An Analysis Of 190 Cases Of Suspected Pesticide Illness

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Background: **The diagnosis of mild to moderate pesticide exposure presents a challenge because the signs and symptoms of exposure are similar to those of many other diseases. We reviewed all alleged pesticide injuries seen in a single office during a 6-year period to determine which findings were useful in discriminating between a pesticide-related illness and other causes.**

Methods: **We reviewed retrospectively the charts of 190 patients alleging pesticide illness who were treated in a standardized manner.**

Results: **One hundred sixteen (116) patients (61.1 percent) were found to have pesticide illness. Important predictors of pesticide illness were anxiety, vertigo, nausea, vomiting, tearing, and weakness. Seventy-four patients (38.9 percent) were found to have nonpesticide-related illness, with nonspecific irritant contact dermatitis and scabies the most common diagnoses. Rash was the only significant predictor of nonpesticide related illness.**

Conclusions: **It is difficult to relate signs and symptoms to pesticide poisoning, and exposure history is very important. Alternative diagnoses need to be considered. Laboratory tests are not nearly as valuable as many might expect, and skin rash is not a common finding in mild to moderate pesticide poisoning. (J Am Board Fam Pract 1995; 8:278-82.)**

The diagnosis of pesticide illness might seem simple when dozens of employees come to an emergency department after a witnessed pesticide overspray. In other situations diagnosis can be more difficult; for example, a worker states that the crop he handled is responsible for a rash even though other workers were not affected and the field had not been sprayed in months. Exposure information that is incomplete or distorted as a result of fear, litigation, or anticipation of secondary gain complicates diagnosis.

Not only is a precise diagnosis necessary to treat the patient, but there are also political, economic, and legal consequences. It is important to differentiate a pesticide illness from other diseases, yet with the enormous number of chemicals on the market, each with its own clinical expression, differentiation can be difficult.

Case reports in the medical literature are concentrated on patients with diagnosed pesticide-related illnesses, whereas nothing is written about those found to have other illnesses. Thus, there exists no list of differential diagnoses. Brown and associates[1] reviewed occupational illness from cholinesterase-inhibiting pesticides among agricultural applicators in California from 1982 to 1985. Only cases classified as definitely, probably, or possibly pesticide related were included, and cases judged to be unlikely were excluded.

Data from poison control centers[2,3] give information about people who state that they have been exposed to pesticides. These studies rely only on the initial complaint and fail to segregate pesticide-related illness from other diseases.

The value of an accurate diagnosis was illustrated by Kurtz and Esser,[4] who described three episodes of mass psychogenic illness among agricultural workers in which the common presenting complaint was pesticide exposure. One patient was even treated with atropine. Later, careful analysis revealed that no exposure had occurred. The news media, helicopter flyovers, strong odors, attitudes and actions of physicians, and, most notably, knowledge of physicians were found to be important factors in recognizing and controlling the problem.

In China, He and associates[5] examined 573 cases of acute pyrethroid poisoning reported in the Chinese medical literature. They emphasized the importance of avoiding overdiagnosis (calling a mild case severe), misdiagnosis (attributing symptoms to the wrong pesticide), and maldiag-

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nosis (diagnosing a poisoning when one did not occur). Several patients experienced near death by the administration of atropine given for organophosphate poisoning that did not occur.

In the January 1993 issue of the *JABFP*,[6] a method for diagnosing pesticide illness was reported. The current study presents a series of patients whose conditions were diagnosed using that method. Two groups of patients emerged from patients alleging pesticide illness: those ill from pesticide exposure, and those ill from another cause. We asked the following questions: (1) How did the two groups differ? (2) What was the differential diagnosis of pesticide poisoning? (3) What impact did laboratory tests make in the diagnosis? (4) What symptoms were more common? (5) Which symptoms were more useful in making a diagnosis?

Methods

As part of a comprehensive pesticide illness resolution program organized for industry by the primary author, all the patients were seen by a single family practice group using a standardized method. The practice is situated in the agriculturally rich San Joaquin Valley of California, an area with more than 120 cash crops and intense pesticide use.

