

Review Article

PARKINSON'S DISEASE

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ABSTRACT

Basal ganglia (nuclei) are masses of gray matter present in the white matter of the cerebral hemisphere. These function in close association with the motor cortex and corticospinal system. Their functions include control of complex motor activity, cognitive control of motor activity and change of timing and extent of motor activity. Degeneration of neurons pars compacta of substantia nigra leads to Parkinson's disease. There is deficiency of dopamine in caudate and putamen. There is imbalance between the neurotransmitter acetyl choline & dopamine which leads to features of the disease.

Key Words: Basal ganglia, Dopamine, Putamen

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INTRODUCTION

Basal ganglia (nuclei)

Basal ganglia (nuclei) are composed of gray matter and are present in the white matter of each cerebral hemisphere. These include the caudate nucleus, putamen, globus pallidus, substantia nigra, and subthalamus.^{1,2}

Basal nuclei do not function independently but perform their function with the help of the motor cortex and corticospinal tracts. Their functions include control of the complex pattern of motor activity, cognitive control of motor activity, and change of the timing and extent of movements. In the connections of the basal ganglia, caudate nucleus and putamen circuits are important. (Figure-1)^{3-5,6}

Neurotransmitters in basal ganglia:

Corticostriate fibers secrete acetyl-choline at their endings. Nigrostriatal fibers release dopamine at their nerve endings. Fibers that pass from caudate and putamen to globus pallidus and substantia nigra secrete gamma-aminobutyric acid (GABA). (Figure-2)^{3,7}

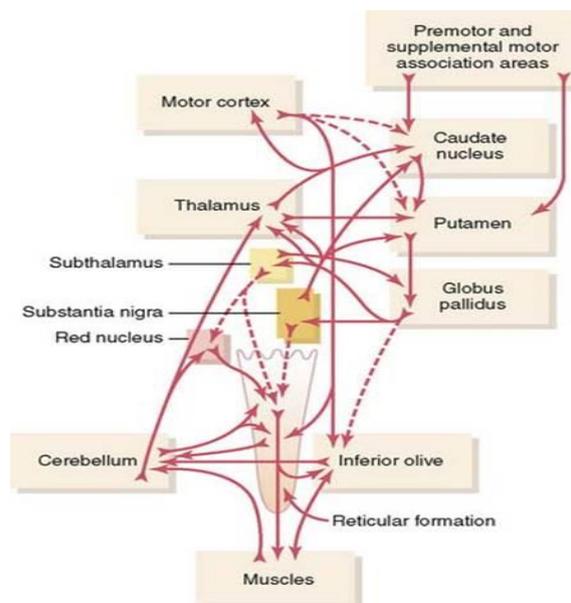


Figure-1: Connections of the basal ganglia³

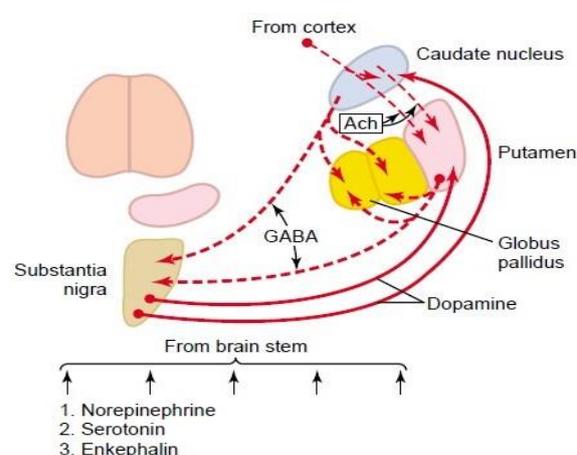


Figure-2: Neurotransmitters in the basal ganglia³

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PATHOPHYSIOLOGY OF PARKINSON DISEASE

This disease is named after the British physician James Parkinson who published an essay on shaking palsy in 1817. World Parkinson's Day is celebrated on 11th April every year (birthday of James Parkinson). The red tulip is used as a symbol of the disease.^{8,9}

