Neuroscience of Human Movement
Department of Multidisciplinary
Indian Institute of Technology, Madras

Lecture - 72
Basal Ganglia – Disorders

Welcome to this class on Neuroscience of Human Movement. In this class we will be talking about some of the Disorders that affect Basal Ganglia.

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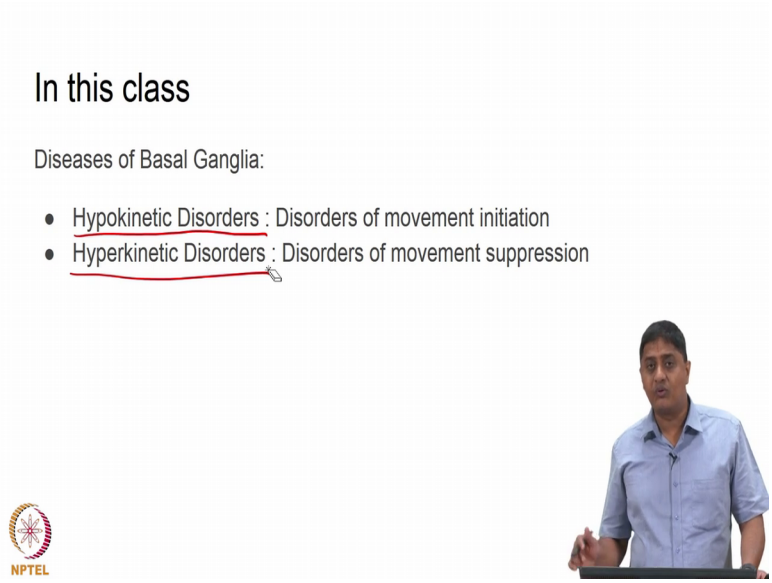

So, in this class we will take a couple of example one each for each kind of a disorder the Hypokinetic disorders. Where there is a difficulty in initiating or selecting movements. Then Hyperkinetic disorders in which it is difficult to suppress unwanted movements right. Hypokinetic case is the case in which I am unable to perform intentional volitional wanted movements. Hyperkinetic case is the case in which I am producing movements that are not wanted. I am doing things that I do not want to do.

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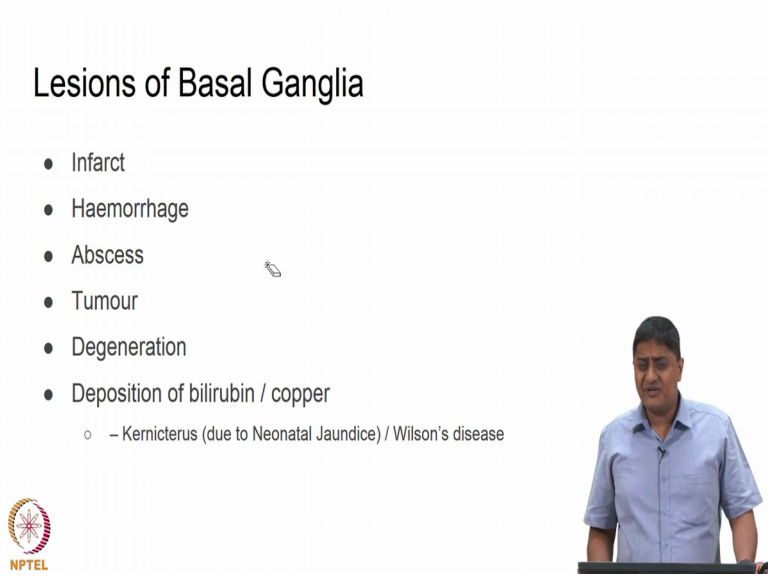

However, this things even happening lesions of the basil ganglia happen due to multiple reasons this may be due to infarct, this may be due to haemorrhage, this may be due to a tumour, abscess, and importantly this maybe due to degeneration. And in some cases it may be due to the deposition of bilirubin like in the case of kernicterus which is caused due to neonatal jaundice right or copper right in which case it is called Wilson's disease. So, that different reason why basal ganglia function may be compromised.

