

MUSCULAR SYSTEM

Muscle is MEAT:

1. Psoas major = Filet mignon
2. 700 skeletal muscles
3. Females = 36%, Males = 42% of total body weight

Why is muscle tissue important?

1. Produces skeletal movement
 - a. gross movement - arms, legs
 - b. fine movement - eye muscles, constrict/dilate in bv's
2. Maintain posture & body position
3. Support soft tissues: abdominal wall
4. Guards orifices: voluntary and involuntary control
5. Maintain body temperature
 - a. muscle contraction: major source of heat
 - b. emergency heating = shivering

Properties of muscle:

1. irritability
2. contractility
3. extensibility
4. elasticity

Muscles contain several tissue types:

1. muscle tissue
2. connective tissue
3. nervous tissue
4. epithelial tissue (blood vessels)

Neuromuscular junction: Synapse

1. nerve impulse arrives at nerve ending
2. causes release of neurotransmitter (acetylcholine)
3. acetylcholine "jumps" the synaptic gap/cleft
4. acetylcholine contacts receptors on motor end plate
5. muscle is stimulated and contracts

Pre-synaptic poisons

- interfere with ACh release (scorpions & botulism)

Post-synaptic poisons

- interfere with ACh reception (snake venom, strychnine)

Mechanism of Contraction

1. Sarcomeres are the functional unit of contraction
2. Myofilaments = actual "contractile" muscle proteins
 - Thin filaments (*Actin*) & Thick filaments (*Myosin*)
3. Arrangement of filaments = striations/banding
4. Contraction: myofilaments slide along each other
5. filaments < sarcomeres < myofibril < fibers < muscle

Types of muscle

Skeletal muscle = voluntary muscle: (ex. arms, legs)

- a. controlled by cranial & spinal nerves
- b. large multi-nucleated cells: syncytium
- c. striated: proteins polarize light differently
- d. NOT branched

Cardiac muscle = involuntary muscle:

- a. single nucleus
- b. striated
- c. branched with intercalated discs

Smooth muscle = involuntary muscle:

- a. blood vessels, digestive, urinary, reproductive
- b. controlled by autonomic NS, hormones
- c. single nucleus, spindle-shaped
- d. NOT striated, NOT branched

Skeletal muscle structure:

1. a muscle consists of 1000's of muscle fibers (cells)
2. a fiber consists of 100's of myofibrils
3. a myofibril subdivided into 1000's of sarcomeres
4. a sarcomere consists of 100's of myofilaments

Skeletal Muscle - Motor unit:

1. a single muscle is composed of several motor units
2. a motor unit is composed of several muscle fibers
3. a single motor neuron controls each motor unit
3. when a neuron fires, all fibers in the motor unit contract
 - a. motor unit = 2-3 fibers: precision-low strength
 - b. motor unit = 500-2000 fibers: strength-low precision

All-or-None principle:

1. single muscle fibers are either on or off
2. single motor units are either on or off
3. contraction of muscle = # motor units that are activated

Muscle tone: resting tension of a muscle

1. some motor units in each muscle are always active
2. activity does not produce movement
3. stabilizes bones and joints
4. generates warmth

Skeletal muscle CT: (coordinated action)

1. Endomysium = CT surrounds single muscle fiber (cells)
2. Perimysium = CT binds muscle fibers into fasciculi
3. Epimysium = CT binds fasciculi together (muscle)
4. Peri- & epimysium fuse together = tendon/aponeurosis
5. Deep fascia = CT separates adjacent muscles
6. Superficial fascia = CT binds skin to underlying muscle

Skeletal muscle terms:

1. Tendon: attaches muscle>bone (ligament: bone>bone)
2. Aponeurosis: broad flat tendon
3. Muscle belly: thick fleshy portion @ center of the muscle
4. Origin: attachment does NOT move during contraction
5. Insertion: attachment DOES move during a contraction
6. Action: movement results from a muscles' contraction
 - a. agonistic - prime mover
 - b. synergistic - muscles accomplish the same task
 - c. antagonistic - muscles work against each other

Organization of skeletal muscle fibers

1. parallel - long fascicles span between tendons
2. convergent - long fascicles radiate from short tendon
3. pennate - short fascicles attach obliquely to tendon
 - unipennate: fascicles insert to one side of long tendon
 - bipennate: fascicles insert to both sides of long tendon
 - multipennate: fascicles insert on multiple tendons
4. circular - arranged in concentric rings = sphincters

Clinical terms

Hypertrophy:

- enlargement of a stimulated/exercised muscle
- # of muscle fibers does not change
- muscle cells simply attain more fibrils

Atrophy: - reduction in muscle size, tone, and power

Muscular dystrophy (MD): Congenital

- decrease in ACh receptors on muscle end-plates, progressive muscle deterioration and weakness

Rigor mortis (occurs after death)

- without ATP, muscles remain contracted

Botulism and tetanus: (bacteria)

- toxins which prevent release of ACh = paralysis