

Exploring the Brain 3e

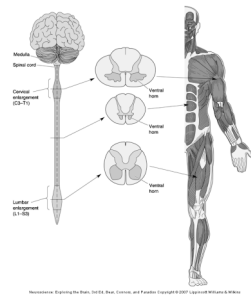
- Chapter 13: Spinal Control of Movement

- **Motor Programs**

- Motor system: Muscles and neurons that control muscles
- Role: Generation of coordinated movements
- Parts of motor control
 - Spinal cord → coordinated muscle contraction
 - Brain → motor programs in spinal cord

The Somatic Motor System

- **The Lower Motor Neuron**
 - Lower motor neuron: Innervated by ventral horn of spinal cord
 - Upper motor neuron: Supplies input to the spinal cord



Spinal cord injuries

- Motorneurons below the injury remain intact.
- Motor cortex commands do not reach muscles and muscles atrophy.
- Electrodes can artificially activate muscles and prevent atrophy

UPPER MOTOR NEURON SYNDROME DAMAGE TO DESCENDING PATHWAYS

Damage to the pathways driving the motor neurons

•Spasticity

TONE AND REFLEXES INCREASED
Spastic cerebral palsy for example

LOWER MOTOR NEURON SYNDROME - DAMAGE DIRECT TO MOTOR NEURONS

Diseases or lesions at the level of the motorneuron or its axon

•Atrophy- loss of muscle volume

DECREASED TONE AND REFLEXES
Poliomyelitis for example

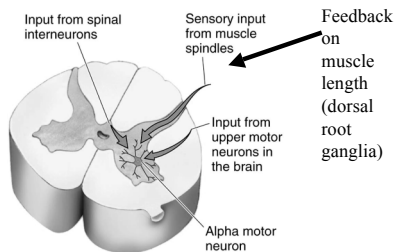
Guillain Barre syndrome

(ghee yan bah ray)

- Syndrome not disease (unclear what disease)
- Paralysis (can be total)
- Attacks Schwann cells, then axons
- Autoimmune
- Similar to MS in CNS
- 70% recovery! Why????
- Following vaccine (rabies, swine flu)
- 1 case per million 1 death per 20 million (normal?)

The Somatic Motor System

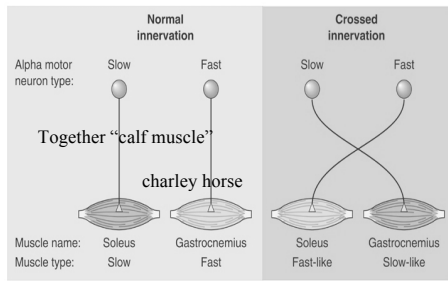
- THREE Inputs to Alpha Motor Neurons



The Somatic Motor System

- Types of Motor Units
 - Red muscle fibers: Large number of mitochondria and enzymes, slow to contract, can sustain contraction
 - White muscle fibers: Few mitochondria, anaerobic metabolism, contract and fatigue rapidly (but POWERFUL - escape)
 - Fast motor units: Rapidly fatiguing white fibers
 - Slow motor units: Slowly fatiguing red fibers

FAST twitch (fatigue rapidly – white) SLOW twitch (fatigue slow – red)



Neuroscience: Exploring the Brain, 3rd Ed., Bear, Connors, and Paradiso Copyright © 2007 Lippincott Williams & Wilkins

Forced change in input – switch phenotype (physical characteristics)
30-60/sec bursts - 10-20/sec steady

Excitation-Contraction Coupling

- Muscle contraction
 - Alpha motor neurons release Ach
 - Innervate muscle fibers
 - ACh produces large EPSP in muscle fibers (via nicotinic Ach receptors)
 - EPSP evokes action potential
 - Action potential (excitation) triggers Ca^{2+} release, leads to fiber contraction
 - Relaxation, Ca^{2+} levels lowered by organelle reuptake

Duchenne Muscular Dystrophy

- Genetic – Duchenne 1 in 3500
- ONLY males, so X-linked
(single X is enough)

X region codes for protein “dystrophin”

In MD, no mRNA for this cytoskeletal protein

Muscles tears

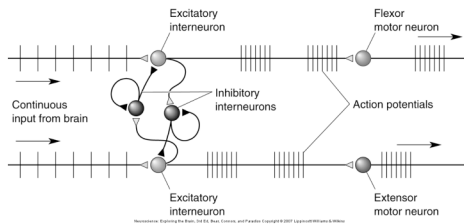
WHY normal phenotype for early life?

Could virus help???? (gene therapy)

Could stem cells help?

Excitation-Contraction Coupling

- The Generation of Spinal Motor Programs for Walking



Excitation-Contraction Coupling

- The Generation of Spinal Motor Programs for Walking

