Movement Disorders

Psychology 372

Physiological Psychology

Steven E. Meier, Ph.D.

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Background

- Early Studies
  - Found some patients with progressive weakness had problems with nerve cell bodies or peripheral nerves but no problems with muscle fibers.
  - Other patients had problems muscles with little problems in the nerve cells.
- Two important features
  - Some neurological disorders only affect sensory systems while others affect only motor systems
  - Neurological problems may only affect one component of the neuron Axon vs. Soma

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Many Types

- Nerve-Muscle Synapse Problems
  - Myasthenia Gravis
- Neurogenic and Myopathic Diseases
  - Amytrophic Lateral Sclerosis (Lou Gehrig Disease)
  - Muscular Dystrophies
- Basal Ganglia Disorders
  - Parkinson's Disease
  - Huntington's Disease
- Cerebellar Disorders
  - Hypotonia
  - Others

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Myasthenia Gravis

- Means severe weakness of the muscle
- Is a functional disorder at the synapse between the motor neuron and skeletal muscle.
- Two causes
  - Autoimmune Disorder
  - Genetic

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Autoimmune Type

- Antibodies are produced to attack the Nicotinic Ach receptor in the muscle.
- Reduces the number of receptors
- Muscle becomes weakened

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Some Characteristics

- Affects cranial muscles and limb muscles
  - Eyelids, eye muscles
  - Legs, Arms
- Symptoms vary during the day and between days.
  - Get remission and exacerbation
- No conventional clinical or electromyographic evidence of denervation although muscle weakness is occurring.
- Weakness is reversed by drugs that inhibit acetylcholinesterase

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Some Symptoms

- Muscle fatigue and weaknesses
- Repetitive stimulation of the nerve produces a decrimental response over time.
- Patients generally complain of muscle weakness not fatigue
- Generally progresses and becomes worse over time

Treatment

- Use of Anticholinesterases provide symptomatic relief.
  - e.g., Pyridostigmine
- Immunosuppressive Therapies
  - Suppress immune functioning
- Plasmapheresis
  - Removes plasma and ACh antibodies
- Each does not alter the course of the disease

Other Treatment

- Thymectomy
  - Remove the Thymus
  - ½ of patients enter total remission
  - Have no more problems
  - Also is used when patients enter severe respiratory distress from MG

Neurogenic and Myopathic Diseases

Symptoms

- Appear slower than when a nerve is cut.
- Generally symptoms occur as the muscle becomes weak and begins to waste away - Atrophy
- Affects limb movement
  - Lifting and walking
- May also have
  - Cramps and pain
  - Muscle may not be able to relax
  - Red tinged urine
  - Others
- Does not influence Sensory Neurons

Overview

- Neurogenic disorders
  - **May** get distal limb weakness
  - Visible muscle twitches under the skin are a good indicator for neurogenic disorders
    - Called Fasciculations
- Myopathic Disorders
  - May also get distal limb weakness
  - Other symptoms

Motor Neurons

- Lower
  - Are from the spinal cord and brain stem
  - Directly innervate skeletal muscles
- Premotor
  - Past called Upper Motor Neurons
  - Originate in higher brain areas (Cortex)
  - Synapse on lower motor neurons
  - Combine with motor neurons in the spinal cord.
  - Make up the corticospinal tract

Premotor and Lower Neurons

- Diseases in each group produce distinct symptoms.
- Lower
  - Atrophy
  - Fasciculations
  - Decreased muscle tone
  - Loss of tendon reflexes
- Result in weak, wasted and twitching muscles

Upper

- Symptoms
  - Muscle Spasticity
  - Overactive tendon reflexes
  - Others
- Result
  - Get overactive tendon reflexes

Disorders

Amytrophic Lateral Sclerosis

- Also called Lou Gehrig Disease
- Involves both lower and premotor neurons
- Characterized by
  - Atrophy of the muscle
  - Hardening of the Spinal Cord due to astrocyte increases and scarring of the lateral columns
- Premotor neurons degenerate progressively

Symptoms

- Usually begins around age 60
- Begins with fine movement difficulties
  - Playing the piano
  - Working with tools
- Develops into weakness in the limbs
- Get an increase in tendon reflexes
- Other symptoms as well

Muscular Dystrophies

- Are inherited
- Symptoms begin by or before adolescence
- All symptoms are caused by weakness
- Weakness becomes more severe
- Can also get a delayed relaxation of the muscle – called myotonia

