

The Cardiovascular System

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Lecture Objectives

- Classify the different types of blood vessel
- Describe the great vessels in the mediastinum
- Explain the arterial supply and the venous drainage of the thoracic wall
- Distinguish between the pulmonary and the systemic blood supply to the lungs
- Briefly explain lymphatics

Blood Circulation

Systemic circulation

- left side of heart pumps blood through body
- left ventricle pumps oxygenated blood into aorta
- aorta branches into many arteries that travel to organs
- arteries branch into many arterioles in tissue
- arterioles branch into thin-walled capillaries for exchange of gases and nutrients
- deoxygenated blood begins its return in venules
- venules merge into veins and return to right atrium

• **Pulmonary circulation**

- right side of heart pumps deoxygenated blood to lungs
- right ventricle pumps blood to pulmonary trunk
- pulmonary trunk branches into pulmonary arteries
- pulmonary arteries carry blood to lungs for exchange of gases
- oxygenated blood returns to heart in pulmonary veins

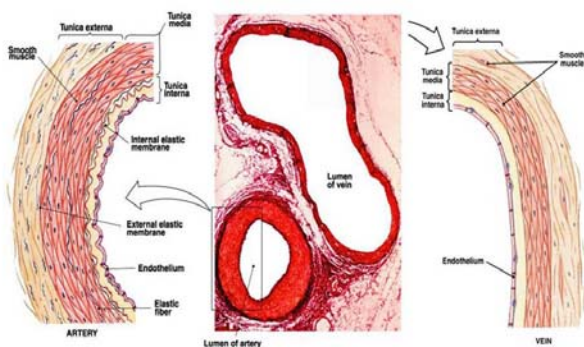
Anatomy of Arteries and Veins

- **Tunica interna (adventitia)** – outer layer
 - CT elastin and collagen
 - Protects, Strengthens, Anchors
 - Vasa vasorum
- **Tunica media** – middle layer
 - Circular Smooth Muscle
 - Collagen & Elastic Fibers
 - Vaso-constriction/dilation
- **Tunica intima** – innermost layer
 - Basement membrane
 - Endothelium – simple squamous
 - Endothelial function - Vasoactive / Minimizes friction
- **Lumen**

Structure of

-arteries

-veins



Vessels of Cardiovascular System: Arteries

- Carry blood AWAY from heart
- Systemic Circuit: carry O₂ blood
- Pulmonary Circuit: carry de-O₂ blood
- Walls thicker than Veins
 - Tunica media > Adventitia
- 3 Types
 - Conducting (elastic)
 - large, elastin, high pressure
 - Distributing (muscular)
 - medium size, to organs
 - Arterioles
 - smallest

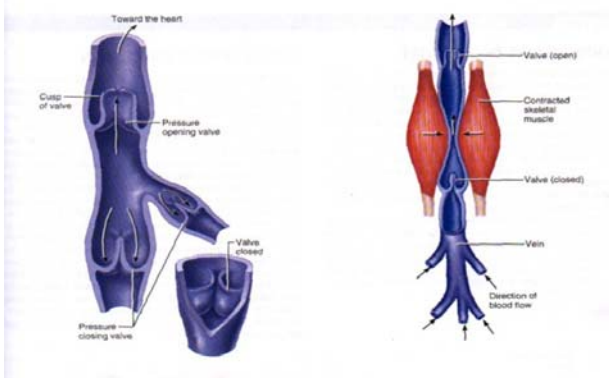
Vessels of Cardiovascular System: Capillaries

- Smallest blood vessels
- Single layer of endothelium surrounded by basal lamina
- Deliver O_2 and nutrients to cells and remove waste
- Capillary Beds: networks of caps. Regulating amount of blood going to cells throughout tissues

Vessels of Cardiovascular System: Veins

- Carry blood from capillaries INTO the heart
- **Systemic Circuit: O_2 poor blood**
- **Pulmonary Circuit: O_2 -rich blood**
- Thinner walls than arteries
 - Adventitia > tunica media, Less elastin
- Larger lumen than arteries
- Contain valves (made of Tunica. intima)
- Normal movement, Muscular contraction push blood through
- **Venules- smallest veins**

