Animal Physiology
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Lecture - 31
Alzheimer's Disease

Welcome back into the lecture series in Animal Physiology. We have finished 6th weeks, so we are starting 7th week. So, if you remember in the last week we talked about the differentforms of memory.

So, we started with epilepsy, and then we talked about different forms of memory which includes long term potentiation, long term depression very basic models and then we discussed about the emergent behaviour in terms of the time where in the space matrix of the brain the changes happen at the level of synapse and those changes are irreversible changes.

In other word if you remember the drawing which I was drawing. So, you have this brain at different time points, any brain at different time points So, what you acquire at the age of say 10 adds upon what you acquire at the age of by the age of 20, by the age of 30, by the age of 40 likewise so on and every time either you can call it like layer after layer the information kind of you know get accumulated or gets partly modified keeping the base information the same or you evolve about particular stuff

So, it is something like say for example, you learn a law or you learned something and over the years of practicing or kind of thinking over it you evolved a much improvised version of that particular thing. So, that is kind of an emergent property and it is a function of space and time, the changes happening over period of time in a space matrix which is a brain.

So, while closing on that in the last week I told you that you are you, I am I am; it is because within my brain matrix there is an identity I have developed- my name, my association, whom I know, my country, my society, my language, my religion, what not. These are nothing but pieces of information in our system which are believed to be in stored in the synapse.

Now, think of a situation if somewhere other those informations which are stored at different part of the brain started to wipe out and if that happens then it may lead to a situation where you lose your own identity, you cannot recognise who are you because informations which associate you with the surrounding. So, your near and dear ones, the locality where you stay or the people whom you know is that started to fadeout. So, you are no more view there and that is something where we call there is a loss of memory. The informations which are stored in you what makes you as you is now getting lost.

So, with this informal introduction I will switch over to the concept or our understanding about or very limited understanding about diseases like Alzheimer's Dementia.

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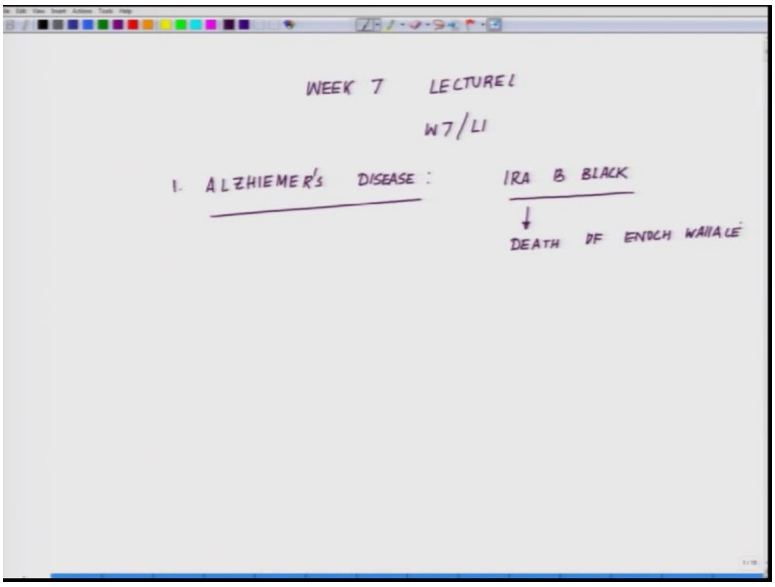

So, today's or this week we are starting with some of the memory related disorders and whatever we know about it. So, start of it, so we are into week 7 lecture 1: W 7 L 1. And what we will be dealing with we will be Alzheimer's disease.

So, I will just quote you a story written by Ira B Black. And the title of the book is 'Death of Enoch Wallace'. This is a scientific primer or a scientific novel written by Late Professor Black. Somewhere around written 2000 and 2003 somewhere at that time when this book was release. And that is the time when I read this book, so the story goes like this.

So, here is the gentleman called Enoch Wallace, who is a banker in New York. Very high profile job and a very well accomplished person in the finance sector. Alyson Manhattan, it is a wonderful locality. So, one morning mister Wallace wakeup and kind for a fragment of a movement, kind of good confused where is the rest room or the bathroom in his own house.

