MEDICAL CASE PROFILE

NATIONAL PESTICIDE INFORMATION CENTER
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Medical Cases and Topics for Health Care Providers are based upon inquiries received by NPIC, as well as relevant publications in the scientific literature. They are intended to educate health care providers about pesticide toxicology.

Pesticides: Testing for Exposure Using the Clinical Laboratory

Scenario:

A 37 year-old landscaper presents to their primary care physician's office after an accident that had taken place at work one week earlier. The worker was applying an herbicide from a backpack sprayer, when the hose became disconnected. The herbicide spilled onto the worker's back, and his shirt was saturated. The active ingredient in the herbicide formulation was 2,4-D, a chlorophenoxy herbicide.

At the time of the incident, the worker removed the backpack but not his shirt. He did not wash his skin immediately after the incident. Within the next several hours, he noticed some itching and irritation of the skin where his shirt had been saturated. Over the next 48 hours, he developed an erythematous rash in the same area.

At the time of presentation to the physician's office one week later, he is no longer experiencing itching or irritation in the exposed area. The physical examination reveals some mild and resolving erythema on the back, in the area where the skin had been exposed. No secondary changes are observed, and no other abnormal findings are present on examination. He is asking the physician whether he can be tested for exposure to the herbicide, to confirm that the rash was caused by the accident that had occurred at work.

Discussion:

There have been significant advances in the development of analytical methods to detect and quantify pesticides in blood and urine samples.[1] These advances have enabled researchers to monitor levels of different types of pesticides in blood and urine samples obtained from the general population.[2] Examples of pesticides for which biomarkers have been developed include certain herbicides, insecticides, fungicides, and insect repellents. The Centers for Disease Control and Prevention have developed a list of pesticides that are currently included in the Fourth National Report on Human Exposure to Environmental Chemicals.

While these data can be useful in the establishment of reference ranges, a limitation is that for many of these biomarkers, health-based guidelines for their interpretation have not been established.[2] Finding a measurable amount of pesticides in a blood, urine, or other biological sample does not necessarily mean that an adverse health effect will occur.[2] These biomarker data can be helpful in assessing exposure, but at the current time there are many pesticides for which the clinical utility of such testing has not been well-defined.

In this case profile, the worker presented with signs and symptoms consistent with an irritant skin reaction. The exposure history consisted of an incident involving occupational overexposure to 2,4-D, a chlorophenoxy herbicide that can cause moderate irritation to the skin and mucous membranes.[3] The risk of developing an irritant

dermatitis increases when decontamination of the exposed area does not take place. Chlorophenoxy herbicides are not well-absorbed across the skin, and systemic toxicity does not commonly occur from dermal exposure.[4] In the current case, confirmatory laboratory testing (of blood or urine) would be of limited utility given the relatively low absorption of 2,4-D across the skin, as well as the amount of time that had passed since the exposure incident occurred. In this specific scenario, the exposure history and signs and symptoms provide sufficient clinical information to conclude that the rash was probably caused by the accident.

Some clinical reference laboratories offer testing services for pesticides, based upon urine, blood, and other biological matrices. The table below lists some of the specific pesticides for which clinical laboratory testing is currently available. The decision to utilize such testing should be based upon an understanding of the toxicology of the specific pesticide, the exposure history, and the clinical findings on physical examination. Clinicians should be aware of the applications as well as the limitations of clinical laboratory testing in the assessment of exposure to pesticides.

Table 1. List of Pesticides that can be Analyzed by Clinical Laboratories

(Biological Matrices: B=blood, S=serum, P=plasma, U=urine, F=fat)

Fumigants	
acrylonitrile	B,U
halocarbons panel	B,S,P,U
carbon disulfide	B,S,P,U
carbon tetrachloride	B,S,P,U
chloroform	B,S,P
dibromoethane	B,S,P
dichlorobenzenes	B,S,P
methyl bromide	B,U
naphthalene	B,S,P,U
Herbicides	
alachlor	B,S,P,U
atrazine	B,S,P,U
cyanazine	B,S,P,U
2,4-D	B,S,P,U
dicamba	B,S,P,U
diquat	S,P,U
MCPA	B,S,P,U
metribuzin	B,S,P,U
paraquat	S,P,U

Insecticides: Organophosphates	
azinphos-methyl	B,S,P,U
carbophenthion	B,S,P,U
chlorpyrifos	B,S,P,U
cholinesterase	B,S,P
coumaphos	B,S,P,U
diazinon	B,S,P,U
dichlorvos	B,S,P,U
dimethoate	B,S,P,U
EPN	B,S,P,U
ethion	B,S,P,U
fenchlorphos	B,S,P,U
fenthion	B,S,P,U
fonofos	B,S,P,U
malathion	B,S,P,U
metasystox	B,S,P,U
methyl parathion	B,S,P,U
mevinphos	B,S,P,U
paraoxon	B,S,P,U
parathion	B,S,P,U

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Herbicides	
pendimethalin	B,S,P,U
picloram	B,S,P,U
propazine	B,S,P,U
simazine	B,S,P,U
2,4,5-T	B,S,P,U
triclopyr	S,P
trifluralin	B,S,P,U
Insecticides: Carbamates	
bendiocarb	S,P,U
carbaryl	B,S,P,U
carbofuran	B,S,P,U
propoxur	B,S,P
Insecticides: Organochlorines	
aldrin	B,S,P,U
chlordane	B,F,S,P
DDD, DDE, DDT	B,F,S,P
dicofol (kelthane)	B,S,P,U
endrin	B,S,P,U
HCB	S
b-BHC	S
hexachlorobenzene	B,F,S,P
heptachlor	B,F,S,P
lindane	B,F,S,P
methoxychlor	B,F,S,P
oxychlordane	B,F,S,P
trans-nonachlor	B,F,S,P
Insecticides: Organophosphates	
phorate	B,S,P,U
phosmet	S,P
propetamphos	U
temephos	U
terbufos	B,S,P,U
p-nitrophenol	B,S,P,U
(metabolites of organophosphates)	
dimethylphosphate	U
dimethylthiophosphate	U
diethylphosphate	U
diethylthiophosphate	U
diethyldithiophosphate	U
Rodenticides	
brodifacoum	B,S,P,U
difenacoum	B,S,P,U
warfarin	B,S,P,U
Other Pesticides	
arsenic	B,S,U
chromium	S,U
copper	S,U
nitrobenzene	U
rotenone	B,S,P,U

References

1. Olsson AO, et al. A Liquid Chromatography-Tandem Mass Spectrometry Multiresidue Method for Quantification of Specific Metabolites of Organophosphorus Pesticides, Synthetic Pyrethroids, Selected Herbicides, and DEET in Human Urine. Anal.Chem. 2004;76(9):2453-2461.
2. Centers for Disease Control, National Center for Environmental Health, Atlanta, Georgia. Fourth National Report on Human Exposure to Environmental Chemicals. 2009.
3. Chlorophenoxy Herbicides. In: Reigart JR, Roberts JR, eds. Recognition and Management of Pesticide Poisonings (Fifth Edition), 1999:94-98.
4. Bradberry SM, Proudfoot AT, Vale JA. Poisoning Due to Chlorophenoxy Herbicides. Toxicol. Rev. 2004;23(2):65-73.