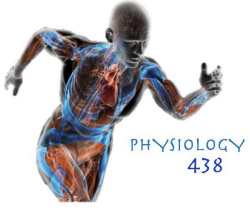
LECTURE 5

- Red : important
- Black : in male / female slides
- Pink or purple: in girls slides only
- Blue : in male slides only
- Green : notes, Extra

HOMEOSTASIS II (EDEMA)



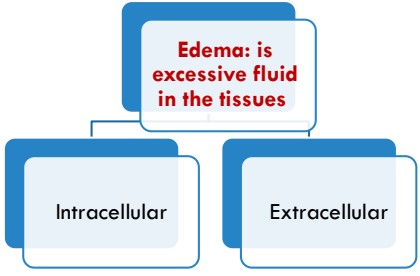
OBJECTIVES :

- Define edema and describe its different types.
- Discuss and describe the Starling forces governing fluid exchange across capillary walls.
- Link changes in hydrostatic and osmotic pressures to the pathogenesis of edema

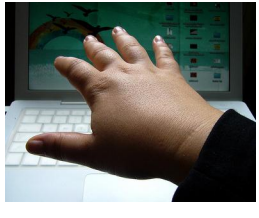
EDEMA

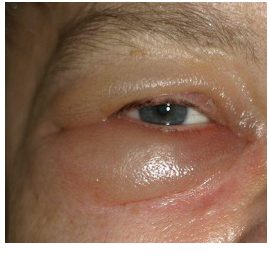
What is "*edema*"?

- Edema = swelling
- The presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body.



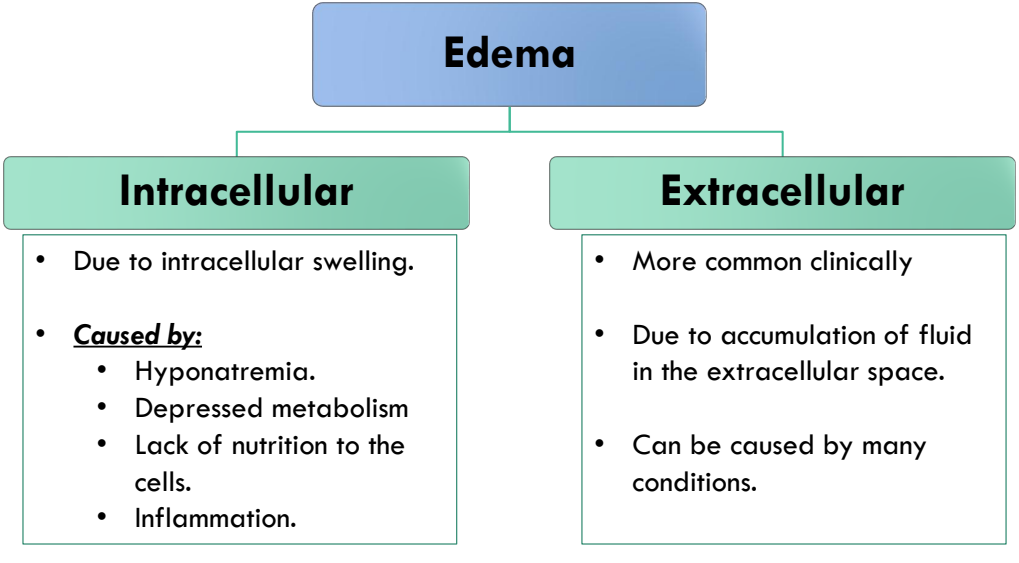
- **Edema occurs mainly in the ECF compartment**



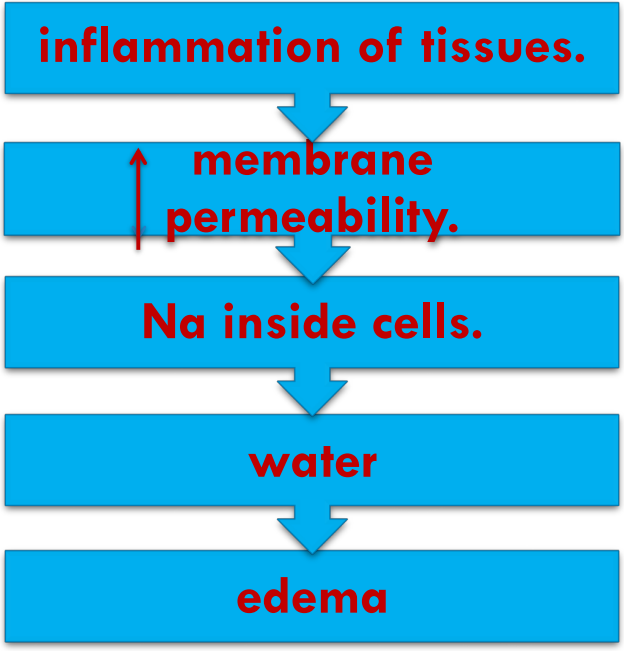


Types of Edema

Edema occurs mainly in the ECF compartment, but it can involve the ICF compartment as well.



