Pyrethrin and Pyrethroid Illnesses in the Pacific Northwest: A Five-Year Review

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Introduction

- Types of pesticides used in U.S. have evolved over time
- Phase out of OP, IPM approaches result in increased use of pyrethrins and their synthetic derivatives pyrethroids

Introduction

- Mechanism of action is on voltage-sensitive sodium channels. Insects acutely affected and experience nervous system overstimulation
- Mammals are less susceptible to effects
  - larger body size
  - poor dermal absorption
  - higher body temperatures

Introduction

- Signs and symptoms described in literature:
  - Paresthesias
  - Contact dermatitis
  - Anorexia
  - Fatigue
  - Dizziness
  - Muscular fasciculations
  - Salivation
  - Airway irritation
  - Allergic reactions
  - Coma
  - Seizures
  - Pulmonary edema
  - Confusion
  - Weakness
  - Heart palpitations

Introduction

- Case-based surveillance remains an important tool to monitor trends in adverse effects associated with these substances
- This analysis used pesticide surveillance data from OR and WA from 2001-2005 to describe the scope and nature of acute illnesses associated with currently used products

Methods

- Data collected from 2 pesticide illness surveillance systems-Washington Department of Health (DOH) and Oregon Public Health Division (OPHD)
- Similarities between the states
  - Mature systems in operation > 15 years
  - Collect data through mandatory reporting laws
  - Use NIOSH standardized variables
  - Have similar climates and pest pressures
  - Receive electronic reporting from PCC, individual referrals from other agencies, and accept self-reports

Methods

- Differences between the states
  - WA DOH identifies more cases from WC
  - OPHD receives majority of cases from PCC
- Illness severity assigned using standardized criteria
- Cases classified using standardized NIOSH definition. Only *definite, probable or possible* cases used for current analysis
  - Cases were included if they involved exposure to at least one pyrethrin/pyrethroid, regardless of any other chemicals involved in the incident

Results

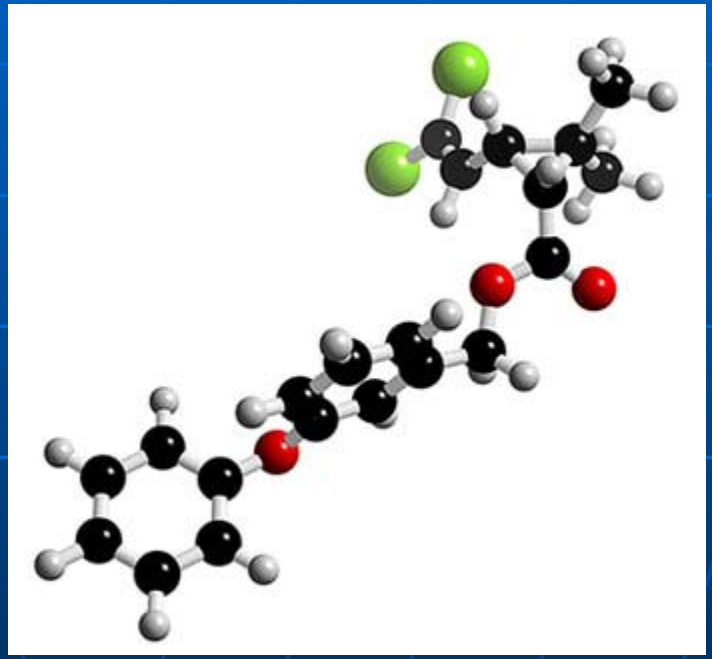
- Total of 407 cases between 2001-2005
  - 64 definite (16%)
  - 45 probable (11%)
  - 298 possible (73%)
- 26% of cases occupational in nature
- Slightly higher percentage of women (55%)
  - Incidence rate ratios for genders not significantly different