But then kind of ignore eventually found it, went to the rest room. Got ready and this is a financial banker who is very meticulous about how to put the tie and you know what about the belt and everything like you know absolutely (Refer Time: 07:38) I will not call it (Refer Time: 07:40) or very particular about everything very meticulous about you know dressing up.

Here, that day he was kind of little careless. I think he is bit lost and this was noticed by his wife, but nevertheless he went out for his to start his day. So, one of these days while he was coming back had a big meeting and something, a place where he used to walk back he kind of start losing track that which street is his house or which avenue is his house. There is something very unusual for him, because he had been coming there for as a bankruptcy is for years and decades for him to forget that was something very unusual.

So, apparently he was kind of realizing that as if his sense for a space; in space here I means the geographical space, like I am standing here in this studio, outside there is a room and then as I go outside this building there are ease on my left hand side corner there will be a parking way and then right hand side if I move along there will be the main gate come out of it there is a road, on a right hand side I will have my academic area. So, there are certain space map which is their stored in my brain, somewhere other in my synapses.

So, this gentleman was realizing that he is losing sense of that space. And as if he is geography was kind of getting compromised. And this pattern started to progress further and his wife was worried and took him to consult initially. The suspicion was that because of overwork and fatigue this gentleman is kind of losing track. But then, somewhere best neurologist figured out that he's losing his memory and that is happening because he is in the very very early stages of Alzheimer's disease. And then of course, this story will continue.

And I recommend those of you can really pull this book online, you should read it. It will take you through the crest and cuff achievements and agonies off neuroscience of last 100 years. It is one mesmerizingly beautiful novel where late Professor Black on the back graph of a patient explain the signs. Probably one of the finest book I have read and the fortune to grab it well flying out from one of the airports; so, in his extremely logical and informatic book.But now coming back what is happening to this gentlemen, what really Alzheimer's means.

So, this will take us back to where memory accusation was happening, if you remember. See, your memory accusation process was as we discussed in the last week it was all happening in the oracles by our best of our understanding. Your random access memory or net buffer where the first sets of memories were being acquired was the hippocampus or is the hippocampus.

So, in the hippocampus if you recollect the circuit what we have talked about the hippocampus.

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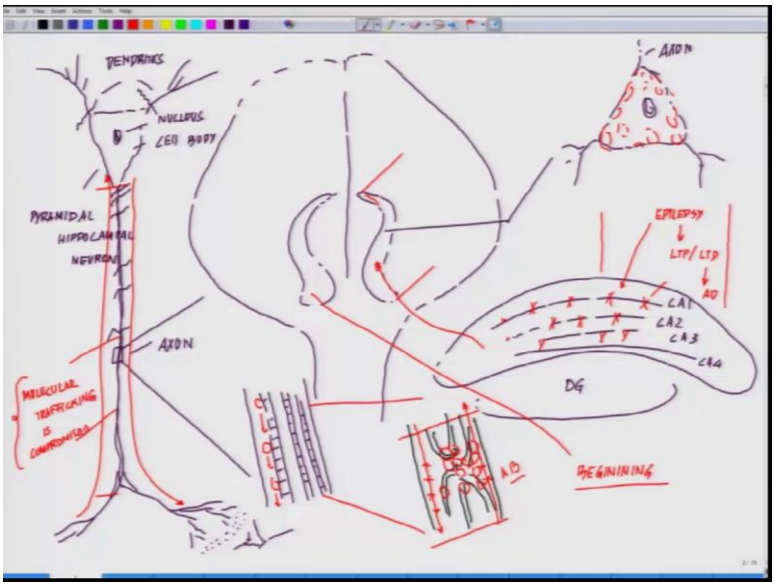

Just little recap about the brain and we talked about hippocampus sitting out here, right. Now out here when I drew the circuit I told you that if you place like this, this is the dental gyros what I am drawing now- DG, and this hippocampus region has this you know CA1, CA2, CA3, CA4 pathways different emergent pathways which are there in the hippocampus: CA1, CA2, CA3 and CA4.

