Host-Pathogen Interaction (Immunology)
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Lecture: 10
Immune organs - 2

Hi, in the previous session we have learned about the primary lymphoid organ thymus bone~~known~~ marrow and secondary lymphoid organ is spleen. In this session we will discuss about the lymph node how lymph node where the lymph node is located how it function and how it play important role in immunity. And the most important system we will learn is a lymphatic system which is very important for the immunity. It is a kind of subsystem for immunity. So, let us begin with a lymph node.

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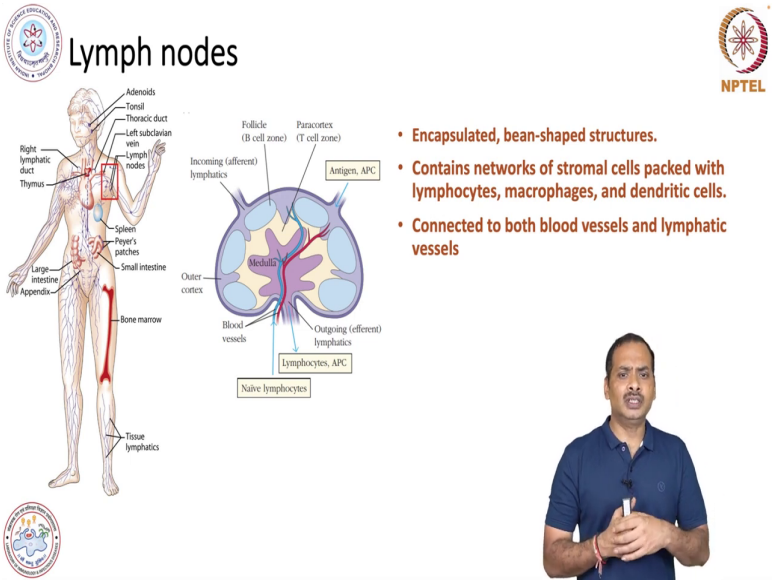

So, lymph node is basically they are basically a bean sha~~v~~ped structure and it is present throughout the body. Here you can see in one part of the body and basically this is a bean shape structure and this is basically an encapsulated structure. And this structure is basically consists of various component one of the most important component is incoming lymphatics, incoming lymphatics means so, there will be inflow of lymph.

Just hold on I will explain about the lymph later on in after finishing the lymph nodes. So, lymph is basically coming inside the lymph node and we call it as a efferent lymphatic vessels and there is a very clearly defined zones which is present which we call it as a cortex.

Here you can see there is the outer cortex and there is a one central region which we call it as a medulla and there is a in between cortex and medulla there is a paracortex region.

So, in this image you can see that this afferent vessels are there are so, many efferent vessels in the lymph node. So, that lymph is coming from uh. So, many places and everything is going into this lymph node and then there will be a follicle which is a B cell Zone and paracortex which is a T cell zone and there is a and this aefferent vessel is rich in antigen and antigen presenting cells.

So, there are some antigen presenting cells which we will discuss when we will take the immune cell. So, antigen presenting cells are nothing it is a they take up the antigen microbial antigen and then they present this antigen along with one specialized molecule known as MHC or Major Histocompatibility complex. And then this antigen complex with ~~m~~ MHC is presented to the T cell in order to induce the T cell mediated immune response.

So, let us look at more detail. So, basically this container stromal cell packed with there will be a lot of lymphocyte. And again please remember this is a there will be a both kind of lymphocytes are there one it could be a naive immunocompetent lymphocytes or it could be sensitized or already in the immunocompetent cells saw the antigen and then they are proliferating and then inducing the if it is a B cell then it is differentiated into the plasma cell and producing antibody.

Or if it is a T cells then this is basically have seen the antigen and then they are proliferating in bigger number and in and they are basically inducing some T Cell dependent immune response it could be and Th or Tc cell. We will discuss later on this different kind of T Cell responses. So, this lymph node is also having the blood vessels and these blood vessels basically provide oxygen and nutrient both this arteries and veins are there.

