

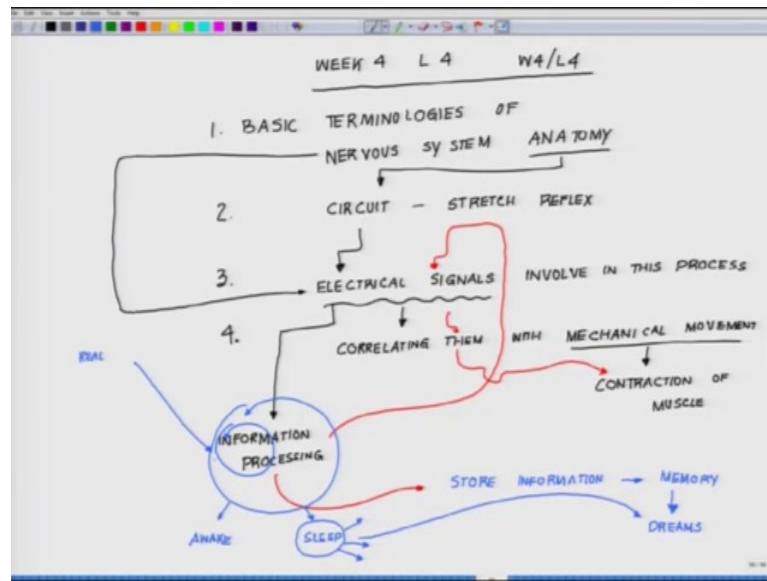
Animal Physiology
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Lecture - 19
Nervous System Anatomy & Signalling

Welcome back to the lecture series in Animal Physiology, we are into week four. So, we have finished three lectures and in the last lecture I introduced you to the or among the most primitive circuits or neuromuscular circuit which is called stretch reflex arc, where I highlighted that muscle itself act as a sensing element and that is relayed by a neuron or a population of neuron to its central processing unit which is called the spinal cord and of course, the brain, but in this case we only dealt with the spinal cord, and then the process information comes via another set of neurons and the command is executed by the muscle upon getting the response from the neuron.

In the last slide I introduced you to that other small population of muscle subtype called the Intrafusal fibres right. So, when I told you that between the intrafusal fibre and the extrafusal fibre the basic difference or the most fundamental difference is in the myosin. So, today we will come back to this circuit stretch reflex arc, which is a line which demarcates the nervous system versus the muscular system, but before I get into that just to give you a little bit of an anatomy of the muscles and the terminologies which concern or which will be important for you people, and then again we will pick up the circuit where we left it right.

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So, let us start our lecture four. So, today we are in week 4 lecture 4 w 4 slash L 4. Today we talk about some basic terminologies of nervous system anatomy and second in the light of this anatomical feature, we will revisit the circuit the very first circuit we have dealt with stretch reflex and from here subsequent class we will move about the electrical signals involved in this process; and forth as we will proceed further these electrical signal what you see correlating them with mechanical movement and best mechanical movement we are talking mostly about the contraction of muscle.

Apart from it talking about these electrical signals, we will talk about this electrical signal at a different context totally different context which is of course, nothing to with do it stretch reflex, which will be information processing. When I am using the word information processing this is happening in this simple circuit too out here also there is a significant amount of information processing which is taking place, which is leading to this contraction.

So, information processing is the critical word or critical signature of the nervous system, but then what is nervous system to start off with. So, I am standing here. So, at several parts of the body and I function as one unified unit it does not happen that you know if I wish to raise my right hand I am raising my left hand or if I raise my left hand doesnt

mean automatically my right hand will rise up; we walk we walk in a particular fashion left right left right likewise.

We breathe if you follow your breathing carefully what people does in breathing exercise like pranayam and all these they control the breath your heart of course, just a piece of caution there is no role of nervous system there, but something like a rhythmic behaviour, something which controls most of your actions or you take the food the food moves through by peristalsis through the alimentary canal or you feel like urinating. So, you get the feel that you have to urinate which is called the maturation reflex, you go to sleep you feel very sleepy you dream, you remember, these all falls under the control of the nervous system. As a matter of fact your own self is what distinguishes you as who you are, is what falls under the purview of nervous system your consciousness which are the very very higher functions of the brain.