Types

- Duchenne
- Facioscapulohumeral
- Myotonic
- Limb-girdle

Basal Ganglia Disorders

Characteristics

- All have tremor or other involuntary movements.
- Have changes in posture and muscle tone
- Have slowness of movement without paralysis.
- May have diminished movement or excessive movement
- Also have cognitive disorders as well

Structures and Connections

- Consists of the
  - caudate nucleus,
  - Putamen
  - Globus Pallidus
- Gets input from
  - Primary motor cortex
  - Substantia Nigra

Output

- Goes to:
  - Primary motor cortex
  - Supplemental motor area
  - Premotor cortex
    - Brainstem motor nuclei (ventromedial pathways)
- Cortical-basal ganglia loop
  - Frontal, parietal, temporal lobes send axons to caudate/putamen
  - Caudate/putamen projects to the globus pallidus
  - Globus pallidus projects back to motor cortex via thalamic nuclei

Parkinson's Disease

- Is a **Hypo**kinetic Disorder
- One of the most common movement disorders

Major Symptoms

- Reduced spontaneous movement
- Impaired initiation of movement
  Akinesia
- Reduced amplitude and velocity of voluntary movement
  Bradykinesia
- Increased muscular rigidity
- Tremor at rest
- Shuffling gait
- Flexed Posture
- Impaired Balance

Classic Symptoms

- Tremor at rest
- Rigid facial expression
- Flexed posture
- Few movement
- Movements are slow

Causes

- Occurs from a degeneration of dopamine neurons in the substantia nigra
- Many have environmental causes as well
  - MPTP exposure
  - Insecticides

Results

- Get more output from the BG goes to the Thalamus and cortex
- Causes more activity
- Get symptoms

Treatment

- Drugs
  - L-dopa
    - Works well 3-5 years then begins to lose effectiveness
- Other Drugs
  - Entacapone (Comtan)
  - Tolcapone
  - Selegiline

Transplants

- Fetal Tissue Implants
  - Place dopamine-secreting neurons from aborted fetuses into the BG
  - Mixed results
- Globus Pallidus (internal division) lesions
- Alleviates some symptoms of Parkinson's disease

Huntington's Disease

- Is a **Hyper**kinetic disorder
- Is a hereditary disorder caused by a dominant gene on chromosome 4
  - Gene encodes a large protein (Huntingtin)
  - Mutant huntingtin protein may react within the nucleus
- Results in neuronal degeneration

Characterized by

- Heritability
- Behavior/psychiatric disturbances
- Chorea
- Cognitive impairment (dementia)
- Death 15-25 years after onset
- Usually diagnosed between ages 30-50
- Many people also have children before being diagnosed

Symptoms

- Excessive motor activity which are Involuntary
  Dyskinesias
- Decreased muscle tone
  Hypotonia
- Usually see uncontrollable jerky limb movement

Damage

- Occurs across the brain
- Begins in the striatum
- Results in rigidity and akinesia
- Damage occurs in other areas as well

Cerebellar Disorders

- Results from damage to the cerebellum
- Symptoms depend on the location of damage.

Symptoms and Damage

- Several Categories
  - Hypertonia
  - Abnormalities in movement
  - Tremor at the end of movements

Hypertonia

- Is a reduced resistance to limb displacements
- Tap knee with a percussion hammer
  - Lower leg normally reflexes and returns to resting position
  - With Hypertonia, leg reflexes and oscillates several times

Abnormalities in Movement Ataxia

- Many types
- Generally related to a lack of coordination
  - Get delays in initiating a response
  - Errors in the rate and regularity of movement
  - Cannot repeatedly tap the hand on the front then the back
  - Others

Tremor at the End of Movements

- Person moves arm to some location
- Tries to stop when supposed to
- Get lots of overcompensation and corrections.
  - Get jerks

Sites of Damage

- Damage can be identified based on the type of symptom.
- Vermis lesions
  - Produce problems in the control of muscles to the trunk
  - People sit or stand with their legs apart to help with their balance.
    - Often seen in thiamine deficiency - Alcoholics
  - Also get slurring and slowing of speech
    - One word at a time quality – scanning speech

Intermediate Cerebellum Damage

- Produce limb tremors
- Results in uncoordinated actions
- Often move one joint at a time.

Other Cerebellar Problems

- Involved with procedural memories
  - Causes problems with motor learning
- Also has a general role in some mental operations
  - Damage causes problems where a skill is developed through repeated practice.

Conclusion

- Multiple types of motor disorders
- Some can be helped, others cannot
- Symptoms can be very useful in diagnosing brain damage