

Human Physiology
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Lecture - 01

Hello everyone, welcome to another brand new classes of human physiology. In the last few classes as you remember we discussed about like various anatomical part of body, about cells, about ion transport. These classes will see how our body maintains a balance which is called homeostasis. and also we will discuss about different type of cellular disorder and if the disorder happens what type of diseases can cost hopefully you will enjoy. So, what are different contents we will try to cover in this class. So, first we will discuss about the homeostasis and what is homeostasis, what is different type of homeostasis mostly like positive and negative feedback, then we will discuss different cellular disorder which can cause in different cell organelles like in lysosomal disorder, microchondria related disorder, ribosomal disorder, cell membrane associated disorder, endoplasmic reticulum associated disorder.

Hopefully, you will like the class. Let us see one by one how it goes. So, first, we will discuss homeostasis. Homeostasis is maintaining balance of our body right because our body always performs in an optimum state even if we sleep it is continuously performing it is generating energy delivering nutrients and glucose to all of our cells maintaining a steady heart rate blood pressure maintaining our neuronal activities our endocrinal activities.

So, everything is happening in a balanced state. If there is certain up regulation or regulation of certain molecules or any pathways or any physiological condition, our body will try to mitigate that condition and retain back the body into the original natural balance. So, this process of maintaining the balance is called the homeostasis. As you can see that in normal condition our body is like in a balance situation, it is in a balance situation. And now in case if there is any imbalance happens, what will happen body will try to create certain activities to attain the homeostasis.

So, in cases of imbalance that imbalance as a pulse or as a condition will be kind of it will alert the receptor or our different type of receptors will get a sense that there is an imbalance condition in our body. Once the receptor sense about that imbalance it will kind of create a signal to basically activates the control center. So, basically the receptor will receive the information and as a postman it will deliver the message to the control room or the control center. So, once the control center receive that signal what it will do it will alert the effector So, effector type of situation like maybe a new release of a molecule or new condition will arise in the body that will minimize that imbalance. So, basically the effector molecule will probably secrete some molecule or maybe some hormone or maybe it will change our certain muscles or certain situation in a way that it will mitigate that imbalance to attain the homeostasis condition or the balance condition.

So, let us see how different type of homeostasis happen in our body mostly it happens in two different way right. So, one is like positive feedback loop and then the second one is the negative feedback loop. So, mostly it is two category one is positive and second is negative. So, what is basically the positive feedback loop? So, if in the last slide you remember right how if there is an imbalance happen it first gets sensed by the it gets sensed by the receptor and

then receptor sends the signal to the control center. So, in this case the control center will activate the effector molecule in a way that it further kind of enhances that initial condition.

Let us see the kind of the situation how it happens. So, you remember during the pregnancy, during the delivery what it happens like the uterine contraction happens, baby try to kind of pushes and come out from the uterus. So, once baby's head which is kind of in the lowering situation it is creating a pressure or force to the uterus. This creates a stimulation kind of situation, that is what it does basically, it this impulses of the stimulation during the uterine contraction, it affects our brain or the nerve. And once this message goes to our brain which is the control center, the brain or in the like certain part of our brain which is mainly the pituitary gland, it secretes an important hormone which is called the oxytocin.

So, what is happening again like when the baby is basically pushing during the uterine contraction situation that stimulation is going by the nerve or the pulse it is hitting the brain mainly the pituitary gland, the pituitary gland when it is receiving the signal it kind of secretes a hormone called oxytocin and then the oxytocin hormone kind of comes with the blood it gets circulated in the body and eventually it further kind of stimulates the uterine muscle to contract. So, what it cause once the oxytocin molecule is released it further stimulates the uterine muscle for contraction right and the contraction further helps the baby to push further and same the mechanism kind of goes in a loop condition. So, this is you can see this is a positive feedback loop right the body is not trying to prevent the condition the body in a way is trying to further progress the condition so that baby gets delivered. So, this is a positive feedback homeostasis where you can think that yeah maybe balance is now removed from that it is not a natural condition of course, but this is an emergency situation right. So, we need the mother to push out the baby and in this case body cannot maintain the balance they have to kind of trigger the situation in a way.

