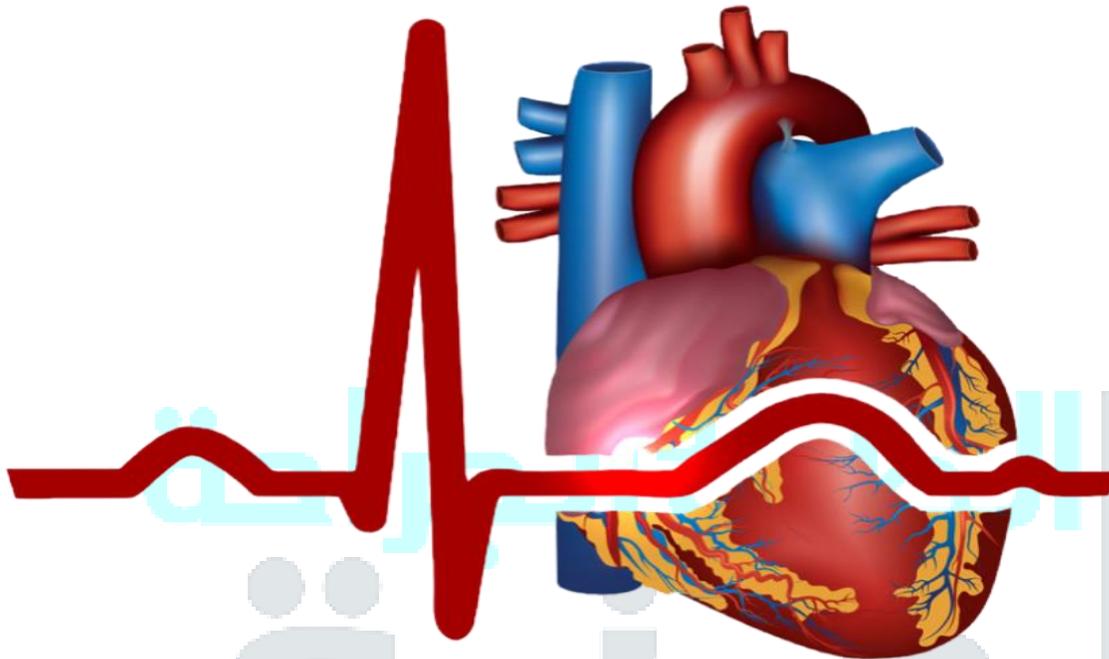


Doctor 2020 - wateen - medicine - MU



physiology sheet

DONE BY:

Hala mahasneh

corrected BY:

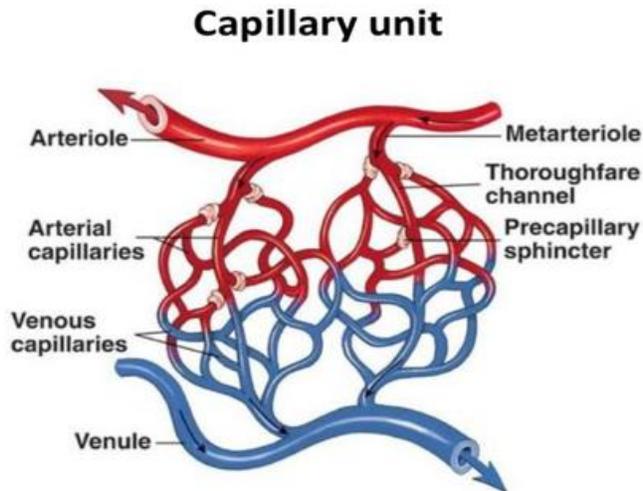
Ajyad qawab'a

Doctor :

Dr . Arwa Rawashdeh

Blood flow to tissues

Capillary unit



★ **In metarterioles (precapillary) :**
link arterioles to capillaries -
has pre-capillary sphincter do
vasodilation or vasoconstriction –
when it's needed –