The study criteria for the diagnosis of pesticide illness were as follows:

1. Objective evidence of exposure to pesticides or the possibility of exposure
2. Objective evidence of illness that could be accounted for by pesticide exposure
3. Exclusion of other diseases accounting for the clinical findings

The charts of 190 consecutive patients alleging pesticide illness seen during a 5-year period were abstracted. Data from each patient were collected in a separate chart. Later, these data were abstracted by an author who had not seen the patients. Where possible, missing data were collected from the patients, their employers, or the Tulare County Agricultural Commissioner's office. The data were then coded and analyzed.

Multivariate logistic regressions were run on signs and symptoms one at a time while controlling for age, sex, and race to estimate the odds of a patient having actual pesticide illness given the presence of those signs and symptoms. The logistic regressions gave estimates of the relative risk of patients alleging pesticide illness and exhibiting the sign or symptom under consideration.

Results

Our 190 cases consisted of 138 (72.6 percent) men and 52 (27.4 percent) women. The median age was 31 years with a range from 4 months to 68 years. In the sample, 168 (88.4 percent) were Hispanic, 21 (11.1 percent) were white, and 1 (0.5 percent) was African-American. Of these patients, 116 (61.1 percent) were found to have illness caused by pesticide exposure, while 74 (38.9 percent) were found to have other illnesses.

Pesticide exposure was documented in 110 (57.9 percent) patients. Employers sent 126 (66.3 percent) patients for medical attention, 55 (28.9 percent) were self-referred, and 9 (4.7 percent) were sent by insurance carriers. When patient occupations were examined, pesticide applicators accounted for 23 (12.1 percent), farm labor for 147 (77.4 percent), clerical for 5 (2.6 percent), and various other jobs for 15 (7.9 percent). Forty workers in a vineyard were exposed in a single aircraft overspray.

Patient complaints most frequently reported were rash 89 (46.8 percent), chemical exposure 63 (33.2 percent), nausea 11 (5.8 percent), anxiety 8 (4.2 percent), headache 4 (2.1 percent), and vertigo 3 (1.6 percent); 11 (5.8 percent) asymptomatic cases were detected in routine cholinesterase monitoring (Table 1).

All blood and urine testing was done within 4 hours of alleged exposure. Of our 190 patients, 116 (61.0 percent) had red cell and serum cholinesterase activity levels measured, 68 (35.8 percent) had blood panels, 12 (6.3 percent) had urinalyses, 12 (6.3 percent) had chest radiographs, and 7 (3.7 percent) had urine pesticide screening tests.

Of the 116 patients who received cholinesterase activity level testing, 95 (82.0 percent) tested in the normal range. Of those 95 cases, 68 (72.0 percent) eventually had a pesticide-related illness diagnosed.

Of the 7 patients tested with urine pesticide screening, all were found to have pesticide exposures and illness, yet no pesticides or metabolites were detected. In each case, the exposure was documented by a supervisor.

Table 1. Findings of Analysis of 190 Consecutive Cases of Persons Alleging Pesticide Illness.

Finding	Total	Pesticide-related Illness	Nonpesticide-related Illness
Patient complaints			
Rash	89	36	53
Chemical exposure	63	58	5
Nausea	11	4	7
Routine screening	11	11	0
Anxiety	8	4	4
Headache	4	0	4
Vertigo	3	3	0
Nosebleed	1	0	1
Exposure history			
Route			
Dermal	147	89	58
Multiple	20	19	1
Unknown	15	2	13
Inhalation	5	5	0
Ingestion	3	1	2
Crop			
Grape	82	54	28
Other	64	47	17
Orange	42	14	28
Walnut	1	0	1
Kiwi	1	1	0
Method			
Residual	71	38	33
Sprayed	48	46	2
Handling	38	14	24
Drift	18	16	2
Unknown	15	2	13
Symptoms and signs (patient could have more than one)			
Rash	103	48	55
Pruritis	75	44	31
Nausea	43	36	7
Vertigo	32	28	4
Headache	31	26	5
Anxiety	23	20	3
Vomiting	22	14	3
Weakness	14	14	0
Tearing	8	8	0
Abdominal cramps	5	5	0
Diaphoresis	4	4	0
Diarrhea	4	5	1
Eye tremors	4	4	0
Anorexia	4	4	0
Physical examination			
Rash	103	48	55
Respiratory difficulty	7	5	2
Nystagmus	6	6	0
Faciculations	4	4	0
Bradycardia	3	3	0
Miosis	0	0	0
Laboratory work			
Cholinesterase activity levels done	116	90	26
Abnormal	21	21	0
Blood panel	68	58	10
Urinalysis	12	9	3
Urine pesticide screening	7	7	0
Abnormal	0	0	0
Documented exposure	63	58	5
Pesticide ill	190	116	74
Treatment			
Antibiotics	27	10	17
Oral steroids	38	23	15
Disposition			
Work days off (average) 173 patients		2.71	0.88
Modified duty days (average) 17 patients		3.10	0.29