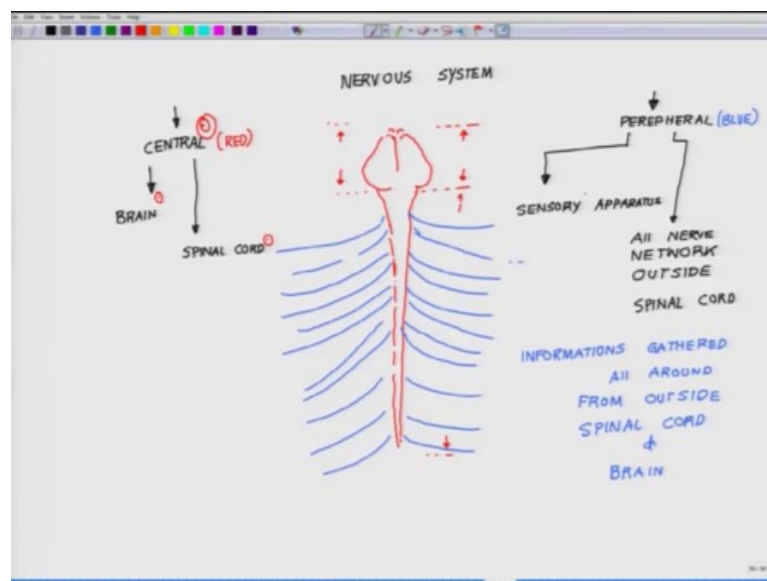
So, all and all if you look at it your body is controlled at different level one of the highest level of control is the nervous system, which execute part of the control or delegates some of its task to the endocrine system; endocrine system either independently or in tandem with immune system as well as nervous system execute some of the functions. So, there are three profound control systems in our body; endocrine system, nervous system, immune system and among these three the highest seat is of the nervous system which ensures who we are.

Say for example, you wake up in the morning and go to brush your teeth, no one tells you are like if you are right handed person like me or you are left handed person like me there is a pattern by which you brush your teeth. You might be surprised to know that there is already a coded information which tells you how to brush the teeth which is already stored in your system, and any information which is the stored in any kind of system there is a word for that and that word is memory. So, any information processing eventually you do not process the information all the time, you store information and the storage of information falls under memory.

It is the memory which has its direct and indirect role in dreams good dreams bad dream and this information unit has its sequence of being awake or going to sleep, and when it

is in sleep it gets all these kinds of dreams and even within the sleep based on the information processing speed, you have different classification of sleeps and yet some people there are they see information from outside which is the real information. Yet there they dont process the internal external real information they process their own information and they see a word which does not exist. So, it means I am standing in this room I am seeing all the things you know I have a blackboard behind me, I have a cameraman in front on my left hand side there is a t v like, but I am not seeing this I am saying something else. So, in other word there are people who can suppress the reality and start seeing images which are not there and believe that is true people who suffers from schizophrenia or other disorders psychotic disorders, but this is all I have to do with this part of the body.

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So, nervous system broadly is classified into two parts; central nervous system and peripheral nervous the system. Central nervous system constitutes your brain and the spinal cord. So, to start off with nervous system you have central and you have peripherals. Central consist of the highest centre which is the brain next centre which is the spinal cord, peripherals are all your sensory apparatus and all nerve network outside spinal cord of course, definitely that is outside brain. So, the way it looks like is this, if your brain is like this and this is your spinal cord the one which I have drawn in red; this

