MCN Sponsored Webinar: The Nuts and Bolts of Cholinesterase Monitoring for Farmers, Ranchers and Agricultural Workers

3/28/2012

Disclosure Statement

Faculty: Matthew Keifer, MD, MPH and Carolyn Sheridan, BSN, RN

Disclosure: We have no real or perceived vested interests that relate to this presentation nor do we have any relationships with pharmaceutical companies, biomedical device manufacturers, and/or other corporations whose products or services are related to pertinent therapeutic areas.

Sponsoring Organizations

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Objectives

1. Assess the human health importance of cholinesterase screening.
2. Identify which types of pesticides require cholinesterase screening and the people most likely to be exposed to those pesticides.
3. Analyze screening protocols including baseline testing, laboratory specifics, and follow up for applicability to clinic sites.
4. Evaluate appropriate testing and follow up for acute exposures.
5. Discuss roles and responsibilities of providers in screening, prevention, treatment and follow-up of pesticide exposures.

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Cholinesterase in Washington State

One BIG state-wide experiment

- Cholinesterase (ChE) monitoring since 2004
- Applicators of class 1 & 2 Organophosphates (OPs) and carbamates
- >30 hrs in 30 days

Is Significant Exposure Happening? ChE in WA Handlers 2006

Benefits of Che Monitoring

- Remove overexposed workers before illness begins
- Identify failures in worker protection
- Raise awareness of hazards of chemicals monitored
- Diagnose acute overexposure
- Drives the financial equation toward safer chemicals

Cholinesterase Protocol for Healthcare Providers

- Whom to Test?
- Testing
- Post Exposure Testing
- Medical Removal
- Level of Return to Handling
- Review of Handling Practices

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Pesticide Exposure Health Risk

- Some of the most toxic pesticides are insecticides
- Some of the most toxic insecticides are cholinesterase inhibitors (LD₅₀ 0.5 - 1000 mg/kg)
- Organophosphates (OP) and N-methyl – carbamates are the insecticidal cholinesterase inhibitors

Cholinesterase Algorithm

Organophosphates: Born of A Bad Seed

- OPs and carbamates inhibit cholinesterase
- Toxicity is similar but OPs have longer inhibitory persistence
- OPs found to be in Nazi Germany
- Tabun, Sarin, Cyclosarin and Soman are their homicidal sibs

Route and Toxicity Oral vs. Dermal LD₅₀ of some OPs

<table>
<thead>
<tr>
<th>Organophosphate</th>
<th>Oral</th>
<th>Dermal</th>
<th>Dermal/Oral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phorate</td>
<td>2 mg/kg</td>
<td>6 mg/kg</td>
<td>3</td>
</tr>
<tr>
<td>Azinphos-Methyl</td>
<td>13 mg/kg</td>
<td>220 mg/kg</td>
<td>17</td>
</tr>
<tr>
<td>Methamidaphos (rat)</td>
<td>32 mg/kg</td>
<td>94 mg/kg</td>
<td>3</td>
</tr>
<tr>
<td>Oxydemeton (rat)</td>
<td>75 mg/kg</td>
<td>250 mg/kg</td>
<td>3</td>
</tr>
<tr>
<td>Diazinon (rat)</td>
<td>108 mg/kg</td>
<td>900 mg/kg</td>
<td>9</td>
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<tr>
<td>Phosalone (rat)</td>
<td>130 mg/kg</td>
<td>1500 mg/kg</td>
<td>12</td>
</tr>
<tr>
<td>Chlorpyrifos (rat)</td>
<td>155 mg/kg</td>
<td>202 mg/kg</td>
<td>1.3</td>
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<tr>
<td>Malathion (rat)</td>
<td>1375 mg/kg</td>
<td>4444 mg/kg</td>
<td>3</td>
</tr>
<tr>
<td>Aldicarb (rat)</td>
<td>0.5 mg/kg</td>
<td>3.5 mg/kg</td>
<td>3</td>
</tr>
</tbody>
</table>
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Plasma and Acetyl cholinesterase

What is Cholinesterase?

Toxicity of Cholinesterase Inhibitors
Organophosphates /Carbamates

Muscarinic SXs
- Miosis
- Diaphoresis
- Salivation
- Lacrimation
- Urination
- Defecation
- Gastroenteric cramping
- Emissis

Nicotinic SXs
- Diaphoresis
- Salivation
- Headaches
- Weakness
- Nausea
- Resp Paralysis
- Fasciculations

Miosis:
a characteristic of OP and Carbamate poisoning

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Who to Monitor?
- Individuals who apply Class I or II Organophosphate pesticides or Organophosphates and N-methyl-Carbamates
- Working 30 or more hours within any 30-day period

Why not Carbamates?
Work by Fowler P and Mkenzie J. 1967

What to Measure
- Measure both acetylcholinesterase (red blood cell cholinesterase-AChE) and butyryl cholinesterase (plasma cholinesterase-PChE)
- Use the same laboratory and the same methodology for all testing so that results may be accurately compared. Repeat baselines yearly

Working Baseline Guidelines
- Perform a 2nd baseline after halting exposure. If values differ by more than 10%, obtain a third baseline.
- The highest value should be used as the baseline.
- Attempt to obtain longest non-exposure interval before baseline testing.

