

Body fluid I

Introduction :

before we start talking about body fluid I want to mention a few point why we give you these lectures , as mentioned in the first lectures with doctor faisal we have a balanced and a healthy life when our homeostatic mechanism is maintained , when we lose homeostasis then diseases will occur , the most difficult cases that doctors confront everyday is when they try to retain back homeostasis in a critically ill patient and this is what distinguishes an ordinary physician from a consultant , sometimes you hear this person is so sick , he is in the intensive care unit they have requested for a consultant to come and examine him just to maintain his homeostasis ,when disease occurs majority of the disturbance occur within a homeostatic mechanism and a smart doctor must be aware of what fluid this patient should have to get back to normal ,if you don't know how to maintain homeostasis and what IV fluid to give the patient you might kill him instantly

the topics that are going to be discussed are :

-what do you need to know about homeostasis ?

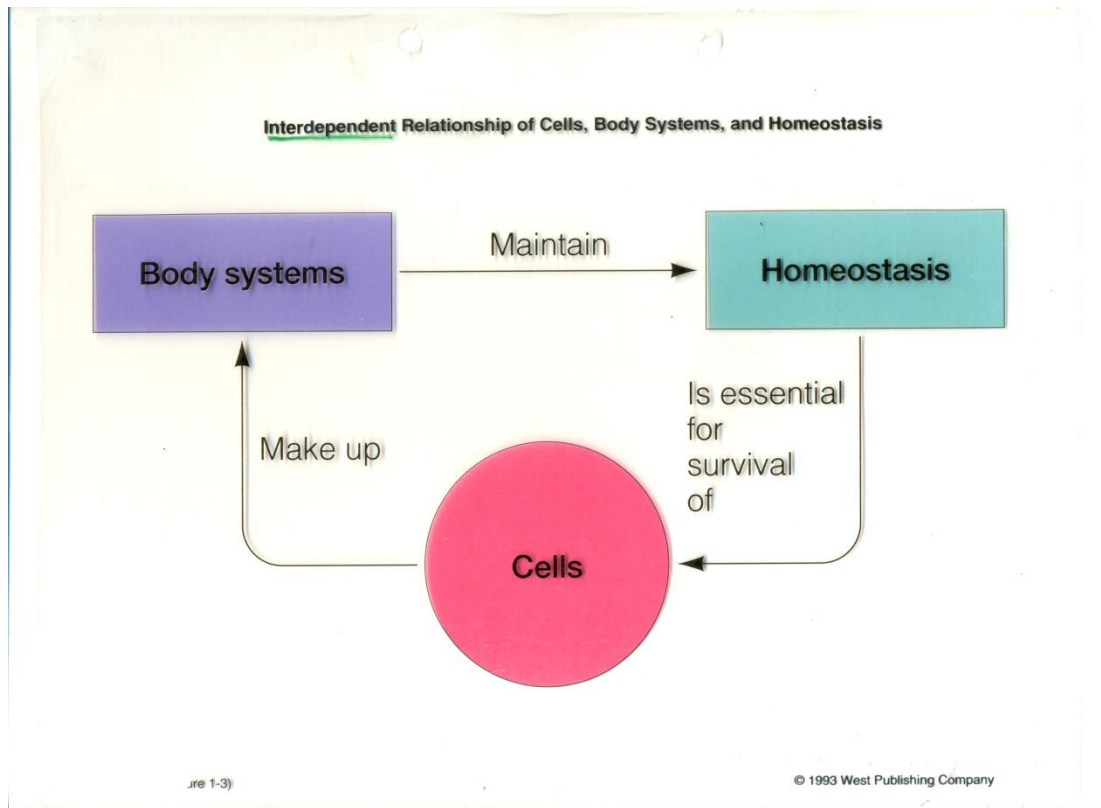
-what are the dangerous things that can happen to it

-what type of IV(Intravenous) fluid should be given to this patient

-Homeostasis and body fluids :

Homeostasis :It is a state of internal environment balance that all of our body systems work to achieve

Fluids in the body have an important effect on homeostasis that 's why it's important to study it.



As seen in the slide there is an interdependent relationship between cells, systems and homeostasis and it's explained as follow :

A group of cells will form a tissue , and a group of tissues will form an organ and a group of organs will form the systems of the body , if the body cells are healthy and happy that will lead to make all our body system healthy and functioning well and that will lead to a perfect healthy homeostatic mechanism that's what we mean by an interdependent relationship cells are healthy , making all the systems functioning well and healthy and that help in regaining homeostatic mechanism .

