

""Clinical abnormalities of the fluid volume regulation""

-It is so important to keep in mind as a physician that we always deal with the plasma. we treat our patient through it and we measure the water amount and concentration of salts to evaluate patient's fluid statue from it.

-***First***, we have to distinguish between two important hormones:

Hormone's name	Aldosteron	ADH (antidiuretic hormone)
The organ that secretes it	Cortex of adrenal gland (suprarenal gland)	Posterior pituitary in the brain
The organ that it affects	Kidney	Kidney , affecting: * distal Convoluted tubules. * collecting ducts
Function (stimulating the organ it affects to):	Retention of salts (Na) then follows the water	Reabsorbing only WATER

keep in mind :

*When we are talking about salts we mean mainly Na as it is the major ion of the plasma

*The Aldosteron causes the reabsorption of salts (mainly Na) first , and because Na can't be uptaken alone so the WATER must follow it .

The Abnormalities:

Remember :

- *Adrenal cortex: Aldosteron
- *Adrenal medulla : epinephrine and norepinephrine .

1- Hypo-osmotic dehydration:(hyponatremia)

meaning : salts are down , water is down

hormone involved : Aldosteron

Causes:

1- *Tveruse of diuretics:* المدرات

There are many types of them. A type called (loop diuretic) that:

1- Works on the loop of Henle (nephron loop) in the kidney

2-Causes loss of water and salts (diarrhea)

We usually use diuretics to treat heart failure and overloading of the circulation .And sometimes the patient is given too much of diuretics , causing hypo-osmotic dehydration.

2- Suffering from diarrhea and vomiting(التقيؤ):

Cause:

* May be from food poisoning ,when you eat food that is not fresh, we call it Gastroenteritis (التهاب أمعاء) (Which is an inflammation in the stomach and the intestine.)

* the vomiting and diarrhea is good as you're getting rid of the microbes, but at the same time you are losing water and salt.

3- Addison's disease :

cause:

* lack of aldosteron as the cells producing it in the adrenal cortex are destructed

How to know that this patient is suffering from Addison's?

#first sign (early stage):

1- **Hyperpigmentation** (dark coloration in the mucus membrane) and an increase in deposition of melanin , which is observe in :

* lips * Gums *edge of the nails *areas that are exposed to the sun or even not .

#late stages :

He will suffer from Addison's crisis and He goes to shock. The reason behind that is the decrease in water and salt leading to hypovolemia and hypotension .

2- Hypo-osmotic overhydration :

Meaning : salt is less water is high , OR the salt is the same but excess water diluted it.

hormone involved : ADH (which will increase and cause reabsorption of water back to circulation.

causes:

1- **Bronchogenic carcinoma :** A cancer in the lung

*In some kinds of this carcinoma , the cells release excess ADH .

what is cancer?
Abnormal growth of cells and huge amount of cells that may secrete certain substances, like Serotonin or ADH.

FIRST Sign : hypo-osmotic overhydration and overloading the circulation.

2- Syndrome of inappropriate ADH secretion :

when the body is not in need of water and the brain releases excess ADH .

3- hyper -osmotic dehydration : (hypernatremia)

meaning : salt is high ... water is low (notice that the major loss is water , causing the salt concentration to be high .

Hormone involved : ADH (decreases)

causes:

1- diabetes insipidus : البول المائي

* it is decrease in ADH because of :

1-tumor in the pituitary gland destroying the secretion of ADH.

2- NO response from the kidney to ADH because of some diseases in kidney.

3- Sensible excessive sweating :

diabetes: urination , flushing out.

insipidus: watery , light.

mellitus : honey , sugar , sweet .

so, diabetes insipidus: بول مائي

diabetes mellitus: بول سكري

* when the temperature is very high (50 Celsius or more) , you start sweating like hell. When the clothes dry , you see only the salt .However, the loss is MAJORLY WATER.

* **But** this also has an advantage: cooling the body , preventing the raising of the core Temp that may lead to fever and affecting our enzymes and chemical reactions.