INTRACELLULAR EDEMA:



EXTRACELLULAR EDEMA:

Extracellular edema = the abnormal accumulation of fluid in intercellular tissue space (i.e. interstitial space).

Normally, fluid is constantly moving in & out of the interstitial space to allow ECF to distribute between plasma and IF.

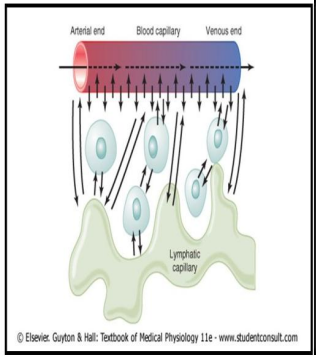
This process happens without fluid accumulating between the cells.

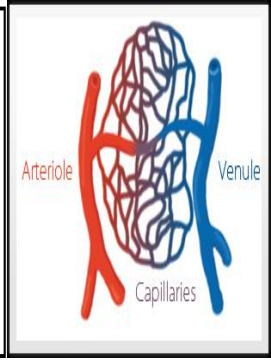
What happens to cause fluid to accumulate between the cells leading to edema?

To understand EC edema one must first understand how fluid exchange occurs between capillaries and tissue cells.

EXTRACELLULAR EDEMA

common clinical cause is excessive capillary fluid filtration.

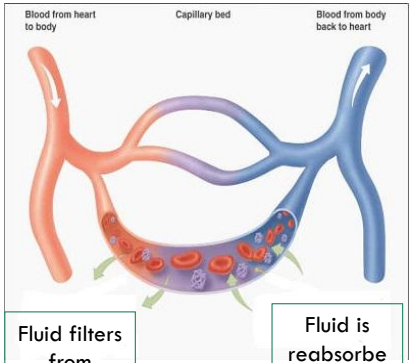




- Fluid exchange between blood and tissue cells occurs at the level of the capillaries.
- Capillaries are the **smallest** blood vessels in our vascular tree.
- They are very small and have a very thin wall allowing easy exchange of fluid across the walls.

Filtration : خروج الجزيئات والماء وغيره عن طريق جدار ال capillaries

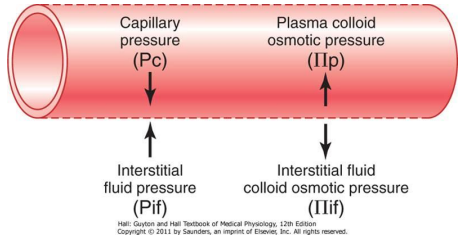
reabsorption : دخول الجزيئات والماء وغيره للداخل عن طريق جدار الcapillaries



Fluid filters from plasma to interstitium

Fluid is reabsorbed from interstitium into plasma

Movement of fluids across capillary walls depends on the balance of ***starling forces*** acting across the capillary wall



Starling Forces
Forces that control movement of fluid in/out of a capillary

- ***Hydrostatic*** pressure (P)
  - ***Capillary Hydrostatic*** pressure (Pc)
    - The pressure exerted by blood (water) on the walls of the blood vessel
    - ***Pushes*** fluid ***OUTSIDE***
      - Arterial end = 30 mmHg
      - venous end = 10 mmHg
  - ***IF Hydrostatic*** pressure (Pif)
    - ***Pushes*** fluid ***inside*** +ve
    - ***Pulls*** fluid ***outside*** -ve
    - تفاصيل اكثر في السلايد اللي بعدها
- ***Colloid osmotic (oncotic)*** pressure (π)
  - ***Plasma Colloid osmotic (oncotic)*** pressure (πp)
    - The osmotic pressure created by the non-diffusible plasma proteins inside the blood vessel
    - ***Pulls*** fluid ***INSIDE***
      - 28 mmHg
  - ***IF Colloid osmotic (oncotic)*** pressure (πif)
    - ***Pulls*** fluid ***outside***
      - 8 mmHg

العلاقه عكسيه بين المساحه و الضغط وبما ان المساحه واسعه فان الضغط راح ينخفض يعني تركيز السائل بيقل

