Basics of Biology
Professor Vishal Trivedi
Department of Biosciences and Bioengineering
Indian Institute of Technology, Guwahati
Human Physiology – Part II
Lecture – 40
Circulatory System – Part II

Hello everyone, this is Doctor. Vishal Trivedi for Department of Biosciences and Bioengineering IIT Guwahati and what we were discussing, we were discussing about the different properties of the living organism and in this context, what we have discussed so far we have discussed about the classification of the living organisms, evolutions and then many other aspects related to the living organism. And recently in the couple of modules we were discussing about the human physiology.

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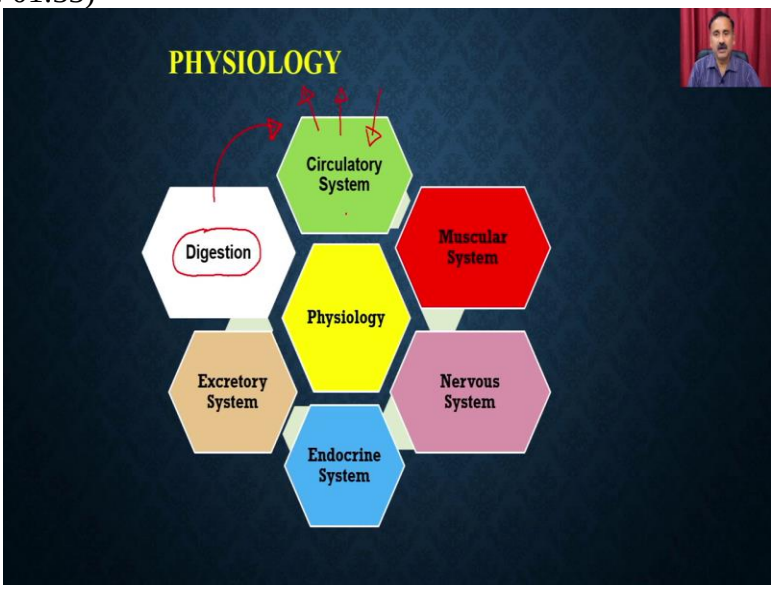

So, what we have discussed so, far is that we have discussed about the digestive system and in the digestive system, we have understand how the complex food material is being digested within the elementary canal and what are the different components are involved into the processing the food from the very crude to the very simple molecule and then these simple molecules are going to be absorbed.

And once they will absorb they are actually need to be distributed throughout the body and that is the function of the circulatory system. So, circulatory system is actually going to distribute the nutrients it is actually going to distribute the gases and in return, it also going to collect the waste

material from the different parts of the body. So, while we were discussing about the circulatory system in the previous lecture, we have also, we have discussed about the machinery like.

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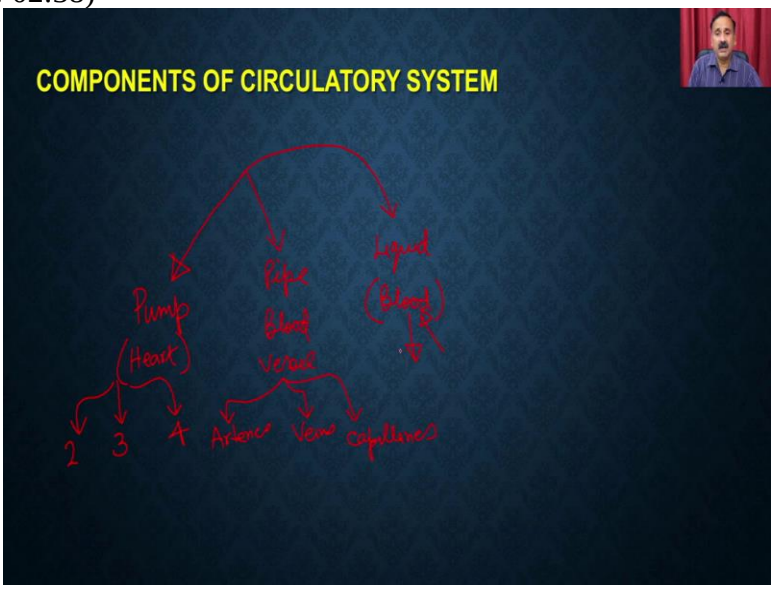

So, in the circulatory system, what we have is that we have the three components. We have the machinery like. So, we require a pump so we have the pump and that is called as the heart and we also require the pipe so, that you can be able to flow the liquid and that pipe is called as the blood vessels and the third is the medium the liquid. So, the liquid which you are going to flow and that liquid is called as the blood which is actually going to flow throughout the body.

As far as the pump is concerned the pump can be of multiple types, it could be the two chamber pump, it could be three chamber pump and it could be four chamber pump and we have in the, and as far as the blood vessels, the blood vessels could be of three different types you can have the arteries, you can have the veins, and you can also have the capillaries. And when we were discussing about the different properties of these components, we said that what is the disadvantage or what is the advantage of the four chambered heart.

And we have also discussed about the properties of the arteries, veins and the capillaries. In the today's lecture, we are going to start discussing about the liquid what is going to be responsible for carrying the gases and as well as the nutrients and in return it is also going to collect the waste material from the different parts of the body. So, as the name suggests, the liquid is actually going to be called as blood.

And the blood is going to be made up of the different components so, that it actually can be able to serve this purpose of carrying the food material, carrying the nutrients and also it can actually be able to bring the waste material from the different parts of the body.

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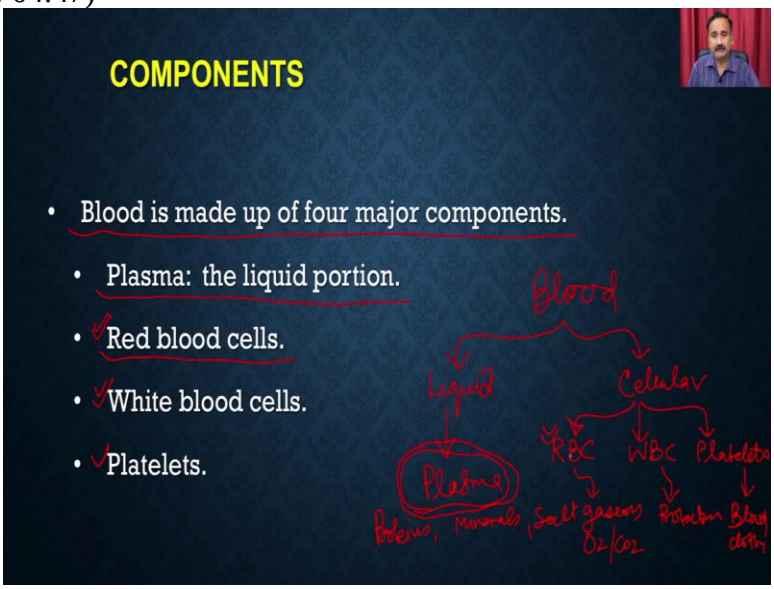

So, as far as the component is concerned, the blood is made up of the four major components. So, it has the liquid part which is called as the plasma and it also has the cellular part which is called as the so it actually has a different types of cells, it can have the red blood cells, it can have the white blood cells and it also can have the platelets. So, as far as the composition is concerned the blood is going to have the two components one is the liquid component and the other is the cellular component.