In the group with diagnosed pesticide illness (n = 116), 7 (6.0 percent) had respiratory difficulty. There were no instances of pulmonary edema, cyanosis, loss of sphincter control, heart block, convulsions, or death. Only 7 patients (6.0 percent) received field decontamination, and only 5 (4.3 percent) had any first aid. One person faked injuries for reason of secondary gain.

Of the 116 patients with diagnosed pesticide illness, 31 separate pesticides, used alone or in combination, were identified in 113 (97.4 percent) cases. The most common were insecticides, found in 80 (71.0 percent) cases, followed by fungicides in 17 (15 percent), miscellaneous in 9 (8.0 percent), herbicides in 5 (3.5 percent), and fumigants in 2 (1.7 percent).

There was an average of 3.15 office visits per patient for those who had a pesticide-related illness and 1.76 visits for those who did not ($P = 0.0002$). The group with a diagnosed pesticide-related illness lost an average of 2.71 days of work because of illness, whereas those found not to have a pesticide-related illness lost an average of 0.88 days of work ($P = 0.0055$). Seventeen patients (15 percent) with pesticide-related illness were placed on modified duty until their condition improved. There were no hospitalizations.

Of the 103 (54.2 percent) cases of rashes, 48 (46.6 percent) were associated with a pesticide illness, whereas 55 (53.3 percent) were related to another cause. In the nonpesticide rashes, the most common diagnoses were nonspecific irritant contact dermatitis (27.7 percent) and scabies (7.7 percent). The nonspecific irritant contact dermatitis rashes were found to be due to perfumes, soaps, detergents, and household chemicals (Table 2).

All cases involving tearing and weakness were diagnosed as actual pesticide illness; therefore, the logistic regression was not able to express properly the odds ratio confidence interval. While not statistically testable, tearing and weakness would seem to be predictors of pesticide exposure (Table 3).

The variables in descending order from highest to the lowest odds of being associated with pesticide illness are anxiety, nausea, vertigo, vomiting, headache, respiratory difficulty, pruritis, diarrhea, and rash. Respiratory difficulty, pruritis, and diarrhea were all nonsignificant. Anxiety, nausea, vertigo, vomiting, and headache were associated with

Table 2. Diagnoses of Nonpesticide-related Illnesses (n=72).

Diagnoses	No. Cases	(%)
Irritant contact dermatitis	27	(37.5)
Scabies	7	(9.7)
Chicken pox	4	(5.6)
Drug eruption	4	(5.6)
Influenza	4	(5.6)
Gastroenteritis	4	(5.6)
Sinusitis	3	(4.2)
Acne vulgaris	2	(2.7)
Dermatitis, plants	2	(2.7)
Dermatitis, solvents	2	(2.7)
Dermatitis, other chemical	2	(2.7)
Herpes zoster	1	(1.4)
Tinea cruris	1	(1.4)
Diabetes mellitus	1	(1.4)
Bronchitis	1	(1.4)
Pityriasis rosea	1	(1.4)
Folliculitis	1	(1.4)
Urticaria	1	(1.4)
Inset bite	1	(1.4)
Epistaxis	1	(1.4)
Dermititis, detergent	1	(1.4)
No evidence of disease (fraud)	1	(1.4)

pesticide illness, whereas rash was associated with other causes of illness. A logistic regression model that included all the variables could not be run because of insufficient data.

