Cholinesterase Monitoring in Washington State

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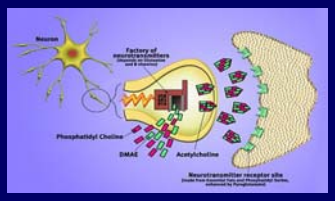
Thank you to Jonathan H. Siekmann, Ph.D

What Is Cholinesterase (ChE)?

- Enzyme
- Present in nerves, brain, and muscle
- Nervous system's "off" switch
- If ↓ ChE → ↑↑↑ acetylcholine → overstimulation & exhaustion of nervous system



Cholinesterase-inhibiting Pesticides

- Organophosphates
- N-methyl-carbamates
- Toxicity class I & II products
  - "DANGER" or "WARNING" on the label
    Class I LD 50 of < 50 mg oral or 100 dermal
    Class II LD 50 of >50 <500 oral or <1000 dermal

Pesticide-Related Illness

- Mild
  - tiredness, weakness, dizziness, nausea, blurred vision
- Moderate
  - headache, stomach cramps, sweating, drooling, vomiting, tearing, twitching
- Severe
  - urinating, diarrhea, muscle twitching, staggering gait, pinpoint pupils, seizures, hypotension, slow heartbeat, breathing difficulty, coma , death

Blood Cholinesterase: Convenient Biomarker

- Red Blood Cell (RBC) ChE
  - Sensitive to organophosphates
  - Measures longer-term exposures
  - Slow recovery
- Serum ChE
  - Sensitive to most ChE inhibiting pesticides
  - Measures recent exposures
  - Rapid recovery

Measure both for accurate picture of exposures

Considerations

- Normal individual ChE levels vary
  - Establish exposure-free baseline
  - Compare periodic samples to baseline
- Different analytical methods exist
  - Use same laboratory
  - Use same method
- "Depression" is a decrease in ChE activity in periodic sample vs. baseline

Why Monitor Cholinesterase?

- Detect overexposure to pesticides
- Increase hazard awareness
- Identify unsafe environments & fix problems
- Reduce risk of possible long-term adverse health effects
- Decrease take-home exposures

ChE Monitoring in Washington: History and Legal Authority

- 1993 – ChE monitoring recommended
- 2002 – Rios v Washington
- 2003 – WAC 296-307-148 adopted
- 2004 – 1st year of operation
- 2006 – Final SAC report
- 2007 – Move to commercial laboratory

Who is Tested in Washington?

Agricultural handlers of Class I and II

- Organophosphates
- N-methyl Carbamates

Exposure threshold:

2004	≥50 hours handling in 30 days
2005	≥30 hours handling in 30 days

Pesticide Handling

- **Agriculture pesticide handling***
  - Mixing, loading transferring applying
  - Disposing of pesticides or pesticide containers
  - Handling open containers of pesticides
  - Acting as a flagger
  - Cleaning, maintaining equipment that may contain pesticide residue
  - Assisting with application

**** See WPS for complete definition***

Handler Participation

- May decline participation
- Employer provided training
- Informed consent process with medical provider
- Signed declination statement
- Averaged ~12% annual declination rate

Required Actions

- **Work practice investigation**
  - ≥20% depression in either RBC or serum ChE
- **Exposure removal**
  - ≥30% depression in RBC ChE*

    or
  - ≥40% depression in serum ChE*

**Can return to handling when within 20% of baseline*

Experience

	2004	2005	2006	2007*
• # Employers	370	312	244	219
• # Baseline tests	2630	2239	1889	1859
• # Periodic tests	1048	994	692	494
• # Employees with periodic tests	580	612	471	362

** Preliminary numbers*

Experience

	2004	2005	2006	2007*
• Work practice investigations	97 (17%)	49 (8%)	50 (11%)	48 (13%)
• # Medical removals	22 (4%)	10 (2%)	7 (1%)	14 (4%)
Total	119 (21%)	59 (10%)	57 (12%)	62 (17%)

Work Site Violations

- Respiratory Protection
- Personal Protective Equipment
- Personal clothing as exposure source
- Decontamination
- Pesticide Handler Training

Effects

- Increased knowledge
- Increased hazard awareness
- Training integration
- Changes in pest management practices
- Improved medical services
- Increased stakeholder collaboration