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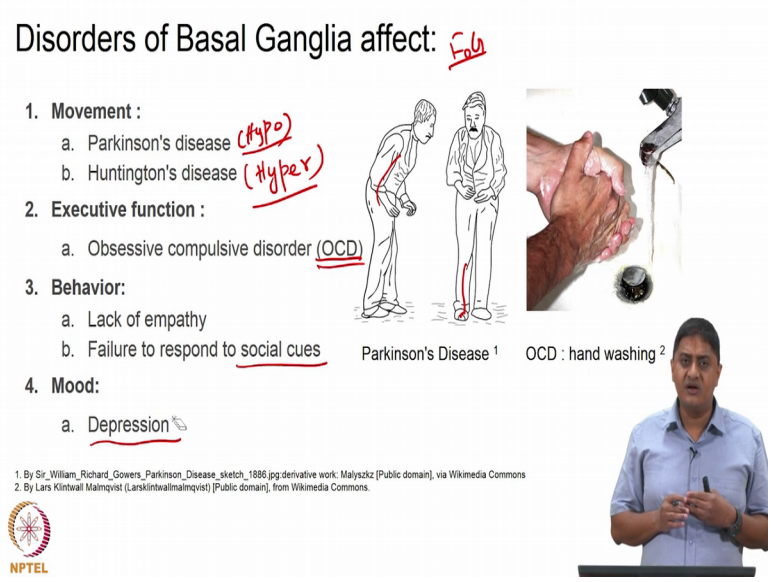

An important reason of course, is degeneration there are different disorders that affect different looks and; that means, different functions are affected. If it affect the movement loop different diseases can happen actually only a couple of these are presented. Parkinson's disease is a hypokinetic disorder and huntington's disease is a hyperkinetic disorder. So, essentially Parkinson's disease is this disease that is caused due to the degeneration of the nigrostriatal pathway right. Are the death of neurones in the substantia nigra pars compacta the dopaminergic neurones are compromise because of this reason what happens. The striatal neurones no longer receive modulation of the cortical inputs or thalamus inputs right.

Because of this reason what happens is that that is an inability to initiate movements classical science of a Parkinson's disease; will discuss this in greater detail in future classes; stooped posture, masked face, freezing of gait, resting tremors, right and many such other symptoms right. So, the classic science are shown for example, stooped posture and the inability of this person to make the first step this is also called as the fog episode or the freezing of gait not able to make the first step right.

And if basal ganglia function is affected for example, in the executive loop; then what happens disorders such as obsessive compulsive disorders. For example, frequent washing of the hands right basal ganglia is implicated the. It seems that role is still not completely understood, but a is basal ganglia is implicated in executive functions or this functions of the executive ability such as OCD or Obsessive Compulsive Disorder right. And importantly in behaviour there is inability for people to empathise with others. And there is inability for people to respond to important social cues.

Like I said in one of the previous classes you have somebody else's pen on a table usually there if an inhibition from picking up in front of that person you want to pick it up and put in your pocket. A socially unacceptable you would not want to do it, but a person with a certain disease actually has no control over his behaviour. So, what happens is that he knows that this is unacceptable if you ask him he will tell you so yet he will pick it up and you know put it so specific problems right so this as important.

Then mood functions of mood or emotion motivation right depression the exact path of a physiology of this disorder is not understood. There is a huge need to understand this disorder. This disease as to why this happens what is the exact path of physiology of

depression right purely understood right. So, these are the various disorders for the purpose of this course of course, we will focus only on the movement disorders paths.

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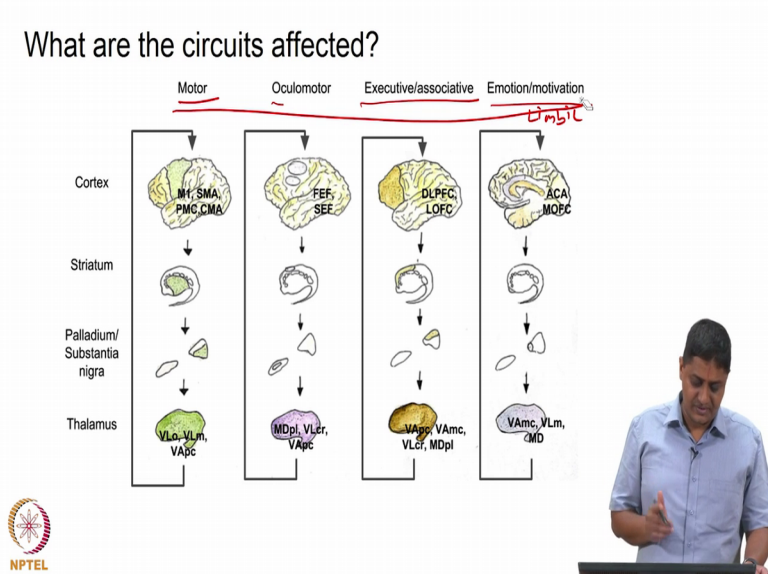

So, what are the various loops that are affected the motor loop of course, and the oculomotor loop, executive association loop, emotion motivation are there limbic loop. Of course, we said which areas of the cortex and which areas of the thalamus project to each other or project to the basal ganglia and from the from the thalamus back to the cortex. How does this projection happens is something that we saw in a previous class. If one of these loops is compromised then that particular function is affected. Actually what happens is that in diseases or especially neurodegenerative diseases such as a Parkinson's disease.

