Animal Physiology
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Lecture - 34
Spinal Cord Injury

So, welcome back to the lecture series in animal physiology. So, previous class so, we are into week 7th and today we are starting the lecture 4 here.

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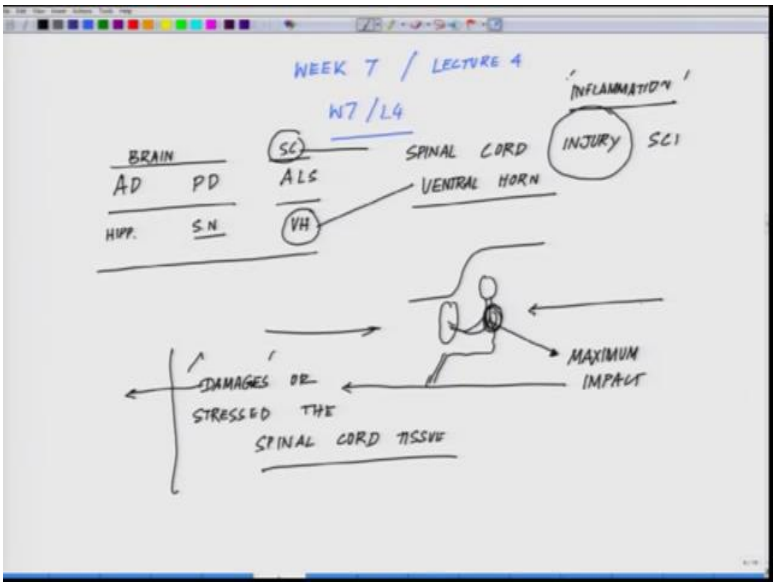

We are into week 7 th lecture 4 W 7 L 4. So, in the previous class we talked about some of the degenerative diseases of the brain, different parts of the brain and the spinal cord.

Today we will talk about the patients who suffer from spinal cord injuries. So, in the earlier 3 case studies, when we talk about AD PD and ALS, these 2 are at the level of the brain, this one at the level of spinal cord, within it this was in the ventral horn leads to one is at hippocampus and the other one is at substantia nigra SN (Refer Time: 01:35)

So now again we will be dealing at this level spinal, cord spinal cord injury. A big area in the western world mostly because of high speed driving and the severe impact which happens during accidents. Which directly say for example, if you think a person driving a vehicle something like sitting in a car and driving a vehicle like this. So, whenever the impact comes, whether I hit from the back or I hit in the front, this part of the body is the

one which gets the maximum impact. And this maximum impact many a times or most of the time damages or stressed the spinal cord tissue.

So, this whole broad category or damages which are happening in the spinal cord leads to some form of a inflammation and injury and in today's class we will talk about how this inflammation progresses and what are the problem, what are the associated problems which kind of prevent or reduces the regeneration potential of the injured spinal cord motor neuron, and mostly it is the ventral horn motor neuron which are getting affected. So, let us again draw the spinal cord for your understanding.

So, you can look at the spinal cord in 2 ways you can look take a side view like this when the impact is hitting it, either it may be a front impact or a back impact.

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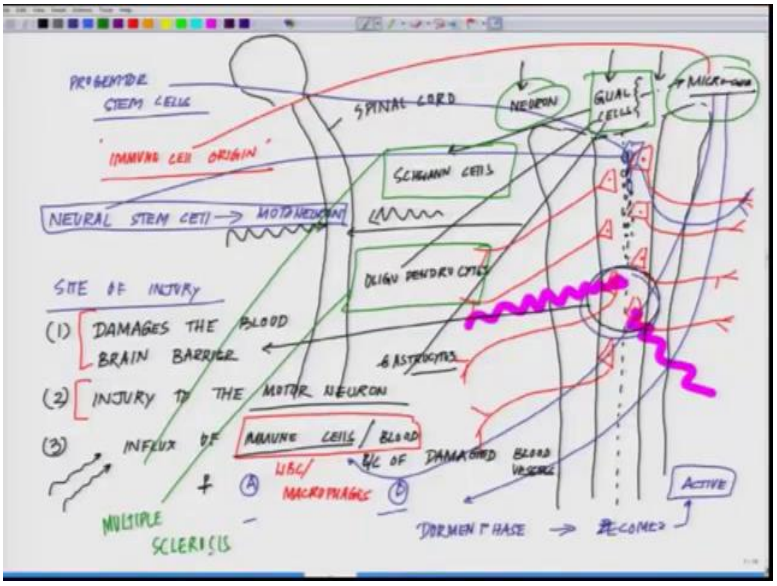

So, this is the spinal cord. Now if we look at the spinal cord when you are standing sideways, suppose I am standing like this and look at the impact and I am taking the hit here, right? Or I am taking the hit here, from the front or from the back, what happens is. So, for example, I take a hit here. So, essentially if you kind of dissect out the spinal kind of look at this the dissected (Refer Time: 05:05) of the spinal cord this is the part of the spinal cord on an this is the ventral horn and this is the central canal. And along the central canal you have a lot of the population of neuron or progenitor, cells which are sitting there all along, and here you are having the cell bodies of the motor neuron which

are sitting as in different laminin. And they are transforming or sorry, they are conveying signals to different set of tissues all over ok.