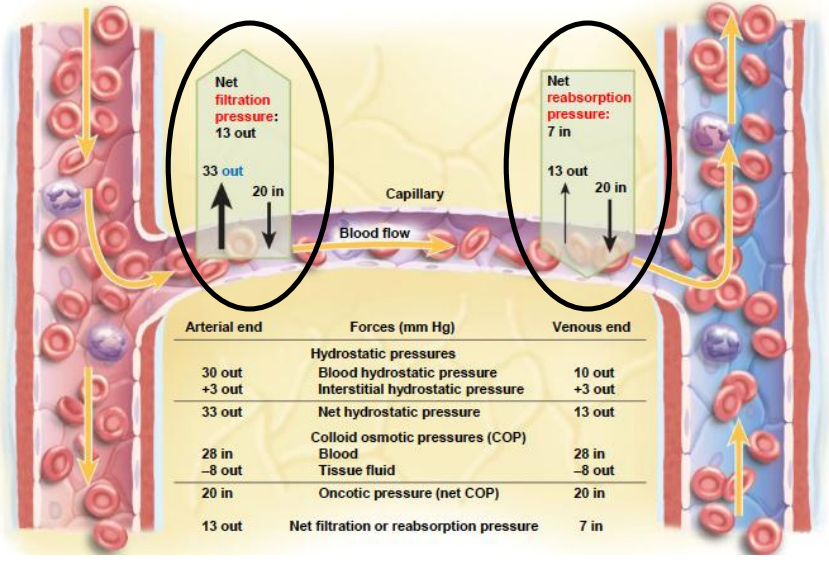
IF ***hydrostatic pressure (Pif)*** is usually subatmospheric in loose connective tissue (≈ -3 mmHg). Because **Pif** is negative it will actually favour filtration rather than oppose it.

راح تفضل انها تسحب الجزيئات لها للخارج بناء على قاعده ال **osmosis**

اهم شي نعرف ان عدد الجزيئات الخارجه اكثر من الداخله في ال capillaries

Definition of SUBATMOSPHERIC

: less or lower than that of the atmosphere • *subatmospheric* pressure



ارجعوا لتعريف filteration and reabsorption بسلايد رقم 6

Arterial end

مواد خارجه > مواد داخله

عشان كذا يصير هنا filteration

Venous end

مواد خارجه < مواد داخله

عشان كذا هنا reabsorption

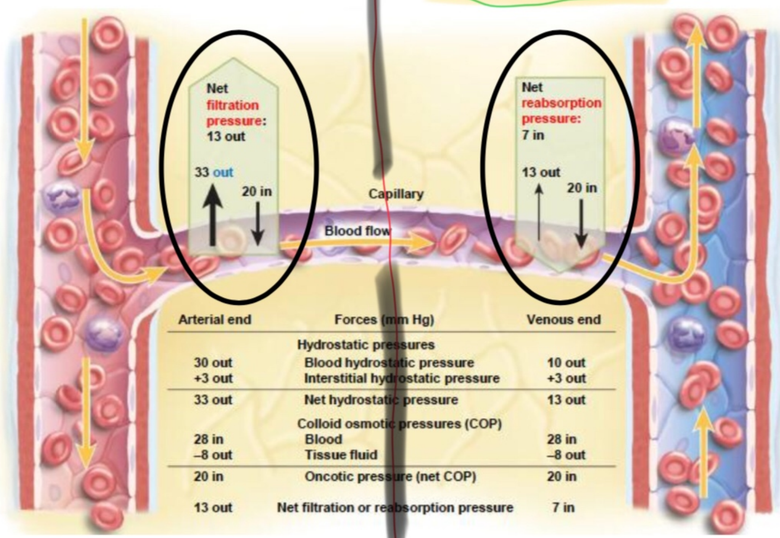
اهم شي نعرف ان عدد الجزيئات الخارجه اكثر من الداخله في ال capillaries بشكل عام

artery محصله 13 out

vein محصله 7 in

13out + 7in = 6 out

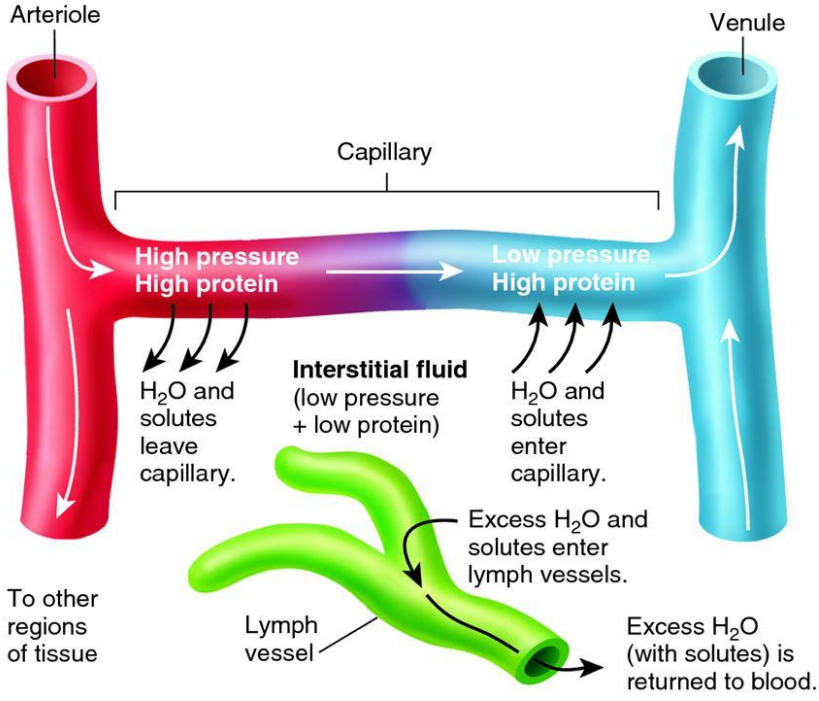
الدكتوره قالت افهموا الفكره فقط والارقام مو مهمه