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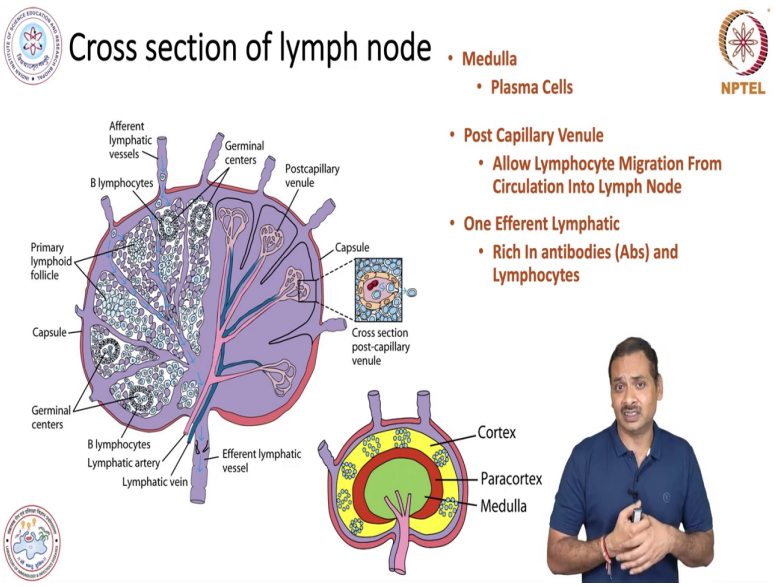

And here this is a cross section of lymph node and this has a more detail as I said that this lymph node has a very active reason which we call it as a germinal center. If you remember my previous ~~previous~~ session I have explained about the germinal center. So, in germinal Center all these active B and T cells and antigen presenting cells macrophages d~~e~~andritic~~elie~~ cells all those cells are present and this is a very active zone.

And there is a here you can see that there is a germinal center there is a primary lymphoid follicles or primary follicles which is not active. So, all these things are there and there are efferent lymphatic vessel if you if you notice at the bottom of this organ there is a efferent lymphatic vessel. So, efferent lymphatic vessels are basically rich in antibodies as well as it is rich in effector T cells ~~e~~affector T cells against the particular pathogen or antigen.

So, again this region is I will explain each re~~agis~~on this cortex, para~~m~~ cortex and medulla region what is the cellular composition and so, cortex is basically rich in B lymphocyte follicular dendritic cells, dendritic cells. So, these are two different kind of dendritic cells please note. So, follicular dendritic cells are playing very important role in B cell development and B cell associated things.

But dendritic cells are very good antigen presenting cell they present the antigen to the to the T cells and then there will be a differentiation of T cell to the effector T cells, memory T cells and so, on and so, forth. So, the FDC and DC's are very different here just I want to say that do not get confused. There is one more kind of cell which we call it as a PDC's plasmacytoid ~~cytot~~ dendritic cells this is just a note in this in in this session.

So, PDC's are playing a very important role against the virus infection. So, this notice that there are three kinds of dendritic cells one is follicular dendritic cells, another is dendritic cells which is also known as conventional dendritic cells and there is a PDC's plasma-cytoid dendritic cells. All these three dendritic cells are very different although the name has some similarity this is just a note please remember this thing.

There is a macrophages in cortex and there is a germinal center as I have explained you it is a very active region where this B cells are differentiated into plasma cell and producing the antibody. There is a paracortex region which is a rich in T cells T helper cells macrophages and dendritic cells. And there is a medulla region this medulla region is having a plasma cell it will be a rich in plasma cell.

It is not that some plasma cell will be also some in germinal center will be also there will be a differentiating B cell to the plasma cells are there but most of plasma cells are residing in the medulla region and that is why the efferent vessel is rich in antibodies. There is a post-capillary venules which allow the lymphocyte migration from circulation to the lymph node. So, there is a process by which this lymphocyte can move from circulation to the lymph node.

And efferent which is I already explained this efferent lymphatic vessels are rich in antibodies and they it is also rich in various effector T cells.

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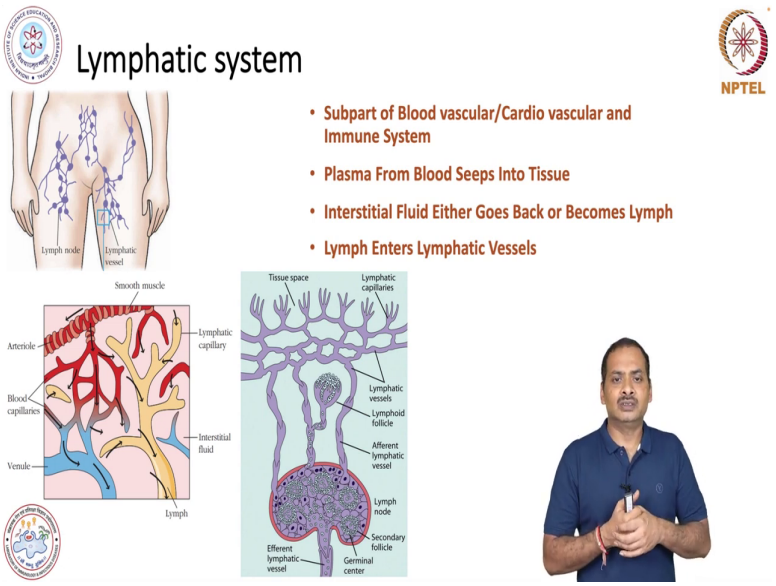