■ **More blood flow ; in exercise**
vasodilation of metarterioles then
increase metabolic (getting O₂ to
interstitium)

■ **Less need for blood flow ;**
vasoconstriction

needed of metabolism) حسب الوضعية
(reaction in specific time

tissue controls its own blood flow according to its needs (get O₂ ,
nutrients and remove CO₂) - according to metabolic rate of
tissues –

Blood flow starting from aorta → major arteries → arterioles →

Metarterioles → venous capillaries → venules → major

(superior and inferior vena cava) → heart

* **Blood flow is directly proportional to radius** أهم عامل

* **Blood flow is inversely proportional to resistance.**

↳ **Two major theories for local blood flow are : (metabolism
theory**

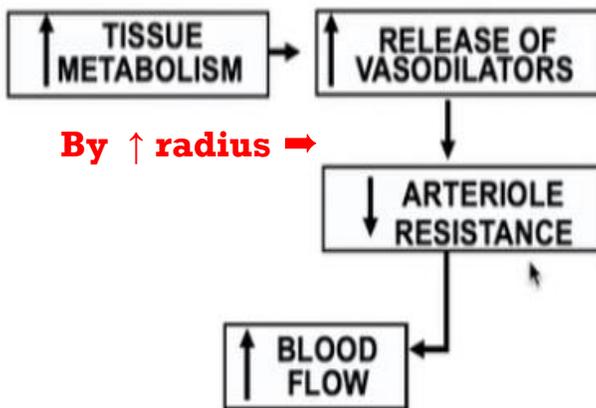
▶ **Oxygen demand theory**

▶ **The vasodilator theory**

metabolism theory

the process of supply the body with metabolites during exercise

Vasodilator Theory for
Blood Flow Control



- 90% of RS & CVS caused by changes in radius
- There is more blood flow to skeletal muscles during exercise than blood flow to GIT or UT

Demand :: need

During exercise

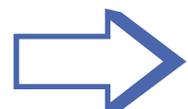
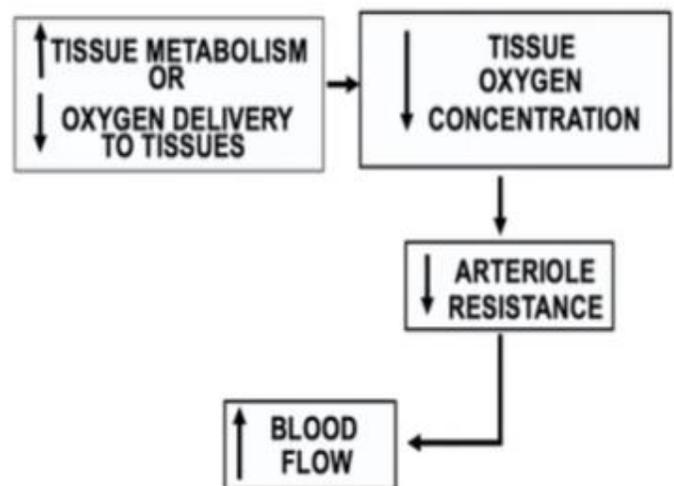
↑ in O₂ consumption → ↓ in arterial oxygen → ↑ tissue metabolism →

Muscle vasodilated → ↑ blood flow

→ during exercise ; blood flow to tissues not equal , HOW ?



Oxygen Demand Theory
for Blood Flow Control



Organ	At rest (cm ³ per min)	Maximum effort (cm ³ per min)
Skeletal muscles	1000	26 000
Coronary vessels	250	1200
Skin	500	750
Kidneys	1000	300
Liver/gut	1250	375
Brain	750	750
Other	250	625
Whole body	5000	30 000

In skeletal muscle :

there is severe increase in maximum effort and that for metabolites and O₂ supply

In coronary vessels :

increase but little bit , not compared to skeletal muscles

In kidney and liver :