And the in the liquid component you are actually going to have the plasma. So, plasma is actually going to contain the different types of proteins it is going to have the minerals, it is going to have the salt and the purpose of the plasma is that it is actually going to provide the medium for the cells to swim and cells to reach to different parts of the body and the plasma is also going to contribute in terms of the distributing of the nutrients.

Apart from that in the cellular component, you are going to have the major the three different types of cells you are going to have the red blood cells, you can actually have the white blood cells and you can also have the platelets. And all these cellular component is going to have its own functions. Like for example, the RBC is actually going to carry the gases like oxygen or the

carbon dioxide whereas the WBC is having the major role in terms of providing the protection. And platelet it is actually having the major role in terms of the blood clotting.

So, let us discuss about these different components of the blood. So, let us start with the discussion with the RBCs. So, as the name suggests, the red blood cells are actually going to be as red in color and they are red in color because they have the red color pigment.

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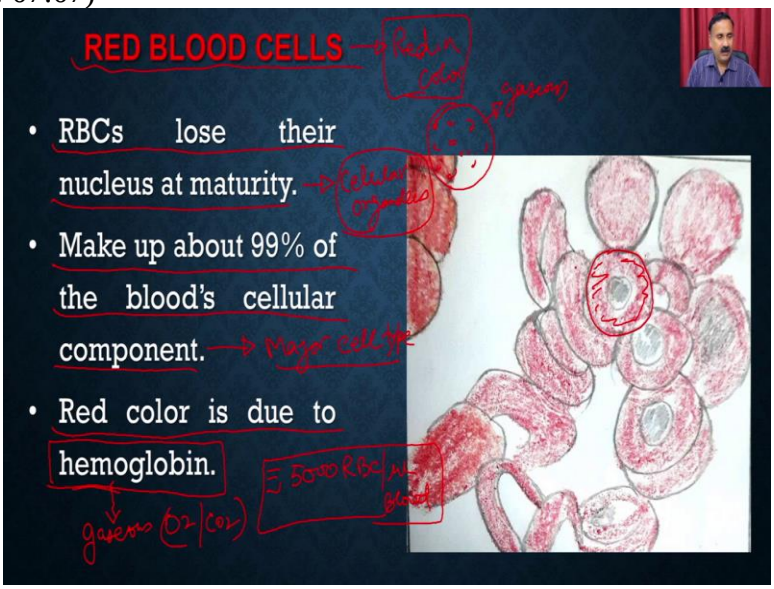

So, the red blood cells are going to be called as the red blood cell because they are red in color and they are red in color because they are actually having the red color pigment. The RBCs are being produced from the bone marrow and then they lose the nucleus at the maturity. So, RBCs does not contain the cellular organelles including the nucleus and other parts. So, it only is like a bag where you have the different types of protein what is present and the function of these RBC is actually going to carry the different types of gases.

It is made it is made, makeup of the 99 percent of the bloods cellular components. So, this is a major cell what is going to be present into the blood. So, it is a major cell type what is going to be present approximately we have the 5000 RBCs per microliter of the blood. So, its number is very high and the RBC is red color because of the red color protein what is called as the hemoglobin.

And hemoglobin is a major protein what is going to be responsible for the carrying the gases, whether it is the oxygen or the carbon dioxide. So, what you see here is these are round shaped

cells, which are actually having the red color and they are actually going to have the red color pigment.

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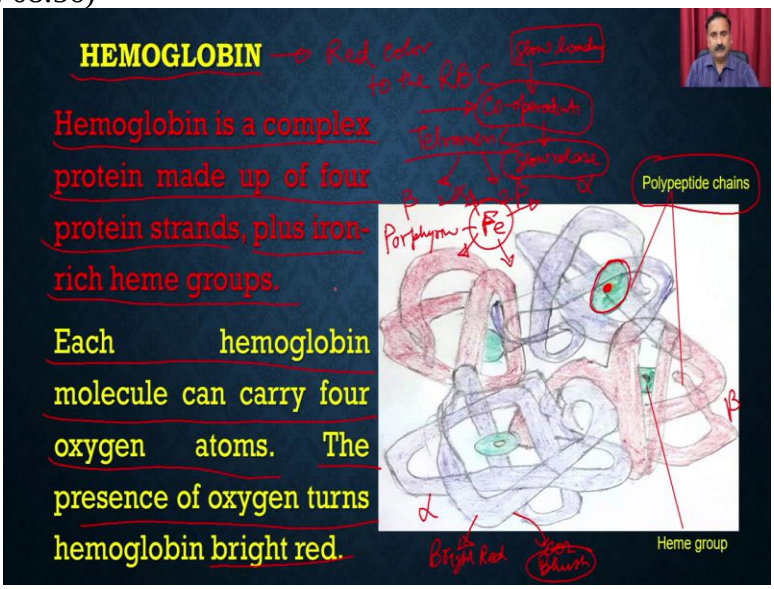

The hemoglobin is a very very complex protein. So, hemoglobin is a protein which is responsible for providing the red color to the RBCs. And hemoglobin is a complex protein it is made up of the four protein chains and it also has the iron containing heme proteins. So, what you see here is this is the hemoglobin molecules where you have the four polypeptide chains and these polypeptide chains are having the bound hemming.

So, hemming is the pole firing structures which actually has the iron in the center and this iron is responsible for binding the oxygen. So, it is made up of the four polypeptide chains, you have the Alpha chain, you have the beta chains and you have the Alpha chain and then you have the beta chain. So, it actually has a tetrameric protein, which is made up off of the two alpha and two beta chains where the alpha and beta are alternatively being placed.

And the each hemoglobin molecule can carry the four oxygen atoms at the same time and the presence of oxygen turns the hemoglobin slightly bright in red. So, that is why the hemoglobin actually can form the two different colors. So, if hemoglobin is binding two oxygen it is actually going to be bright red and if the hemoglobin is binding to the carbon dioxide then it is actually going to be bluish in color.

And because of this, you might have seen that the deoxygenated blood is actually going to be dark in color, whereas the oxygenated blood is bright red in color. Apart from that the four sulfur subunit, four subunits which are responsible for the binding the oxygen or the carbon dioxide is mostly because they are actually having the Hemen bound and heme is a porphyrin structure which actually are going to have the iron into this.

So, it actually has the iron in the center and this iron actually can bind the four oxygen molecules at the same time. And the hemoglobin is also showing another property which is called as the co-operativity. So, this means the hemoglobin is going to bind the first oxygen molecule with the less affinity and the subsequent oxygen molecule with the more and more affinity and that co-operativity behavior is very important because it actually helps the molecule to bind the more and more oxygen molecule.

