Living and Working in Agriculture

Case Report of Severe Acute Illness in a Toddler Exposed to Pesticides

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Office of Environmental Public Health
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Outline

1. Background
2. Case report
3. Investigation
4. Conclusion
Pesticide Illness Monitoring and Prevention

WA State Department of Health’s Program:

- Investigates reports of pesticide-related illness
- 250–300 reports investigated annually
- Sentinel Event Notification System for Occupational Risk (SENSOR)–Pesticides
How Does EPA Know There Is a Problem with a Chemical?

- **Reports from Clinicians**
  - These are rare

- **Surveillance data**
  - State systems like Washington
  - NIOSH SENSOR system
    - Both dependent on clinician reporting

- **Poison Control Data**
  - Mostly Clinician reports are biased toward children and exposures not poisonings

- **6(a)2 reports from Registrants**
  - Dependent on clinician reports
Agricultural and Non-Agricultural Occupational Cases (2007–2013)
# Pesticides and human health

## Potential long-term effects
- Learning disabilities
- Endocrine disrupters
- Cancers
- Asthma, COPD, chronic bronchitis
- Parkinson’s Disease

## Acute health effects
- Eye and Skin
- Neurological
- Gastrointestinal
- Respiratory
- Cardiovascular
- General
Pesticide poisoning—high risk populations

- Agricultural workers, other occupations that work with pesticides
- Pregnant women, and growing fetus
- Children

Photo: Petra Cortes Lopez
Numerous epidemiological and laboratory animal studies have associated prenatal parental pesticide exposure with adverse neurodevelopmental effects in their offspring.
Agricultural work
Occidental & Environmental History

For the adult patient and the pediatric patient

After establishing the chief complaint and history of the presenting illness...

Photo credit: Eric Lafforgue

Photo: LoraxGirl
## Top 10 pesticides involved in acute occupational pesticide-related illness

<table>
<thead>
<tr>
<th>Rank</th>
<th>Pesticide Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pyrethroids</td>
</tr>
<tr>
<td>2</td>
<td>Chlorinated compounds</td>
</tr>
<tr>
<td>3</td>
<td>Organophosphates</td>
</tr>
<tr>
<td>4</td>
<td>Pyrethrins</td>
</tr>
<tr>
<td>5</td>
<td>Glyphosate</td>
</tr>
<tr>
<td>6</td>
<td>Ammonium/ammonia</td>
</tr>
<tr>
<td>7</td>
<td>N-methyl carbamates</td>
</tr>
<tr>
<td>8</td>
<td>DEET</td>
</tr>
<tr>
<td>9</td>
<td>Sulfur compounds</td>
</tr>
<tr>
<td>10</td>
<td>Triazines</td>
</tr>
</tbody>
</table>

2005–2009 SENSOR Pesticides Program (n=9,906)
Pyrethroid *products*

neurotoxic, irritants

Not absorbed well across intact skin; efficiently absorbed by gut
Cholinesterase inhibiting pesticides

N-methyl carbamates
- Carbaryl
- Methomyl

- Sign/Sx: miosis, salivations, sweating, HA, NVD, bradycardia, respiratory depression.
- Antidote = atropine
- Also useful in first 24 hrs – 2 PAM
- Carbamates (AchE inhibition spontaneously reversible)

Organophosphates (OPs)
- Chlorpyrifos
- Diazinon

Photos: [www.keystonepestsolutions.com](http://www.keystonepestsolutions.com)
DEET
Low toxicity, but may be neurotoxic following ingestion or repeated topical application. Absorbed across skin & gut.