Movement through Veins



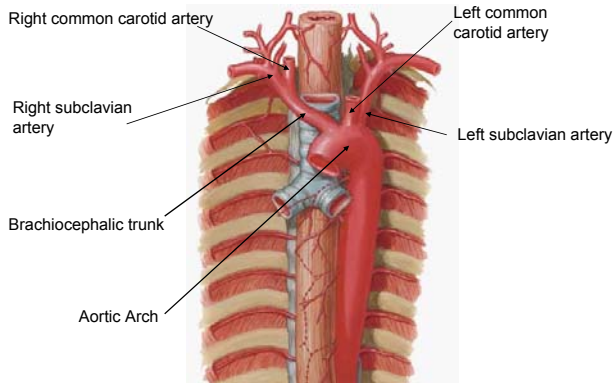
Classification of blood vessels

aorta		<ul style="list-style-type: none"> • Elastic arteries eg aorta <ul style="list-style-type: none"> - wide lumen, elastic wall - damp pressure variations
arteries		<ul style="list-style-type: none"> • Muscular arteries eg other arteries <ul style="list-style-type: none"> - wide lumen, strong non-elastic wall - low resistance conduit
arterioles		<ul style="list-style-type: none"> • Resistance vessels eg arterioles <ul style="list-style-type: none"> - narrow lumen, thick contractile wall - control resistance & therefore flow - allows regional redirection of blood
capillaries		<ul style="list-style-type: none"> • Exchange vessels eg capillaries <ul style="list-style-type: none"> - narrow lumen, thin wall
venules		<ul style="list-style-type: none"> • Capacitance vessels eg venules & veins <ul style="list-style-type: none"> - wide lumen, distendable wall - low resistance conduit, & reservoir - allows fractional distribution of blood
veins		

- **Blood Flow to the Organs Matches Body Requirements**
- Active organs such as the liver, brain and kidney have high blood flows at rest
 - About 25% of the cardiac output goes to the kidney
 - Composition of the blood is continuously regulated by the kidney
 - Gastrointestinal tract & liver get another 25%
 - Muscle circulation at rest is about 20% of cardiac output
 - Brain needs about 15% of the cardiac output
- Circulatory system adapts to meet body's needs:
 - In exercise blood flow to active muscles is greatly increased
 - Total cardiac output increases up to ~25 liters/min
 - Percentage to muscles increases to as much as 80%
 - Blood flow to skin is increased or decreased to regulate body temperature
 - What do you think happens to blood flow to the viscera (stomach & intestines) during exercise? What do you think happens to the blood flow to the heart muscle?

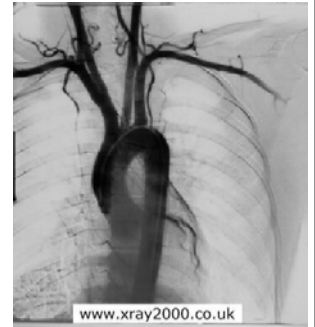
- **Blood Flow through Organs is Regulated by Nerves and Chemical Agents**
- Blood flow can be increased by increasing the blood pressure (higher cardiac output, constriction of many arterioles)
- It can also be increased by opening up (dilating) arterioles in the tissue which needs more blood
- Both cardiac output and blood vessel diameter are controlled by hormones and nerves
- The regulation is automatic, mostly controlled by the autonomic nervous system

Aortic Arch and Great Vessels

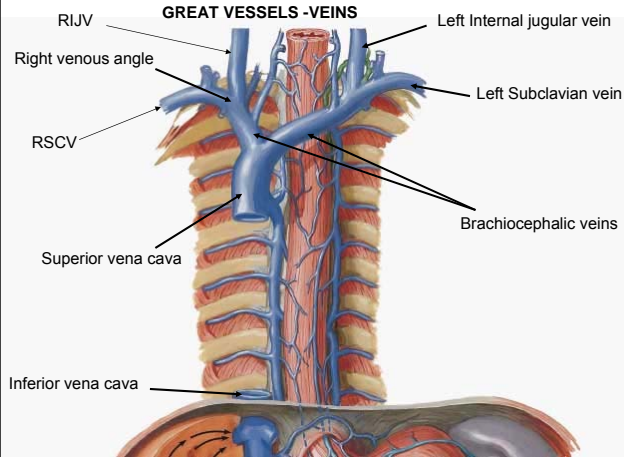


Vascular arteriogram: The aortic arch and great vessels

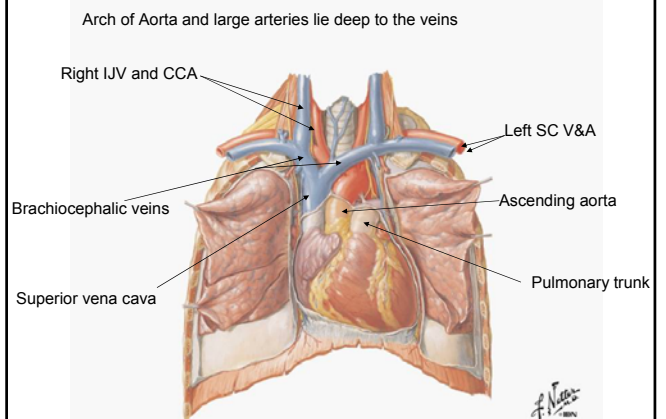
- Coronary arteries
- Ascending aorta
- Aortic arch
- Brachiocephalic trunk
 - right subclavian art
 - right common carotid a
- Left common carotid a.
- Left subclavian a.
- Descending aorta