But when the environment is changed, then it is actually going to release the molecules also at the same time. So, it actually going to have the slow release at the site of the tissue, whereas it also going to have, it is going to have the slow loading as well. So, and this slow leads and slow loading has very significant, very highly, high significance, because if the hemoglobin molecule is going to release the large quantity of oxygen at the tissue site, or if it is going to bind a large quantity of oxygen at once, that is actually going to create trouble.

Because if you release the large quantity of oxygen at the tissue site, it is actually going to, the tissues will not be able to take up that oxygen and they will these oxygen is actually going to create trouble rather than the it is going to be beneficial.

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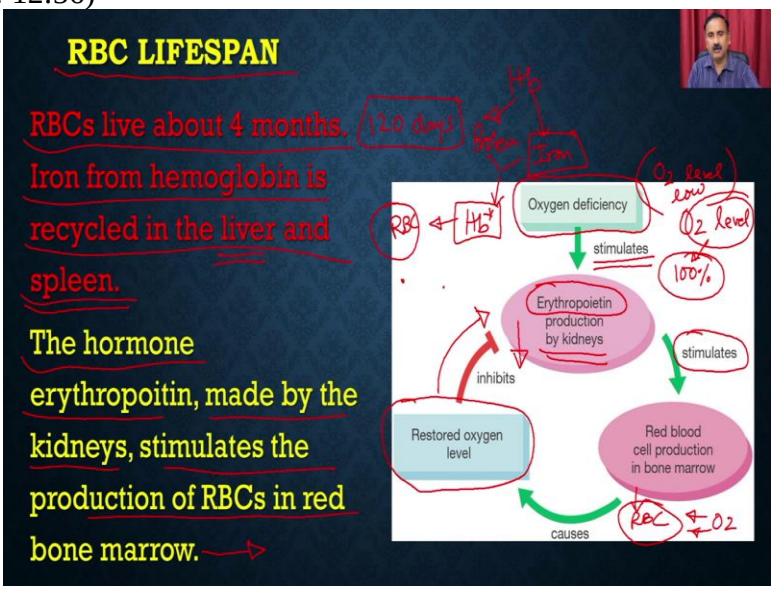

Now, the as far as the lifespan is concerned the RBCs actually approximately will have the 120 days of the lifespan. So, during these 120 days the iron from the hemoglobin is recycled in the liver and actually into the spleen. So, hemoglobin as I said you know hemoglobin has two components it is actually going to be made up of the protein and the iron and this iron is very important.

So, iron is actually going to be recycled back. So, that this iron is actually going to combine again with the another molecule of the protein and that is how it is actually going to form the new molecule of hemoglobin and this new molecule of hemoglobin is then going to be packed and that is how it is actually going to responsible for the generation of RBCs. So, this iron recycling is going to happen into the liver and as well as the spleen.

So, what you see here is actually a condition where the body is actually having the oxygen deficiency. So, if there will be an oxygen deficiency that is actually going to stimulate the secretion of the erythropoietin hormone. So, erythropoietin is a molecule which is going to be produced from the kidney. And once the erythropoietin is going to be produced, that is actually going to stimulate the production of the RBCs from the bone marrow.

And that is also going to so once there will be a production of the RBCs from the bone marrow it is actually going to produce the more amount of oxygen. So, if it is going to have the more amount of RBCs it is actually going to help the carry the more amount of oxygen and that is how it is actually going to restore the normal oxygen level and once there will be a normal oxygen

level then it is actually going to inhibit the erythropoietin stimulations from the kidney and that is how it is actually going to down regulate the erythropoietin production from the kidney.

And that is how this cycle is connected to the oxygen availability into the body. Remember that during the corona people were saying that you should always remember or always monitor your oxygen level. So, oxygen level is very important or normally people should have the 100 percent saturation. But if the oxygen level will go down, whether it is the naturally or because of some disease, this is going to happen.

But the erythropoietin is going to be produced from the kidney and that is actually going to stimulate the large quantity of RBC production. You might have observed the people who go on to the hilly areas for example. So, if they will go to the hilly area, where the oxygen level is low, they are actually going to have the this kind of cycling events. So, when there will be oxygen level is low that is actually going to stimulate the RBC production.

And that is why you might have seen the people who are staying in the hilly areas, they are actually having more amount of in the blood and their blood is also red in color and because of that, you might have seen that their cheeks are actually slightly pinkish. So, that is mostly because they live in a place where the oxygen level is low, and that oxygen level, low oxygen level is actually inducing the production of erythropoietin and that ultimately causes the enhanced production of RBCs.

So, the hormone the erythropoietin is made by the kidney and that stimulates the production of RBCs into the bone marrow, and that is responsible for the to restoring the oxygen level and that is how it is actually going to overcome the oxygen deficiency.

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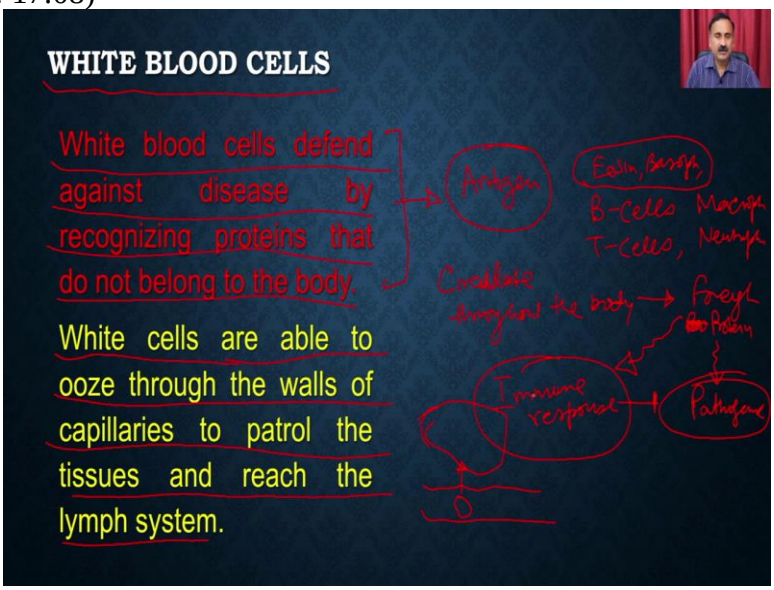

Now, let us move on to the next blood. So, next blood type is the white blood cells and the white blood cells are the cells which actually are going to defend against the diseases by the recognizing the proteins that do not belong to the body and these external proteins are called as the antigens. So, antigen is actually going to recognize by the body and that is the function of the white blood cells. So, what the white blood cell is going to do is they are actually going to circulate throughout the body.