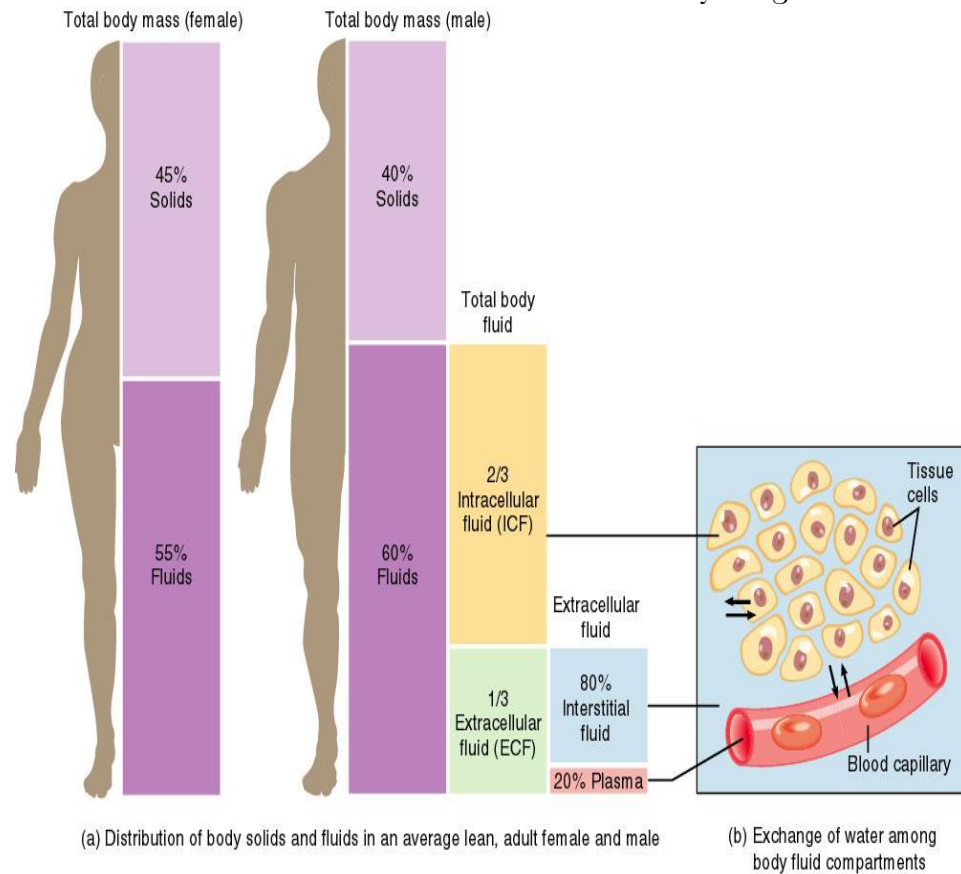
Example of things that should be maintained in homeostasis : concentration of each ion , amount of water in each compartment , amount of proteins , activity of enzymes, amount of hormones

if some of the cells are damaged or part of the system are non-functioning then the homeostatic mechanism will be disturbed and the cells now start suffer and diseases will occur (it's your job as a physician to regain the interdependent relationship between cells, systems and homeostatic mechanism in the internal environment of the body)

-Body fluids :

what do we mean by the internal environment of the body?

when we say internal environment we mostly mean the interstitial fluid of the body because if we maintain the interstitial fluid everything will be maintained



27.01

Here in this slide is the distribution of the body fluid compartments

The body fluid is $\frac{2}{3}$ intracellular and $\frac{1}{3}$ extracellular, and the extracellular is divided into 80% interstitial and 20% plasma, interstitial compartment is the internal environment - whenever we maintain it happy and healthy and in a perfect concentration cells will be all living well and ultimately everything will be okay - is this clear guys? :P

As you can see there is a difference between males and females, who is having more total body water? males, Males have more total body water because women have more fats than men

-healthy body configuration :

In females : adult females they usually have a specific type of a body figure we call it the hourglass, where the shoulder and pelvis are equal and she has a narrow waist this is a perfect healthy, normal body configuration

In males : in adult males their shoulders must be wider than the pelvis

You can notice that the general figure of the body gives me an important information about the health of the patient that's why it's very important to look at the patients and see their general look whether he is dressed well and have a clean body this helps to give me an indication on the mental and the physical condition of the patient.

