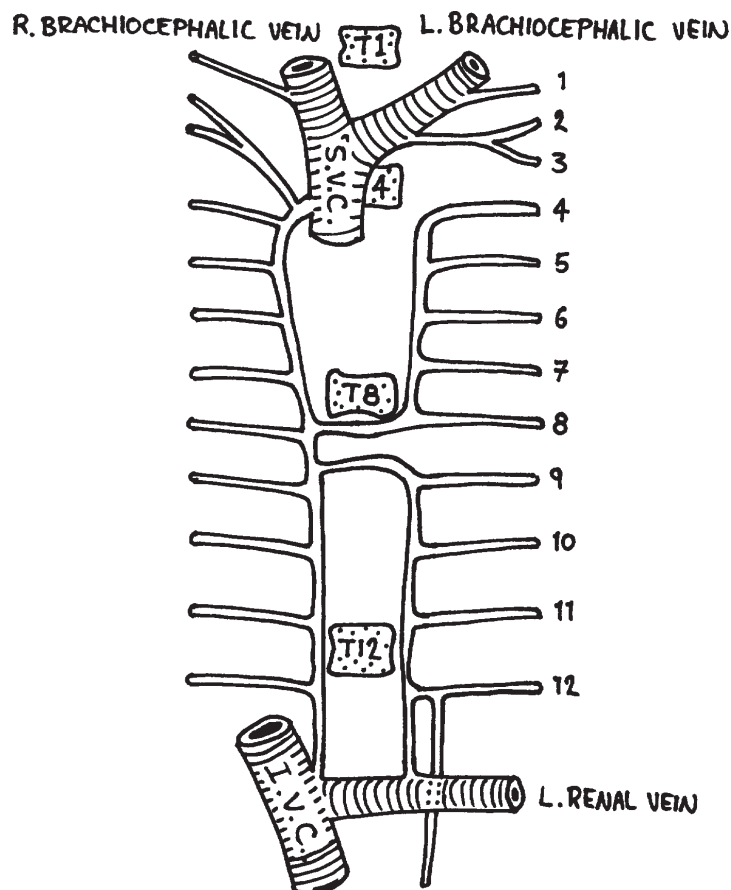
**hemiazygos vein**

**accessory azygos vein**

**supreme intercostal vein**

**superior intercostal vein**

**ascending lumbar vein**



*What is the relationship of the azygos vein to the root of the right lung?*

*Which posterior intercostal veins drain into the azygos vein?*

The **azygos vein** also receives the **oesophageal** and **bronchial veins** and drains part of the posterior abdominal wall, as it is formed in the abdomen usually by the union of the right subcostal and ascending lumbar veins. These vessels, frequently also connect to the inferior vena cava. Try to find the hemiazygos veins on the left side of the vertebral bodies of your prosected specimen (don't try too hard - these vessels are small and very variable).

Clearly the azygos system forms a potential anastomosis between the **inferior** and **superior vena cavae**.

*Why might this be clinically important?*

Note that the azygous system is highly variable.

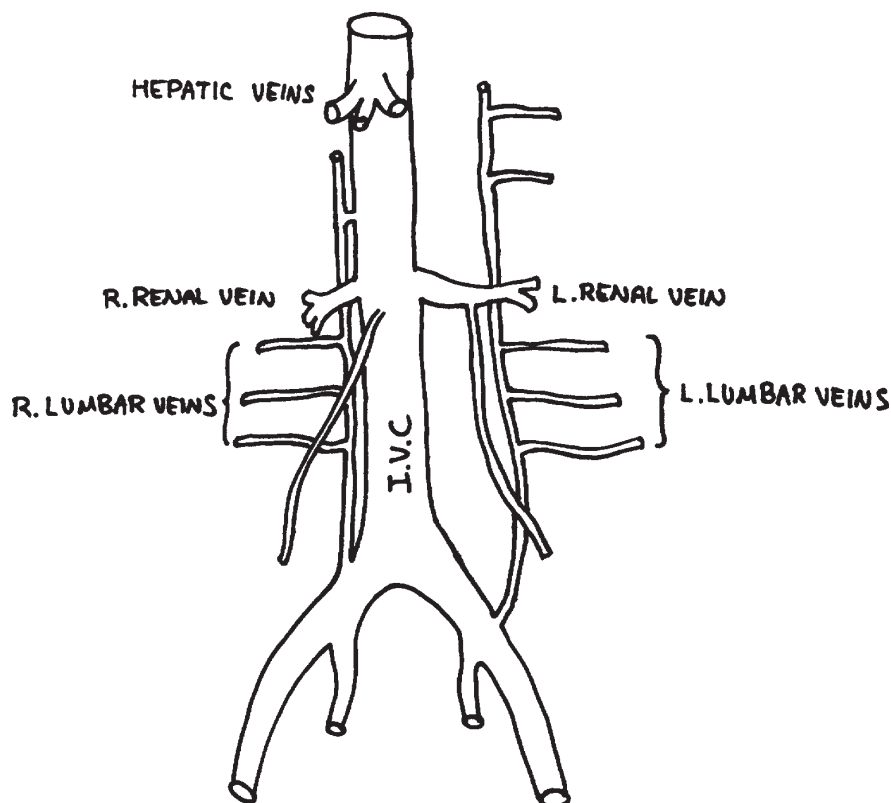
### *The inferior vena cava*

The inferior vena cava (IVC) carries the blood from the lower limbs, the abdominal walls, the pelvic and abdominal viscera.