So, they are going to circulate throughout the body and they will be looking for the foreign proteins. So, they will be looking for the foreign proteins, and these foreign proteins are indirectly be coming from the pathogenic organisms. And so, because of that, they are actually looking for the pathogenic organisms. So, wherever they will found the pathogenic organisms, then they are actually going to cause the immune response.

And that immune response is actually going to be, will actually going to attack on to the, this particular pathogen, and that is how it is actually going to reduce the pathogen. So, that is how the white blood cells are actually going to protect the body from the external antigen or the external infectious organisms. White blood cells are able to ooze out through the walls of the capillaries to patrol the tissue and reach the lymph system. So, because the white blood cells are doing these functions, they are having the ability to even to ooze out from the you know that the blood vessels have the cells.

So, white blood cells actually can ooze out from the capillaries, and then they can actually be able to reach to the tissue and then they can actually be able to scan the tissue also whether there will be any infectious organism present inside the tissue as well. And that is actually is a main function of the white blood cells. Within the white blood cells we have the different types of cells, we have the B cell, we have the T cells, we have the macrophages, we have the neutrophils, and so on.

So, we have the eosinophil, we have the basophil and we have the. So, these are the different types of cells but the main function of some of the all of these cells are that they are actually going to cause the protection of the body from the infectious organisms, and also, they are actually going to circulate throughout the body to scan the infectious organisms. How they will do that is actually because they are actually going to have , they can, they have the ability to cause the immune response. What is immune response?

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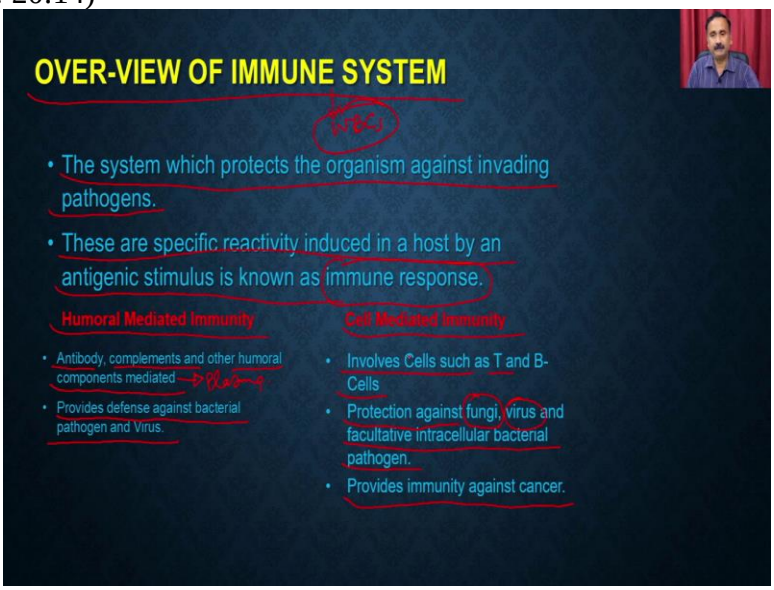

The immune response is actually a system of the reactions what is going to be generated by the WBC or the white blood cells and they are actually going to protect the body from the different types of immune responses. So, the system which protects the organism against the invading pathogens, these are specific reactions induced in a host by an antigenic stimulus and that is known as the immune response.

So, you can have the two different types of immune responses, you can have the humoral immunity, humoral response or you can have the cell mediated response. In a humoral response,

the cell is actually going to take up or the body is actually going to take up the help from the antibodies, complements and other the humoral response which is present into the plasma. So, this is actually going to happen in the plasma.

So, antibody complements and other humoral components which are present in the plasma are actually going to be responsible for providing the humoral response and they are mostly been going to provide the defense against the bacteria as well as the viruses. Whereas, the cell immunity, cell mediated immune response actually involving the cells, which are actually going to cause the response such as the T cells or the B cells.

They are actually going to provide the protection against the in fungi, viruses and the facultative intracellular bacterial pathogens. In some of the cases the cell mediated immune response is also going to provide the immunity against the cancers. So, the question is how the immune response is actually going to protect the cell or the body from the pathogenic organisms and what are the different events it is actually going to catalyze while it is protecting the cells, the body actually.

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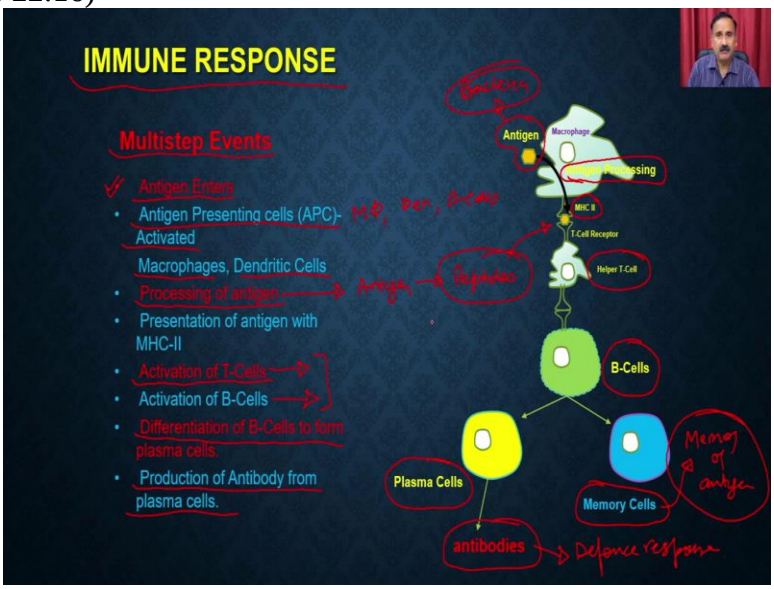

So, the immune response is a multi-step process. So, what will happen is that once in a, once for an antigen is actually antigen or I will say the foreign organism for example, the bacteria. If the bacteria will enter into the body, it is actually going to encounter by the macrophages. So, and these macrophages are called as the antigen presenting cells or antigen processing cells.

So, the first step is that antigen is actually going to enter into the body, then they are actually going to encounter by the antigen presenting cells such as the macrophages or the dendrite cells or the B cells. Once they will actually going to have the antigen presenting cells activated, which involves like the macrophages or dendritic cells, these macro these cells are actually going to do the processing of the antigens.

So, they are actually going to do the processing of antigens, and what they do in during the processing is that they are actually going to generate from the antigen they will actually going to generate the peptides. These peptides are actually going to be expressed along with the MHC class two. So, these are the some of the receptors what are present on to the antigen presenting cells. And once the peptide is actually going to be presented along with the MHC class two, it is actually going to activate the more number of cells like.

So, it is going to activate the T cells, it is going to activate the B cells. So, once they will actually going to activate the T cells or B cells. So, initially they are actually going to activate the T cells and then the T cells are actually going to activate the B cells. And once the B cell is actually going to activate, the B cell is actually going to differentiate into the two different types of cells, it is going to differentiate into the plasma cells or it is going to differentiate into the memory cells.

