Physiopathology – Movement disorders

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Brain structures involved in motor control
Basal Ganglia pathways

Dopamine

Striatum (Caudate and Putamen)
Basal Ganglia: direct pathway

Cortex → Striatum → Glodus pallidus internal segment, S. Nigra pars reticulata → Thalamus

Movement

Cortex → Striatum → Glodus pallidus internal segment, S. Nigra pars reticulata → Thalamus

Basal Ganglia

Striatum → GPi, SNr

Disinhibition

Thalamus activity

Striatum activity

Excitatory

Inhibitory
Basal Ganglia: indirect pathway

Cortex

Globus pallidus
external segment

Striatum

Subthalamic
nucleus

Globus pallidus
internal segment

S. Nigra
pars reticulata

Thalamus

Basal
Ganglia

Globus pallidus
e external segment

Striatum

Subthalamic
nucleus

Globus pallidus
internal segment

S. Nigra
pars reticulata

Thalamus

Movement

Cortex

Globus pallidus
e external segment

Striatum

Subthalamic
nucleus

Globus pallidus
internal segment

S. Nigra
pars reticulata

Thalamus

Excitatory
Inhibitory

Striatum activity

Disinhibition

Thalamus activity
Direct and indirect pathways

Basal ganglia

-ve input to cortex

+ve

Indirect pathway

balance

Direct pathway

attenuates movement

promotes movement

Direct pathway

balance

Indirect pathway
Basal Ganglia: neurotransmitters

- Glutamate
- GABA
- Dopamine

Diagram:
- Cortex
- Glodus pallidus external segment
- Subthalamic nucleus
- Glodus pallidus internal segment
- S. Nigra pars reticulata
- S. nigra pars compacta
- Thalamus

Connections:
- D1: Striatum to S. nigra pars compacta
- D2: Glodus pallidus internal segment to Subthalamic nucleus
- Red arrows: Connections involving Glutamate
- Blue arrows: Connections involving GABA
- Yellow arrows: Connections involving Dopamine
Direct and indirect pathways

Basal ganglia input to cortex

-ve

Indirect pathway

balance

Direct pathway

+ve

attenuates movement

promotes movement

DOPAMINE
Parkinson’s disease

- Hypokinetic disorder
- Resting tremor, Muscle stiffness, Bradykinesia (slowness of movements)
- Cognitive decline (e.g. depression, insomnia)
- Dopamine levels reduced by degeneration of substantia nigra pars compacta, MPTP
Deep brain stimulation-activate?
This should further enhance the indirect pathway
Stimulation at high frequencies actually reduces STN activity
Reduces indirect pathway
Mechanism still not completely understood – Basic Research needed
Deep brain stimulation: surgery
Deep brain stimulation: patient report
Huntington’s disease

- Hyperkinetic, hereditary disorder
- Uncontrolled movement (Chorea), Fidgetting, clumsiness, falls
- Cognitive decline (Absent mindedness, irritability, depression)
- Increased activity in Dopamine neurons.