Now let us let us look at the lymphatic system this is most important component in order to integrate the immunity. So, lymphatic system is basically here you can see there is a this is a lymph node there is a series of lymph node present in our body and what is this lymph. So, due to blood pressure there is a some squeezing of fluid and this squeezing of fluid is present in inter in between the tissues we call it as an interstitial fluid.

So, this fluid is present in this in between this these tissues and this ~~T,~~ this fluid we call it as a lymph due to the blood pressure you can understand if you have some perforated some kind of tube and if you put the pressure if you put some fluid and put the pressures then some fluid will squeeze it out and that fluid we call it as a lymph. So, this lymph is a very rich in antigen. If you see very carefully you can understand that this lymph will be rich in the antigen.

And this antigen will come from where? It will come from the tissues. So, the antigen can go into the tissues as well I have explained you the role of a spleen. So, whatever antigen which is present in the blood or bloodborne antigen will be filtered in the spleen but in case of tissue antigen; so, this tissue antigen will be present in this lymph. And then this will be antigen will be subsequently transported because this is linked with the lymphatic vessels.

So, this will this antigen will be transported to the nearest lymph node where this all immune activity is going on. So, now I think you can visualize overall. So, antigen can wherever antigen is there it can be transported to the immune place or immune competent place where there could be a development of immune reaction in order to eliminate the pathogen whether it is a bloodborne or it is a tissue Bond it is a solid tissue whatever.

So, so, here you can see that this lymphatic it is another image about the lymphatic system where you can see all those component which I have explained and basically this lymphatic system is a kind of sub part of blood vascular or cardiovascular system and immune system it is it is it is playing very important role in immunity. So, I can say that this is a part or sub part of a blood vascular and immune system it is a partial thing.

So, plasma from blood seeps into the tissue which I which I already I have explained and this ~~interest~~ in interstitial fluid will again go back to the go back or become a lymph and this can go back to the blood vascular system I will show you in a in a short while. And all these ly~~i~~mh~~o~~s basically enter into the lymphatic vessels.

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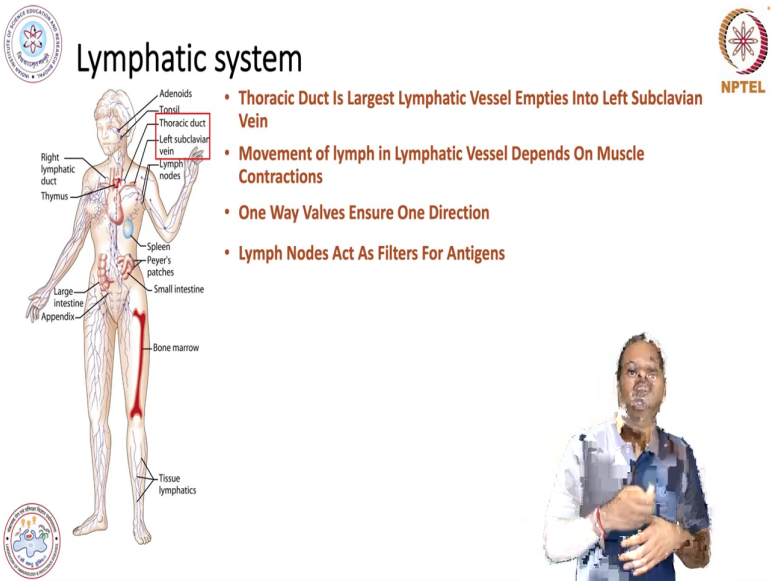

And this lymphatic vessels are playing very important role in collection of this fluid because if this fluid is keep on accumulating that will cause the oedema. And there is a some disease probably you may know that name of the disease known as Filariasis~~filariosis~~. So, the parasite of filaria which is ~~micro flarea~~ microfilariae which is basically feeding on the lymph. So, what it is causing it is going in the lymphatic system and they sits over there.

And then they become a large they become adult and then the problem arises. So, they basically block the lymphatic system and that is why you might have seen that they block major lymphatic vessel and the individual develop kind of a very fat leg we also call this disease as ~~elephantitis~~ elephantiasis the elephant-like leg. Why because of blockage of lymphatic vessel and then there will be a accumulation of fluid and that accumulation of fluid results to the oedema and this oedema is a massive oedema.