It actually affects multiple pathways it affects not just a motor function although what is frequently and very well observed are the motor symptoms. There are of course, other devastating effects that neurodegenerative disorders such as Parkinson's disease has another systems for example, (Refer Time: 06:21) right. These are of course, relatively poorly studied when compared with the motor dysfunction related with Parkinson's disease. Actually the motor dysfunction related with Parkinson's disease itself still needs to be more understood it is not completely understood right. So, something that we will discuss in future classes.

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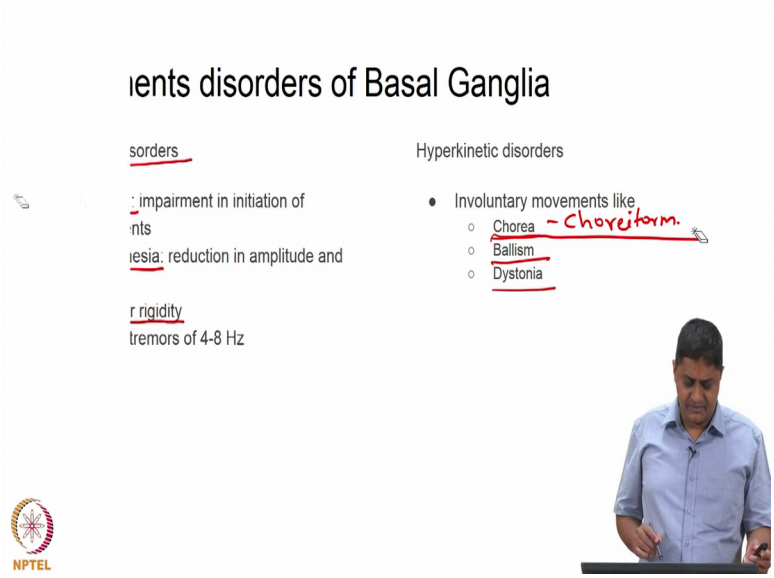

Essentially movement disorders of the basal ganglia can be classified into two types. One is the hypokinetic type; this is the case when I want to perform a movement and I am not able to perform a movement. Then the patient wants to perform a movement wants to take a step is not able to take us this is hypokinetic disorders. These are there are different manifestations of this akinesia. This is the inability to initiate or start a movement for example, the freezing gait episode right I am not able to take the first step the patient is not able to take the first step freezing of gait right.

Bradykinesia or slowness general slowness reduction in amplitude and velocity also called bradykinesia. Then rigidity may be of multiple types, then importantly in the case of a Parkinson's disease tremors, tremors right. They you see relatively old people you maybe you may have seen have this problem right. They do this and frequently they rub the index finger and the thumb tips with each other like that right. Actually not exactly like this I am not able to produce the actual movement something like that they do this right so, that tremor.

And hyperkinetic disorder, right this case what happens is I am producing unwanted movement. In previous case I wanted to do something and I am not able to do it in this case I do not want to do something, but I am doing it right unwanted movements right. These are of different types Chorea are what as what is called as choreiform movement right; ballism and the dystonia all this things. We will discuss in a greater detail in future

classes for the purpose of this class will only discuss chorea of one type chorea itself is of multiple types. In this class will discuss the Huntington's chorea in a future class will also discuss sydenhams chorea ok. Chorea itself is of multiple types here will discuss Huntington's chorea.

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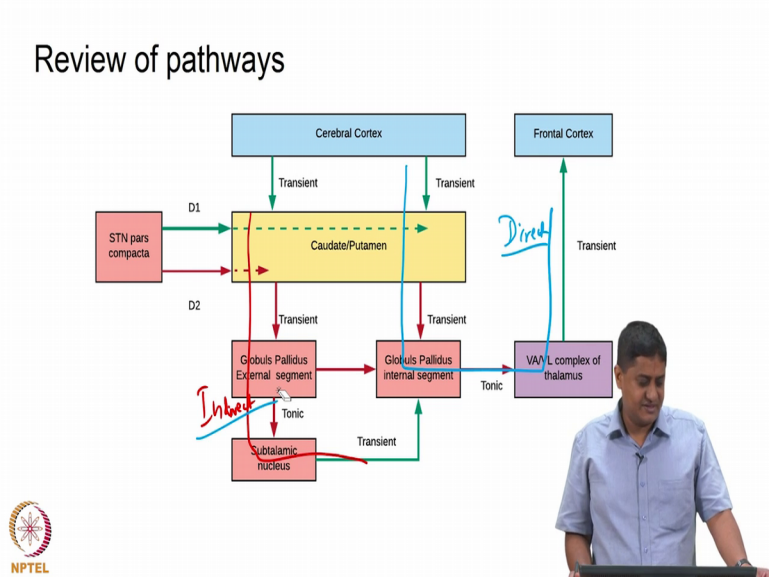