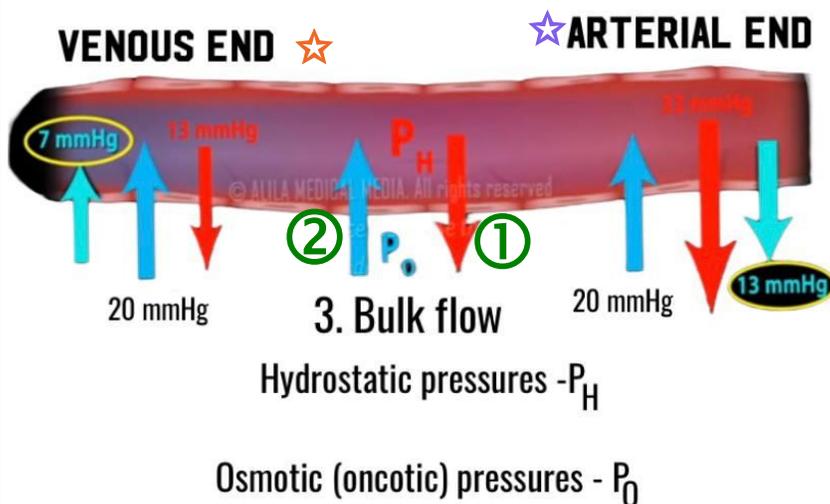
Decreased because there in no need for blood flow here

shunt all blood flow here

in brain : haven't change , because brain want to keep lower blood flow in it and then lower pressure , because if the pressure in brain high → hypertension → injury in arteries → stroke

↪ if there is a little bit decrease in pressure inside brain , this will lead to subconscious ; like which is occurring during awaking from sleep

Starling force



The movement of fluid across capillaries and in the surrounding interstitium (between hydrostatic and oncotic pressure) :

1> Oncotic pressure is caused by plasma proteins (albumin not another protein, because its quantity is high) and not cross capillary membrane → fluid back into the capillaries ~ fixed

2» **Hydrostatic pressure is caused by fluid (more than oncotic pressure) which increased by cardiac contractility causing blood flow = capillary blood pressure**

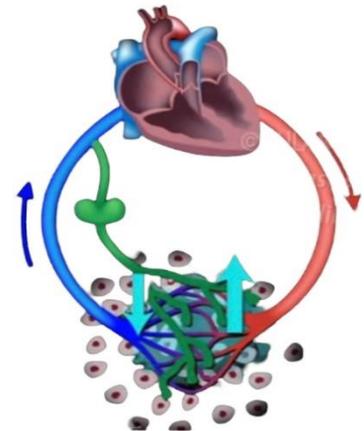
- **Per a day**

20 liters seeps out

17 liters is reabsorbed

3 liters left in tissues (still in interstitium)

