Agricultural Exposure Hazards

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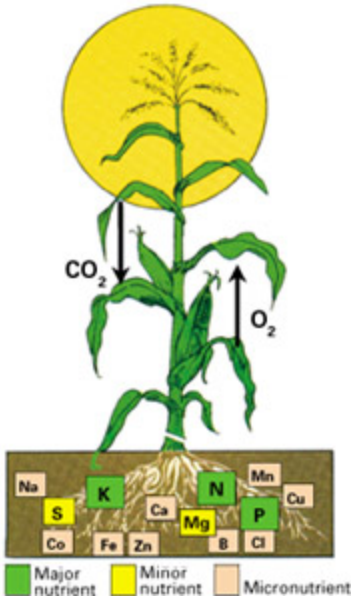


Recently, we were asked to include exposures to agricultural products in the body of our chemical weapons presentation for an agricultural community. Not fully grasping the sheer volume of such products in daily use in the agricultural industry, it was an “eye-opening” experience.

After a rather in depth research of the products most widely used in the community that we were serving, several concepts came to the forefront. First and foremost, it became readily apparent that those individuals working with these products must have a healthy respect for their toxic nature and must also heed warnings and don appropriate PPE, and second, the potency of the organophosphate and carbamate products must be significantly less than that of the “weaponized” chemical organophosphates, as evidenced by the relative infrequency of lethal exposures.

The following presentation is not all-inclusive and only pertains to commonly used agricultural pesticides made from organophosphates and carbamates.

Pesticides

- “A pesticide, herbicide, fungicide, is any chemical substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest” EPA

Exposure to Agricultural Products:

- Organophosphates (insecticides and herbicides)
  - Irreversibly inhibits cholinesterase
  - Many are mixed in hydrocarbons for application
    - Flammability
    - Can degrade latex gloves

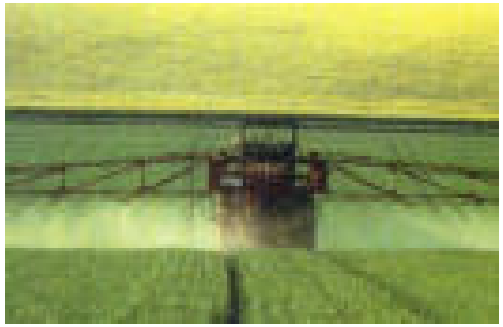
- Carbamates (insecticides and herbicides)
  - Reversible cholinesterase inhibition

Pesticide Statistics

- There are 25,000 pesticides in the U.S.
- There are 20,000 pesticide poisonings annually and this number is thought to be under-reported (Association of Poison Control Centers)
  - Account for 1% of “worker illness”
- 80% of all pesticide poisonings are related to organophosphate or carbamate product exposures
- Type and severity of poisoning are dependent upon
  - Toxicity of pesticide
  - Amount of pesticide involved in exposure

Toxicity

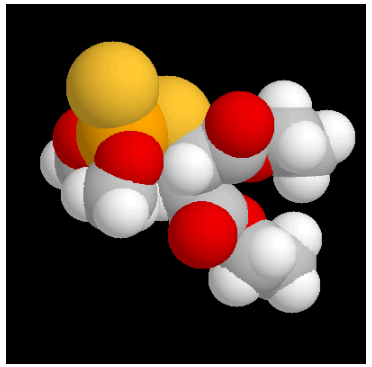
- In 1998, the American Association of Poison Control Centers reported the following:
  - Organophosphate Exposures:
    - 16,392 toxic exposures and 11 deaths
  - Carbamate Exposures:
    - 4,332 toxic exposures and 1 death



Morbidity and Mortality

- Mortality rate is generally low in patients who receive prompt treatment
- Delayed or inadequate treatment can lead to prolonged or permanent neurotoxic symptoms
- Cummulative effects of low dose exposures can be neuropsychological
  - Often severe excessive fatigue, poor concentration, impaired memory, depression, and suicidal thoughts
- Certain organophosphorus esters have been associated with delayed onset of symptoms, taking up to 10 days for symptoms to manifest (OPIDN) or Organophosphate Induced Delayed Neuropathy