Results

- Most cases were low severity (92%)
  - One death is captured in moderate/high (8%)
- Severity group (low vs. higher) did not differ by age group, gender, year of event, or work-related status (chi-square)
- Severity did differ by state ($p=0.002$) and case classification status ($p<0.0001$).
- Overall incidence rate significantly higher in Oregon (IRR 1.70, 95% CI 1.40-2.07)

Results

- Most commonly reported AI were Type I pyrethroids (n=221, 41%)
- 2nd was pyrethrins (n=172, 32%)
- 3rd was Type II pyrethroids (n=141, 26%)
- Cases with moderate or high outcomes were more likely to be exposed to Type I pyrethroids than lower severity cases (Chi-square p=0.0117)



Permethrin (Type 1)

Results

- Reported signs & symptoms
  - Respiratory (52%)
  - Neurological (40%)
  - GI (33%)
  - Ocular (30%)
  - Dermal (21%)
  - Cardiovascular (4%)
- Exposure routes
  - Inhalation (63%)
  - Dermal (37%)
  - Ocular (28%)
  - Ingestion (8%)
- Pre-existing conditions
  - Allergies (17%)
  - Asthma (15%)
  - MCS (4%)
  - Pregnancy (1%)
  - Significant association between presence of any of these conditions and higher illness severity ($p=0.035$)

Results

- Non-occupational cases (n=293, 74%)
  - 46% occurred while mixing, applying, or otherwise handling pesticide
  - 49% were not handling pesticide
  - Most common equipment was “bug bomb”
  - Most exposures occurred at a residence

Results

- Occupational cases (n=74, 26%)
  - 71% exposed during routine work that didn't involve handling pesticide
  - Most common equipment was bug bomb
  - Most exposures occurred at non-manufacturing facility, e.g. retail nursery or office building

Discussion

- OR and WA overall had increasing rates of acute pesticide poisonings from pyrethrins and pyrethroids between 2001-2005
  - May be explained by phase out of chlorpyrifos (2001) and diazinon (2004) with replacement by pyrethrins/pyrethroids
  - Cannot be verified since neither state tracked pesticide sales/usage during time period
  - Study results match other investigators†

†Power LE, Sudakin DL. J Med Toxicol 2007;3:94-99.

Discussion

- Significant association between pre-existing conditions and case severity
  - Only limited data on PEC reported; data incomplete
  - Exacerbation of asthma†, death of child with asthma described in literature‡
- Association between Type I and higher severity cases
  - Usually Type II more toxic to mammals
  - Type II more potent neurotoxins—this may not be underlying cause of symptoms in our data (more skin, eye, respiratory)
  - More attention to inert ingredients or synergists is warranted

†Newton JG, Breslin AB. Med J Aust 1983;1:378-8.

‡Wagner SL. West J Med 2000;173(2):86-87.

Discussion

- Difference in proportion of moderate-high cases between OR and WA
  - May not mean WA has more severe cases
  - WA receives higher proportion of cases from health care providers
  - Oregon had decline in reports directly from clinicians over this time period
  - Suggests lack of knowledge that pesticide poisoning is a reportable condition

Discussion

- Limitations of analysis
  - Likely under-reporting
    - Washington study found 60% of workers with pesticide-related diagnoses captured in system†
  - Exposures might be reported days or weeks after an incident
  - Some cases did not seek medical attention and would not enter surveillance system
  - Non-specific symptoms might have been coincidental (false positives)

†Washington State Department of Health. Available from URL: **http://www.doh.wa.gov/ehp/oehas/publications_pdf/improvingdataqualitypesticideillnessssurveillance-2004.pdf**

Conclusions

- Analysis shows scope and magnitude of acute illness associated with pyrethrin and pyrethroid insecticides in both Oregon and Washington
- Data underscore importance of state-based surveillance
  - Estimate magnitude of problem
  - Identify new or emerging issues
  - Identify risk factors and areas for intervention
  - Communicate research results

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"Sure it costs more. We have to squash bugs by hand."

What are the trends in pyrethrin/pyrethroid usage and illness in your state?

What are your ideas for intervention? Label changes, point of sale education, applicator training?