4- hyper-osmotic overhydration :

meaning: salt is high and water is high .

hormone involved: Only Aldosteron (increases) unless it was very similar like cortisone.

causes:

1-primary aldosteronism :

That occurs when there is a tumor in the adrenal cortex making the cells secrete more Aldosteron. the result is excessive reabsorption of water and Na (salt) and preventing it from being excreted with urine.

2- Cushing Syndrome :

The cause of it is not Aldosteron but high corticosteroids:

(Ex: cortisone , prednisolon or steroids).

#What is Corticosteroid (ex: cortisone)?

***It is the stress hormone that is released highly in the morning to combat stresses of life physically and emotionally.**

***By the end of the day it decreases as you return to home where there is no stress ,so you will relax**

Types of stress:

1- acute (good) :

when you prepare for exam or say a speech , its healthy and brings the best of you.

2- chronic: (bad, so stay away)

when you have an angry family member or someone that keeps nagging on you or bad boss.

SO, cortisone is always high and this is the major cause of psychosomatic illnesses. causing hypertension , heart problems, peptic ulcer ,... etc

Patients are described as a lemon on two match sticks, so there will be wasting in the upper and lower limb.

***what will happen if the level of cortisone is**

very high ?

1-damaging the body.

2- causing central obesity.

the patients develop central obesity and

fats accumulate in the trunk ,face and the back

(which is called *Buffalo hump*).

3- It will work as Aldosterone , retaining water and salt .

Why do some people beg you to write cortisone for them?

As it makes the faces like the moon

The Dr said (zai elgumar) :D, as they think

fatty face is a sign of beauty .

How to diagnose ?

Patients are described as a lemon on two match sticks,

so there will be wasting in the upper and lower limb.

BE CAREFUL IN YOUR CLINIC :

*Many patients will come to you and beg you to write for them CORTISONE.

*NEVER EVER write it as they will develop Cushing's syndrome.

*some asthma's need cortisone ,not all of them . so don't prescribe it to any one tells you he has asthma.

The dangers of misuse of cortisone:

*hypertension *diabetes *wasting of the muscle * rarefaction of the skin *metabolic disorders.

cutting it abruptly leads to crisis and emergency .

Edema :

Types: * intracellular and extracellular .

definition: (we usually refer to the interstitial edema)

excess amount of water and fluid in the interstitial compartment.

1-intracellular:

*if the patient is suffering from it , he is really in a big trouble and he is in the intensive care unit.

*it is very dangerous as it disturbs all the chemical reactions in the cell and all the systems are affected.

Causes:

*hyponatremia (decrease in salt concentration in the blood , so the water will move into the cells in order to return osmolarity to normal.

*disruption of the cell membrane for any reason , such as : inflammation, disturbance in cell membrane metabolism (like in case of cerebral edema) and lack of nutrition to the cells , when the cell membrane can't perform its function in keeping the internal environment proper.

I'm sure you are asking yourself how reduction of metabolism and nutrients cause edema?

lack of O₂ and nutrition will cause lack of production of ATP needed for the function of the Na/ K pump in pumping Na that leaks to the cell , so it will lead to increase in osmolarity and diffusion of water into the cell causing edema.

1-Extracellular (interstitial):

*the most common type of edema and most of the patients we receive suffer from it.

*** be careful** that if extracellular edema wasn't treated properly and the patient's condition deteriorates, the patient will go to intracellular edema, which is very dangerous.

causes:

- 1- increased capillary pressure (hydrostatic pressure): caused mainly by heart failure.
- 2- decrease in plasma proteins (colloid osmotic or oncotic pressure)
- 3- increase in capillary permeability . (such in case of inflammation and burns)
- 4- lymphatic blockage.

A very important thing to understand before studying the causes

the major functions of the circulation are :

- 1- deliver O₂ and nutrients to the cells all over the body
- 2- reabsorb the wastes and CO₂, so wastes will be excreted by the kidney and CO₂ will be expelled by the lungs.

the capillary has two sides : arterial and venous

- * on the arterial side filtration must increase (higher hydrostatic pressure)
- * on the venous side reabsorption must increase (higher oncotic pressure)

on the wall of the capillary there are 4 driving forces:

two from the circulation : capillary oncotic and hydrostatic pressure.

two from the interstitial compartment : interstitial colloid and hydrostatic, but they are very weak and they are the reverse of the vascular system. what does that mean?