So, the major impact happens out here. That side impact what you see falls on this, falls on this. So now, when such impact happens it leads to some interesting set of reactions which happens there. So, this whole tissue is covered by a blood brain barrier. So, whenever the impact happens where 2 things 2 associated events which occurs.

So, at this location where the impact has happened the first thing which happens is, damages the blood brain barrier, damages the blood brain barrier is one aspect, which happens, 1.

Second this leads to the injury to the motor neuron, which sitting at that location. Third important thing what happens is, there is a because of the damage of the blood brain barrier the influx of immune cells which either arise from blood because of damaged blood vessels, influx of immune cells and one more thing, there are some very dormant cells, if you remember when I talked you about a classification I told you, on one hand you have neurons in another system. You have set of glial cells in the system and within the glial cells I told you there are schwann cells. You have oligodendrocytes. You have astrocytes and you have another family which is not truly glial cells as it emerge called microglia. This microglia is a family of glial cells which are of immune cells origin and these glial cells unless otherwise provoked do not, mark my word, do not take part in any kind of immune reaction. But if there is a damaged here there is the injury here there is the influx of blood immune cells which includes WBCs and macrophages.

Then this triggers an action for this microglia to get to the site of injury. So, at the site of injury or say for example, this site of injury. So now, we see there are essentially 4 events which are happening, if I classify them A and B. Damage to the blood brain barrier, injury to the motor neuron and influx of the immune cells from the damaged blood vessels as well as the influx of the microglia. And microglias from dormen phase becomes active. This is how the initial set of reactions at the site of the injury happens.

Now, let us map it what will happen. Say for example, here on the ventral horn you have this motor Neuron.

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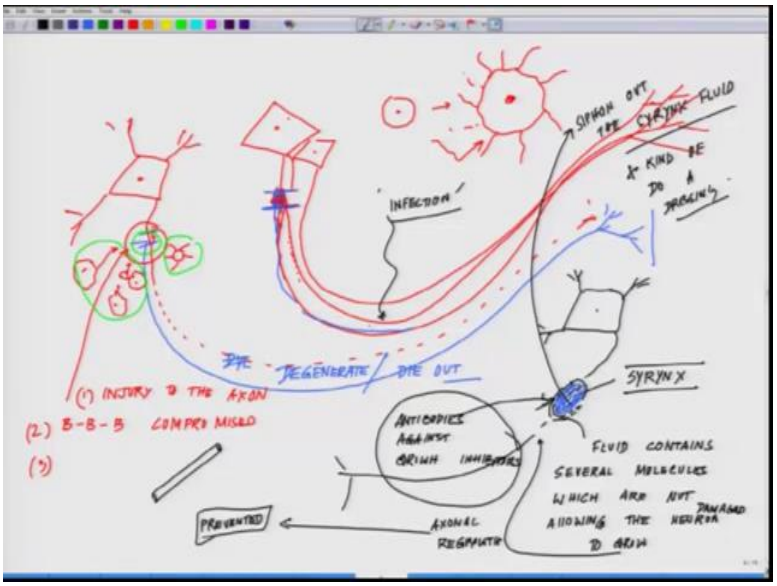

And it is process is going like this. Now say for example, there is an injury. So, example there is an injury here. So, what will happens this path is coming out fine right. So now, this path is kind of you know getting discontinued. So, somewhere other one has to repair this part or allow this one to grow and kind of form a contact and let it survive or a process a new process has to come which will you know, take it up. And go to the site or if the injury is not very fatal most of these motor neurons are in like a lamina. One on top of other.

So, some degree of compromise can happen this neuron may not work and you further vary, but the one which is sitting underneath it can do the job. But with certain degree of compromise, that is a different scenario.

So, scenario here is if there is a cut somewhere other either you insert in tube and this has to grow, and somewhere other make a contact with this part because the more this part this part of the axon which is this connected now I am putting into a green colour. In that case one second the more time this spends. So, this blue stuff is going to will be will degenerate or die out. So, sooner we could make such a repair, or allow this neuron to extend this process further as a repair and really set the target. But as soon as this reaction happens certain unique reaction takes place out here.

First I told you the blood brain barrier that is, so B, B stand for blood brain barrier is compromised. You could see the first thing which is the injury to the axon one blood

brain barrier compromised third as I mentioned you. So, the macrophages started to rush to that area, and the microglia which were otherwise very silent cell. So, these cells otherwise remains like this spherical, but as soon as they become active this they become enlarge and they send out lot of filopodias and all sorts of processes, and they started rolling towards the injury site. And once all this different family of cells merge into the site, in order to prevent any further damage they form a very unique fluidic you can call it like a like pond like a structure.

So, something like this. So, for example, there is a motor neuron. So, here is the injury. So, here they will form a pond like structure. So, fluidic structure and this is the part which is no more in connectivity. So, this structure is called syrynx, syrynx interestingly is a kind of pool of fluid which accumulates there in the spinal cord which contains several molecules which are not allowing the neuron or the damage neuron to grow or in other word axonal regrowth is prevented ok.