So, that the process kind of delivers in a quick manner. And once the process is delivered body will come back to its normal physiological condition or homeostasis condition. So, this way when body kind of positively trigger that situation is called positive feedback homeostasis. In the contrary there is a one more example right. If you see like if there is a injury to blood vessels what will happen? If there is a injury to blood vessels it will bleed in cases of bleeding it will basically like various clotting factor for example, like formation of prothrombin activator will cause change of prothrombin to the thrombin and then it will further convert fibrinogen to fibrin.

So, you can see this step by step is eventually causing like the stoppages of the bleeding right. So, when the bleeding happens various molecular interaction will happen some chemical reaction will happen some hormonal reaction will cause eventually all these cascades of pathway mainly the protein clotting pathways they will cause the bleeding to stop. So, this is also an important like feedback mechanism you can see in detail about the blood coagulation pathway we will discuss in the after next few class in the blood classes, but just remember this is how the homeostasis work. Some negative feedback homeostasis also we will discuss for example, if there is like condition happens right if there is like a problem in the homeostasis then maybe our blood pressure may kind of rise what it will cause it will send some receptor signal by the nerve impulse right brain will intercept those nerve impulse and they will cause like the heart blood vessels to kind of have some effect. Basically, what will happen? There would be like a decrease in the heart rate and the blood pressure.

Why? Because there is an increase in the blood pressure due to the disruption of homeostasis, body needs to kind of reduce the condition. So, the heart blood vessels will have a condition of maybe like a vasodilation. So, maybe the blood heart rate and the blood pressure will kind of fall and eventually the BP will go back to the normal condition. In this way you can see there is a negative feedback loop playing and our body is trying to maintain the balance. And then another very important negative feedback loop which is like the blood glucose right.

As you see normally like in our body we have like a certain amount of glucose right in the body. So, when we eat too much of food what will happen? When we eat too much of food the glucose level will go up right. So, once we eat a lot of food the glucose can go up and after consuming some amount of glucose for natural activity body can still left with excess amount of glucose molecule. And that situation is not good because if too much of excess glucose is present in our body, what can happen? They can kind of start like damaging our organs, they can also increase our fat deposition and many other problem like inflammatory cascades can come, our body can become more prone to like bacterial infection. So, having high glucose is never good.

We will thoroughly discuss about glucose, how the excess glucose can cause diabetes, different type of therapies about diabetes in our endocrine classes. But just remember here if the glucose gets high, what our body will do? So, basically our pancreas has different type of cells, right. So, our pancreas has beta cells also our pancreas has alpha cells. So, what this beta cells does? This beta cells basically they secrete a hormone called insulin right and what insulin will do? Insulin will do two things right. So, you remember in our ion transport class we discussed that there is this receptor called GLUT4 receptor right in the facilitated diffusion class we have discussed.

So, this insulin will basically overexpress that GLUT4 receptor. GLUT4 receptor and what it will do it will increase the delivery of the glucose to the cells right. So, by the expression of insulin or the release of insulin our body will kind of supply the glucose to the cell So, more amount of glucose will be delivered to the cells. And even after the delivery of the glucose to the cells if some amount of glucose are still excess then what will happen? Then insulin will further take that excess glucose right and it will convert to glycogen and store in our liver. So, what insulin will do? Insulin has importantly two role one is it supplies the glucose to the cell and second is if some excess glucose is left it will convert the glucose to glycogen and store in the liver for future use.

So, you can see how right once we eat like more food it can contribute to like the higher glucose and whenever there is a higher glucose, this pancreatic cells, this pancreas of ours will secrete from the beta cells, it will secrete like an insulin hormone and insulin hormone will either supply the glucose to the cell or it will convert the glucose to glycogen and store in the liver for future use. So, this is one important type of balance insulin creates. Now, assume another condition for example, we are in a fasting condition for 2-3 days and our body is not having too much of food right that means our body is now our body is now like having lack of glucose. So, if we are like in a fasting condition maybe for like 2-3 days. What is happening? Our body is now having very low glucose, right? And now who will save, right? You remember what insulin did? Insulin stored some excess glucose, they converted it into glycogen.