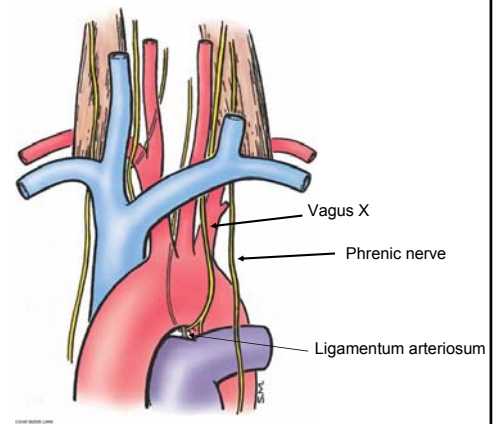
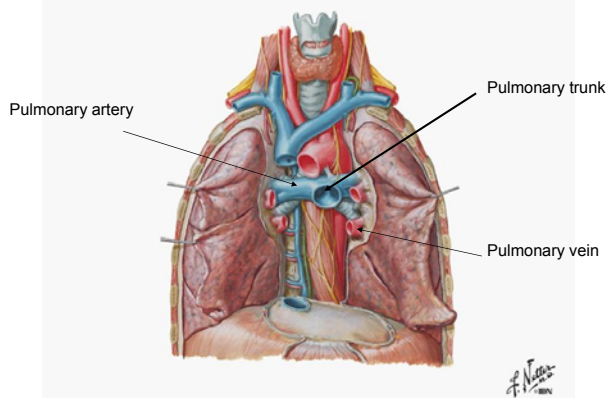
GREAT VESSELS -VEINS



Heart: Anterior Exposure

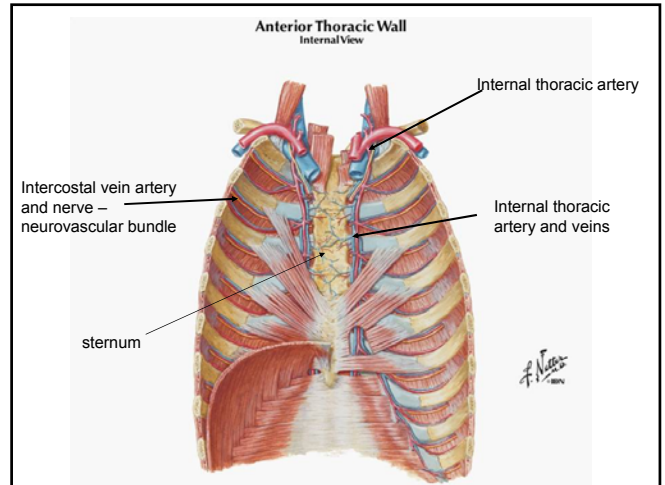


Great Vessels of Superior Mediastinum



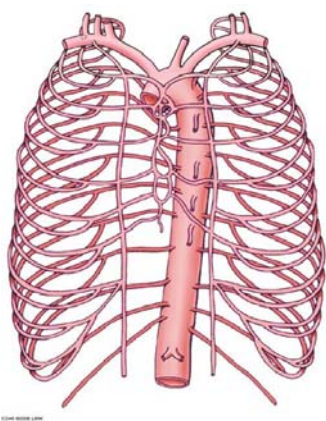
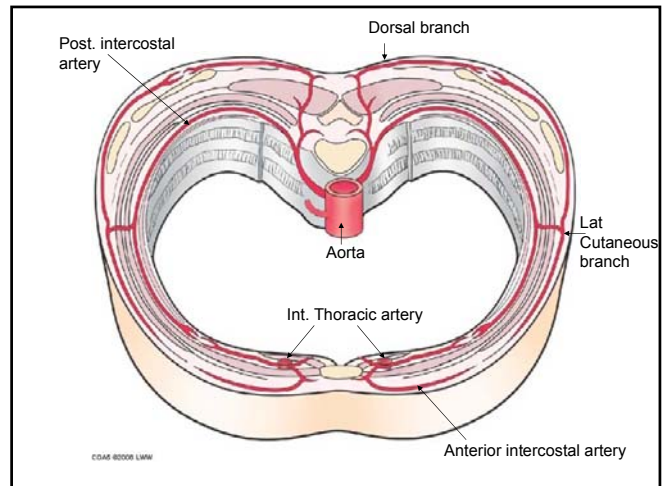
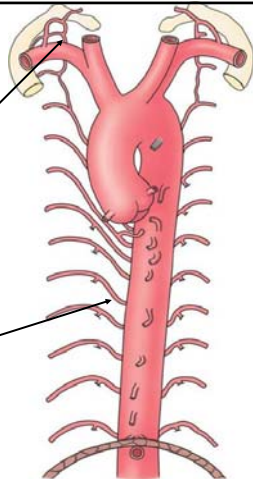
Thoracic Arterial Supply