This memory cell is actually going to keep a memory of the antigen so that when the same antigen is actually going to enter by the second time, they will not going to follow this particular processing, they will actually directly going to activate the memory cells, so, that the memory cells are actually going to produce the antibodies. So, B cell is also going to form the plasma cells and from the plasma cell is actually going to start producing the antibodies.

And these antibodies are actually going to provide the defense response. So, that thought is actually going to produce the antibody from the plasma cells and these plasma cells are, these ones these antibodies are being produced, they are actually going to cause the defense response. Now, the question comes, what is antibody.

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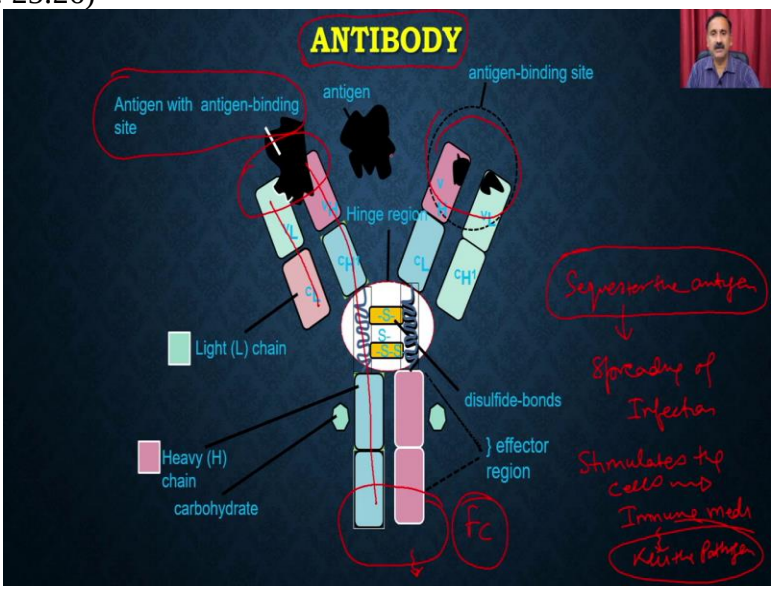

So, antibody is a is a Y shaped molecules, and that is actually going to provide the protection against the infectious organisms. So, what you see here is a antibody molecules, and it is actually going to have the two chains, it is going to have the heavy chain, and it is going to have the light chain. So, this is the heavy chain, what you see and this is the light chain, and it has the two region, one is called as the antigen binding region, which is actually going to be on the top of this molecule.

So, this is the antigen binding region on the two. So, two antigen binding site is going to be present onto the antibody. And on the other hand, it is also going to have the FC region and that is called as the constant region and this FC region is actually going to bind on to the cell surface, and that is how it is actually going to relay the signal from the antigen. The function of the antibody is that it is going to sequester the antigen and that is how it is actually not going to allow the spreading of the infection, spreading of the infection.

And apart from that, it also going to stimulate the cells, it is going to stimulate the cells for production of the immune molecules or the immune mediators and these immune mediators are actually going to kill the pathogens, or the infectious organisms. So, the introduction of the antibody is very, very, very important into the host, so that it actually going to create the protection against the infectious organisms. There are many steps at which which are involved into the antibody production within the host. And these events are well, these events are fine

controlled and that is how they are actually going to provide the protections. So, the question is what is these events?

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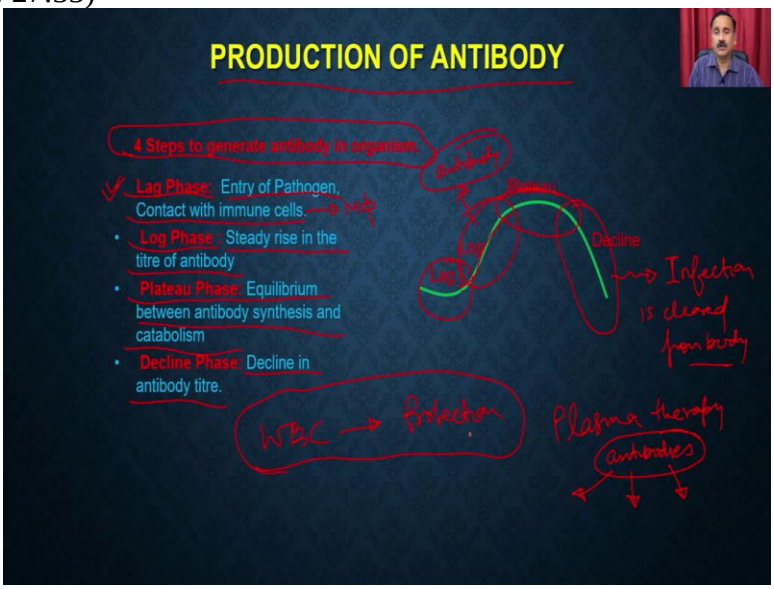

So, in a production of antibodies, you can have the four steps to generate the antibody into the organisms. You can have the lag phase and in during lag phase, you are going to have the entry of the pathogens, and then it is going to contact the immune cells, such as the antigen presenting cells, then it is going to have the log phase. So, it is going to have the lag phase, it is going to have the log phase, during the lag phase there will be a steady rise in the title of the antibody, which means at this stage, there will be a production of the antibodies and that antibody production is going to be very, very fast.

And then it is going to have the plateau stage where the equilibrium of the antibody synthesis and catabolism is going to be achieved. And then it is going to have the decline phase where the antibody titer is going to down. So, in the decline phase, the infection is going to be cleared from the infection is going to be cleared from the body. And that is how the WBCs are actually going to provide the protection against the infectious organism.

So, WBCs actually depends very heavily on to the antibodies for the providing the protection and that is why remember that during this pandemic, the people were actually going with the plasma therapy. So, what is the plasma therapy is doing is the plasma therapy is actually contains the antibodies and these antibodies are doing the same function, what we have just discussed, it is

actually going to stimulate the immune response so that it is actually going to clear the Coronavirus from the body, it actually also going to stimulate the neighboring cells.

So, that is actually going to cause the robust immune response and that is how it is going to cure the system. And it also going to sequester the virus so it is actually going to keep the virus in a limited area so that it is not going to spread throughout the body. So, this is the brief overview of how the WBCs actually provides the protection into the host.