So now we have what? We have glycogen reserve in the liver. Last time it was a beta cell, this time the alpha cell. Alpha cell will secrete another hormone which is called glucagon and what glucagon will do? Glucagon will basically convert this stored glycogen glucagon will convert

this stored glycogen which was initially stored in the liver back to glucose and this glucose will eventually get circulated by the blood and it will try to maintain the glucose homeostasis in our body. So, hopefully you understood in case of either glucose goes high or low insulin or glucagon can simultaneously act or in a specific situation insulin may act in a specific situation glucagon may act and it will maintain glucose homeostasis in our body. Glucose is very important for our brain cells also because in case of prolonged lack of glucose our brain cells can get damaged and we can also go to a situation called coma ok.

So, we should never ignore taking like glucose of course, doing fast is good for your health but you should not be kind of ignoring like your morning breakfast or have like a prolonged skip of like between two meals that can always cause like a damage of your glucose regulation in the body. And in continuous run, if this type of imbalance persist for a longer period of time, it can cause like a situation called diabetes. So, be very careful with how you take your meals, try to be very regular between the next, we will try to quickly go through various like disorders of different cell organelles right. We discussed in last few classes right how the cell organelles are important. Can you tell what is the role of mitochondria? Yeah, mitochondria is very important in terms of like ATP and energy production right because it maintains like our it supplies the energy for various body function.

What about the role of lysosome? Do you remember the role of lysosome? Yeah, you are right like in the lysosome helps to kind of produce like various sort of like acidic enzyme to destroy like worn out cells to destroy various like pathogenic bacteria. So, lysosome was like a suicidal bag of ours. It maintains like overall like cellular integrity and it destroy various infection also at times. So, this type of organelles like other organelles like nucleus, cytoplasm all like algae body everything has their own role you remember, but in cases of any dysregulation for example, like there might be a genetic changes right maybe like a genetic mutation in those cell or maybe some sort of dysfunction happen for a certain organelle. So, what diseases can happen we will briefly discuss.

So, first one we will discuss about the disorder due to the mitochondrial malfunction. So, mitochondrial diseases are like kind of chronic or long term it can be like genetic also in many cases the genetic mitochondrial disorders are inherited that means like from parents it can go to like daughters. right and then there are lot of different type of mitochondrial disease due to this type of genetic reason or other environmental reason it can affect our various organ right you can name any organ because mitochondria mostly present in all the cells. So, like brain, nerve, muscles, liver, lung, kidney everywhere it can affect ok and it can be like inherited. So, that means, like mitochondrial disease can originate or initiate or it can stay during the birth also.

So, what are different type of mitochondrial disease? You just remember that this all the disease what we will discuss like Alzheimer, muscular dystrophy, diabetes, this can cause for other dysfunction also. So, many other dysfunction can also cause this type of disease, but the mitochondrial dysfunction also if it happens, this type of disease can happen. So, there might be multiple cause, but mitochondrial dysfunction is one of the important cause. So, we will not discuss about too much of in detail what is the disease, but just for example, mitochondrial malfunctioning can cause Alzheimer disease and this can affect our brain memory, right, thinking skills and all. Then it can cause muscular dystrophy, our muscles can become weak, our muscle can lose loss like a mass and then we can have like a impaired muscle activity and it can slowly affect our heart it can slowly affect our lung and other activity right then this is

or the amyotrophic lateral sclerosis this is also a neurogen like kind of genetic disorder this can also cause due to like mitochondrial dysfunction, diabetes, cancer.

So, many of the disease which are very common nowadays apart from like genetic disorders also are some of the diseases that can be caused by mitochondrial malfunction ok. And then lysosome malfunctioning as you remember that lysosome has a very important role to kind of destroy all the worn out like old cellular components or particles sometime like different unwanted proteins or maybe even like pathogens. So, in cases of lysosomal disorder what will happen this type of old turn out cells and they have lot of glycolipid present they will not even like get degraded or destroyed. So, this type of glycolipids right will eventually store in the body where they will store mostly like they can store in our liver they can get stored in our spleen. So, if this glycolipids fats they get stored in this liver and spleen, what it will cause? It will cause like a fatty liver or fatty spleen.

