

HUMAN ANATOMY AND PHYSIOLOGY-1(BP101T)

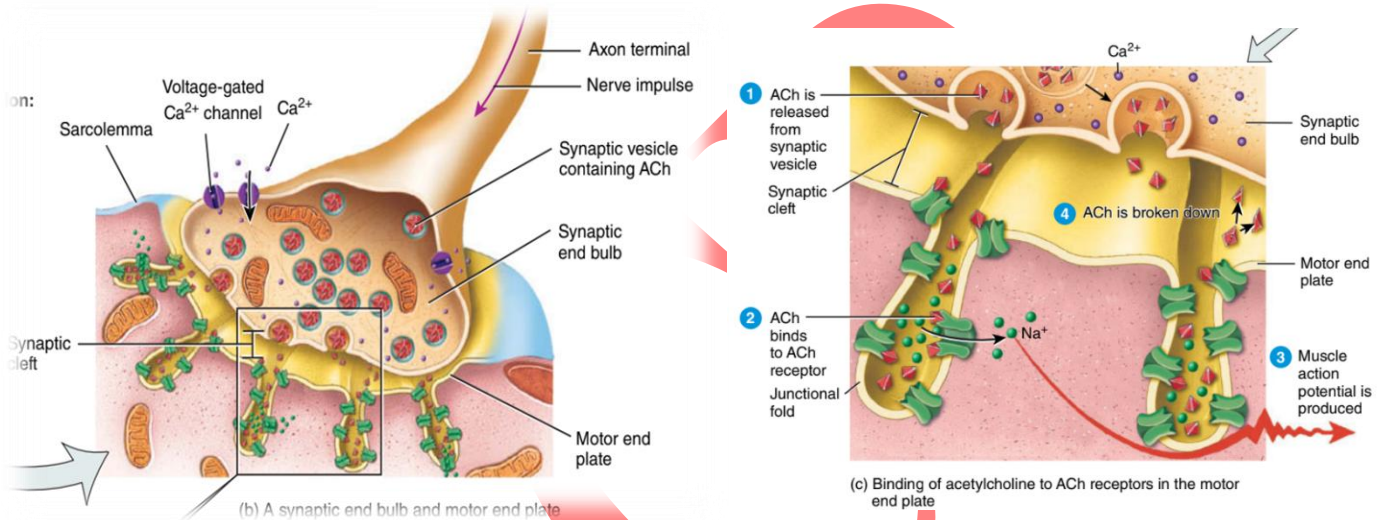
UNIT: 2 SKELETAL SYSTEM

CLASS: 7

TOPIC: NEUROMUSCULAR JUNCTION:

- ✓ Neurons that stimulate skeletal muscle fibers to contract are called **SOMATIC MOTOR NEURONS**.
- ✓ Each somatic motor neuron has a threadlike axon that extends from the brain or spinal cord to a group of skeletal muscle fibers.
- ✓ A muscle fiber contracts in response to one or more action potentials propagating along its sarcolemma and through its system of T tubules.
- ✓ Muscle action potentials arise at the **NEUROMUSCULAR JUNCTION (NMJ)** the synapse between a somatic motor neuron and a skeletal muscle fiber.
- ✓ A **SYNAPSE** is a region where communication occurs between two neurons or between a neuron and a target cell in this case, between a somatic motor neuron and a muscle fiber.
- ✓ At most synapses a small gap, called the **SYNAPTIC CLEFT**, separates the two cells.
- ✓ At the NMJ, the end of the motor neuron, called the axon terminal, divides into a **cluster of synaptic end bulbs** the neural part of the NMJ.
- ✓ Suspended in the cytosol within each synaptic end bulb are hundreds of membrane-enclosed sacs called **SYNAPTIC VESICLES**.
- ✓ Inside each synaptic vesicle are thousands of molecules of acetylcholine (ACh) the neurotransmitter released at the NMJ.
- ✓ The region of the sarcolemma opposite the synaptic end bulbs, called the motor end plate, is the muscular part of the NMJ.

- ✓ Within each motor end plate are 30 million to 40 million acetyl choline receptors, integral transmembrane proteins to which ACh specifically binds.
- ✓ These receptors are abundant in junctional folds, deep grooves in the motor end plate that provide a large surface area for ACh.



1.RELEASE OF ACETYLCHOLINE:

Arrival of the nerve impulse at the synaptic end bulbs stimulates voltage-gated channels to open. Because calcium ions are more concentrated in the extracellular fluid, Ca^{2+} flows inward through the open channels.



The entering Ca^{2+} in turn stimulates the **synaptic vesicles** to undergo **exocytosis**. During exocytosis, the synaptic vesicles fuse with the motor neurons plasma membrane, liberating **ACh** into the **synaptic cleft**.



The ACh then diffuses across the synaptic cleft between the motor neuron and the motor end plate.

2.ACTIVATION OF ACH RECEPTORS:

Binding of two molecules of ACh to the receptor on the motor end plate opens an ion channel in the ACh receptor.



Once the channel is open, small cations, most importantly Na^+ , can flow across the membrane.

3.PRODUCTION OF MUSCLE ACTION POTENTIAL:

The inflow of Na^+ makes the inside of the muscle fiber more positively charged.



This change in the membrane potential triggers a muscle action potential.



Each nerve impulse normally elicits one muscle action potential. The muscle action potential then propagates along the sarcolemma into the system of T tubules.



This causes the sarcoplasmic reticulum to release its stored Ca^{2+} into the sarcoplasm, and the muscle fiber subsequently contracts.

4.TERMINATION OF ACH ACTIVITY:

The effect of ACh binding lasts only briefly because ACh is rapidly broken down by an enzyme called acetylcholinesterase (AChE). This enzyme is located on the extracellular side of the motor end plate membrane.



AChE breaks down ACh into acetyl and choline, products that cannot activate the ACh receptor. If another nerve impulse releases more acetylcholine, steps 2 and 3 repeat.

