physiology

faculty of medicine - JU2017

◉ Sheet ○ Slides

Number

8

Done by:

Ragad Alhawi

Corrected by:

Marah Bitar

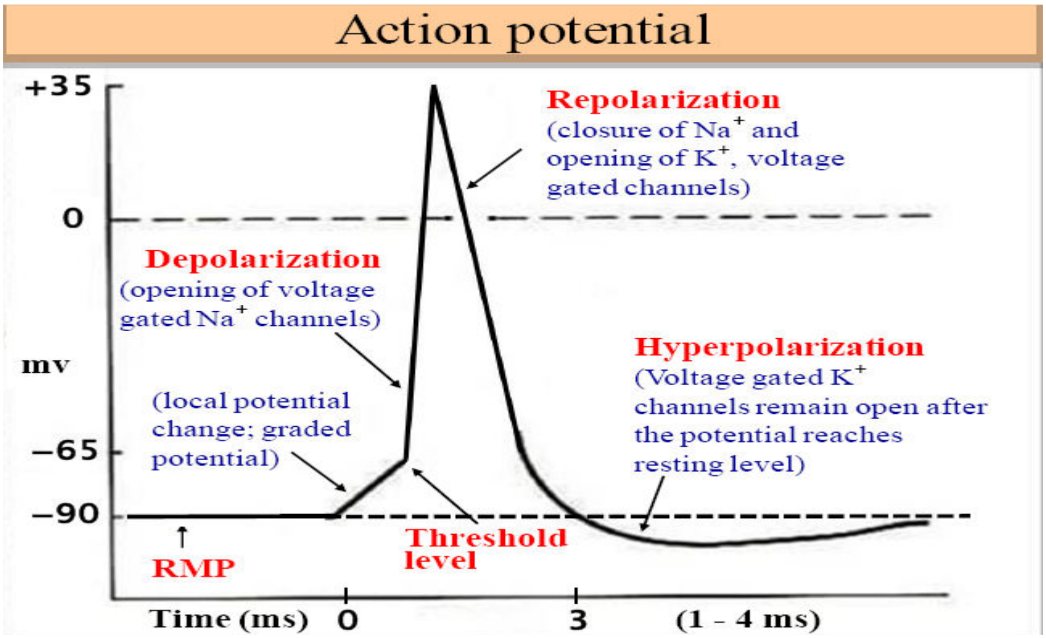
Doctor

Mohammad Khatatbeh

A quick recap of previous lectures

Resting membrane potential: The voltage difference across a cell plasma membrane in the resting state.Different types of cells have different values for the resting membrane potential.

Action potential in nerve fibers: are rapid changes in the membrane potential. Each action potential starts with a sudden change from the normal negative resting membrane potential to a positive potential and ends with an *almost* equally rapid change back to the negative potential.



Resting stage: it is the resting membrane potential before the action potential begins. The membrane is said to be polarized during this stage because of the -90 millivolts membrane potential that is present.

Depolarization stage: the membrane suddenly becomes permeable to sodium ions allowing large numbers of Na+ to diffuse to the interior of the axon. The -90 millivolts potential is immediately neutralized by the inflowing positive sodium ions, it rises in the positive direction. The great excess of Na+ moving to the inside causes the membrane potential to *"overshoot"* beyond the zero level and to become positive.

