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

Lecture - 77
Neuropsychiatric disorders due to BG Dysfunction

Welcome to this class on Neuroscience of Human Movement. In this class we will discuss Neuropsychiatric disorders arising out of Basal Ganglia Dysfunction. So, slightly different from the regular classes that we seen in which we usually limit our discussion to movements and dysfunction of movements. In this case we are going to discuss psychiatric disorders right.

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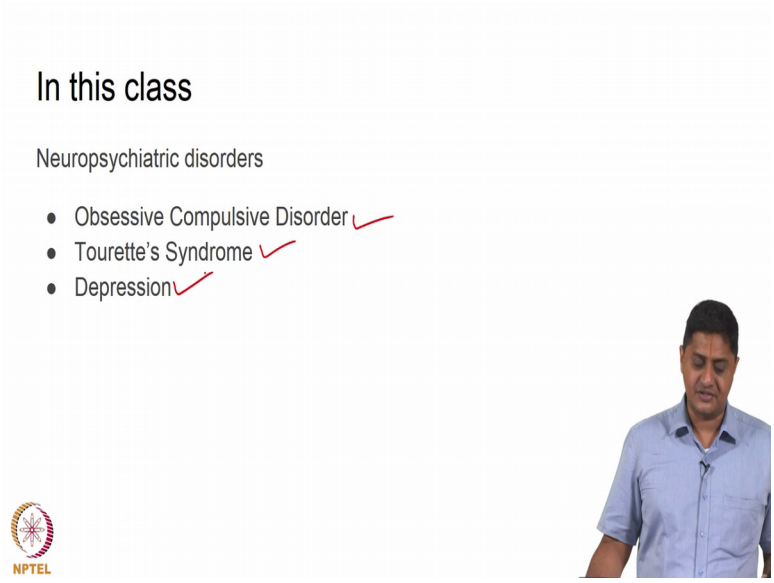

We will take three examples of neuropsychiatric disorders, obsessive compulsive disorder, Tourette's syndrome and depression. And discuss the possible role of basal ganglia in these disorders.

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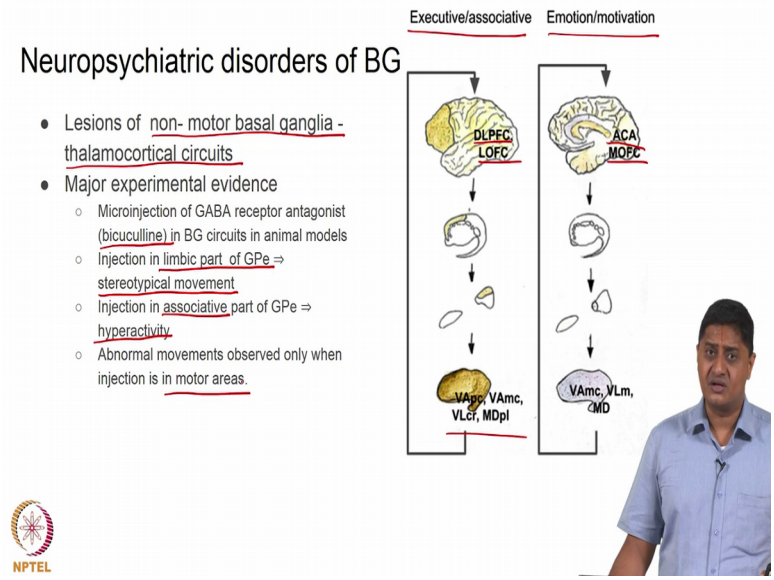

So, essentially the question is how does basal ganglia possibly cause or dysfunction of basal ganglia possibly cause this right, let us remember that we discussed four independent loops of basal ganglia right. So, these are essentially the skeletomotor loop, the oculomotor loop, the limbic loop and the executive or a association loop.

So, now if there is lesion in the executive or associative or if there is lesion in the limbic loop, this leads to behavioural disorders of behaviour right. So, essentially this caused due to lesions of non motor basal ganglia thalamocortical circuits right, because of lesions in the anywhere in this loop right. So, it can be here or it can be in the thalamocortical loop, it can be in the striatum or it can be in the GPe; GPe right.