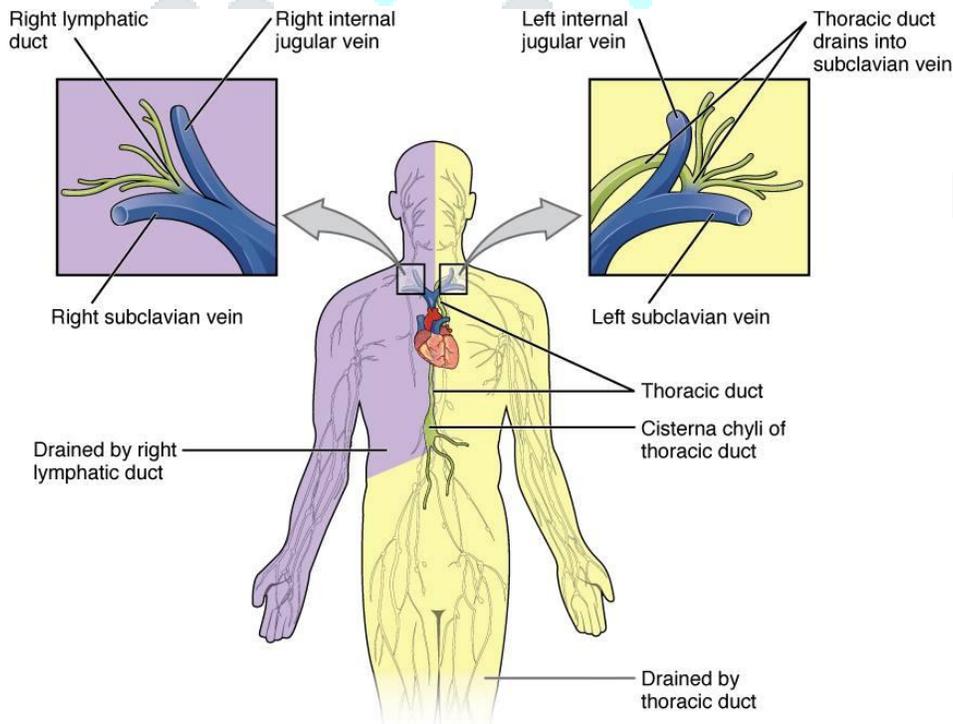
Filtration is more than reabsorption



SO , we need to another way for drainage → By lymphatic system (which we dealing with it as interstitium) مرتبطات مع بعضهم البعض

ما بقدر أحكي انه ال lymph مختلف عن ال interstitium لأنه ال lymph vessel داخله interstitium

- **Mainly by thoracic drainage duct , not right drainage duct → to subclavian vein → SVC & IVC**

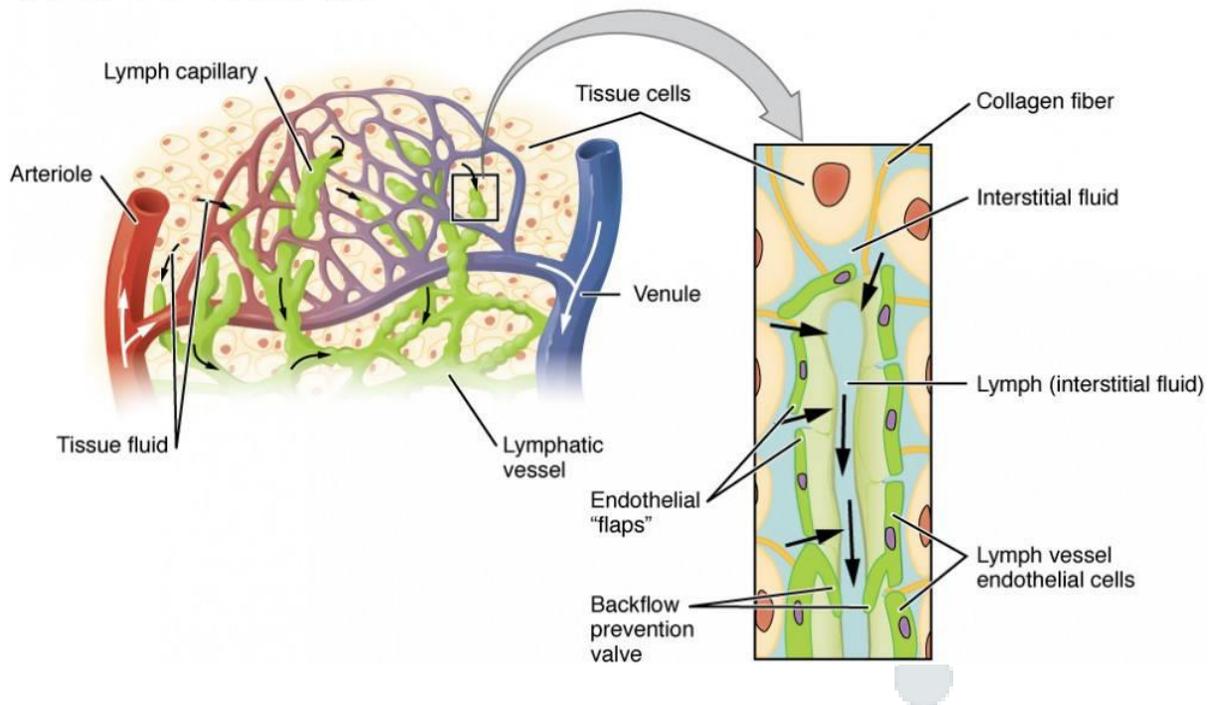


↳ blood circulation is closed circulation , because it is start from heart and end in heart

