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Disorders of the Motor System

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INTRODUCTION

The motor system is broadly divided into the pyramidal and extrapyramidal systems. The pyramidal system is a single neuron system, which originates in the primary motor cortex of the frontal lobes and, with white matter projections, coalesces to form the internal capsule; it then traverses the brainstem (as the cerebral peduncles in the midbrain, the basis pontis in the pons and the pyramids in the medulla where the majority of neurons decussate to form the corticospinal tracts), and ultimately synapses on the lower motor neurons in the anterior horn of the spinal cord (Fig. 114-1). The extrapyramidal system consists primarily of the basal ganglia and the cerebellum, and provides coordinating and integrating information to the pyramidal tract system under the influence of various afferent feedback loops. The components and pathways of the basal ganglia (Fig. 114-2) and cerebellum (Fig. 114-3) influence and modulate voluntary motor activity of the motor cortex.

Disorders of the motor system affect the components of the pyramidal and extrapyramidal systems. The approach to the patient with motor dysfunction depends on the ability to accurately localize the neuroanatomical region affected through a careful history and focused examination.

SYMPTOMS AND SIGNS OF MOTOR SYSTEM DISORDERS

Table 114-1 summarizes the neuroanatomic localization of diseases and the associated symptoms and signs characteristic of dysfunction at those levels. While "weakness" is a frequent complaint, it does little to help with the localization of the problem because it can occur with any disorder of the motor system and does not always reflect weakness on examination. In addition, weakness of insidious onset may be completely overlooked by the patient. Some patients may complain of feeling numb, or that the limb is asleep, uncoordinated, or fatigued. Symptoms referable to impaired balance and gait are common. Patients with distal weakness may complain of impairment in fine motor tasks, buttoning buttons, opening jars/doors, handwriting, stumbling, or tripping with walking. Proximal weakness of the upper extremities will result in difficulty performing tasks over their heads, including washing their hair or applying makeup. Proximal weakness of the lower extremities is often manifested as difficulty with stairs or getting up from sitting. Bulbar weakness with dysarthria and dysphagia may be referable to a variety of diseases of the motor system and can often provide important clues to the differential diagnosis. Involuntary movements may reflect diseases of the basal ganglia but, similar to weakness, may not be appreciable to the patient; therefore, information from a secondary observer is beneficial. Complaints of diffuse motor incoordination including deficits in speech, fine motor coordination, and gait imbalance suggest cerebellar dysfunction.

SIGNS OF CENTRAL MOTOR SYSTEM DYSFUNCTION

Central nervous system diseases affecting the motor system are divided into abnormalities of pyramidal tract (upper motor neuron), basal ganglia, and cerebellum. Each presents with distinct clinical signs; however, overlapping syndromes may occur, which suggests more diffuse disease processes.

Upper motor lesions affecting the motor cortex and the subcortical white matter prior to the medullary decussation are associated with contralateral weakness, whereas lesions of the medulla and corticospinal tracts in the spinal cord post-decussation cause ipsilateral weakness. Both are associated with upper motor neuron signs. Lesions of the spinal cord may cause mixed upper motor neuron dysfunction below the lesion and lower motor neuron dysfunction at the level of the lesion due to involvement of descending corticospinal tracts and peripheral motor neurons originating in the anterior horn. Dysfunction of upper motor neurons traditionally causes distal greater than proximal weakness, increased muscle tone with spasticity, increased muscle stretch reflexes with clonus, and pathologic reflexes (Babinski's sign). There is little or no muscle atrophy. Acute lesions of the spinal cord can initially cause a flaccid paralysis with areflexia that eventually evolves into a typical upper motor neuron syndrome.

The basal ganglia are important for the planning, initiation, and execution of movements. They facilitate desired movements while inhibiting unwanted movements through pathways that ultimately interact with primary motor cortex. Disorders of basal ganglia function often cause movement disorders characterized by heterogeneous and mixed impairments in voluntary movement not associated with muscle weakness, and often involuntary movements. Disorders of tone are common and variable. Speech and posture are often affected. Patients may have involuntary movements when awake but, with rare exceptions, the involuntary movements are abolished during sleep. Gait dysfunction with postural instability may be seen.

The cerebellum constantly monitors afferent input from muscles, joints, and motor cortex and integrates planned movements to fine tune motor control through efferent projections that regulate motor cortex activity. Disorders causing cerebellar signs may result from direct impairment of cerebellar function or impairment in afferent and efferent pathways of the cerebellum. Cerebellar disorders result in signs that reflect difficulty with