THE EXTRAPYRAMIDAL SYSTEM

Prof. M. Gavriliuc
THE EXTRAPYRAMIDAL SYSTEM
THE CEREBELLUM

Motor activity is intricately controlled by the interactions of three major regions of the brain: the cerebral cortex, the cerebellum, and the basal ganglia. These regions influence the lower motoneurons either directly through the pyramidal system or indirectly through the extrapyramidal system. The pyramidal system consists of the corticobulbar and corticospinal pathways.
THE EXTRAPYRAMIDAL SYSTEM

The extrapyramidal system is composed of all other projection pathways that influence motor control, including the basal ganglia and the projection pathways from the brain stem to the spinal cord (e.g., the rubrospinal, reticulospinal, vestibulospinal, and tectospinal tracts). The neuronal circuits of the extrapyramidal system are closely connected with those of the pyramidal system; thus, separating the connections into two systems are artificial.
Nevertheless, the term “extrapyramidal system” is frequently used clinically to denote the components of the basal ganglia and related subcortical nuclei that influence motor activity, and disease of the extrapyramidal system results from neurologic symptoms different from those occurring with diseases of the pyramidal system.
STRUCTURES IN THE BASAL GANGLIA

The major components of the basal ganglia include the **caudate nucleus**, the **putamen**, and the **globus pallidus**.
The Basal Nuclei

- Lateral ventricle
- Caudate nucleus
- Putamen
- Globus pallidus
- Third ventricle
- Thalamus
Components of the Basal Ganglia and Their Connections

Fig. 8.1 Topographical relationships of the basal ganglia (in red)

- Thalamus
- Globus pallidus
- Putamen
- Caudate nucleus
- Amygdala
- Head of the caudate nucleus
- Putamen
- Subthalamic nucleus
- Amygdala
- Tail of the caudate nucleus
- Lateral ventricle
- Thalamus
Components of the Basal Ganglia and Their Connections

Fig. 8.3 Lateral view of the basal ganglia. X, XX: horizontal planes of section for Figs. 8.4–8.4; coronal planes of section for Figs. 8.5–8.8

Fig. 8.4 Two horizontal sections through the basal ganglia (for planes of section, see Fig. 8.3)
STRUCTURES IN THE BASAL GANGLIA

The **caudate nucleus** occupies a position in the floor of the lateral ventricle, dorsolateral to the thalamus.
STRUCTURES IN THE BASAL GANGLIA

The bulge at the cephalic end of the caudate nucleus is known as the head.
STRUCTURES IN THE BASAL GANGLIA
The putamen and globus pallidus together form the lenticular, or lentiform, nucleus.
The major input to the basal ganglia is from the cerebral cortex, the thalamus, and the substantia nigra, and the major output is to the thalamus. From neurons in all areas of the neocortex, axons project to the striatum.
The major outflow of efferent fibers from the basal ganglia comes from the medial segment of the globus pallidus.
FUNCTIONAL CONSIDERATIONS

Lesions of the basal ganglia in humans cause:
- Disorders of the initiation of movement (akinesia);
- Difficulty continuing or stopping an ongoing movement;
- Abnormalities of muscle tone (rigidity);
- The development of involuntary movements (tremor).

Thus, the basal ganglia are thought to participate in movement control, particularly in the initiation of movement, but also in the support of ongoing movement. The movements influenced by the basal ganglia include those related to posture, automatic movements (such as swinging the arms while walking), and skilled volitional movements.
BASAL GANGLIA DISEASE

CHOREA

Chorea is a movement disorder that results from disease of the basal ganglia. Choreiform movements consists of a rapid, irregular flow of motions, including “piano-playing” flexion-extension movements of the fingers, elevation and depression of the shoulders and hips, crossing and uncrossing of the legs, and grimacing movements of the face.
Sydenham’s chorea occurs in children as a complication of rheumatic fever, but the disease is self-limited and recovery is complete.

Huntington’s disease is a disorder inherited as an autosomal dominant trait and characterized by progressive dementia and choreiform movements, usually beginning in adult life. Recently, the approximate site of the genetic locus responsible for this disease was found.
Athetosis is a movement disorder characterized by slow, writing movements of a wormlike character involving the extremities, trunk, and neck. Athetosis occurs in association with dystonia, which is the abnormal persistence of limb and trunk postures. Athetosis is frequently seen in patients with cerebral palsy and results from brain damage that occurred at birth from hypoxia and ischemia.
HEMIBALLISMUS is a movement disorder characterized by the sudden onset of continuous, wild, flinging motion of the arm and leg on one side of the body. This result most often from a vascular lesion of the contralateral subthalamic nucleus.
Akathisia — motor restlessness where the patient constantly shifts, crossing and uncrossing his legs and walking on the spot.

Dyskinesia — a term used to describe movements associated with neuroleptic drugs; particularly used to describe movements of mouth and face (oro-facial dyskinesia).
**BASAL GANGLIA DISEASE**

**DYSTONIA  TIC  TREMOR**

**Dystonia** — co-contraction of agonist and antagonist which may lead to an intermittent or persistent maintenance of abnormal posture. Position maintained is usually at an extreme of extension or flexion.

**Tic** — a stereotyped and irresistible repetitive action, normally a repeated purposeful action.

**Tremor** — rhythmical alternating movement.
QUESTIONS?