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AChE versus PChE

- Red blood cell turnover is slow (about 3 months)
  - AChE measurements reflect this slow replacement rate.
    100/120= 0.83% recovery per day
- PChE turnover is quicker. Estimates are about 1.2% recovery per day
  - PChE is more sensitive to certain organophosphates.
- Obtain a baseline reading of both measures during the non-exposed period, at least 30 days since the last exposure to OP pesticides. Two baseline values ideal. Average the values.

Post Exposure Testing Guidelines

- Ideal: Test within 3 days of any 30-day period in which individual has met or exceeded handling hours threshold.
- Compare each reading to individual's baseline and calculate per cent of activity relative to baseline.
- % act. = BL act – PE act/BL act x100

Action Levels

- Evaluate Work Place
  - >20% decrease from baseline in AChE or PChE = Evaluate work practices
- Medical Removal
  - >30% decrease in AChE or >40% decrease in PChE
  - Remove worker from exposure to OPs and carbamates until levels return to within 80% of baseline

Return to Work

- Level to Return to Work
  - Return to work when test result is greater than or equal to 80% of baseline.
- Retest for Return to Work
  - Days to repeat test is determined by degree of ChE activity reduction.
  - RBC: (% depression - 20) / 0.83 = # of days to repeat test
  - Plasma: (% depression - 20) / 1.2 = # of days to repeat test
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**Review Work Practices**
- Review work practices when test result is less than 80% of baseline.
  - Reading and understanding label
  - Use of personal protective equipment
  - Pesticide handling practices
  - Precautions taken with chemical spills
  - Reporting symptoms
  - Reporting exposures

**Role of Clinician**
- Monitor Cholinesterase levels
- Understand signs and symptoms
- Review protective measures with patient
- Review protective measures with employer
- Report
- Remember – No need to be an expert
  - Plenty of resources!

**MCN’s Environmental and Occupational Health Program**
- SIMPLE, Flexible, Effective
- Partnerships with Health Centers
- Practical Training for Primary Care Providers
- Resources
- Connecting Primary Care to Occupational and Environmental Medicine
- Technical Assistance

**MCN’s Pesticide Exposure Reporting Map**
[www.migrantclinician.org](http://www.migrantclinician.org)

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Pesticide Reporting Information

EPA Worker Protection Standard

- Contains requirements for:
  - Pesticide safety training
  - Notification of pesticide applications
  - Use of PPE
  - Restricted entry after pesticide application
  - Decontamination supplies
  - Emergency medical assistance

Information available at www.epa.gov

Prevent Exposure

Education

- Read the Label
  - Look for "precautionary statement" which describes how poisonous the product is and how to best protect yourself
  - Use of restricted pesticides requires specialized training and certification
- Partner with organization offering the Pesticide Applicator Training

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Personal Protective Equipment

Head to Toe Protection

- Wear head protection – waterproof disposable hood or plastic wide brim hat
- Wear unlined, chemical resistant gloves (neoprene and nitrile are best) – \textit{do not wear cotton or leather}
- Chemical resistant aprons
- Unlined rubber neoprene or PVC boots or shoes willing to discard
- Wear eye protection – goggles with indirect vent and fog- free lenses
- Disposable coveralls such as Tyvex or long sleeved shirts and pants
- If label says wear a respirator – wear one


Employee Rights and Responsibilities

You have the right to:
- A safe and healthful workplace
- Know about hazardous chemicals
- Information about injuries and illnesses in your workplace
- Complain or request hazard correction from employer

Employee Rights and Responsibilities

You have the right to:
- Training
- Hazard exposure and medical records
- File a complaint with OSHA
- Participate in an OSHA inspection
- Be free from retaliation for exercising safety and health rights

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Employee Rights and Responsibilities

- OSHA website: [www.osha.gov](http://www.osha.gov) and OSHA offices: Call or Write (800-321-OSHA)
- Compliance Assistance Specialists in the area offices
- National Institute for Occupational Safety and Health (NIOSH) – OSHA’s sister agency
- OSHA Training Institute Education Centers
- Doctors, nurses, other health care providers
- Public libraries
- Other local, community-based resources

Resources

- ChE Protocol
- ChE Algorithm
- EPA’s Recognition and Management of Pesticide Poisonings
- *Handbook of Pesticide Toxicology, 1991*
- EPA Pesticide Guidelines
- [www.epa.gov/pesticides/](http://www.epa.gov/pesticides/)
- [www.osha.gov](http://www.osha.gov)

All Resources: [www.migrantclinician.org/nutsandboltsresources](http://www.migrantclinician.org/nutsandboltsresources)

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- Please help us continue to provide webinars and complete the evaluation
- Must complete evaluation to receive CME/CNE
- Thank you!

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- This material was made possible, in part, from Grant Number U30CS09742 from the US Department of Health and Human Services, Bureau of Primary Health Care, Health Resources Services Administration. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the US Department of Health and Human Services.

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