How is this cast let us remember once again the pathways this is the indirect pathway and that is the direct pathway. So, depending on which part of the system is compromised it depending on which particular pathway is compromised. The response or the actual manifestation of the pathology is different right.

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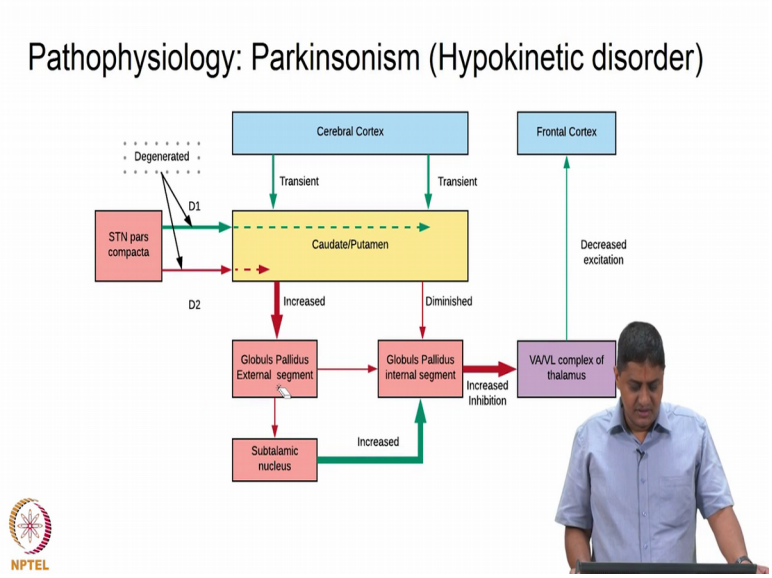

So, in the case of hypokinetic disorders such as Parkinson's disease what happens is that the nigra striatal neurons are the neurons from the substatia nigra pars compacta that produce dopamine. And modulate the cortico striatal inputs are the thalamo striatal inputs actually are degenerating. Note the effect of dopamine and basal ganglia output are the thalamo cortical neurons is always excited. In other words whenever dopamine is coming which pathway and goes through it is going to always exide the output not the medium neurons right something to remember. So, suppose this dopaminergic input is compromise the amount of dopamine that comes in is reduced for whatever reason right what happens is that the substantia nigra pars compacta neurons degenerate.

Why do they degenerate that is the topic that we will discuss in future class right. So, whatever reason for the purpose of this class it degenerates. Suppose it degenerates what happens the output of the indirect pathway is increased right. Essentially the output of the direct pathway is increased, whereas the output of the direct pathway is reduced decreased diminished. So, essentially the output from the subtalamic nucleus which is excited or (Refer Time: 11:06).

Let us remember the subtalamic nucleus excites the globus pallidus internal signals which in itself inhibits thalamo cortical neuron. So, the excitation going from the globus pallidus ; so, the excitation going from the sutalamic nucleus increases to the globus pallidus internal which means at the inhibition going from the globus pallidus internal to

the VAVL thalamus. Actually increases not decreases it increases so; that means, the inhibition increases; that means, there is a less ability to produce wanted movements right. So, essentially there is decreased excitation of the thalamo cortical neurons there is decreased excitation of the frontal cortex.

Essentially the person wants to do something, but he is not able to do that act right. The patient wants to do something the patient wants to take a step it is not able to take the step right which is what results in what is called as freezing of gait. What about the hyperkinetic disorder.