So, one away and there are series of such molecules which are present in this complex fluid let me shade it with blue out here. This structure called syrynx. So, one way one can think of by passing the situation is that you somewhere or other have an axis in your spinal cord, and you develop antibodies against growth inhibitors, because there are molecules which are growth inhibitors. We develop antibodies and you know with antibodies at that site this is one approach.

The second approach is you siphon out the fluid, siphon out the syrynx fluid and kind of do a dressing. Which is risky indeed because you are accessing into the area where these locations are very prone to infection. When you are penetrating something of that sort, you are always you always carry the risk of infection. Third think what you can do So, I told you then you can develop antibodies which you can put there somewhere other or you manage that is a different story. Some people at the rodent level rodent [FL] rats and all this kinds were they are trying to develop conduit tubes like this, which kind of or being put like here let me redraw it.

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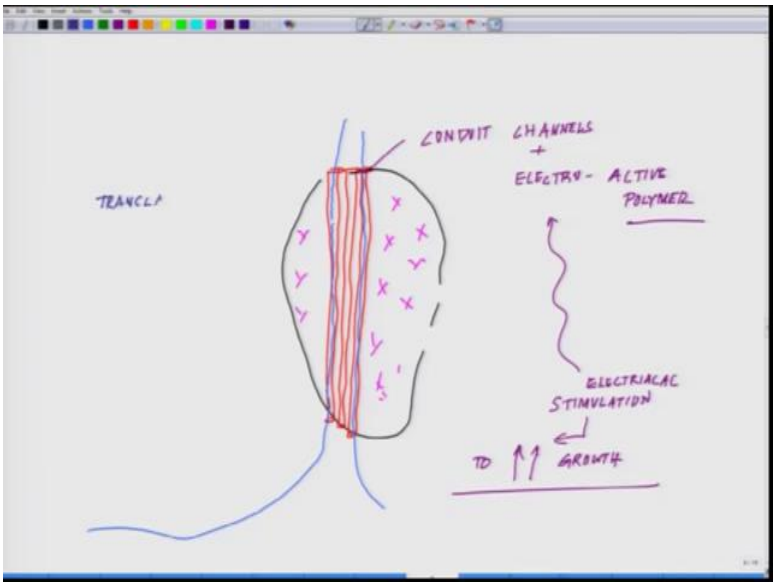

Say for example here you have the syrynx structure which is kind.

So, they are putting these kind of tubes micro tubes how they are, which could guide the axon to kind of cross this fluidic cavity and go to the other site. So, essentially the idea is that injured axis on regenerate and travel along it and come to the site, like this, because the other area. So, these areas are not allowing the growth to happen. So, how to bypass it? You can bypass it by having such conduit channels. And even some of the people are even using this conduit channel plus electro active polymers. These electro active polymers are being mixed or this channels are even made with electro active polymers in order to give stimulation. Electrical stimulation to the growth, kind of a growth promoting situation are being created. So, there are several ways where people are attempting to address this issue that how we can get around into this complex situation. And the reason to invest on these kind of situations are because your lifestyle is compromised very heavily.

Say for example, these patient who are lower motor neuron are effected say for example, this part out here. They suffered from like their issues with bladder issues. So, they cannot you know pee or they have issues you know, to pass their urine. Or they may have a deification problem ok.

Some have issues in their if they are wearing the gut; they have issues in the gut. So, there are several parts of the body which are very severely their functions are being

compromised. And we being part of this whole modern world, where there is tremendous amount of thrust on driving and car industry, and of course, that comes with all other problems of injury, node injuries and you know accidents. So, every government cross the world are investing a lot on it, but really to crux is really to get around it. So, some of these fields are at this point based on the fundamental research are working on translational therapies.

There is another aspect which I haven highlighted yet there are attempts which are being made if you remember, when I, when I was drawing this, I told you that this location has lot of those progenitor or stem cells presents. So, there are people who were attempting, could we activate the those neural stem cells to become motor neuron, there are attempts which are underway and you convert them, but whether they become motor neuron and then they will exactly follow the path, well exactly in a rate that xyz muscle those are something for the future, we do not know. We do not have an answer, but there are people who are attempting because along the line of the central canal there are several neuro progenitor cells which are sitting there. Is it possible in a controlled way we can divide them? We do not know. Because again we are worried that that may should not lead to some kind of tumor or some other neuro glial tumors. So, it is a very tricky area for therapy, but their efforts which are underway why people are trying to you know get around it and only future will tell how soon we have an answer to this.

So now we have covered different kind of pathologies of neurons starting from neuro degeneration to injury. Next what we will do is that we will talk about some of the problems of the glial cell, which we have not talked about, because there is another population of the glial cells. So, we have covered if you look at it we have talked about neurons, we have talked about microglias activation, which may lead to worsening the conditions of spinal cord injury and then we are left to the glial cells, where we will be talking about the schwann cells and how they myelinate we will talk about the oligodendrocytes how they myelinate and how some of these things leads to multiple the sclerisis.

So, thank you, and thanks for your patient listening.