At the first 10 min.s, Dr. Moh'd made quick review for the last lec, there is nothing new 😊 everything is written in sheet # 23 ;)
last time we were talking about microcirculation & capillary system, microcirculation is very important since it is the area where exchange only occurs.
so it's very important in transport nutrient & removal of waste products.
the total surface area is large & this performs function in solute & fluid exchange.
we talked about the precapillary sphincter at the arterial site of capillary, which opens & closes controlling the amount of blood that is going to supply the capillary system.
capillary wall is of unicellular layer of endothelial cells that has intercellular clefts & plasmalemma vesicles that are very important in fluid exchange, vesicles are very important for large, water soluble molecules' transport like proteins.
we talked about the processes of exchange: * DIFFUSION, the most important method, by which substances move down their concentration gradient, specially for gases (O2, CO2), used in anesthesia because of its fast diffusion, some substances can't diffuse like protein except in the case of sinusoid capillaries, but in the case of BBB WHERE the junctions between cells are very tight >>> limited permeability * ENDO & EXOCYTOSIS (TRANSCYTOSIS) for lipid insoluble substances, large molecule
* BULK FLOW which is passive transport that control the fluid volume & fluid quantity, bulk flow between capillaries & interstitial fluid may be: filtration or reabsorption.
Capillaries are of 3 kinds: * CONTINUOUS as in the BBB where the diffusion is limited due to the tight junctions which prevent transport of substances into the brain * SINUSOID as in liver which * FENESTRATED as in kidney there are 4 forces that control the fluid transport; 2 promote filtration & 2 promote reabsorption blood hydrostatic pressure & IFOP promote filtration while oncotic pressure (mainly due to Albumin, more than 75% of colloid osmotic pressure is mainly due to Albumin because of 2 things; 1- the concentration is larger 2- its molecular weight is smaller >>> much more molecules that affect colloid pressure & we knew that oncotic pressure depends on the # of molecules not on the concentration) & IFHP (+) promote reabsorption.
let's start >>>>
as there is no time, I will write the extra information regarding each slide please refer to the slides

Slide # 17
Most important means by which substances are transferred between plasma and interstitial fluid down their concentration gradient is by diffusion, which is directly through cell membrane of capillaries for lipid soluble substances like (CO2, O2) & indirectly via intercellular clefts for lipid insoluble substances like (H2O, Na, Cl, glucose).

Slide # 19
the permeability of Capillary depends on substance if we assume that the permeability of capillary wall to water is 1, then its permeability to NaCl is 0.96 (96%), to urea = 80% & 60% for glucose while it's very small to plasma proteins like Albumin, Globulin & fibrinogen. notice that as the MOLECULAR WEIGHT increase, the PERMEABILITY decrease.

Slide # 21 & 22
Determine of net fluid movement across capillaries; 4 forces control the fluid movement across capillaries which are:
- hydrostatic pressure of capillaries tend to force fluid outward (filtration)
- interstitial fluid hydrostatic pressure that promote reabsorption & opposes filtration
- plasma colloid osmotic pressure: opposes filtration causes reabsorbtion
- interstitial fluid colloid pressure: that causes filtration

Net Filtration Pressure = (Pc-Pif) – (πc-πif)
Pc (hydrostatic pressure of capillaries) – πc (plasma colloid osmotic pressure) - Pif (interstitial fluid hydrostatic pressure) + πif (interstitial fluid colloid pressure).
* if we multiply the NFP by filtration coefficient we end with how much fluid can be filtered. Remember that filtration coefficient depends on the permeability of capillaries to substances.

**Slide # 23**

At the arterial end we have:

* hydrostatic pressure of 35 mmHg causes filtration + interstitial oncotic pressure of 1 mmHg causes filtration

\[ \Sigma \text{forces that cause filtration at the arterial site} = 35 + 1 = 36 \text{ mmHg} \]

* forces that promote reabsorption; plasma oncotic pressure of 26 mmHg, interstitial hydrostatic pressure of 0 mmHg

\[ \Sigma \text{forces that cause reabsorption} = 26 + 0 = 26 \text{ mmHg} \]

So the NFP = 36 - 26 = 10 mmHg (filtration)

At venous end we have:

* hydrostatic pressure of 16 mmHg (less than that of the arterial end), colloid osmotic pressure of 26 mmHg

\[ \Sigma \text{filtration} = 17 \text{ mmHg} \]

\[ \Sigma \text{reabsorption} = 25 \text{ mmHg} \]

So the NF = 17 - 25 = -8 mmHg (Reabsorption)

**The net fluid movement across capillaries** =

fluids that are filtrated – fluids that are reabsorbed (as amounts, regardless the charge)

= 10 - 8

= 2 mmHg (filtration)

That is normal at the level of the capillary, to get more filtration than reabsorption.