The hormonal effect on body fluids and configuration :

In adult females : after puberty at the age of 12 to 14 estrogen will start to be released in a high amount and the most important effect of it is that it will start accumulating fat in the breast and in the pelvis region making the body of the female in an hour glass configuration so even if the female is thin it will have a bulk of fats in the breast and in the pelvic region because of the effect of estrogen

In adult males : at the age of 14 they start releasing testosterone - the males sex hormone - and testosterone will form more muscles than fat that is why the shoulder is wider and the pelvis is narrower - this is a typical male configuration

If I have an 8 years old boy and an 8 years old girl do you think that when we measure the total body water we will find a 60% and 55% ? A: No , there are sex hormones determine that

The difference in total body fluid cannot found in children between males and females because the sex hormones are not yet high enough to cause this difference, keep in mind this difference only in adults.

The effect of age in total body water :

If you were asked about the total body water in 5 year old and 50 year old do you think there is a difference in total body water with age or there isn't any difference between them?

A: Yes there is difference, in young male who are lean and athlete have a high level around 60% of total body water, in infants and newborns it rises to 73% so you see the babies are fluffy and very soft almost 3/4 of their body is water, the highest percentage of total body water is in newborns and in babies and we start getting less and less water as you grow older.

For females they are lean, athlete, muscular, less fat , she has almost 50%total body water when she start gaining weight and usually it is fat the percentage of total body

water gets less and less, fatty and non-athlete females gets less and less total body water.

Elderly people : usually they lose muscles bulk when they grow older the muscles gets smaller in size and when we look at old person they usually have a lot of fibrous tissue, elastic tissue and the muscle bulk is much less even the fat they are no more than the skin , saggy skin and the skeletal , therefore the total amount of water is much less because the tissues that usually contains high amount of water are gone which is the muscular tissue **that's why the more you grow older and older the less total body water you have .**

So now you have 3 factors affecting your total body water:

1- Gender

2- age

3- The fat content (the more you are fatty the less water you have

You must know that drinking water can really substitute for the loss or the degree of dehydration (hydra: water,, dehydration: less water or no water,, overhydration: excess water) , if any person suffers dehydration we can let him drink water , now drinking water needs half an hour to be distributed all over the compartments , sometimes we face patients that cannot wait half an hour so how we give him the water? A:we give him IV fluid in the hospital, it is instantaneous it will be distributed around the body in minutes so keep in mind we use IV although it is risky, it is invasive technique, it goes directly to the blood stream, you might cause infection, you might cause disturbance to homeostatic mechanism but sometimes we need it , when a pressure is dropping, when the patient conditions does not allow you to wait or the patient is unconscious for example he can't drink water on his own so we give IV fluid.

Question: if I have a patient who is perfectly healthy -like you □- and I asked him to drink 300 ml of water, how much of this water will go to his blood after half an hour?

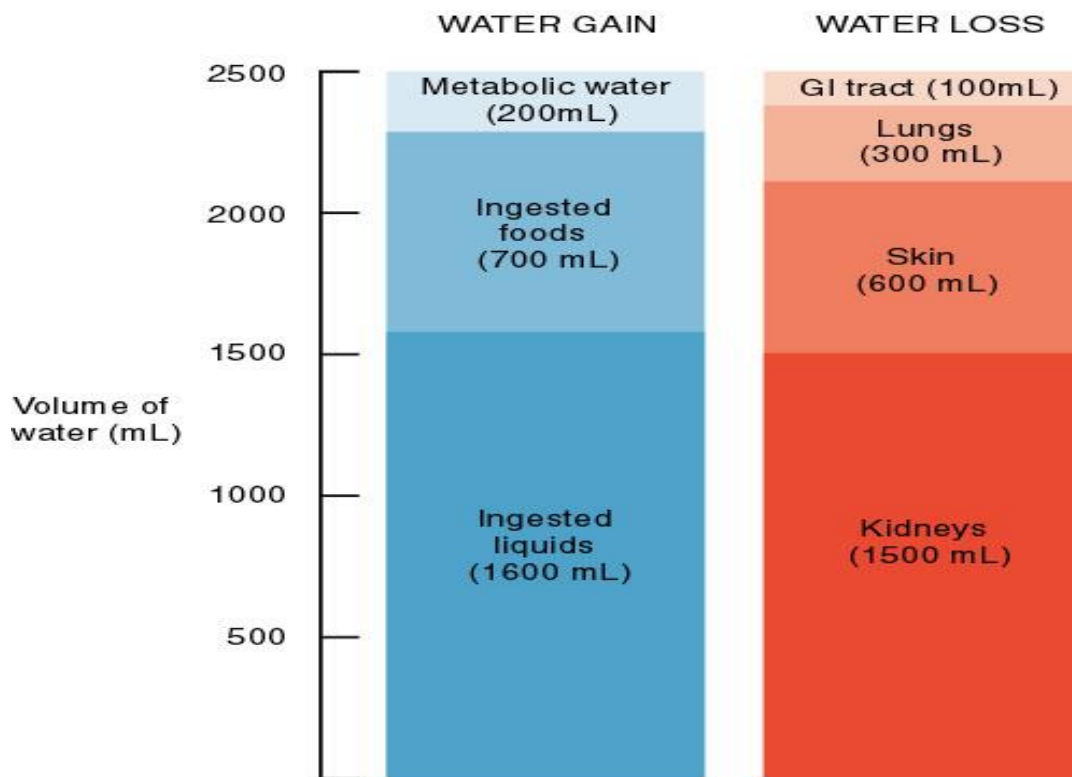
A: within half an hour it would be distributed as follows : $\frac{2}{3}$ of body water is intracellular so 200ml of 300ml will go intracellular, we are left with 100ml which is extracellular 80% of it will go interstitial which is 80ml and 20 ml of it will be go to the blood. :D