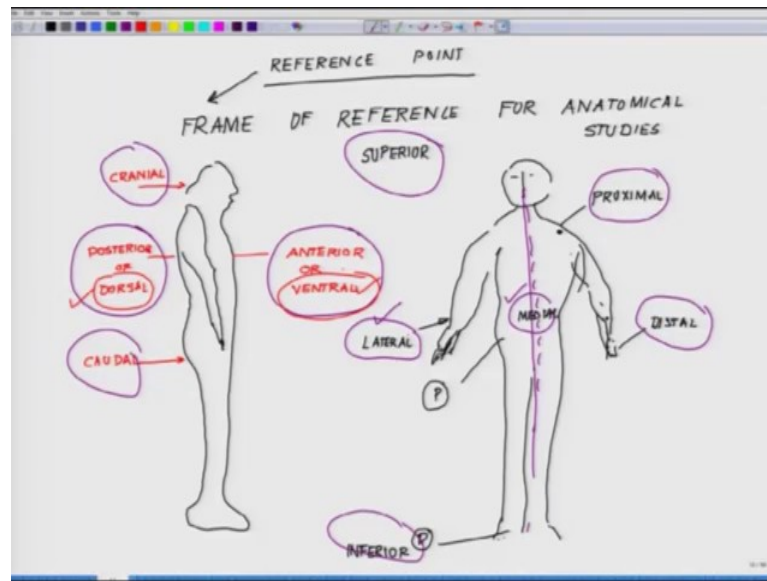
constitutive your central nervous system. Peripheral nervous systems are all outside except I will come to that, there are several series of nerves which are coming out ok.

Now, from all over your body informations are gathered, but these informations gathered from all around these informations can even be from gut form inside. So, this is all outside the spinal cord. So, when I say all around it not only signifies outside world, but some of the things which are happening inside your body, but they are outside say your body is like a cavity right its kind of a cavity, and the cavity you have this is spinal cord sitting here like this. So, in my spinal cord setting there, but within that cavity there are other organs too right. So, those are also sitting there. So, any information coming from them whether it is coming from the lungs, whether it is coming from the gut, whether it is coming from any other internal part of the body that also falls under outside information gathered all around from outside spinal cord and brain.

These informations are picked up could be visual information, it could be sensity touch information, it could be smell information, it could be thermal information, could be pressure information, it could be information of saying there is lot of acid in particular place acid sensors, there is series of such sensors which are present in your body, these informations are carried to the central nervous system. Remember some of the informations are processed exclusively at the level of spinal cord, some information are carried all the way to the brain because they need higher level of processing. So, when we see the word higher level of processing we meant by that the processing which are happening out here in the brain; and when we say lower level of processing they are happening in the spinal cord fair enough.

Now, this spinal cord has a very unique anatomy, spinal cord anatomy is something. So, if you look at the spinal cord say I am standing here like that. So, spinal cord if I kind of you know lie down. So, the upper part will be the dorsal part you remember when I thought you the dorsal part, sagittal part or ventral part right. So, the outer part may back if I lie down back will be the dorsal part inner will be the ventral part am I making sense ok.

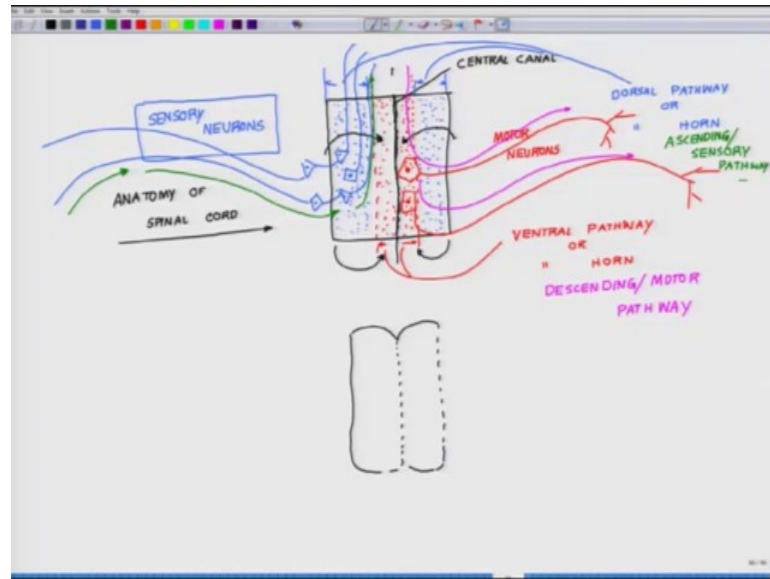
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So, now if you look at the way spinal cord has been arranged it is very interesting. So, look at it. Here I thought you the dorsal part you remember. So, if I am standing like this my back is the dorsal fine and my front is the ventral if I am lying down like this my tummy touching the ground right. So, that is what I wanted to show you. So, here is the dorsal and here is the ventral just for your recap from the very very early lectures.

