From Poison to Medicine

Introduction

Chemical weapons are arguably some of the cruelest forms of attack. Organophosphate nerve agents are a family of phosphoric acid ester compounds that are commonly used in this type of warfare. Read the New York Times article below and focus on the symptoms felt and observed by the survivor of the Syrian chemical attack.

<https://www.nytimes.com/2017/04/07/opinion/what-its-like-to-survive-a-sarin-gas-attack.html>

The story above mentions one landmark usage of sarin, a type of organophosphate nerve agent. Sarin is a clear, odorless, lethal liquid. Apart from the attack in Syria, a subway attack in Tokyo also utilized the nerve agent. These important cases have led to significant research into sarin, and especially into its interaction with its biological target, the enzyme acetylcholinesterase (AChE). Throughout this exercise, the interactions of sarin and AChE will be explored.

Sarin inhibits AChE, resulting in the host of symptoms described in the article. AChE is an enzyme that is present in synapses found in the central and peripheral nervous system (commonly at the neuromuscular junction) that hydrolyzes the neurotransmitter acetylcholine.

**Introductory Questions**

Question 1: What symptoms were consistently observed in victims of the sarin chemical attacks?

Question 2: Where does the acetyl-CoA present in the axon terminal that is used in acetylcholine synthesis originate from? Which biochemical pathway gives rise to it, and in which cellular compartments is it formed?

Question 3: Acetylcholine is important for nerve transmission, but it’s also critical that it gets broken down. What would be the result on nerve stimulation if AChE were to be inhibited?

Question 4: How might acetylcholinesterase inhibition lead to the symptom of difficulty breathing that was observed in the victims of the nerve agent attack?