- Arterial supply to chest wall is supplied by intercostal arteries which run in the upper part of each intercostal space (with their corresponding nerve and vein in in neurovascular bundle) in the costal groove
- Anterior intercostal arteries (AI) anastomose with posterior intercostal arteries (PI) in each space.
- AI arise from the internal thoracic artery which runs deep to the costal cartilages
- PI are branches of descending aorta (except 1 and 2, which branch from costocervical trunk of subclavian).



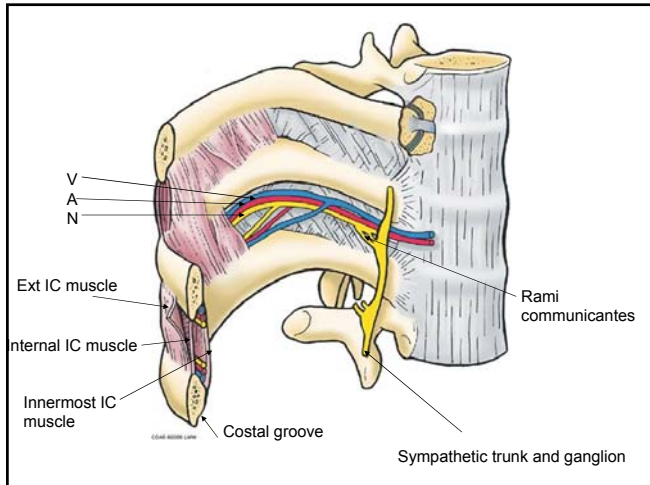
Arterial Supply to Post Thoracic Wall

- Costocervical trunk (branch of subclavian) (1 and 2)
- Posterior intercostal arteries (3 to 12)



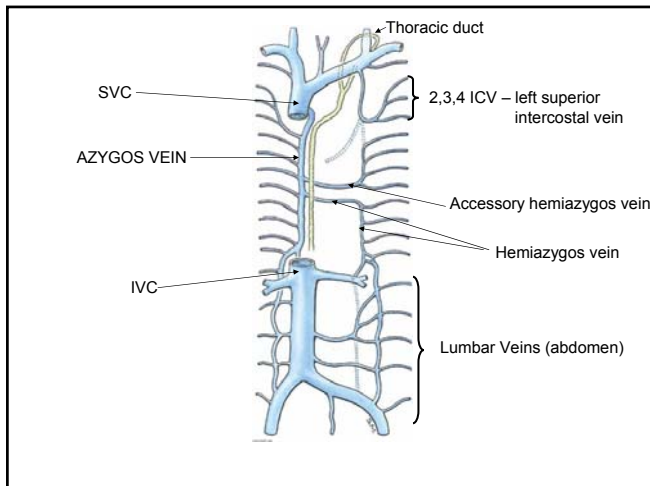
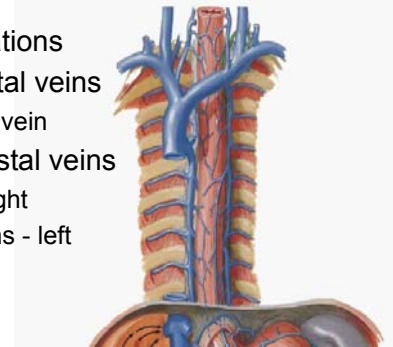
Contents of an intercostal space

- External intercostal muscle
- Internal intercostal muscle
- Neurovascular bundle – running in costal groove
 - Vein (superior)
 - Artery
 - Intercostal nerve (inferior)
- Innermost intercostal muscle