*Which vessels unite to form the IVC?*

*At which vertebral level?*

Complete the labelling of the following diagram of the IVC and its major tributaries to include **ascending lumbar**, **gonadal** and **iliac** branches, then identify as many of these veins as possible in suitable prosections.



As the IVC ascends through the abdomen, it receives tributaries that correspond to the branches of the abdominal aorta to body wall and paired viscera (although the left suprarenal and gonadal vessels join the IVC via the left renal vein).

Note that the IVC does not receive venous blood directly from the digestive tract, pancreas or spleen. The blood from these organs passes first through the capillaries/sinusoids of the liver before entering the IVC by way of the hepatic veins.

The hepatic portal system will be considered in detail during the classes concerned with the gastrointestinal tract.

Indicate the vertebral levels on the diagram at which the hepatic and renal veins branch, and the I.V.C. bifurcates.

## **LIVING ANATOMY OF THE HEART AND GREAT VESSELS**

The aim of this class is to study the surface markings of the heart. As many of you as possible should come to the class prepared to act as subjects for this study.

Working in groups of 3 or 4, with the subject removing their shirt to expose the chest wall, mark the borders of the heart and the position of the heart valves.

### **POSITION OF HEART**

Draw a line along the right side of the sternum between the medial ends of the 3rd and 6th costal cartilages. This marks the right border of the heart, formed by the right atrium. From here, a nearly horizontal line to the left 5th intercostal space in the midclavicular line marks the inferior border of the heart. This border is formed mainly by the right ventricle. The left (oblique) border, formed mainly by the left ventricle, runs from the left 5th space in the midclavicular line to the medial end of the left 3rd space.

Observe the completed outline. It should be comparable to the outline in the following diagram, which shows the position of the heart valves.

The heart apex lies at the meeting point of the inferior and oblique borders, in the 5th intercostal space. Skin pulsations produced by ventricular contraction can often be seen here and the apex beat should be easy to feel.

*Where does the apex beat lie relative to the nipple?*

*How constant is this relationship?*

*How does the orientation of the heart change: during respiration?*

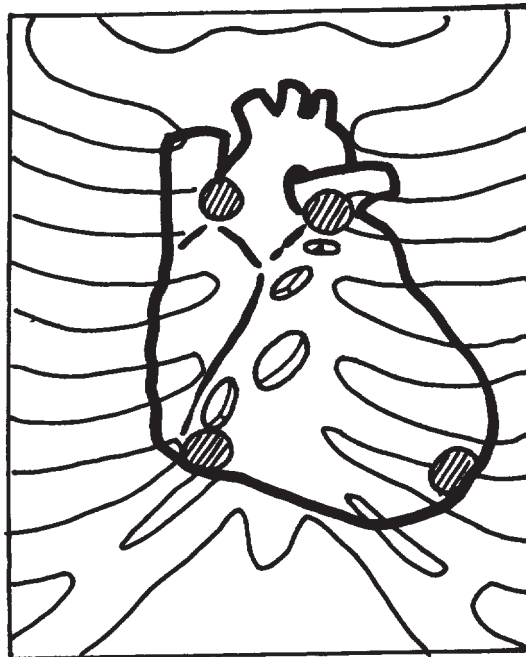
*with posture?*

*Devise a route by which you would insert a needle into the pericardial cavity to drain an effusion.*

## SURFACE MARKINGS OF THE HEART VALVES

All 4 heart valves are embedded in the fibrous atrioventricular septum of the heart. They lie on a line running from the medial end of the left 3rd intercostal space to the medial end of the right 4th intercostal space. Mark this line on your subject. The order of valves from above down is **pulmonary, aortic, mitral, tricuspid**.

*Label these on the diagram.*



## AUSCULTATIONS OF HEART SOUNDS

Place a stethoscope over the apex beat and listen to the normal “lub-dub” sounds caused by the closure of the atrioventricular and arterial valves respectively. The composite heart sound can be heard if the stethoscope is placed anywhere over the heart. However, using a little anatomical knowledge, it is possible to position the stethoscope so as to increase the contribution of any particular valve and so detect any functional problems of that valve. The sounds from a particular valve are best heard from a blood filled space downstream from the valve.

The diagram below shows the position of the heart valves and the sites at which the sounds made by individual valves can best be heard on the chest wall (these are indicated by shaded circles).

*Indicate at which site you would here the sounds of which valve.*

# RADIOLOGY OF THE HEART

Examine the size and shape of a normal heart on the P.A. radiograph (compare the radiographic image with the diagram of the anterior aspect of the heart, earlier in this section).

*On a radiograph, identify the structures which form the borders of the mediastinal shadow.*

On the left

On the right

**arch of aorta**

**right brachiocephalic vein**

**pulmonary trunk**

**superior vena cava**

**left atrium**

**right atrium**

**left ventricle**

**inferior vena cava**

*How wide is the normal heart relative to the width of the whole thorax?*

*Why might it be useful to know the width of a normal heart as seen in a standard P.A. chest X-ray?*

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