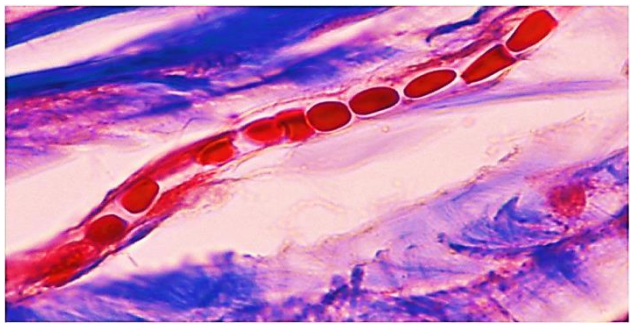
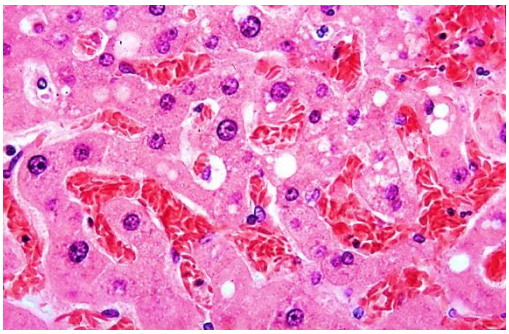
capillaries

From where	Capillaries
Def	- where exchange between blood & tissue fluids occur - Is where exchange of water and nutrients occur between blood and tissues hence called (Exchange vessels)
Char	1- The smallest blood vessels 2- The diameter 5- 8 µm 3- 90% of all blood vessels of body
The wall of capillaries	- formed by a 1. single layer of endothelial cells 2. Pericytes 3. basal lamina 4. NO smooth ms cells
Types مهم جدًا	Depends on the continuity of endothelial cells (pores & intercellular clefts) & the basal lamina
	1- Continuous (Somatic) - tight junctions between the cells - Continuous basal lamina - has the lowest permeability (water, ions, lipid soluble molecules) - the way of transport (diffusion , transcytosis)
	2- Fenestrated (Visceral) - cells have pores may be/ may be not covered by diaphragm - continues basal lamina - relatively high permeability - the way of transport (active filtration, reabsorption, hormone secretion) - No diaphragm: renal glomeruli (capillary in kidney) - Has diaphragm: intestine & endocrine gland , pancreas
	3- Discontinues (Sinusoidal) - Extremely highly permeable - the way of transport (permit cross of cells & serum proteins) Liver, spleen , bone marrow

Pericytes

From where	Pericytes
Def	branched cells
Fun	1- act as smooth muscle cells 2- It gives a stent (support) to the walls of the blood vessels 3- stabilize capillary wall 4- control permeability (contract) 5- play role in vessel repair 6- They are considered stem cells because if there is any defect (damage) in the endothelial cells and they can replace it and give new epithelial cells.

From where	Blood capillary	Blood sinusoid
1- The shape of lumen	Narrow regular lumen	Wide irregular lumen
2- The diameter	(5-8 µm) Uniform diameter	(30-40 µm) Variable diameters & tortuous (متعرجة)
3- The type of endothelium	Continuous or fenestrated endothelium	Always fenestrated
4- The continuity of basal lamina	Complete basal lamina	Incomplete basal lamina
5- Surrounded with Pericytes	Surrounded with Pericytes	Not Surrounded with Pericytes Contain macrophages e.g. Littoral cells (spleen), Kupffur cells (liver)
6- present in	Present in all tissues 	present in certain sites as :bone marrow, spleen, liver& Endocrine glands. 

Arterio- venous anastomoses (AVA)/ Shunt

From where	Arterio- venous anastomoses (AVA)/ Shunt
Def	Direct connection between arterioles & venules without passing through capillary bed →↑ venous return to the heart
Conditions	A- contraction of pre- capillary sphincters → Blood will pass through thoroughfare channel B- AV anastomosis: small vessels connect directly arterioles to venules
Char	1- The AVAs are short vessel with a large inner diameter 10 - 150 µm 2- thick muscular wall 3- with no capillary section between them 4- They are densely innervated by adrenergic fibers When they open they provide a low resistance connection between arteries and veins 5- AVAs play important role in temperature regulation e.g. skin (hands & feet) Blood flow in genital organs

Venules

From where	Venules
Char	1- The smallest veins 2- The diameter (20- 30 µm) 3- Its structure similar to arterioles
The char of tunica intima in venules	Endothelium
The char of tunica media in venules	- 1 or 2 layers of smooth ms. Cells -The thickness ↑ as the vessel diameter increases
The char of adventitia in venules	relatively thick

Medium size veins

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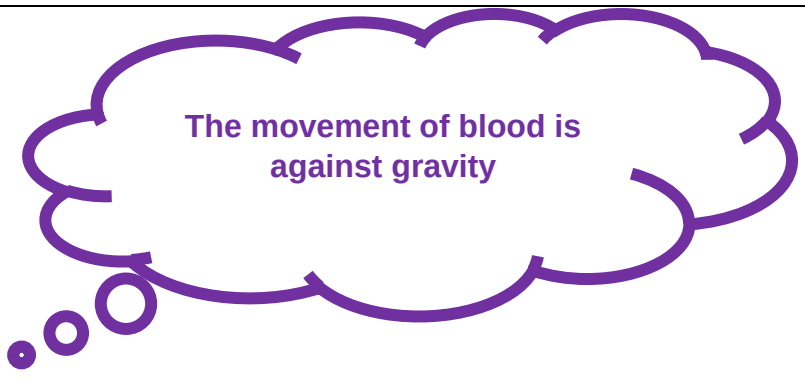
From where	Medium size veins
Fun	Carry blood toward → heart.
Char	1- The blood pressure in veins is much lower than arteries 2- Veins have 3 tunics 3- thinner walls with wider lumen comparing with corresponding arteries 4- they can hold most of the blood 5- called capacitance vessels
The char of tunica media in Medium size veins	Thin
The char of tunica adventitia in Medium size veins	thick