Lot of experimental evidence actually comes from the usage of the GABA receptor antagonist bicuculline right in basal ganglia circuits. And it has been shown that in animal models injection of bicuculline in specific areas cause specific dysfunctions. So, if the injection is to the limbic part of the GPe there are stereotypical movements, where as if it is to the associative part there is hyperactivity. Abnormal movements are observed only when the injection is in motor areas.

So, depending on which part is affected then the response also varies. So that means, if that particular part is lesion for whatever reason then the response is going to vary according to the region that is lesioned ok and the network part of the network that it forms.

So, if it forms part of the limbic circuitry then that is going to result in a specific neurobehavioral disorder. If it forms part of the executive or associative network then that is going to cause a specific behavioural disorder. So, and these two are not expected to be the same. If it of course forms part of the motor circuitry then it is going to cause some motor disorders.

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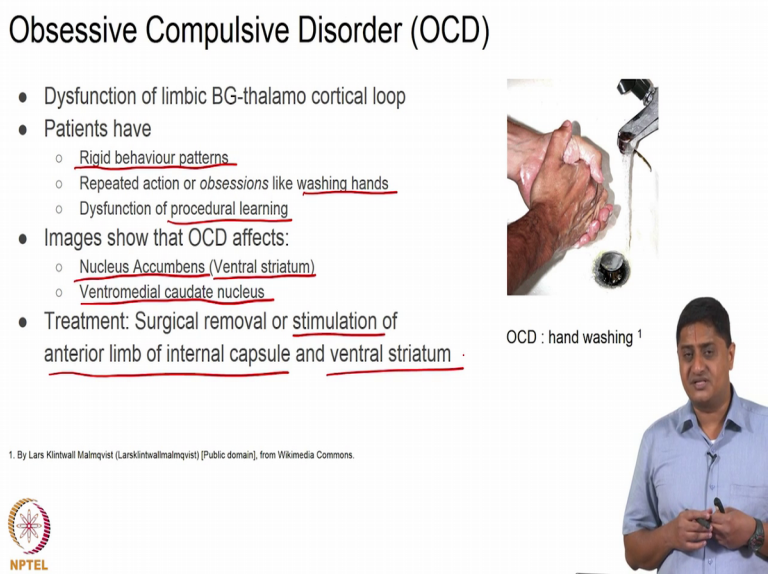

So, one example of behavioural disorders is obsessive compulsive disorder. In this case people keep on doing something because they never feel that they have done it enough number of times. Say for example, washing hands very common example people keep on washing their hands, every few minutes once each the person has to wash their hands. So, they have an obsession to keep on doing this right so, they are repeated actions ok.

So, and this is something that they cannot you know change you keep telling them hey this is not required this is not something that they can change, so easily. It is not something that they can change, so easily right and so; that means, they have rigid behaviour patterns. You would observe this also among some of your classmates, or co workers right.

Some people do things only in the particular way they cannot do it different way and extreme form of that is obsessive compulsive disorder right. We all have habits we all you know keep doing things in specific ways right, so that is habit. But, if you cannot do it in any other way right, so if you do this at the exclusion of other things and in such a

way that it effects your normal life then that becomes obsessive compulsive disorder. And an extreme form of that becomes obsessive compulsive disorder right.

So, again what is basal ganglia's role in this right? It is believed that this is caused due to compromised basal ganglia function, in the sense that the important role of basal ganglia in procedural learning right. Let us remember one thing sometime ago we discussed the role of basal ganglia in learning right. So, we said that specific part of basal ganglia plays a role in a acquisition of tasks. Whereas, a different part of basal ganglia plays a role in doing well practice or well learnt motor tasks this is what we discussed some time ago.

So that means, basal ganglia is a procedural learning engine, so it is learning procedures not just input output relationships, abstract representations. So, this is differentiated from factual learning right. So, remembering some facts and figures and numbers that is different from remembering a procedure.

So, essentially even in the motor function right even in motor function basal ganglia is involved in procedural learning. If this procedural learning is compromised in the limbic, or associative area or limbic or executive area then what happens is you have a disorder such as OCD that develops right.