World Wide 7-10 million people have been diagnosed to be suffering from Parkinson's disease. Men are 1.5 times more common than women to suffer from this disease.¹⁰

Parkinson's disease is also called paralysis agitans. It is one of the most common neurodegenerative diseases of the middle age and elderly people. It is due to the destruction of the pars compacta of the substantia nigra that sends dopamine secreting nerve fibers to the caudate nucleus and putamen.^{3,11} The amount of dopamine released into these basal nuclei is reduced and the balance between facilitatory and inhibitory circuits is disturbed.¹² Caudate nucleus and putamen show overactivity and send the output of excitatory signals to the corticospinal motor system.³ In this disease, alpha-synuclein is misfolded and clumped together with other alpha-synuclein, dopamine cells cannot remove these clumps, which become cytotoxic damaging these cells.¹³⁻¹⁵

Causes

1. Trauma as in boxers^{16,17}
2. With aging, dopamine neurons and receptors are gradually lost in the caudate and putamen.¹⁸
3. As a side effect of intake of phenothiazines derivatives in patients of schizophrenia, which results in deficiency of dopamine.¹⁹
4. Carbon monoxide and manganese poisoning
5. Postencephalitis Parkinson disease after the outbreak of viral encephalitis in 1916-17.²⁰

6. A family history of Parkinson's disease increases the risk of getting disease.²¹⁻²³

Diagnosis

Diagnosis of the disease is mainly based on the clinical features, MRI or Dat scan.^{23,24}

Clinical features

Clinical features include disorders of movement and disorders of posture

Disorders of movement are akinesia or bradykinesia which is difficult to initiate movements and static tremors involving fingers and hands (pill-rolling movements) tongue or lips.^{1,11} There is the alternate contraction of agonists and antagonists.^{20,25}

Disorders of posture are various forms of rigidity like cogwheel rigidity (intermittent resistance, on passive movement of a joint) and lead pipe rigidity (constant resistance, when a joint is passively moved). The face is expressionless, voice is slurred. The unconscious swinging of arms in walking is lost. Arms are flexed and gait is short stepped and shuffling.²⁶⁻²⁸

There is no loss of muscle power and sensations. Superficial abdominal reflexes and tendon reflexes are normal. There is no Babinski sign.²⁰ Patients may have disorders of cognition, mood, behavior, and thoughts.²⁹ Sleep disorders such as daytime drowsiness, disturbances in REM sleep, or insomnia can be manifested in these patients.³⁰ In these patients, the risk of dementia is 2 to 6 times greater compared to the general population. Loss of memory increases with increasing age and duration of the disease.³⁰⁻³¹

Treatment

Administration of L-dopa (Levodopa) reduces many symptoms especially akinesia and rigidity. L-dopa can cross the blood-brain barrier and is converted into dopamine in the brain, which restores the normal balance between excitation and inhibition. Administration of dopamine has no effect as it cannot cross the blood-brain barrier.³ Catechol-o-methyl transferase (COMT)

inhibitors when used with L-dopa, prevents degradation of L-dopa.³²

L-deprenyl, a monoamine oxidase inhibitor. It prevents the breakdown of dopamine and that persists in the basal ganglia for a longer time. L-deprenyl also prevents the slow destruction of dopaminergic neurons in the substantia nigra.³³

Dopamine agonists such as bromocriptine are also effective in some cases in the management of the disease.³⁴ Surgical treatment is given in patients who are non-responsive to drug therapy.

Lesions in globus pallidus (Pallidotomy) or subthalamic nucleus (thalamotomy) have been performed to restore the output balance of basal ganglia.³⁵

Implantation of dopamine secreting cells from aborted fetuses in or near the basal ganglia is another option. Its results are encouraging.³⁶⁻³⁷

Prevention

Exercise in middle age may decrease the risk of getting this disease. Tobacco smoking, intake of tea and coffee decrease the risk to develop Parkinsonism.^{38,39} Antioxidants such as vitamin C and E have a protective role.⁴⁰

AUTHOR'S CONTRIBUTION

HJQ: Drafting of the article

NH: Review and Editing

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