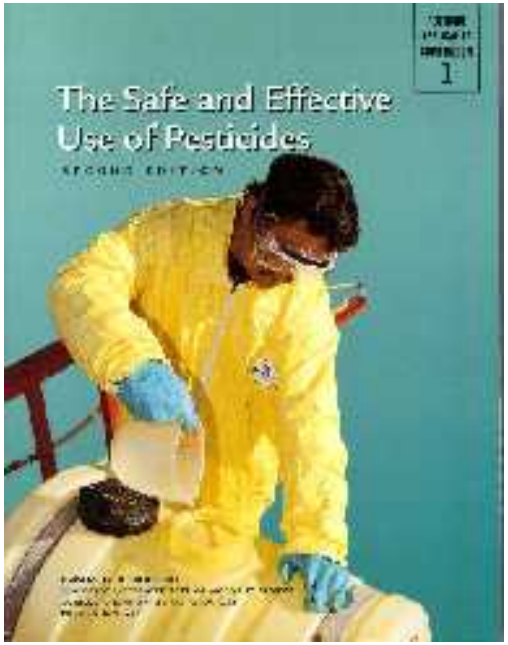
Organophosphates



- Irreversible cholinesterase inhibition
- Treatment with Atropine and 2 Pam (check your agency's administration protocol)
- Insecticides:
    - Organophosphorous
        - Aliphatic amide organothiophospate
        - Oxime organothiophosphate
        - Heterocyclic organothiophosphates
            - Benzothiopyran organothiophosphates
            - Benzotriazine organothiophosphates
            - Isoindole organothiophosphates
            - Isoxazole organothiophosphates
            - Pyrazolopyrimidine organothiophosphates
            - Pyrimidine organothiophosphates
            - Quinoxaline organothiophosphates
            - Thiadizole organothiophosphates
            - Triazole organothiophosphates
        - Phenyl organothiophosphates

Common Organophosphates

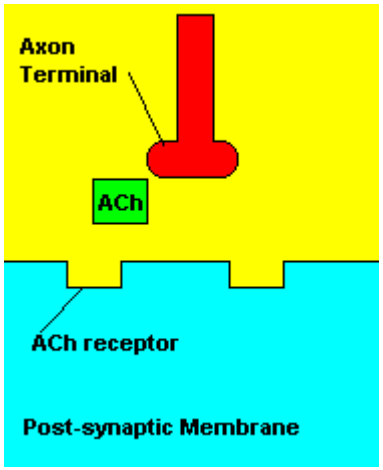
- LORSBAN, DURSBAN (Chlorpyrifos)
- ORTHENE (Acephate)
- BAYTION-C (Chlorphoxim)
- CYGON, DEFEND (Dimethoate)
- MOCAP (Ethoprop)
- SUMITHION (Fenitrothion)
- BAYTEX (Fenthion)
- CYTHION (Malathion)
- DIBROME (Naled)
- COUNTER (Terbufos)
- TABUN
- SARIN
- SOMAN



Pesticide Poisonings

- Pesticides can be rapidly absorbed through the lungs, skin, GI tract, and mucus membranes
- Symptoms typically appear within a few hours of exposure
- Large doses can produce immediate symptoms
- Some of the highly lipid-soluble organophosphates may cause only mild initial symptoms and may not produce a cholinergic crisis for 24-96 hours
- Organophosphate compounds used as nerve agents for warfare are particularly potent, causing death more rapidly and frequently than organophosphate compounds used as pesticides

Toxic Effects of Pesticide Poisonings



- Nicotinic Effects:
  - Muscle weakness, fasciculation's, areflexia, paralysis, hypertension, tachycardia
- CNS Effects:
  - Confusion and seizures
- Muscarinic Effects: SLUDGE
  - Increased contractions of smooth muscle: GI tract and ureters, increased secretions of gland cells: lacrimal, sweat, salivary, gastric, intestinal, pancreatic, bradycardia, bronchoconstriction, miosis** (key clinical finding)

Acute Pesticide Poisonings

- Common presenting symptoms:
  - Headache
  - Diffuse muscle cramping
  - Generalized weakness
  - Excessive secretions
  - Nausea, vomiting, diarrhea
  - Seizures, coma, paralysis
  - Respiratory failure
    - Most common cause of death, yet rare 0.04-1% in typical poisonings

Delayed Poisonings

- Common presenting symptoms
  - Cramping
  - Tingling
  - Ataxia
  - Weakness in lower extremities
  - May be progressive in nature

Immediate Actions

- Removal from source
- Placement in a well-ventilated area
- Removal of contaminated clothing
  - Patients should be advised to have clothing destroyed
- Decontamination of skin
- Airway management
- Establish IV access