And imaging is very useful in understanding how this disease affects or which particular area of the basal ganglia is active or abnormal or showing abnormal activation during specific activity. It turns out that ventral striatum has been implicated specifically nucleus accumbens and ventromedial caudate nucleus have been implicated. In other words these two regions show abnormal activation when compared with you know age matched controls for example, right.

And it turns out what is more interesting is that surgical removal or stimulation of specific regions right, anterior limb of internal capsule and ventral striatum seem to help these patients to overcome these symptoms. So, that means, that these particular regions right these particular regions are the ones that are malfunctioning or at least forming an important part of the network that is responsible for this particular function right. So, this is obsessive compulsive disorder.

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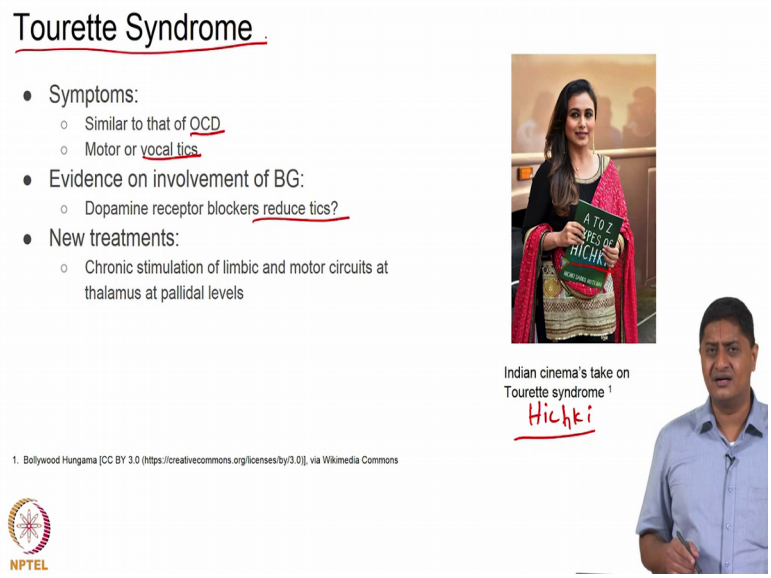

Then there is Turette syndrome of course, you might have seen this movie Hichki right the recent Hindi movie on this particular syndrome. Where this lady Rani Mukherjee she performs this tha, tha, tha, tha, like that frequently which makes it socially awkward and also she wants to be a teacher.

So, it is a very difficult situation you have some sort of you know expression disability this is causing vocal tics right. So, motor or vocal tics that are similar to OCD. So, there is obsessive compulsive necessity for these people to do this tics tha, tha, tha, tha, tha, she also does something like cha, cha, cha, like.

In the case of OCD the person has to wash the hands or do something else in this case the person has to keep on doing this vocal tics right. So, and of course, the story is something I actually have not seen the movie you should see it if you are interested, but you should also read about it if you are interested. So, these vocal tics are probably due to dysfunction of basal ganglia.

How do you know that? This is due to basal ganglia dysfunction. Well it turns out that using dopamine receptor blockers reduces tics in many cases, specific regions of basal ganglia, that are not functioning well that cause this kind of vocal tics typical of Turette syndrome right. And some treatments have been attempted chronic stimulation of limbic and motor circuits and at the thalamus and the pallidal levels seem to help these patients how do you stimulate chronically? Well of course, this is a surgical procedure.

So, this involves implanting electrodes in particular regions of the basal ganglia and using a pacemaker kind of device it is this is a pacemaker kind of device that continuously stimulates the specific regions and ensures that the person does not produce this unwanted, undesirable, socially awkward tics right. So, again this is just therapy this is just a therapeutic approach that is coming up we will have to wait and see how effective are this is or if there what are the other effects that this brings in right?