Valves

From where	Valves
Char	1- are folds project from intima into lumen of the vein 2- Lined on both sides by endothelium 3- their core formed of elastic tissue 4- Most abundant in veins of limbs
Valves in Medium size veins	special adaptation in the veins helps return of blood to heart & prevents its back flow
Valves in small and large size veins	Absent



Vena cava (inferior & superior)

From where	Vena cava (large vein) (inferior & superior)
The char of tunica intima in Vena cava (inferior & superior)	- Endothelium - sub-endothelial CT - No IEL - No valves
The char of tunica media in Vena cava (inferior & superior)	- thin layer - smooth muscle - elastic - collagen fibers
The char of tunica adventitia in Vena cava (inferior & superior)	- Thick - contains longitudinal bundles of smooth muscles fibers facilitate shortening & elongation of the vena cava with respiration.

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مهم جدًا

From where	**Medium sized artery**	**Medium sized vein**
The shape of lumen	Narrow lumen	Wide lumen (offer little resistance)
The wall of it	Thick wall	Thin wall
Prescence the valve	No valves	Valves
Intima	- Thick - IEL	- Thin - no IEL
Media	Thick	Thin
Adventitia	Thin	Thick
Blood flow velocity	Rapid flow of blood	Slow flow of blood

Medical applications

From where	**Atherosclerosis**	**Infarction**	**Aneurysm**
Def	focal thickening of the intima of arteries (coronary artery)	death of tissue	marked dilation of blood vessels
Cause	due to deposition of cholesterol	due to lack of blood supply	due to weakening of tunica media →rupture & hemorrhage.
Other name	- (lipid plaques) - (Foam cells)		

Mechanism **How it is happen**	**Atherosclerosis: when the endothelial cells damage→ ↑ permeability of arterial wall → LDL enter to tunica intima →damaged endothelial cell will attract WBCs , WBCs will squeeze itself and enter by diapedesis to reach intima layer. WBCs will release free radicals that will oxidize LDL molecules.** **Macrophages in tunica media start to engulf the LDL particles→ foamy appearance Accumulating lipid & dead cells will form plaque, the plaque will deposit Ca+ → hardening of the wall as atherosclerosis . If endothelial over the plaque is compromised blood clots can form (thrombus) which may break →emboli**		

Lymph

From where	Lymph
Def	**is a colorless fluid that circulates through the lymphatic system**
When the lymph formed?	**when the interstitial fluid is collected through lymph capillaries**
Char	**1- lymph composition continually changes as the blood and the surrounding cells continually exchange substances with the interstitial fluid** **2- Generally similar to blood plasma + water + immune cells WBCs (lymphocytes & macrophages)** **3- Lymph returns proteins and excess interstitial fluid back to the blood stream. Venous blood** **4- Lymph may pick up bacteria & pathogens and large particles (fat) and bring them to lymph nodes where they are destroyed by immune cells→ blood stream**
lymph circulation	**interstitial fluid will drain into** **lymph capillaries** **↓** **lymph vessels** **↓** **lymph nodes** **↓** **Lymphatic vessels** **↓** **Lymphatic duct** **↓** **ultimately emptying into the right or the left subclavian vein, where it mixes back with blood.** **↓** **lymph vessels similar to veins in structure One direction & contain valves** **↓** **they pass through the lymph nodes where filtration of the lymph from bacteria occurs** **↓** **Lymphatic vessels ultimately drain lymph into 2 main ducts:** **- Right lymphatic duct Drains right side of head & neck, right arm, right thorax → into the right subclavian vein** **- Thoracic duct: Drains the rest of the body → into the left subclavian vein**

From where	Structure of Lymphatic capillaries	Structure of Lymphatic vessels	Structure of Lymphatic duct	Similar in structure to large veins
Char	**1- Begin with a blind (dead) end** **2- Have similar structure to blood capillaries but larger & more permeable ,considered as microcirculation** **3- Made of single layer of overlapping endothelium with interrupted basal lamina** **4- its endothelium Has NO (fenestrae, tight junction, pericytes, smooth muscle)** **5- Lymphatic endothelial cells attached to anchoring filaments made of elastic fibers which** **1- attach endothelial cells to surrounding tissue.** **2- pull on → widen gap between endothelial cells→ draw more fluid into lymphatic capillary** Endothelial cells are one- way swinging door	**1- Thinner wall + large lumen+ valves** **2- Drain lymph from lymph capillaries** **3- Lymph nodes are found along their course** **- Structure:** **1. Endothelium** **2. Valves** **3. media (few smooth muscle cells)** **4. adventitia**	**1- Large vessel that drain lymph into one of the subclavian veins** **2- 2 lymph ducts:** - **Right lymphatic duct** - **Thoracic duct**	**1- Tunica intima: endothelium + CT** **2- Tunica media: smooth muscles. + elastic fibers** **3- Tunica adventitia: CT + smooth muscles.**