↳ **but lymphatic is open circulation because it is start from lymphatic and end in heart**

- **gaps between endothelium of lymph vessels are wider than endothelium of blood vessels so that when pressure increases inside the interstitium → will press the gaps and then open it → which allow the get and out of fluids inside lymphatic capillaries but in blood vessels there is tight junction between them (less gaps)** ف ما رح يسمح بمرور أي بروتين

Lymph capillaries in the tissue spaces



- **lymphatic vessels have valves , but arteries has no valves**
- **arterioles have more smooth muscles than venules , so arterioles control blood resistance .**

Bulk flow : the bulk exchange of fluids and solutes is through the gaps between endothelial cells (intercellular cleft) (fenestrated capillaries) :

↳ ☆ **blood plasma containing nutrients moves out of capillaries at the arterial end of capillaries beds (infiltration)**

↪ ☆ in tissue fluids containing wastes reabsorbed back at the venous end

Bulk flow caused by balance between these two forces :

Hydrostatic pressure & oncotic pressure

① Hydrostatic pressure inside capillaries is more than pressure outside it , so hydrostatic force fluids out , it is opposed by oncotic pressure

② Oncotic pressure inside the capillary is more than outside , so water will flow into blood vessels

Swelling

Buildup of blood or fluid , occurs in two compartments :

- 1- interstitium
- 2- subcutaneous tissue

↪ Edema

Interstitial fluid or subcutaneous tissue (Edema)

- compartments : intracellular , extracellular , trans cellular

Tran cellular compartment (profound area) like :

- 1- Pericardial
- 2- Peritoneal cavity

→ (Effusion) → not edema here:

- 1- In heart (pericardial) → Secondary beaver dam of left heart failure
- 2- Peritoneal cavity (Ascites) → Cirrhosis → metabolism لانه بأثر ع of liver → Double whammy (Decrease albumin) → increase in hypertension
- 3- Plural cavity (lung)
- 4- Joint cavities

Mechanisms of Edema

1- **Dependent edema** depend on blood

→ Dependent edema = **localized** edema

→ most common in lower limbs (Feet or ankle)

Trouble in Venous blood (problem in valves)

(عوامل بزيدوا من ال edema) → by prevent backflow → swelling

- **Gravity & hypertension** will not allow fluids and blood to return back to vessels
- **Insufficiency**
- **Obstruction**

2- **Generalized edema (anasarca)**

All over the body (balloon)

■ The main sites which there edema make **GENERALIZED** :

- 1- **Kidney** → **Nephrotic syndrome (Albuminuria)** podocytes
→ **Glomerulitis or nephritis** inside the kidney (there is albumin in the urine)