Reported symptoms in children:
- Myoclonus
- Low blood pressure
- Reduced consciousness
- Respiratory difficulty
- Seizures
- Coma
- Unreactive, dilated pupils

OFF!
Laws & requirements

PESTICIDE LABELS: “Don’t drift” on people, plants, water…
Suddenly, child wasn’t breathing
Hospital presentation

- Pale
- Limp
- Somnolent, but reactive to physical stimulation
- In and out of consciousness
- He would stop breathing for 15–20 seconds repeatedly
- Tachycardic
- Copious respiratory secretions
Diagnostics

- Nasal and oral exams were unremarkable
- X-ray of neck and chest
- Ingestion of OP (organophosphate)?
- Wouldn’t expect such extreme reaction from the insecticide & fungicide

Lambda Cyhalothrin (Pyrethroid)
Trifloxystrobin
Transferred for specialized care

Approximately 4 hours after symptom-onset:

- Pinpoint pupils observed
- Some apneic episodes
- Continued sleepiness
- Urine drug screen negative
As evening progressed...

- He became more alert
- Behaved appropriately
- No further respiratory distress

- Remained for observation and discharged the next day, asymptomatic
Investigation

18 mo/old ate cherries recently sprayed…

Get the cherries!

Did they collect blood? urine?

Have his clothes been washed yet?
Family’s home is building on the right. Apple orchard faces this Bulletin board and their home.
On the way out, sitting next to the front door was a can of Deep Woods Off! (98% DEET)

They always put it on before going out. That Saturday, the father put it on his shirt. Then he applied to his son with his hand (father’s), sprayed with the Off!
Your ideas?
WSDA Lab Results

Cherries
- Pyrethroid scan
- OP & Carbamate scans
- Imidacloprid

Child’s clothing
- DEET
- Pyrethroid scan
- OP & Carbamate scans

1st orchard, 2nd orchard

<table>
<thead>
<tr>
<th>Compound</th>
<th>1st orchard</th>
<th>2nd orchard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamda-Cyhalothrin</td>
<td>120 ppb</td>
<td>64 ppb</td>
</tr>
<tr>
<td>Trifloxystrobin</td>
<td>180 ppb</td>
<td>30 ppb</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>33 ppb, &lt;LOQ</td>
<td>&lt;LOQ</td>
</tr>
<tr>
<td>Myclobutanil</td>
<td>27 ppb, &lt;LOQ</td>
<td>&lt;LOQ</td>
</tr>
<tr>
<td>Methoxyfenozide</td>
<td>1 ppb, &lt;LOQ</td>
<td>&lt;LOQ</td>
</tr>
<tr>
<td>DEET</td>
<td>&lt;LOQ</td>
<td>&lt;LOQ</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>290 µg</td>
<td>1.6 µg</td>
</tr>
<tr>
<td>Trifloxystrobin</td>
<td>&lt;LOQ</td>
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Possible sources of Carbaryl residue on child’s shirt:

Father’s work before taking son to cherry orchard?

He thinned branches in an apple Orchard (owned by same orchardist above) before taking son to cherries. He does not apply pesticides. He didn’t change clothes before going with son.

Family’s laundry?

Father and mother both work in the orchards. Up to the event, they Hadn’t separated their work clothes

Apple Orchard near home?

Orchardist confirmed that he uses Carbaryl as a thinning agent. He didn’t want to share spray records, he said the father also works for other orchards…
What about biological measures?

- Lab results indicated DEET & Carbaryl residues on the child’s shirt (not helpful as far as determining dose)

DEET biological measures:
- Excreted rapidly- 12-24 hrs. Measuring DEET in blood not widely available. (usually measured in urine).

Carbaryl biological measures:
- Reversible binding to AChE will likely show normal range for blood cholinesterase test (even if collected within 6 hrs of acute cholinergic crisis).
- Excreted rapidly (~48 hrs) in feces and urine. Urine is best way to measure for absorption: look for 1-napthol analyte. Source: NPIC fact sheet

Decided not to run any tests on frozen serum collected approximately 7 hrs post exposure.
Evaluating the Toxicology

1. DEET  *dermal & oral*

2. Lambda-cyhalothrin  *oral*

3. Trifloroxystrobin  *ingestion*

4. Carbaryl  *oral and dermal*
DEET
Low toxicity, but may be neurotoxic following ingestion or repeated topical application. Absorbed across skin & gut.