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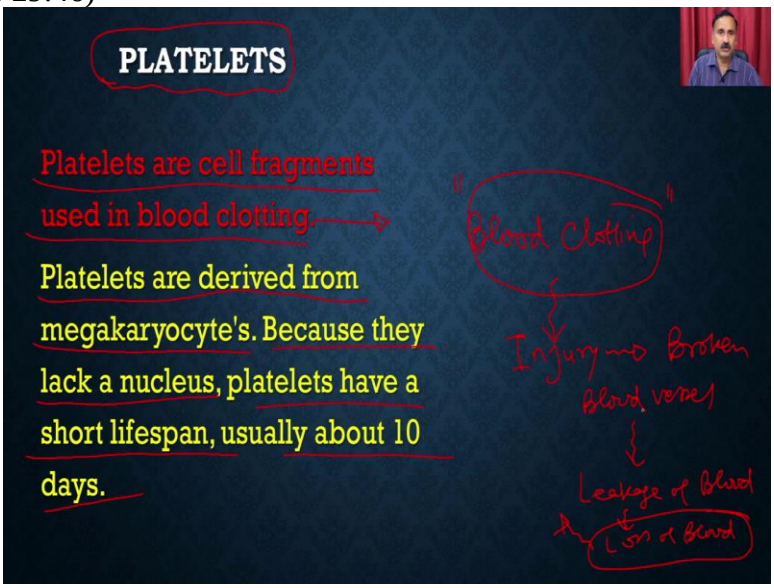

Now let us move on to the third cell types, third cell type is called as the platelets and the platelets are the cell fragments which are used into the blood clotting. The platelets are derived from the megakaryocytes because they lack a nucleus platelets have a very short lifespan usually the 10 days. So, what the platelets are doing is they are actually going to function into the blood clotting. So, why there is a need of blood clotting because you are actually going to have the injury and once a person is going to have the injury it is actually going to have the broken blood vessels.

So, if there is a broken blood vessel the from that place, there will be a leakage of the blood. So, if the leakage of blood it is actually going to be responsible for the loss of the blood and the loss of blood is not good for the organism, because the loss of blood means you are losing the different types of proteins you are losing all the important factor what is present into the blood.

And more importantly, because the blood is going to carry the nutrient and as well as the gases you are actually going to have the loss of that part also. So, because of that the blood clotting is very, very important for ensuring that even if there will be an injury, that injury that injured part can be repaired and that can be restored.

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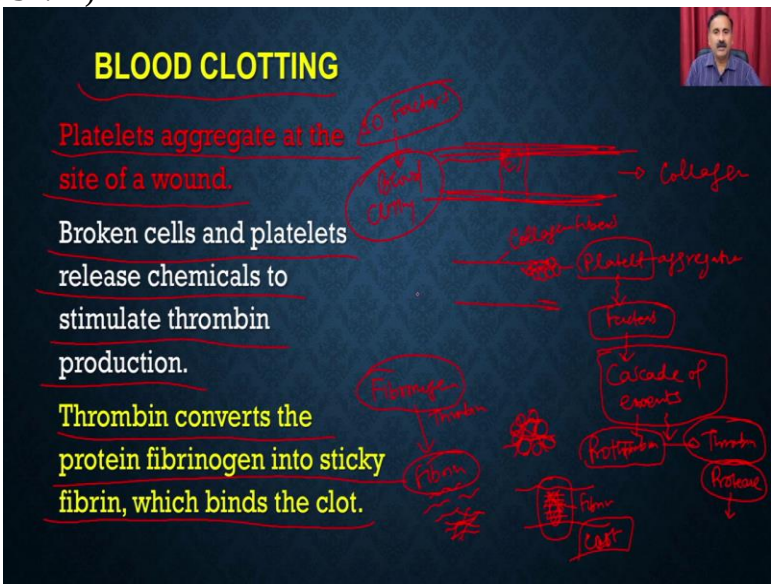

So, what are the things are going to happen when they will be a blood clotting. So, platelets are going to aggregate at the site of the wound and the broken cells and the platelets are released going to release the chemical to stimulate the thrombin production and the thrombin is going to convert the protein fibrinogen into the sticky fibrin which binds a clot. So, you can imagine that if there is a blood vessel like this and suppose there is a damage.

So, once there is a damage you know that the blood vessels are mostly being formed by a protein which is called as the collagen. So, you are actually having a collagen fiber which are actually going to be present on the top as well as the bottom of these blood vessels which has been covered with the muscular, muscles and then it is going to be covered with other cells. So, once there will be an injury it is actually going to open the collagen fibers.

And once there will be exposed collagen fiber that will actually going to allow the aggregation of the platelets and once so, there will be a platelet aggregation. So, if there will be a platelet aggregation the platelets are actually going to release the many factors. So, these are actually going to release the factors and you know that there are almost ten different factors are important for the blood clotting.

So, there are ten different factors which are responsible for the blood clotting. And so, these factors are actually going to initiate a cascade of reactions. Cascade of events, and once they start the cascade of event, ultimately what they do is they are actually going to convert the prothrombin into the thrombin. So, once there will be a conversion of the prothrombin into the thrombin and you know that the thrombin is a protease.

So, it is actually going to start chewing up the proteins. So, what the thrombin will do is it is actually going to convert the fibrinogen into fibrin. So, if it is going to convert the fibrinogen into the fibrin, fibrin is protein like the fiber like protein and that is going to happen when there is a production of thrombin. So, once the fibrin is going to be formed, what the fibrin is going to do is it is actually going to cover up that portion which is damaged and it is actually going to form a mesh.

So, the fibrin molecules until unless they are present as a fibrinogen, they are not going to form but when they will form the fibrins, this is actually going to make the mesh and, in this mesh, they will be entanglement of the RBC. So, RBCs are actually trying to come out the liquid and cell part is trying to come out but when there will be a mesh is being generated because of the fibrin. It is actually going to form a clot and once there will be a clot formation it is going to stop the release of the water or release of the blood actually and that is how it is actually going to stop the injury or the wastage of the blood from the site.

So, these are the some of the overview of the how the platelets are contributing into the blood clotting. So, once initially you have an injury that is going to expose the collagen fibers and once there will be exposure of collagen fibers, it is actually going to allow the platelet aggregation. So, platelets will come in stick to these collagen fibers and they will aggregate once there will be a platelet aggregation is going to stop generating the factors. And then these factors are actually going to activate a cascade of events.

And then ultimately, these cascade events are actually going to activate the prothrombin into the thrombin. And then this thrombin, which is actually a protease so protease job is to cut the proteins is going to cut a protein, which is called as a fibrongen to generate the fibrin and these fibrins are then going to aggregate and that is how they are actually going to form the clot. So,

these are the some of the crucial components, what we have discussed what is present into the blood.