So the final answer is 20 ml according to the percentages and total body water in intra and extracellular compartments

A question that might come in the exam : Blood is considered as:

- A-interstitial fluid
- B-plasma
- C-extracellular fluid
- D-intracellular fluid

Answer: a smart first year medical student he supposed to tell me that I need one of the choices to be (Both intracellular and extracellular) why is that? Blood is not plasma - plasma is the water component of the blood- blood is containing plasma and cells, and the cells are RBCs, white blood cells and platelet and the water inside them is intracellular, so the answer is, blood is part of the both compartment (Extracellular and Intracellular).



27.02

In order to get rid of waste product and get nutrients you have to exchange water in your body , however in order to maintain the total body water and the homeostatic mechanism the amount of water input must equals the output, usually its around 2300 or 2500 mililiters you need to take every day and then you lose equally and the Majority of the intake of water is from drinking – by this we don't mean just water it's any fluid (tea, coffee, juice ... etc) or you can get good amount of water by eating food, food here we mean water balance, cucumbers, vegetables that contains

almost 80 or 90% of water. Also we gain everyday a 200ml of water which we call it the metabolic water, what is the metabolic water?

Any chemical reaction substance, alkyls plus substance be equals for example substance c , substance d plus H₂O so any water that is the end result of any chemical reaction in the body is considered as intake we usually have 200ml of water per day from chemical reactions in the body

We lose water daily in approximately the same amount around 2 and half liters less or more according to the weather or according to the physical activity and it's always almost equal to the intake.

-The loss of water mainly happens in :

1- kidney: water is lost from the kidney as urine . kidney always feels the guilt whenever there is a hypovolemia(decrease in blood volume) or any disturbance in homeostatic mechanism the first organ to be affected and the first organ to be shut down is the kidney, because she feels like she is responsible for losing water, she is the major source of losing water from the body

2- Skin : presented by the two types of sweating : sensible and insensible sweating .

In patients who are suffering from burns they might lose liters of water per day and this is your job as a physician to give them excess water so they can compensate their major loss because of their burn.

3- Through the lungs we lose water in term of Vapor

Do you think we lose vapor with breathing more in summer or in winter? When you go outside your home and start to talk in winter you see the vapor so in cold we lose water vapor more because the atmospheric pressure for the vapor is much less from 47 atm will drop to zero so we lose more that's why we are more exposed to get common cold and dry bronchi and related diseases .