albumin in urine means there is a problem in nephrons of kidney

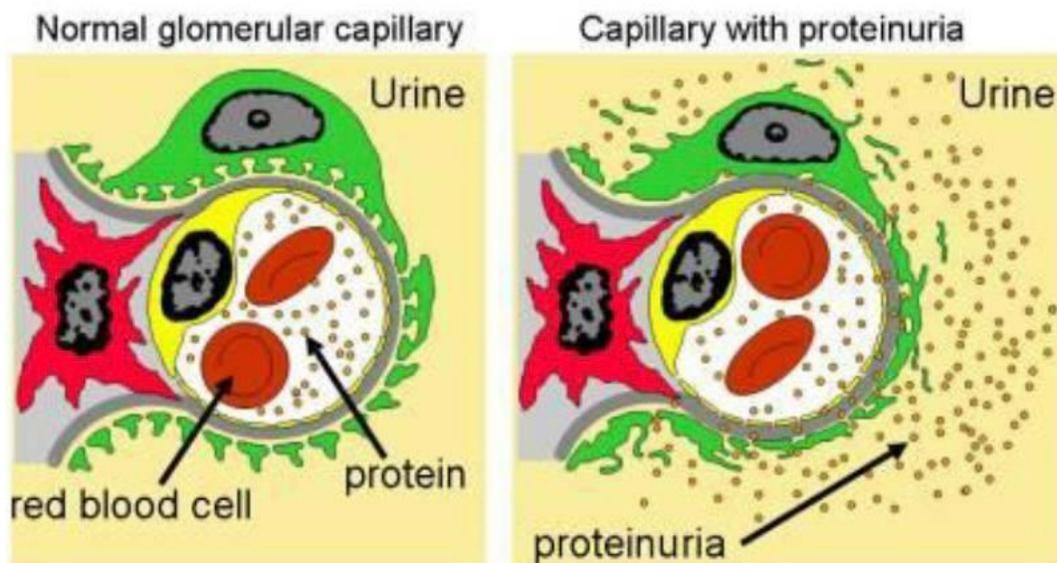
- **Problem in tubule** inside the kidney → affect infiltration and reabsorption → syndrome → when blood with afferent arteriole to bowman's capsule → problem in podocyte (responsible for prevent any protein from inside to outside)
→ so that , podocyte not complete in newborn → proteins getting out to the tubules → urine
- **Albumin should be zero in urine**
- **Rare in newborn (may be genetic)**

2- **Heart (congestive heart failure)**

3- **Liver** → **Cirrhosis or hepatitis (albumin)** **Anaphylaxis**

Increase capillary permeability widen the gap

**Bind to precapillary sphincters of metarterioles and vasodilation
Sever burns leaks albumin**



Heart beaver dams

■ **Causes :**

- 1- Left heart failure
- 2- valvular stenosis
- 3- alcohol abuse
- 4- idiopathic

■ **what's happened ?** رح يصير يمشي بالعكس

- Backup of blood in left side of the heart → (lung) → pulmonary vein → pulmonary artery (in right side) → right atrium → IVC or SVC ... → Pulmonary edema → Pulmonary hypertension → سدود مغلقة
- Kussmaul's sign internal jugular vein very simple : press on right costal region with four fingers → press on liver → pumping up blood flow to inferior vena cava → increase blood flow (jugular vein , subclavian vein ...)
- Hepatomegaly (big palpation from neck)
- Splenomegaly
- Ascites to ankles and feet → Dependent edema

Localized edema

- **Lymphedema**
- **Hemosiderin (iron) → changes in skin color : due to rupture in veins**
- **duct general edema**
- **Valve injury**
- **Dysfunctional valves**
- **Venous hypertension**
- **Stasis dermatitis (long standing)**
- **wearing compression stocks**
- **Skin changes from swelling**
- **Ischemic (hypoxia) → decreased partial pressure of O₂ → gangrene**
- **Telangiectasia → stasis blood → ulceration in leg**

Generalized edema



Severe burns

Decrease in albumin



^ patient with liver disease (Beaver dam + ↓albumin made)

To legs

Cause of liver disease

(albumin)



nephrotic syndrome

In new born

In caesarean section

Skin changes from swelling



Blockage of lymphatic vessels

Accumulation of fluids



Gangrene



وَأَنْ النَّفْسَ إِنْ رَأَتْ مِنْكَ الْجِدَّةَ طَاوَعَتْكَ،
وَإِنْ تَهَاوَنْتَ مَعَهَا فَهِيَ أَمَارَةٌ بِالسُّوءِ

(//٧٧//)