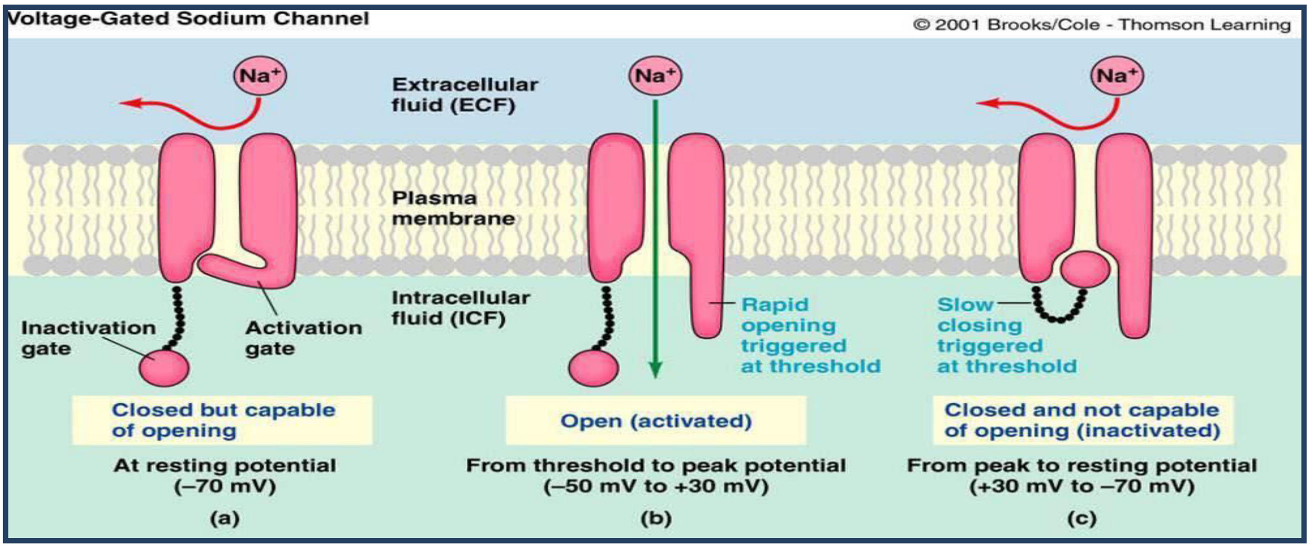
Repolarization stage: after the membrane becomes highly permeable to Na+, sodium channels begin to close and potassium channels open to a greater degree than normal. Rapid diffusion of K+ to the exterior re-establishes the normal negative resting membrane potential.

*Depolarization is faster than repolarization.

Hyperpolarization: the increased outflow of potassium ions carries large numbers of positive charges to the outside of the membrane, leaving more negativity inside the fiber.

Threshold for initiation of the action potential: an action potential will not occur until the initial rise in membrane potential is great enough. In the case of nerve fibers a rise to -65 millivolts is required to initiate the action potential. This level of -65 millivolts is said to be the *threshold* for stimulation. Nerve cells are the most easily excitable cells in the body because they have the smallest threshold.

Voltage- gated sodium channel:



The sodium channel has 3 different states. When the membrane potential becomes less negative, the channel changes its conformation from the closed state to the open activated state. The inactivation of the channel is a slower process. The inactivation gate cannot open again without repolarizing the nerve fiber first.

Role of chloride ion in the action potential (as mentioned in the lecture): permeability of chloride ions increases as the membrane potential becomes less negative. So chloride ions move inside the fiber to try to inhibit depolarization and make the membrane potential go back to its resting state.

Refractory period:

The depolarization that produces Na^+ channel opening also causes delayed activation of K^+ channels and Na^+ channel inactivation, leading to repolarization of the membrane potential as the action potential sweeps along the length of an axon .The action potential leaves the Na^+ channels inactivated and K^+ channels activated for a brief time. These transitory changes make it harder for the axon to produce subsequent action potentials during this interval, which is called the *refractory period*. Thus, the refractory period limits the number of action potentials that a given nerve cell can produce per unit time.

Absolute refractory period	Relative refractory period
This is the time during which another stimulus given to the neuron (no matter how strong) will not lead to a second action potential.	The period during which a stronger than normal stimulus is needed in order to initiate another action potential. After the absolute refractory period, Na^+ channels begin to recover from inactivation and if strong enough stimuli are given to the neuron, it may respond again by generating action potentials.
Na^+ channels are open	Na^+ channels are closed and not capable of opening

Useful links:

https://www.youtube.com/watch?v=OZG8M_ldA1M

note: the graph in this video shows that the resting membrane potential of a nerve fiber is -70 millivolts but Dr Khatatbeh and our book say that it is actually -90 millivolts.

Good Luck