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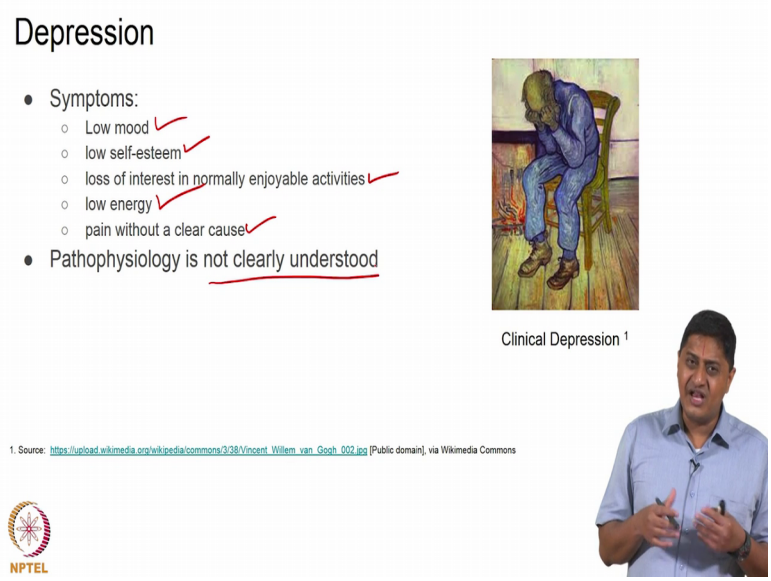

And other disorder is depression; in this case what the person has is low mood, low self esteem. What is normally supposed to help a person enjoy right this is not interesting for these people. So, activities that are enjoyable are not of interest to people with depression.

In general low energy and they have pain for no particular reason. So, pain without a clear cause actually this also causes other physical disorders from time to time. What causes depression? Actually that is the billion dollars if not a Jillian dollar question because we do not understand the pathophysiology of depression.

So, treatment methods are limited and the available treatment methods come with you know baggage's, come with side effects. So, it is not clear what this disorder is and the exact role of basal ganglia in this is also not completely understood. However, it is believed that basal ganglia must form an important part or at least some role in disorder such as depression right. So, this is something that is an open question for the future. So,

we need to continue our research and understand why depression is caused? And what is the approach towards treatment of depression?

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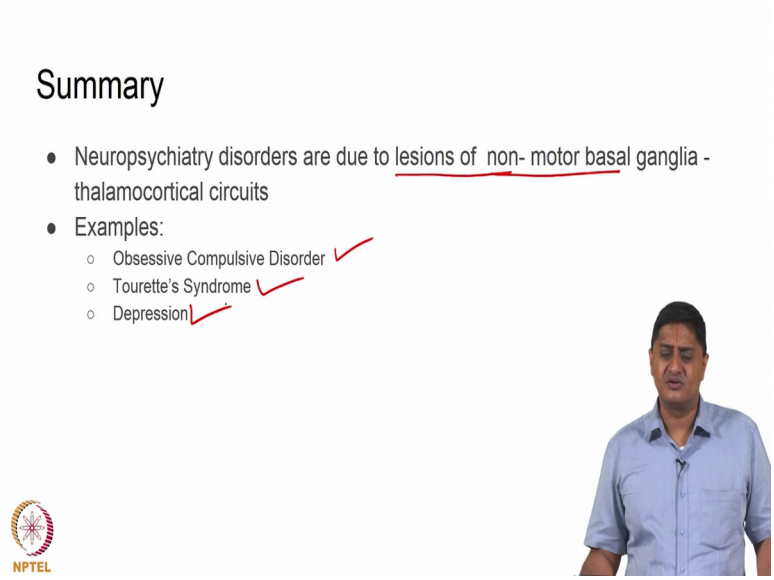

So, in summary what we have seen is that neuropsychiatric disorders of basal ganglia are due to dysfunction of specific circuitry in the non motor regions right. So are lesions of the non-motor regions of the basal ganglia, thalamocortical circuits right. These are some examples these are obsessive compulsive disorder, which make people to engage in rigid behaviour and keep repeating specific tasks for no particular reason.

Tourette's syndrome where the person produces vocal tics such as tha tha tha due to reason similar to obsessive compulsive disorder right. And depression it is believed that basal ganglia must play some role in depression although it is not clear what exactly the role is? So, with this we come to the end of this lecture.

Thank you very much for your attention.