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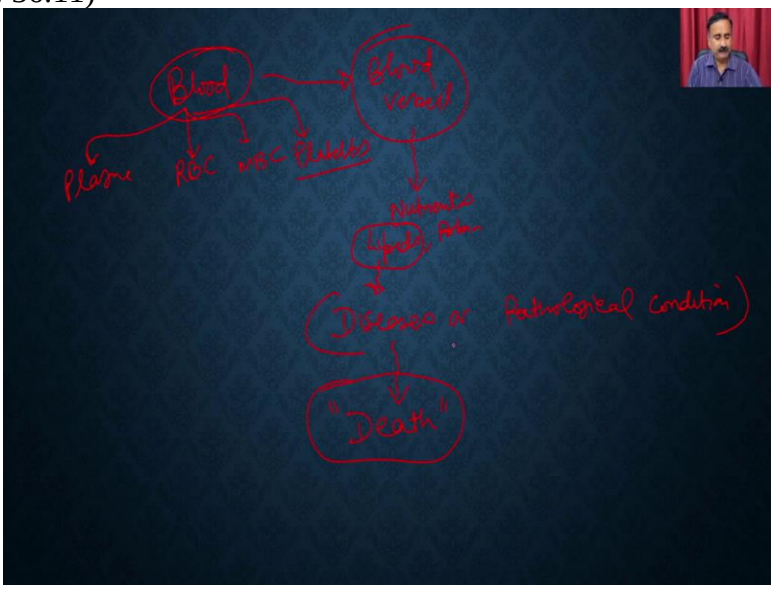

So, in the blood, we have the plasma, we have the RBCs and we also have the WBCs and we have the platelets, and what we have discussed we have discussed about the functions of the individual, but the blood is flowing within the blood vessels. And these blood vessels are actually going to so while the blood is flowing into the blood vessels, it is actually going to carry the different types of products.

So, it is going to carry some of the nutrients and it is going to carry the nutrients like the lipids, it is going to carry the proteins and all that. So, if there will be an abnormality if there will be a problem. Because of that the blood vessels are actually going to have the problem. So, for example, if there will be huge quantity of lipids, it is actually going to make the blood more and more hard. And these are the some of the pathological conditions, which are responsible for the different types of diseases or the or I will say the pathological conditions which are going to be developed into the circulatory system.

And these are some of the pathological conditions which are ultimately been responsible for the death of the organism. So, let us discuss about some of these pathological conditions or the diseases.

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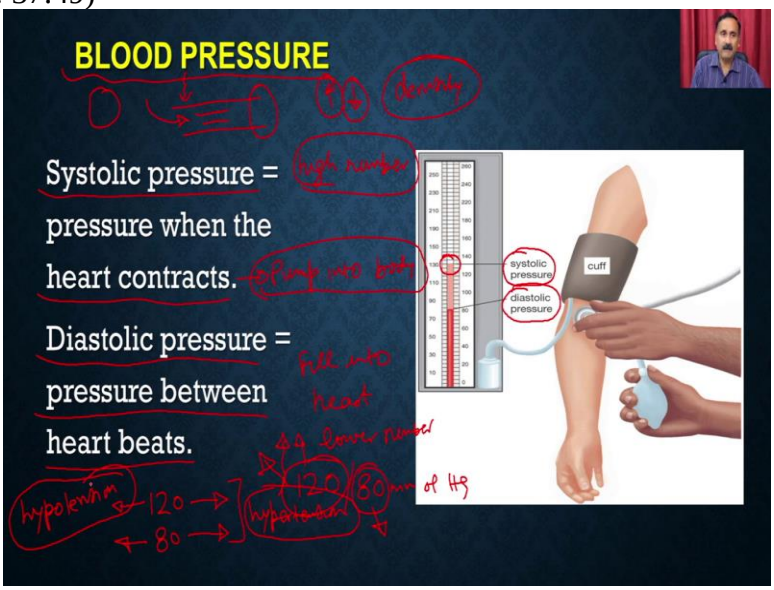

So, the first thing what we have to see about is the blood pressure. So, blood pressure is a pressure, what the blood vessels are actually going to exert, or the heart is actually going to experience when it is actually going to start pumping the blood, you can actually be able to have the blood pressure because the blood is flowing into the arteries, or the veins, and it can actually be able to go up or it can go down simply because if you actually increase the diameter of the blood vessel, the blood pressure will go down.

If you reduce the blood, the diameter the blood pressure will go up, that is the one way of changing the blood pressure. The second is suppose I will change the density of the liquid. So, if I change the density of the liquid, the heart is actually going to experience the more amount of blood. So, that is why you can actually have the two different types of blood pressures, one is called as the systolic pressure the other one is called as the diastolic pressure. Systolic pressure is the pressure when the heart is actually going to pump the blood into the body.

So, that is the actually going to be on a higher side. So, that is why the blood pressure of a high number is going to be called as the systolic pressure. So, what you see here is that if we put the blood pressure monitor onto the, into the arm, what you see here is the top number, the top number, which is the higher number is called as the systolic pressure, whereas the diastolic pressure is the pressure in which the blood is actually going to fill into the heart. So, this is actually going to be on a lower number.

So, what you see here is actually the blood pressure what is been measured from this patient and from the by the doctor and the top number is called as systolic pressure the lower number is called as the diastolic pressure and in a normal human being we can have the blood pressure of the 120 by the 80 millimeter of mercury. So, this 120 is the systolic pressure the 80 is the diastolic pressure and the number which can go above to this is or to lower to this is going to be called as the abnormal blood pressure.

So, you can actually have the 120 which actually can go up or 80, which are also can go up if that happens, then it this is a condition which is called as the hypertension. Similarly, if the 120 will go on to the lower side and the 80 is also going to go on the lower side, then it is called as the hypotension and both of these conditions are problematic, and they are actually going to be responsible for the different types of damages into the body.

If there is a hypertension, it is actually going to cause the problem to the blood vessels and it is actually going to break the blood vessels. If it is the hypotension, then it is actually not going to provide the adequate nutrition to the different parts of the body and that is how it is actually also going to affect that particular part of the body.

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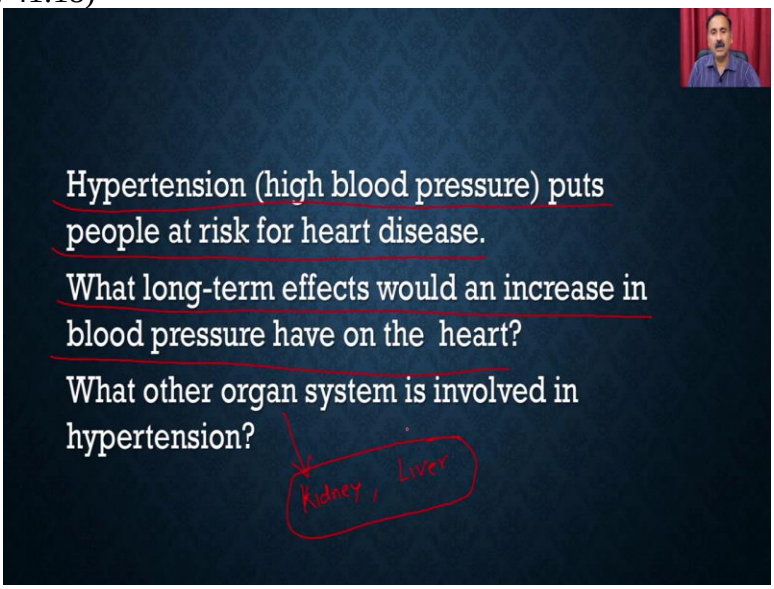

So, the hypertension or the high blood pressure is a very very serious pathological condition, which actually are actually putting the people at the risk of the different types of heart diseases. If you have the, if the person is having the high blood pressure and if it continue for the long term, it is actually going to have the long term effect on to the heart's health. Apart from the

heart, it is also going to affect the other organisms, other organs like the kidney, it is going to affect the kidney and it is going to affect the livers and all other parts of the things. So, if the person is developing the high blood pressure, it is actually going to not only affect the heart it also going to affect the kidney, liver and other organs as well.