The way the spinal cord is arranged is very interesting; it has a very characteristic feature at the dorsal side as well as at the ventral site. You take a sheet of paper and you fold the paper you roll the paper or you take the sheet of paper suppose this is the sheet of the paper and you fold it like this from both sides and fold it like this.

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So, how the paper will look like. So, here is a sheet of paper fine a 4 size sheet. So, now, you fold from both sides you fold this side like this you fold this side like this. So, once before the paper it will look something like this from both sides you have folded the paper. So, you took the paper and just on the centre you are folding it you take this side and you fold it like this you take this side and you fold it like this. So, here is here is a paper this side you fold and fold it like this fine it was found something like this the two ends which were there will come out here like this fair enough.

So, if you open up this fold some way or other make it an a 4 size paper, then what will you observe is very interesting this is what you have to understand. You will observe that this stuff if this is a central line of that paper what you have opened up has a canal like structure out here, the one where I am now on that black line I am drawing, which is called central canal. On two sides of the central canal where I am now putting all the red dots and de marketing on both sides left and the right of it, this part is called the arrow shown is called the ventral pathway or ventral horn. Ventral pathway or ventral horn there is another name to that I will come later on to that.

Now, you see the rest of the part which is all empty now now putting blue coloured dot in these parts on both sides, I am just filling that empty spot with blue and this is exactly it looks like and you can really de market between that these two regions very

clearly because you will see a darker shade and the lighter shade; this blue region what you see on both sides this part to this part, and this part to this part out here out here oh sorry I just do not mention this is called dorsal pathway or dorsal horn.

So, we introduced three new technologies, first of all now your understanding the anatomy of the spinal cord just let me put that down I have not done it. Anatomy of spinal cord; in the anatomy we talked about when you open up I told you it is a folder structure like this hence once its folds and if you open up the fold, you will observe that there is something called a central canal which I have highlighted in black in your picture, in red I have put something dotted line on right hand side of the central canal its called the ventral pathway or the ventral horn, and both these ventral horns or ventral pathways are flanked on at either ends with what here I am marked here is blue dots is called the dorsal horn or dorsal pathway.

Now, there is another term for this, before I get into the term I will tell you the kind of cells which are present here. So, the neurons which are present out here are fairly large and they have their processies going to all your sense organs like this. I will come to the anatomy of neurons at this point just accept it and those neurons which resides in the ventral horn are called motor neuron motor neurons. Whereas, there are neurons which are sitting here and their processies are pointing towards the upper side or towards the brain and they receive signal lot of signals like this. So, these blue colour neurons what I do for you these are called sensory neurons. As the name itself indicates sensory neurons are the neurons which are bringing message from all over the body; sensory are the ones which are bringing signals from all over the body.

Whereas motors are the ones which brings back the process signal to the respective tissue not clear to you right. So, let us clarify that suppose I have to process a information the information from that x y z part of the body will be carried to its processing unit, which is out here either to the spinal cord or to the brain which is both are part of the central nervous system. The information from the different sensory apparatus is brought to the central unit by the sensory neurons right it means from different part of my body the information is travelling like this all the way and going to its spinal cord. Now this information has to be processed and the processed information

has to be brought back either from here or from the spinal cord to that specific part of the body. So, it is relaying the process message and based on that this particular part of the body it is going to act.

Now, this way what we observe is there is a you can assign a vector or a directionality to this information flow. So, information which are being brought from all the peripheral part of your body from all the different parts of your body to the central processing unit are termed as sensory neurons carrying that information, and then there is another term which I told you is used called ascending pathway. Pathway if you follow this now let us put an arrow to this a directionality component to this.

So, here the information is coming like this, from all over moving to the spinal cord and just getting carried to the brain. Or at times I will come to this just give me a minute whereas, the process information from this spinal cord or from the brain is moved out like this as if it is coming down, and that's why this is called this is also called descending slash motor path way whereas, on the contrary the other side is called ascending or sensory pathway from where we will continue the next class.

Thank you.