So, this type of disorder, is also a genetic disorder If fatty liver and fatty spleen happens due to lysosomal disorder, this is called Gaucher disease, this is called Gaucher disease, this is a rare genetic disorder. And progressively the fatty liver and fatty spleen can also cause like a brain related diseases like it can hamper our motor ability or it can also cause certain other neuronal damages. So, you can understand lysosome to have a proper function is so, so important for our body. There are different disease as we discussed the Gaucher disease apart from that there can be like Fabry disease, there can be Niemann-Pick disease, Pompe disease, tay-sachs disease. So, these all are different in terms of their condition, it may affect brain, it may affect liver or spleen, some may affect the skeletal heart muscle, some may affect the brain cells, but these all are related to the lysosome malfunctioning.

So, next is ribosome malfunction. So, what is ribosome important for? Yeah, it is important because it is the house of protein synthesis right. So, ribosome related diseases which are also called like rhizomopathies. if there is a dysregulation or alteration in the structure of components of ribosome this type of disease can happen right and it will hamper the protein production. So, what are the associated disease may be like diamond backfan anemia like a type of anemia. If the ribosome is dysfunction maybe it may cause like anemia because it may cause like a improper synthesis of this type of hemoglobin other protein right and different type of genetic disease like 5q syndrome also can happens right and this type of diseases can kind of affect various part of our body mostly they cause like anemia.

Other type of disease like SDS syndrome, it can be like the dyskeratosis cognatea, the DC type of disease, these are like some sort of like neutropia, apnea disease, genetic disease, it can cause like fibrosis, bone marrow failure. So, you can see like lot of different sort of diseases happen, we are not discussing too much in detail. But just remember this some diseases which were very uncommon few years before with like growing environmental changes, lot of pollution, lot of over excessive use of growth factors, lot of excessive use of like chemical fertilizers right mainly environment pollution and our lifestyle changes these diseases are becoming increasingly more and more prevalent. and especially in the early ages like lot of cases we can hear nowadays that these are happening in cases of child and baby and these are becoming very serious and main problem is many of these cases there is almost no treatment available till date and even if there are certain treatments available the treatments cost are too high. So, in some cases the treatments may cost even like a single injection of certain treatment can go like over 1 crore rupees.

So, you can understand it becomes so difficult for certain family for their babies to suffer to see that they are suffering from this disease, but they do not have any option to treat them. So, go through all these detail briefly of course, about the disease some disease we may cover in certain classes like for example, Alzheimer, Parkinson will cover during our neuro classes, but mostly and diabetes will cover in our endocrine classes right some disease will thoroughly like cover. So, endoplasmic reticulum related malfunctioning can cause like cystic fibrosis this can also hamper our lung mostly like lung also sometime the digestive organ then other disease also can happen. Cell membrane related malfunctioning can also happen right is like the different type of like dysfunction can cause like irregular like development or like use of this cholesterol. So, maybe in cases of this type of dysregulation the bad cholesterol level can go high in the body right and if the bad cholesterol you know right there are like two different type of cholesterol in our body good and bad right and good cholesterol try to mitigate the bad effect of this bad cholesterol.

So, what will happen if the bad cholesterol goes high they can cause may be clogging of our the blood arteries vessels and it can also cause like heart attack. right and other infectious disease like HIV, shingles these also can happen due to the cell membrane malfunction okay so different diseases again so all these showed like how different diseases can happen if like certain organelles disorder can cause in our body so this was this is today's activity okay so do something heavy work right maybe you can jump you can run and then slowly try to touch your heart to measure your heart rate like how fast your heart is beating and once you do some exercise after doing the exercise you sit then try to relax and from start to last you try to measure your heart rate and try to kind of judge that how your body is try kind of increasing or decreasing your heart rate with the whole process. What is the main goal of the heart rate decrease or increase? Because when you do the work, your body may try, may need like lot of oxygen and to deliver lot of high oxygen, your heart rate may increase. So, you can do this task and try to see how it work. Hopefully, you enjoyed today's class of homeostasis, where we discuss about lot of like how the body maintains like balance.

Apart from that, we discussed different like disorders of like cell organelles, some diseases also we discussed. Go through all those briefly. If you have any question, please do not hesitate to ask us. We will also do lot of live session.

Please send your queries. Again, thank you very much for attending today's class and we will meet you again in another new class of human physiology. Thank you again.