**Slide # 24**

At the arterial end we have:

* hydrostatic pressure of 35 mmHg causes filtration + interstitial oncotic pressure of 1 mmHg causes filtration

\[ \Sigma \text{forces that cause filtration at the arterial site} = 35 + 1 = 36 \text{ mmHg} \]

* forces that promote reabsorption; plasma oncotic pressure of 26 mmHg, interstitial hydrostatic pressure of 0 mmHg

\[ \Sigma \text{forces that cause reabsorption} = 26 + 0 = 26 \text{ mmHg} \]

So the NF = 36 - 26 = 10 mmHg (filtration)

At venous end we have:

* hydrostatic pressure of 16 mmHg (less than that of the arterial end), colloid osmotic pressure of 26 mmHg + interstitial hydrostatic fluid of 0 mmHg

\[ \Sigma \text{filtration} = 16 \text{ mmHg} + 1 \text{ mmHg (interstitial oncotic pressure)} = 17 \text{ mmHg} \]

\[ \Sigma \text{reabsorption} = 25 + 0 = 26 \text{ mmHg} \]

So the NFP = 17 - 26 = -9 mmHg (Reabsorption)

**The net fluid movement across capillaries** =

fluids that are filtrated – fluids that are reabsorbed (as amounts, regardless the charge)

= 10 - 9

= 1 mmHg (filtration)
slide # 25 -28
( the main capillary pressur: means the change of pressure over distance , not for the arterial , not for the venous , it’s for the capillary in general ).

Normal Capillary hydrostatic pressure is approximately 17 mmHg.
Interstitial fluid pressure in most tissues is negative the first one who measure it was Guyton
**** Encapsulated organs have positive interstitial pressures (+5 to +10 mmHg).
Negative interstitial fluid pressure is caused by pumping of lymphatic system.
Colloid osmotic pressure is caused by presence of large proteins specially Albumin.
so anything may lead to change Albumin concentration tends to change the osmotic pressure >>> the Net filtration or reabsorption fluids.

filtration rate ( the amount of fluid that filtered ) = NFP
= NF * Kf
= {[(Pc – Pif) – (πc - πif)]} * Kf (filtration coefficient which depends on the permeability of capillaries to the substances )

Slide # 29-33
Arteriolar end :
- Forces that cause filtration
=capillary pressure + IFOP –IFP(negative >> filtration )
= 30 + 8 –(-3)
=41 mmHg
- forces that cause reabsorption
= plasma colloid osmotic pressure
=28 mmHg
- NF
= 41-28
=13mmHg

Venous end :
- Forces that cause filtration
=capillary pressure + IFOP –IFP(negative >> filtration )
= 10 + 8 –(-3)
=21 mmHg
- forces that cause reabsorption
= plasma colloid osmotic pressure ( the same )
=28 mmHg
- NF
= 21-28
=-7mmHg (reabsorption )

-NF OVER THE CAPILLARY (balance between what is filtered & what is reabsorped)
= 13 – 7
= 6 Toward filtration

the extra filtered fluids will be taken by lymph

( الدكتور فقط عم يقرأ السلايدات من دون أدنى توضيح ، فما وجد في السلايدات كاف بالنسبه له )

( تذكروا أن الارقام المستخدمة في الحسابات ما هي الا افتراضات وقد يطرح في الامتحان ما هو مختلف لما هو )
\{(P_c - P_if) - (\pi c - \pi if)\}

From this equation, we can find what can cause edema:

- **Increase in the hydrostatic pressure of the capillary**
  - Venous obstruction like in the case of pregnancy, tumor or bulge in lymph nodes, venous block like thrombosis, hypertension
  - Anything may press on the capillary & cause increase in the main hydrostatic pressure leads to more filtration >>> edema.

- **Decrease blood colloid osmotic pressure**
  - As in hypoalbuminemia >>> trouble in the synthesis in liver due to cirrhosis for example or trouble in losing by kidney as in the necrosis
  - It can also be caused by malnutrition

- **Increased interstitial hydrostatic pressure**
  - By lymphatic capillary blockage >>> as in the case of breast cancer due to surgery & elephantiasis.

- **Leaking capillary wall (Kf)**
  - Histamine release during allergic reaction (in the case of inflammation) which increase the permeability of capillaries wall >>> increase the Kf since it depends on the permeability >>> increase filtration rate >>> increase in the amount of the filtrated fluid >>> accumulated outside >>> edema.

Dr. Moh'd just complete the other slides by reading them without any extra letter.