The reabsorption pressure causes 9/10 of the filtered fluid to be reabsorbed while $1/10^{th}$ remains in the IF.. ***What happens to this $1/10^{th}$?***

The lymph will reabsorbed it

The total quantity of lymph ≈ 2-3L/day.

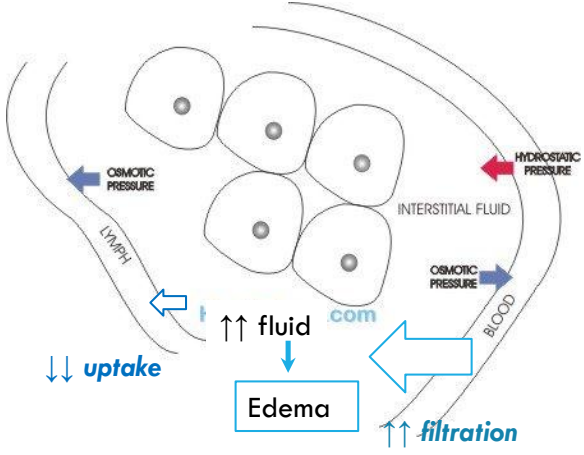


Edema

Edema is a symptom, not a disease

Two main reasons:

1. Abnormal **leakage** of fluid from plasma to interstitial space.
2. Failure of **lymphatic uptake**



These is the diseases which edema is involved in ;:

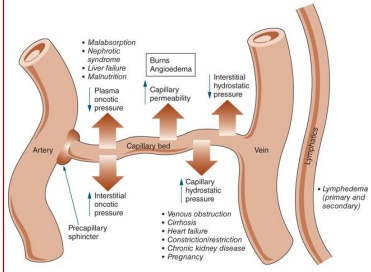
Increase capillary filtration

1. ***Increased capillary pressure***
   - Kidney failure
   - Heart failure.
   - Venous obstruction
2. ***Decreased plasma oncotic pressure***
   - Loss of proteins (nephrotic syndrome, burns).
   - Inability to synthesize proteins (liver failure, malnutrition).
3. ***Increased capillary permeability***
   - Inflammation
   - Infection.
   - Immune reactions.

Decrease lymph uptake

Lymphatic obstruction

- Infection (filaria).
- Surgery.
- Congenital absence.
- Cancer.



QUIZ

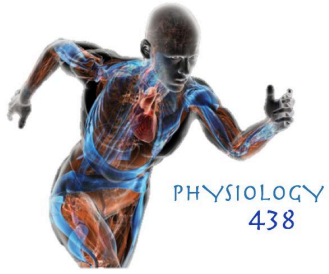
1)Edema mainly occurs in …..?			
a) ICF	b) Cell Membrane	c) ECF	d)SIADH
2) Edema is caused by?			
a) hyponatremia	b) Lack of nutrients of cells	c) Inflammation	d) excessive capillary fluid filtration
3) inflammation of tissue …?			
a) decrease membrane permeability	b) increase membrane permeability	c) increase membrane selective permeability	——
4) Fluid exchange between blood and tissue cells occurs at the level of ?			
a) cell membrane	b) alveoli	c) capillaries	d) veins
5) forces that control the movement of fluid in/out of a capillary?			
a) hydrostatic pressure	b) Colloid osmotic pressure	c) IF hydrostatic pressure	d) a and b

Key answers:

1) C
2) D
3) B
4) C
5) D

THANK YOU

Boys team members	Girls team members
• عمر الدوسري	• اروى الامام
• زياد الدوسري	• ديما المزيد
• عبدالله الغامدي	• جود الخليفة
• محمد الحمد	• جود العتيبي
• جهاد العريني	• رغد المبارك
• فيصل القفاري	• ريناد المطوع
• عبدالله باسمح	• ريما المطوع
	• طرفة آل كلثم
	• مي بابعير
	• نجود العلي
	• نورة المزروع



Team leaders:

- عمر الشيناوي
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