Treatment of Pesticide Poisoning

- Atropine: antagonizes Ach at the muscarinic receptors ADMINISTER PRIOR TO Pralidoxime chloride
  - Dosing regimens are varied, check with your local protocol
  - Adult: (initial or diagnostic dose 1mg IV)
  - 2-4 mg/dose IV every 15 minutes to effect (drying of pulmonary secretions) *Reports of 2mg/kg/hr IV drip for prolonged periods to control secretions exist
  - Pediatric: (initial or diagnostic dose 0.015mg/kg IV)
  - 0.015-0.05 mg/kg IV to effect every 15 minutes to effect (significant reduction in secretions)

http://www.emedicine.com/EMERG/topic346.htm

Pralidoxime chloride

- Pralidoxime chloride: reverses inhibition of acetylcholinesterase and nicontinic effects. Rarely needed in carbamate poisonings. Must be used early in course of poisoning to be effective, before organophosphate-acetylcholinesterase bond has aged.
  - Dosing regimens are varied, check with your local protocol
  - Adult: Initial bolus 1-2 grams IV over 15 minutes initial, followed by 500 mg/hour IV until improved muscle strength
  - Pediatric: 25 mg/kg IV over 30 minutes initial, followed by 10-20 mg/kg/hour IV until improved muscle strength

http://www.emedicine.com/EMERG/topic346.htm

Diazepam

- Valium is used for control of seizures and depresses all levels of CNS activity
  - Adult: 5-10 mg IV over 3-5 minutes
  - Pediatric:
    - 0 days-5 years: 0.2-0.5 mg IV (slowly) every 2-5 minutes until symptoms resolve; not to exceed 5 mg
    - >5 years: 1mg IV (slowly) every 2-5 minutes until symptoms resolve, not to exceed 10 mg

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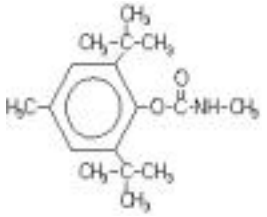
Carbamates

- Reversible cholinesterase inhibition
  - Inhibition generally lasts about 6 hours
  - Clinical presentation is similar to organophosphate toxicity
- Treated with large quantities of Atropine (check your agency's administration protocol)
- 2 Pam is not indicated for a "pure exposure", if purity is unknown and organophosphates have been added, refer to organophosphate treatment
- Many classes of carbamates:
  - Insecticides
    - Benzofuranyl methylcarbamate
    - Dimethylcarbamate
    - Oxime carbamate
    - Phenyl methylcarbamate

Carbamates



– Herbicides
  - Asulam
  - Carboxazole
  - Chloroprocarb
  - Dichlormate
  - Fenasulam
  - Karbutilate
  - Terbucarb

Common Carbamates

- SEVIN (Carbaryl)
- APHIX, RAPID (Primicarb)
- BAYGON (Propoxur)
- LANDRIN (Timethacarb)
- FURADAN (Carbofuran)

References

- EPA, http://www.epa.gov/pesticides
- IRIS database, http://www.epa.gov/ngipgm3-iris
- Poison Control Center, http://www.ace.orst.edu/info/nptn
- http://www.gn.apc.org/pesticidestrust/aifacts/organo.html
- http://poison.org/organph.htm
- http://www.neihs.nih.gov/biology/docs/ACE.html
- Emedicine, http://www.emedicine.com/EMERG/topics346.htm
- Online Lawyer Source, http://www.onlinelawyersource.com/pesticides/organophosphate.html
- Classification of Herbicides, http://www.hclrss.demon.co.uk/class_herbicides.html
- Classification of Insecticides, http://www.hclrss.demon.co.uk/class_insecticides.html

References

- The Fertilizer Institute, http://www.tfi.org
- National Ag Safety Database, http://www.cdc.gov/nasd/docs/d001100/d001062/d00162.html
- Fire Nuggets, http://www.firenuggets.com/schnepp.htm
- National Safety Council, http://www.nsc.org/library/facts/agrinam.htm
- Agency For Toxic Substances And Disease Registry, http://www.atsdr.cdc.gov/MHMI/mmg126.html
- CDC National Center for Environmental Health, http://www.cdc.gov/nceh/demil/articles/initialtreat.htm
- Family Practice notebook.com, http://www.fpnotebook.com/NEU183.htm