In one of the drawing I showed you that these have this pyramidal architecture of neuron, where the cell body is almost like a pyramid and these are the dendritic terminal and this is an axon which is going up, and here you have the nucleus. So, a classic pyramidal neuron looks more like exactly under the microscope, this is how they look like having a long axonal terminal. And here you are having the dendritic tree, here the nucleus; here you have the axon, dendrites, cell body, nucleus,

So, hippocampus is primarily the network of these pyramidal shape neurons; this is pyramidal hippocampal neuron. So now, if you observe these patients, these cells slowly starts to degenerate and the way they degenerate is very interesting. The way they degenerate is, slowly this connecting channel of axon started to die off, it is kind of slowly this and eventually the dendritic tree dies off.

So, it seems in a circuit where you have a neuron which is connected to the other one that slowly dies off. And one of the very classic feature: so there are lot of theories and I will not get into that because, but in emergent property what has been observed is that if you look at this axon is axon is where the neurotransmitters are getting transmitted. If you remember when we talked about the neurotransmitters getting transmitted at this terminals and that is why the neurotransmitters are being ejected out and the dendritic dendrites of the other cell kind of pick them up bind there and then open the ion channels and they move when that is why how the signal gets transmitted.

So, if you really blow-up this part of the axon you will see this axon is almost like as if there has been a railway line which has been spread out there something like this; this kind of an analogy what I am drawing. Suppose you are standing and seeing the rail tracks it will almost looks like rail track. And along this railway tracks you will observe the moment of the neurotransmitters.

Now, suppose this rail track becomes something like this. On the rail track if you see the tracks become something like this instead of this, where the track starts to getting bit of damage. And what you will observe is there will be accumulation of certain unusual protein like a beta and there are several others which are slowly emerging like this. And the proper transport is kind off of neurotransmitters and other molecule is kind of getting hampered.

So, apparently it will look like the trafficking of the molecules all the way whether from the cell body to the axon terminal and vice versa the retro messenger going in the opposite direction from the axonal terminal to the cell body is molecular traffic is compromised. Molecular trafficking is compromised.

And this is what exactly happens in the case of Alzheimer's where this part out here things are getting compromised. And till this date nobody can tell with certainty that why such situation allows or arises we do not know. But what we know is, because of this these cells started to die and especially in this region. And eventually the network between these pathways are slowly started to degenerate and the more it degenerates more you start losing the informations at different parts of the brain.

And the major beginning is in the hippocampal region it is not the complete cell dies immediately, it takes time for it to die. And the next thing you see there will be you know this kind of preparations kind of structures which is started to arise before the cell finally dies. And the brain weight kind of goes down significantly because of significant death of the cells in the hippocampal region.

So, this is what happens in patients suffering from Alzheimer's; a loss of memory, loss of self. So, it is one of the very dreaded disorder of the brain which has rock mankind, because once you lose you are completely at the mercy or your whole lifestyle has now under the governess of Alzheimer's home the nurses and the system.

So, there are tremendous efforts which are happening across the world to understand this brain disorder. There is certain progress, but still you have a long way to go before we really understand why all of a sudden this kind of neurodegeneration happens at certain specific part of the braino ne common theme if you kind of look through you will see that it is the same region where we started talking about epilepsy, you remember. Here is the same region where we talk about our memory model, LTP and LTD. And it is the same region where we are now talking about AD or Alzheimer's disease.

Hippocampus, in the last whole century; sense the time when doctors in Montreal perform that interesting surgery of removal of hippocampus, since that time and till this day in the corner stone of newer and newer discoveries where people have invested tremendous amount of power of that carrier to understand why this happens.

As of now regarding Alzheimer's, we really cannot pinpoint where the problem and how it all starts. Is it genetically predisposed or is it some kind of a hyper excitable damage or is it because of the accumulation of oxidant or oxidative damage or something we still or yet to discover.

So with this bit of memory, I will closing this class for you think what this disease is and keep yourself updated. And please if you get a chance kindly read the Ira B Blacks book the 'Death of Enoch Wallace'.

Thank you and thanks for your patient listening, and hope someday the Alzheimer's patients will be cured.