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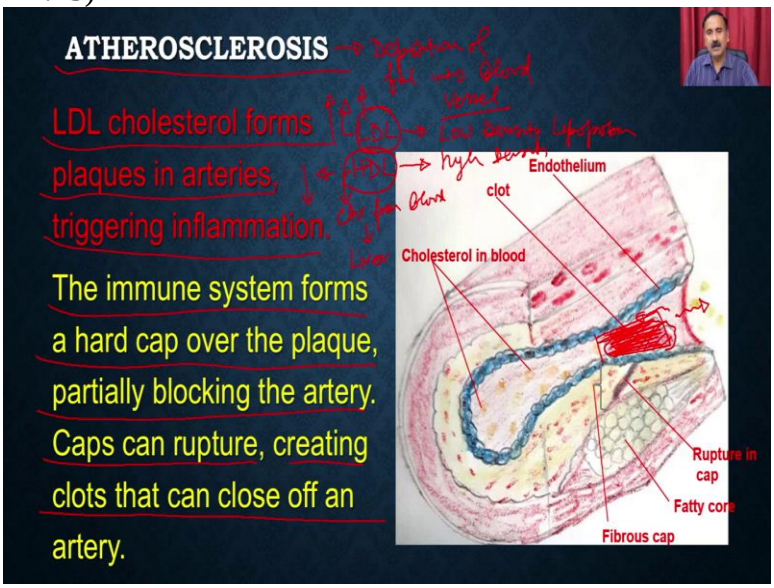

Now, apart from the hypertensions, we can have the another condition which is called as the atherosclerosis. So, atherosclerosis is called is known as the deposition of the fat into blood vessels. So, the LDL cholesterol so actually in the blood we have the two different types of lipids one is called as the LDL or the low density lipoproteins or we can have the HDL which is called as the high density lipoproteins.

LDL is actually going to carry the cholesterol from the liver to the blood. Whereas the HDL is actually going to carry the cholesterol from the blood to different parts of the body including the liver. So, HDL is actually going to lower down, it is actually going to lower down the cholesterol whereas the LDL is actually going to increase the cholesterol and that is why the LDL is called as the bad cholesterol, whereas the HDL is called as the good cholesterol.

So the LDL, which actually is going to form the plaques into the arteries, and it actually triggering the inflammations, the immune system forms a heart cap over the plaque and partially blocking the arteries cap can rupture and creating a clot that can close off and the artery. So, this is what is going to happen if there will be a blood capillaries, where there is a deposition of the fat, it is actually going to stimulate the downstream immune cells and these immune cells are

actually going to trying to engulf or trying to eat the cholesterol what is present in the blood capillaries.

And ultimately, what they are going to do is they are actually going to initiate a cascade of reactions and as a result, it is actually going to form a hard clot. And once it formed the hard clot, it is actually going to constrict the area through which the blood is actually going to flow and because of that, it is actually going to form a blockage into the blood capillary and because of this blockage, the other organ other organs will be not going to get the nutrition and as well as the oxygen and that is how it is actually going to be a problem for the organisms.

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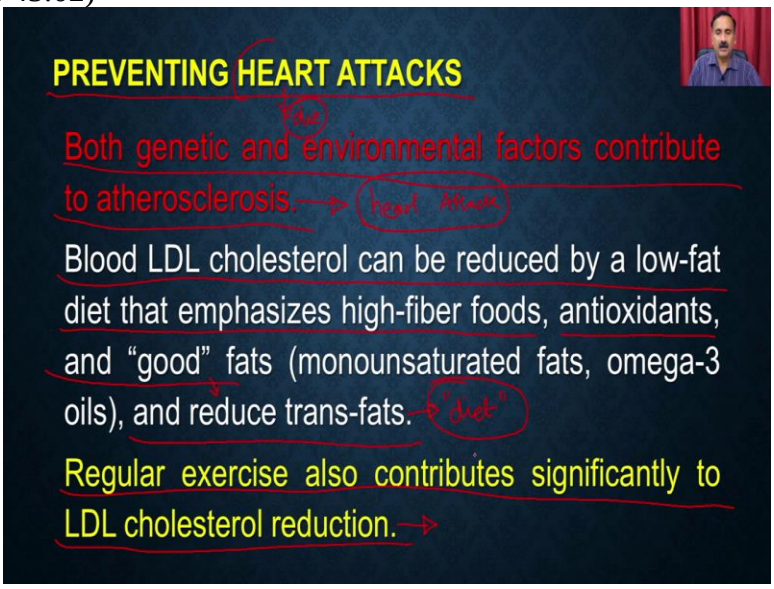

Apart from that, we can also have the heart attacks. So, both genetic and environmental factor contribute into the atherosclerosis, because atherosclerosis is ultimately be responsible for the heart attack. Because if there will be no supply of the nutrients, as well as the oxygen to the heart, the heart is actually going to die. And that condition is called as the heart attack. So, how we can prevent the heart attack, both the LDL cholesterol can be reduced by a low-fat diet and that emphasize the high fiber food.

We can have the antioxidant and the good fat like, as I said, at the HDL so we can actually have some of the activities so that the good cholesterol should go up. And we should also reduce the trans-fat into our diet. So, if we do our diet management, we can be able to overcome or we can be able to reduce the chances of getting a atherosclerosis plaque formation and ultimately we can also be able to reduce the heart attacks.

Apart from that, we can also have the regular exercise which actually are going to significantly reduce the LDL cholesterol from the blood and that is actually going to support the removal of the cholesterol from the blood and that is how it is actually going to be provide the healthy environment for the heart. So, this is what we have discussed so far, what we have discussed? We have discussed about the digestion and in the today's lecture, we have discussed about the circulatory system.

So, while we were discussing about the circulatory system, we discuss about the structure of the heart, we have discussed about the structures of the arteries, blood vessels and the capillaries. And then ultimately, we have also discussed about the blood and blood's component and what are their structure and functions.

So, with this brief discussion, I would like to conclude my lecture here, in our subsequent lecture, we are going to discuss about the muscular system and in that muscular system we are going to understand how the muscles are contracting and what are different types of protein which are responsible for the formation of the muscles and so on. So, with this I would like to conclude my lecture here. Thank you.