TOXIC SYNDROME DESCRIPTION

Nerve Agents and Organophosphate Pesticides

The purpose of this document is to enable health care workers and public health officials to recognize an unknown or suspected exposure to a nerve agent or an organophosphate (OP) pesticide. Nerve agents are chemical warfare agents that have the same mechanism of action as OP pesticides. They are potent inhibitors of acetylcholinesterase. Inhibition of acetylcholinesterase leads to an accumulation of acetylcholine in the central and peripheral nervous system. Excess acetylcholine produces a predictable cholinergic syndrome consisting of copious respiratory and oral secretions, diarrhea and vomiting, sweating, altered mental status, autonomic instability, and generalized weakness that can progress to paralysis and respiratory arrest.

The amount and route of exposure to the nerve agent or OP pesticide, the type of agent or pesticide, and the premorbid condition of the exposed person will contribute to the time of onset and the severity of illness. For example, inhalation of a nerve agent or an OP pesticide leads to a quicker onset of poisoning with more severe symptoms compared with dermal exposure, given the same amount of agent.

Signs and symptoms

The following is a more comprehensive list of signs and symptoms that may be encountered in a person exposed to a nerve agent or OP pesticide. Signs and symptoms are not listed in order of presentation or specificity. Also, partial presentations (an absence of some of the following signs/symptoms) do not necessarily imply less severe disease.

Central nervous system signs and symptoms

- Miosis (unilateral or bilateral)
- Headache
- Restlessness
- Convulsions
- Loss of consciousness
- Coma

Respiratory signs and symptoms

- Rhinorrhea (perfuse watery runny nose)
- Bronchorrhea (excessive bronchial secretions)
- Wheezing
- Dyspnea (shortness of breath)
- Chest tightness
- Hyperpnea (increased respiratory rate/depth)—early
- Bradypnea (decreased respiratory rate)—late

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Cardiovascular signs

- Tachycardia (increased heart rate)—early
- Hypertension (high blood pressure)—early
- Bradycardia (decreased heart rate)—late
- Hypotension (low blood pressure)—late
- Dysrhythmias (prolonged QT on EKG, ventricular tachycardia)

Gastrointestinal signs and symptoms

- Abdominal pain
- Nausea and vomiting
- Diarrhea
- Urinary incontinence, frequency

Musculoskeletal signs and symptoms

- Weakness (may progress to paralysis)
- Fasciculations (local or generalized)

Skin and mucous membrane signs and symptoms

- Profuse sweating (local or generalized)
- Lacrimation (tear formation)
- Conjunctival injection

Laboratory finding suggestive of nerve agent poisoning

- Decreased plasma or red blood cell (RBC) cholinesterase activity

Limitations

- Wide normal range for enzyme activity makes interpretation difficult without a baseline measurement.
- Cholinesterase activity correlates poorly with severity of local effects after vapor exposures.
- Plasma or RBC cholinesterase may be disproportionately inhibited depending on the particular nerve agent, amount of exposure and time interval since exposure.

Interpreting cholinesterase activity

- Plasma cholinesterase
  - usually declines faster than RBC cholinesterase;
  - is easier to assay than RBC cholinesterase;
  - regenerates faster than RBC cholinesterase;
  - may have a day-to-day variation in enzyme activity as high as 20%;
  - is less specific than RBC cholinesterase; and
  - can show false depression from liver disease, malnutrition, pregnancy, genetic deficiency, or drugs (e.g., codeine, morphine, cocaine, succinylcholine).
- Red blood cell cholinesterase
  - is a better reflection of CNS cholinesterase activity;
  - is more specific test than plasma cholinesterase;
  - may have a day-to-day variation in enzyme activity as high as 10%; and

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- can show false depression from antimalarial therapy or pernicious anemia.

Differential diagnosis

- Carbamate insecticides
- Medicinal carbamates (eg, pyridostigmine, neostigmine, physostigmine)
- Cholinomimetic compounds (eg, pilocarpine, methacholine, bethanechol)
- Nicotine alkaloids (eg, nicotine, coniine)
- Muscarine-containing mushrooms
- Neuromuscular blocking drugs (eg, atracurim, vecuronium)

Note: The actual clinical manifestations of an exposure to a nerve agent or an organophosphate pesticide may be more variable than the syndrome described in this document.