*the capillary pressure tends to filtrate while the interstitial hydrostatic tends to reabsorb.

*the capillary colloid reabsorbs (sucks) the water into the plasma while the interstitial colloid pull it out .

HOWEVER, they are very weak and we usually take the algebraic sum.

Returning to discuss the causes:

1- increased capillary pressure:

HEART FAILURE

*it is one of the most common causes of edema.

what happens ?

1-the heart fails to pump blood from veins to arteries and the ejection power of it is reduced greatly .

2- the first consequence is the decrease in the blood pressure , and the first organ to sense that is the kidney (which feels the guilt when there is too much loss of water , even when the water is normal in the body , she starts to reabsorb salts and water by many processes such as :

renin angiotensin or **the direct reabsorption** of Na and water) leading to:

1-increase in the vascular volume and blood volume .

2- venous pressure increases because of too much water

so fluid starts leaking (filtration increase) causing edema.

#where do you test for edema in a patient who has a heart failure ? or Where does extracellular edema start?

ACCORDING to gravity:

1- if the patient was standing or he came to my clinic walking> accumulation in the legs and lower limbs.

Test : I take my thumb and press against a bony prominent (usually the medial malleolus (الكعب)) for 30 seconds and I elevate my thumb ... there will be a depression that stays for more than 3-4 minutes , **then** I go up across the shaft of tibia to the knee **to see the extent of the edema** .

2- if he was in the hospital lying on his bed> in the back.

Test : You examine him from the pelvic crest.

2- Decrease in plasma proteins:

causes:

**mal-absorption* : if you eat and the proteins are not reabsorbed.

**liver failure*. (fail to synthesize proteins).

**starvation* : if you don't eat proteins (malnutrition) and this is the major cause.

ABOUT 1/3 of the population in the world are suffering from starvation especially in Africa . So when you see a child who is thin but has edematous legs , he is not دبدوب ☹️ , he is a patient of

a diseases called **Kwashiorkor** . As the child is not getting enough proteins , there will be decrease in plasma proteins.

* Diseases in kidney (Nephrotic Syndrome) and burns cause excessive loss of proteins , so we give them fresh frozen plasma and blood .

3- Increase in capillary permeability :

Caused by:

*Burns , toxins , bacterial infection , insect bites and vitamin deficiency (especially C)

*Immune reactions due to certain food , drugs etc.

4- Lymphatic block :

*sometimes we call it lymph-adenoma or lymphademopathy.

Causes:

1- Radical mastectomy (not only mastectomy because in the radical type of it we remove the lymph nodes , axillary subcutaneous tissue and even some muscles):

* it means removal of the breast because of breast cancer.

*this operation is only done when the cancer is in its latest stage and it has metastasized .

***Before** the operation you have to tell your patient that her arm and the upper limb will stay edematous for the rest of her life.

why is that?

Since the lymphatics are responsible to return about 10% of the body fluids to the circulation , so the fluids will accumulate in the upper limb as the lymphatics that drain them have been removed

2- Cancer patients after radiotherapy , not chemotherapy , As the lymphatic vessels will be blocked.

3- Filaria nematodes or filariasis or elephantiasis(as the legs looks like the legs of the elephant)

Cause :

A worm -like parasite called Wuchereria bancrofti transferred by mosquitoes,

They block the lymphatics causing so excessive edema to a level that the patient can't walk .

*It is so difficult to treat and in some patients it may weight 27-30 kg .

*The parts of the body that are affected : whenever the worm goes , like scrotum ,legs and hands.

120 million person suffer from filariasis, especially in Sudan , Tropical and Subtropical areas.

Good Luck All! ☺

DONE BY :

Alaa Taha Roto.

IT'S NEVER TOO LATE