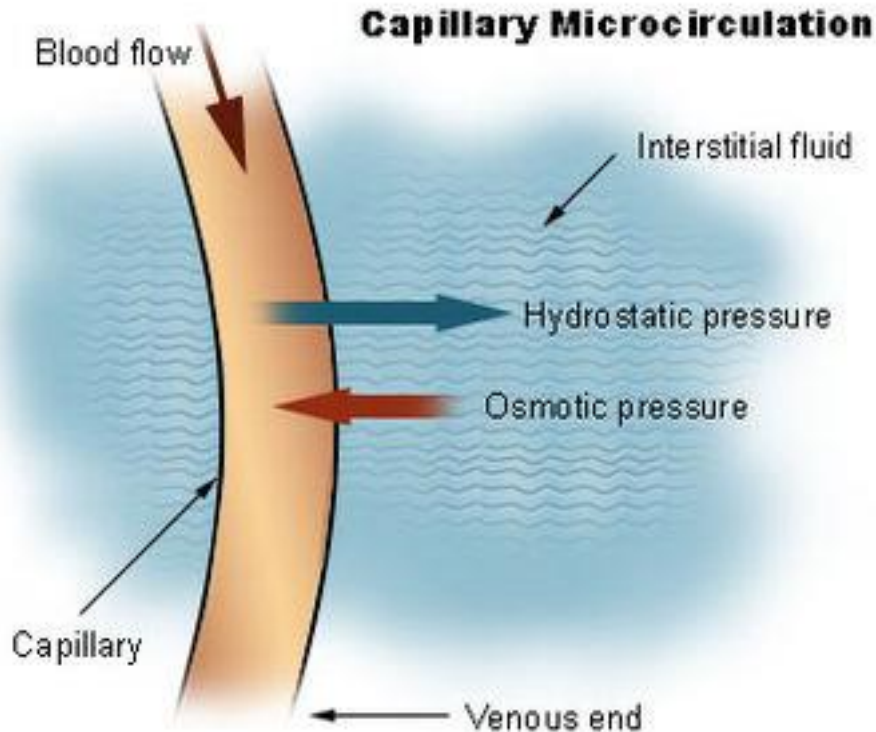
4- GI tract, during defecation when you lose the solid waste product there is a little amount about 100ml of water lost also but this is very significant when patient suffers Diaria, he might lose 1 or 2 liters and you have to give him a replenishment or supplement so that he will regain this lost .

-in our body compartments we have 2 important membranes :

1-cell membrane separating the interstitial and intracellular fluid which is a semi-permeable membrane that is freely flowing to water and it allows some substances to pass and another things that you have taken about transport across membrane where most important exchange of oxygen and nutrients and byproducts between the cell and the interstitial fluid

*the most important driving force of water and the dissolved solutes between the intracellular and the interstitial compartments is the osmotic pressure which must be maintained in an isotonic way for the live of the cell .

2-Capillary membrane (endothelium) :it separate between the interstitial fluid and the plasma



There are 2 major forces acting on the water across the capillary wall :

1-Hydrostatic pressure : caused by the pumping of the heart and causes filtration of water and dissolved solutes from the arterial side to the interstitial fluid

2-osmotic pressure (colloid pressure) : caused by the presence of albumin and large proteins that can't escape from the capillary and it favors reabsorption of the water and byproducts from the interstitial fluid to the venous side of the capillary

Always when we have a critically ill patient is our job as physicians to maintain normal and healthy internal environment by keeping the total body water healthy and normal, how can we do that? By monitoring the input and monitoring the output of fluids

The unconscious patient and patients in intensive care there is a chart where you measure the input and then you measure the output and see how much he needs to replace, this is your major job when you graduate from medical school whether you are caring of preoperative or postoperative patient preparing them for operation or comatosed patient (فاقد الوعي) or unconscious or he came from accident or whatever .

-the dangerous effects in not maintaing stable internal environments and body fluids:

If your patient is not stick and is over hydrate –you give him water more than his need-, what is the dangerous effect ? Or you calculate and you miscalculate and you dehydrate the patient – you give him water less than his need-? What is the major effect of dehydration on the critically ill patient? And what is the major effect of over hydration?

A: if my patient need 2 liter and I give him 1 and he is now dehydrated. Whenever patient suffer dehydration (the water is less than normal) the first organ that feels the guilt is the kidney, and the kidney will immediately shut down. So if you keep your patient dehydrated kidney will sense because the blood coming to the kidney is much less and she has a receptors that she feels the hypovolemia(decrease of blood volume) so she feels the guilt and shuts down and kills its cells, this will cause renal failures. Dehydration is when we are not giving enough fluid to the patient causing the renal artery to bring less blood to the kidneys, kidneys will feel the hypovolemia, feeling the guilt, shut down vasointense vasoconstriction; intense vasoconstriction will lead to anoxia or hypoxia(decrease in blood oxygen) and death of the renal cells and the renal failures. This is one of the major causes of death in hospitals.

dehydration is dangerous and you have to calculate well and give fluids properly when your patient prepare to operation or usually after surgery when he is unconscious he can't drink and he depend on you as a doctor so you will give him the proper amount of fluid.

Now what will happen if there is overhydration?

When the heart is used to volume of 5 liters then you increased the blood volume if you over load the circulation by too much water now the heart has to work very hard so

the heart will go to failure, there will be overhydration will lead to heart failure and pulmonary edema, when you look to your patient and he is trying hardly to catch his breath you know now that you gave him too much water and now he is drowning in his own water and lungs are filled with water (the normal lung suppose to be filled with air), now because the too much water that giving to him there is a heart failure and pulmonary edema.