

Answer on Question #76437, Biology / Human Anatomy and Physiology

Under highly-controlled conditions, a small sample of the military-grade nerve gas NOVICHOK is dissolved in the extracellular solution. How does this poison impact the function of the muscle-nerve preparation and muscle directly as above?

Solution:

As far as is known from sources that are freely available, the "NOVICHOK" is a fluorine-phosphorus-organic poisonous substance with an effect similar to organophosphorus poisoning substances (sarin, soman VX) on the human body.

"NOVICHOK" is an inhibitor of acetylcholinesterase, an enzyme that inactivates acetylcholine in a synaptic cleft, thus regulating muscle tone and their motor activity.

Acetylcholinesterase, catalyzes the hydrolysis of acetylcholine, a neurotransmitter mediator. Hydrolysis of acetylcholine in a healthy organism occurs constantly and is necessary to stop the transmission of a nerve impulse, which allows the muscle to return to a state of rest. The phosphorylated cholinesterase produced by organophosphate poisoning is, unlike acetylated, a strong compound and does not undergo spontaneous hydrolysis. The process of inhibiting cholinesterase is a two-step process. At the first stage, reversible, that is, unstable blocking occurs, at the second stage irreversible blocking of the enzyme.

Thus, under the influence of anticholinesterase substances, the destruction of acetylcholine molecules is inhibited and it continues to exert a continuous effect on cholinergic receptors. Poisoning of NOVICHOK leads to a generalized overexcitation of cholinergic receptors, caused by intoxication with endogenous (having an internal origin) acetylcholine. Acetylcholine begins to continuously excite cholinergic (sensitive to its action) receptors, causing at first a strong stimulation, and then a paralysis of the function of organs and tissues. In this regard, the main symptoms of poisoning NOVICHOK can be interpreted as a manifestation of excess, inappropriate for the body activities of a number of structures and organs, which is provided by acetylcholine mediation. Primarily these are nerve cells, striated and smooth muscles.