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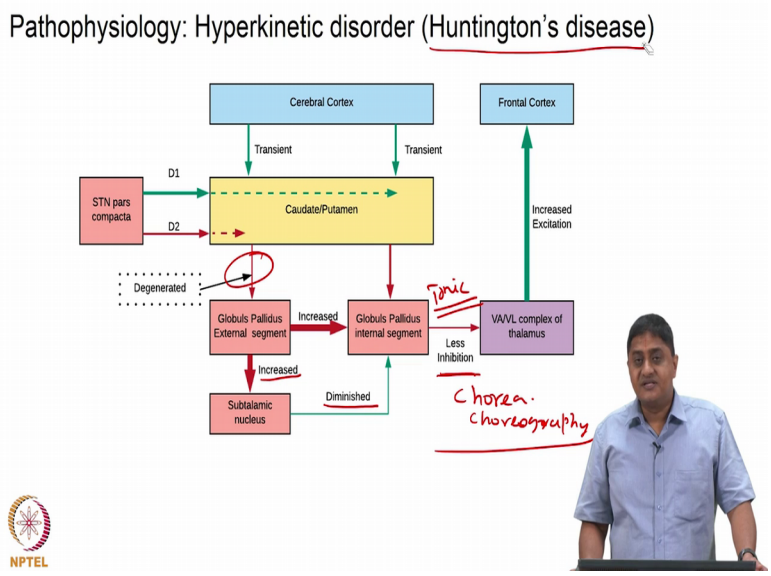

Let us take the case of Huntington's disease; in this what happens there is selective degeneration of the medium (Refer Time: 12:16) neurons in the indirect pathway.

Let us remember what the indirect pathway that is the indirect pathway is essentially an inhibitory pathway; if this pathway is degenerated what happens the amount of inhibition that goes here will be reduced essentially the possibility that the thalamocortical neurons are going to be excited at the probability that the cortical neurons are going to be excited is increased producing unwanted movements. So, essentially what happens so this pathway what is this pathway. This is the indirect pathway the indirect pathway is selectively degenerated not the direct pathway.

So, this does not have any effect on the direct pathway right the indirect pathway selectively degenerated. Essentially increasing the pallidal inhibition to the subtalamic nucleus right; that means, a subtalamic nucleus excitation to the globus pallidus internal segment is reduced a diminished so; that means, what happens that means there is less inhibition. So, let us remember this is actually a tonic inhibition right. So, the globus pallidus internal is tonically inhibiting the thalamocortical neurons if this tonic inhibition is reduced for whatever reason I am going to be producing unwanted movements right. I am going to be produce as unwanted movements dance like movements.

So, the word chorea right it is also related to choreography right choreography means as in dance for example, in movies. So, if the indirect pathway is selectively degenerate what it does is it produces chorea form or dance like movements typical of Huntington's disease right. This disease is also something that we will discuss in future classes right.

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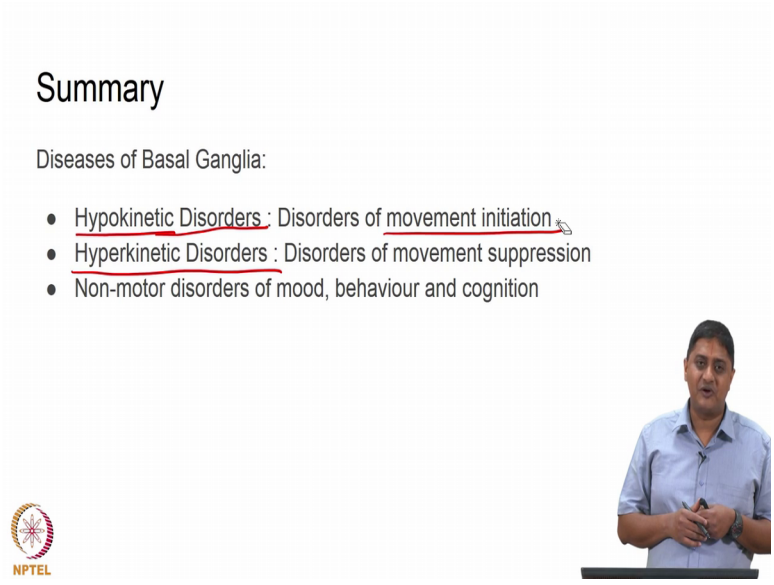

So, in summary we have seen that diseases of basal ganglia can be divided into two types or is the movement related diseases of basal ganglia can be divided into two types, the hypokinetic diseases and the hyperkinetic disorders. In the hypokinetic case the person wants to do something, but he is not able to do something. So, there is a disorder of movement initiation and the hyperkinetic case the person does not want to do something, but is doing something that is not wanted. Such as dance like movements or chorea form movements like Huntington's chorea right.

Non motor disorders are mood behaviour cognition for example obsessive compulsive disorder for example, depression right. And for example, behaving in a socially appropriate manner for examples are also probably due to basal ganglia dysfunction or in other words basal ganglia is also implicated or in other words basal ganglia is also implicated in a other disorders not just motor disorders. And note hypokinetic or hyperkinetic disorders themselves for example, Parkinson's disease by itself can also have other effects on other purpose; for example, cognitive for example, on mood.

So with this, we come to the end of this lecture.

Thank you very much for your attention.