Child’s presentation

Reported symptoms in children:
- Myoclonus
- Low blood pressure
- Reduced consciousness
- Respiratory difficulty
- Seizures
- Coma
- Unreactive, dilated pupils
Lambda–Cyhalothrin
Irritants, neurotoxic
Not absorbed well across intact skin; efficiently absorbed by gut

Reported sx in humans from ingestion:
- Throat irritation
- Nausea, vomiting, abdominal pain
- Increased salivation
- Dizziness
- Headache
- Fatigue

Reported sx in laboratory animals:
- Course tremor
- Reflex hyperexcitability
- Profuse salivation
- Seizure

Child’s presentation
Trifloxystrobin

- A low-toxicity fungicide
- In rodent testing, not found to be neurotoxic (oral)
- Some sx reported in humans:
  - Upper respiratory tract pain (inhalation)
  - Dermal & eye irritation upon direct contact
Carbaryl

Moderately toxic by ingestion
Acts as an acetylcholinesterase (AChE) inhibitor
Unlike Organophosphates, the cholinesterase inhibition is spontaneously reversible

Child’s presentation

Early sx of carbaryl exposure:
- Headache
- Nausea
- Muscle weakness
- Restlessness

Common sx found in children:
- Stupor
- Coma
- Hypotonia
- Miosis
- Bronchorrhea
- Tachycardia
- Excessive salivation
- Lethargy
- Respiratory distress
- Respiratory failure
Pesticide Interaction

Supporting literature:

- DEET, Carbaryl, & Pyrethroid synergistic interaction? Organophosphates administered with pyrethroids slows pyrethroid breakdown, increasing toxicity

- DEET acts synergistically with cholinesterase inhibitors and pyrethroids, increasing toxicity
Quick Recap

- A father went with his 18-month-old son on a 4-wheel ATV to pick some cherries (after he’d thinned apple trees that morning)

- The father rubbed several cherries on his shirt before giving to child to eat

- About 20 minutes later, in the home, the child appeared to choke as he ate cherries
His parents gave the child CPR and took him to nearest hospital. Choking ruled out.

Child in and out of consciousness, limp, somnolent, copious respiratory secretions

The hospital learned from orchardist what the cherries were sprayed with that same day and 2 days earlier. Presentation didn’t match pesticide toxicology
Recap

- Healthcare providers supported respiratory needs; child transferred to tertiary hospital
- Among other signs, child observed having pinpoint pupils
- Within 12 ½ hours of eating first cherries, child acting like normal self. Eating, drinking, alert
Conclusion
Carbaryl intoxication

- symptoms most consistent
- But enough to cause such serious illness?
- Possible synergistic interaction between DEET and Carbaryl; DEET may have decreased pyrethroid breakdown, increasing toxicity
Prevention

In addition to those who handle pesticides, training for farm workers who don’t apply or handle pesticides must emphasize:

- Danger of residues
- Take–home exposure
- Types of pesticides and toxicity
Lessons learned

- Get an environmental and occupational history
  - Pesticide source inquiry stopped at the cherries ingested.
  - DOH investigator asked parent for child’s clothing, didn’t think to ask for Dad’s shirt! (until too late)

- Collect urine and/or whole blood, plasma within first hours of presentation if possible and freeze
  - NPIC resource: 1–800–858–7378
Picture and Data Resources

- [https://www.flickr.com/photos/shavar/27886472/](https://www.flickr.com/photos/shavar/27886472/) slide 2
- [https://www.flickr.com/photos/oblomberg/8734358464/](https://www.flickr.com/photos/oblomberg/8734358464/) Slide 4
- [https://www.flickr.com/photos/petris2289/3013076611/](https://www.flickr.com/photos/petris2289/3013076611/) Slide 7
- [www.ericlafforgue.com](http://www.ericlafforgue.com) slide


Thank You

Jennifer Sievert

www.doh.wa.gov/pesticides