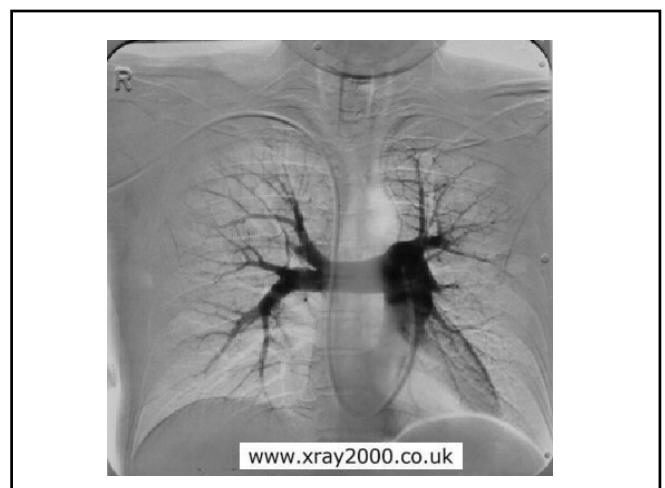
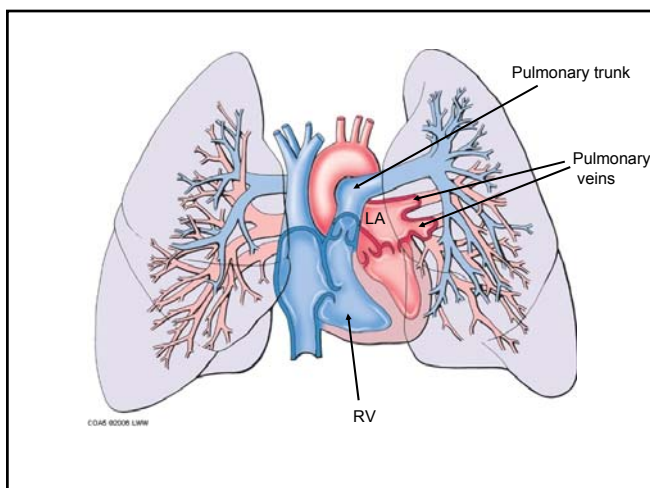
Thoracic venous drainage- azygos system.

- Veins more variations
- Anterior intercostal veins
 - Internal thoracic vein
- Posterior intercostal veins
 - Azygos vein – right
 - hemiazygos veins - left



Blood Supply to the lungs

- Pulmonary circuit
- Systemic circuit (small)
 - Bronchial arteries – supply root of lungs
 - Arise from the thoracic aorta
 - Bronchial veins drain only part of the systemic arterial blood and drain into azygos/accessory hemiazygos veins



The Lymphatic System

- Function: to collect excess tissue fluid collecting at arteriole end of capillary beds, and return leaked blood proteins to blood (maintain osmotic pressure needed to take up water into bloodstream)
- Lymph is moved through vessels
 - Pulse of nearby arteries
 - Contraction of surrounding skeletal muscle
 - Regular movement of body (wiggling legs)
 - Muscle in Tunica Media
- Lacteals-lymphatic capillaries w/unique function
 - In mucosa of small intestine, receive digested fat from intestine
 - Fatty lymph becomes milky = **Chyle**
 - **Chyle** goes to bloodstream

Lymphatic System

- **Lymph**- clear fluid from loose CT at capillaries
- **Lymphatic capillaries** (near blood capillaries) →
- **Lymph collecting vessels** (small, 3 tunics, # valves)→
- **Lymph nodes** (sit along collecting vessels)- clean lymph of pathogens, they are NOT glands
- Lymphatic trunks →(convergence large collecting vessels)
 - Lumbar, intestinal, bronchomediastinal, subclavian, jugular
- **Lymphatic ducts** → empty into veins of neck

LEARNING LANDSCAPE

- SETUP – Workstations
- The purpose of each station
- Revision
- RULES

Learning Landscape

- LAB COATS COMPLUSORY
- NO PHOTOGRAPHY
- NO MOBILE PHONES
- DO NOT REMOVE ANYTHING
 - TISSUES
 - BONES
 - MODELS

LEARNING LANDSCAPE

- COVERED BY THE HUMAN TISSUE ACT
- AUTHORISED PEOPLE ONLY (I.E. DO NOT TAKE ANYONE IN THERE WITH YOU).
- CARD ACCESS ONLY – try not to tailgate as this is a register of your attendance
- Bags left outside the learning centre (in the lobby)
- Camera system

Anatomy Spotter Exam

There will be an examination on Friday 16th February – am (the morning of your CR and MET summative assessment)

Example Question : Identify A

- Posterior intercostal vein
- Posterior thoracic vein
- Thoracic duct
- Sympathetic trunk
- Azygos vein