So, anyway so, this lymphatic system is a working it works means whatever fluid is oozing out or which is present in the lymph it is again returned through this thoracic duct or left subclavian vein it is returned to these and the most important thing that the lymph is basically move in our body by the muscle contraction. So, probably you might understand the value of exercises when you do the exercise then there will be a contraction of muscles and in that way the fluid is keep on moving.

And if there is no muscle contraction I will give you one simple example there are some patients who cannot move they are bed lying patient. So, in those individual in hospital the

nurses or supporting staff they are keep on changing their position if they will not do this thing then they will develop a accumulation of fluid and that result to the another level of complication. So, why it is needed in order to move the lymph and they have they have also evolved in lymphatic vessels there is a wall and this is a one-way Direction.

So, muscle contraction and with the help of this wall the fluid keep on moving and basically lymph node. So, in lymphatic vessels or in lymphatic vessels so, there are lymph node and this lymph node are basically filter for the antigen. As you have seen spleen is a filter for antigen in case of blood bone antigen here it is a tissue bone antigen will be filtered in the lymph node and it will be trapped and then there will be a development of appropriate immune response means development of B cell mediated immune response and T cell mediated immune response.

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So, here I have a one very nice video which will help you understanding the lymphatic ~~lymphatic~~ system. As you can see in a nutshell the lymphatic system is a drainage system that removes excess fluid from body tissues and returns it to the bloodstream. It is actually a subsystem of both the circulatory and immune system. The major purpose of the circulatory system is to bring oxygen and nutrients to body tissues and remove wastes.

This exchange happens in the smallest blood vessels called the capillaries. Blood plasma containing nutrients moves out of capillaries at the arterial end of capillary beds. While tissue fluid containing wastes reabsorbs back in at the venous end. However not all of the fluid is drawn back to the bloodstream at this point. About 15 percent of it is left in the tissues and would cause swelling if accumulated this is where the lymphatic system comes into play.

It picks up the excess fluid and returns it to the circulatory system. Unlike the blood circulatory system which is a closed loop the lymphatic system is a one direction open-ended network of vessels. Lymphatic vessels begin as lymphatic capillaries made of overlapping endothelial cells. The overlapping flaps function as a one-way valve when fluid accumulates in the tissue interstitial pressure increases pushing the flaps inward opening the gaps between cells allowing fluid to flow in.

As pressure inside the capillary increases the endothelial cells are pressed outward closing the gaps thus preventing backflow unlike blood capillaries the gaps in lymphatic capillaries are so, large that they allow bacteria immune cells such as macrophages and other large particles to enter this makes a lymphatic system a useful way for large particles to reach the bloodstream. It is used for example for dietary fat absorption in the intestine.

Once inside lymphatic vessels the recovered fluid is called lymph. Lymph flow is enabled by the same forces that facilitate blood flow in the veins. It goes from lymphatic capillaries to larger and larger lymphatic vessels and eventually drains into the bloodstream via the subclavian veins. On the way it passes through a number of lymph nodes which serve as filters cleansing the fluid before it reaches the bloodstream.

Lymph nodes are small bean-shaped structures scattered throughout the lymphatic network. They are most prominent in the areas where the vessels converge. Lymph nodes contain macrophages and dendritic cells that directly swallow up any pathogens such as bacteria or viruses that may have been taken up from an infected tissue. They also contain lymphocytes T cells and B cells which are involved in adaptive immune response.

A process that produces activated lymphocytes and antibodies specific to the invading pathogen these are then carried by the lymph to the bloodstream to be distributed wherever they are needed. The lymphatic system also includes lymphoid organs primary lymphoid organs the thymus and bone marrow are the sites of lymphocyte production maturation and selection. Selection is the process in which lymphocytes learn to distinguish between self and non-self.

So, they can recognize and destroy pathogens without attacking the body's own cells mature lymphocytes then leave the primary for the secondary lymphoid organs the lymph nodes spleen and lymphoid nodules where they encounter pathogens and become activated.
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I hope you have very well understood about this various lymphoid organ and lymphatic system and how lymphatic system integrates all these lymphoid organ. So, we have a very beautiful system in order to collect or capture or trap the antigen from blood as well as from

tissue with the help of lymphatic vessel. And there are lymph nodes which are basically acting as a filter from a filter for this lymph.

And this lymph basically carries the variety of antigen and then these antigens are transported to the nearest lymph node in order to elicitate appropriate immune response and eventually eliminate the pathogen, thank you.