The most important diagnostic indicator of pesticide illness for the physician was actual documented pesticide exposure ($P<0.001$). In nearly all those cases in which exposure was documented by eyewitness accounts of third parties, the illness reported was due to pesticides, although other illnesses were recorded. Not all exposures produced illness.

Discussion

Studies have focused on cholinesterase-inhibiting pesticide poisoning, with the symptoms of salivation, lacrimation, urination, and diarrhea being well characterized. With other pesticides, the pyrethrenoids for example, the symptoms are less specific, including abnormal skin sensations, vertigo, headache, fatigue, and nausea. In some instances, systemic symptoms were absent, and signs such as dermatitis were present, as in propargite-induced dermatitis.[1,5,7,8]

It is important to consider other types of disease when treating an alleged pesticide injury. Many signs, symptoms, and conditions of pesticide poisoning are nonspecific. In this study, anxiety, vertigo, and nausea were most strongly predictive for exposure, and rash was suggestive of another diagnosis.

Blood and urine testing were performed within 4 hours of exposure. All 7 of the patients who had blood and urine pesticide screening had tests that were negative for pesticide residues; these tests were performed only in cases of witnessed pesticide exposure. Furthermore, although the majority of the diagnosed pesticide illnesses were from organophosphate poisoning, only 21 of the 116 cholinesterase activity tests showed abnormally low values. The most informative testing was the measurement of cholinesterase activity levels, and the least informative were urine pesticide screening tests.

These data, coupled with the data of Fillmore and Lessenger[9] and Ames, et al.,[10,11] suggest that laboratory testing is not useful in the diagnosis of mild to moderate pesticide illness. Two exceptions to its lack of usefulness occur with pesticide applicators who are in formal monitoring programs or when an occasional test result is grossly outside the normal limits.

Irritant contact dermatitis caused by household chemicals and cosmetics was the most common source of rash. Scabies was the second most common cause of rash. Many of the fieldworkers live in conditions of poor sanitation, and this diagnosis was not a surprise to the investigators. There was one case, however, in which the patient had both scabies and a rash due to pesticide exposure.

There were 54 cases of pesticide-related illnesses from vineyards. The large number of injuries from

Table 3. Odds Ratios from Logistic Regression of Single Variables While Controlling for Age, Sex, and Race.

Predictor Variable	Odds Ratio	95% Confidence Interval
Anxiety	9.5	1.1–7.7
Nausea	8.6	1.5–19.4
Vertigo	8.4	1.8–38.2
Vomiting	6.4	1.4–27.7
Headache	5.3	1.5–19.4
Respiratory difficulty	1.4	0.1–15.9
Pruritis	0.7	0.4–1.3
Diarrhea	0.6	0.1–3.1
Rash	0.1	0.1–0.3
Tearing	0.0	*
Weakness	0.0	*

*The regression contained a zero cell, thus the odds ratios and confidence intervals for these variables could not be accurately calculated.

grape fields was a result of two factors. First, the growth cycle of the grapes is short, resulting in a limited time for maturation and harvest, so that large work crews must be used for short periods. Second, grapes are a labor-intensive crop; they must be pruned, tied back, tipped to remove the terminal buds, curled to cut a ring around the trunk, thinned, picked, rot picked, and finally pruned again. This intensive labor in a short season puts the workers in direct contact with the leaves, dust, and undergrowth, which can contain pesticide residues.

Because signs and symptoms can be nonspecific, and the laboratory tests are usually of little benefit, the patient's history becomes critical. Physicians should consider inspecting pesticide application records and perhaps visiting the site. Such a visit could include talking to the foreman, the field manager, or employer to learn which chemicals were used, their application times, and the reentry periods, as well as the circumstances surrounding the exposure.[1,6,12]

Unfortunately, there were only 7 worker decontaminations in the field even though the principal author worked with the field crews to train them. Questioning workers revealed a reluctance to decontaminate in the field because disrobing was required. In addition, in mild to moderate exposures, the employees did not think decontamination necessary.

The finding that the outbreak of rashes was not a primary predictor of pesticide exposure was perhaps the most noteworthy outcome of the statistical modeling process. The logistic model showed that vertigo, anxiety, weakness, tearing, headache, nausea, and vomiting can all be predictors of pesticide exposure. Diarrhea and rash, however, were predictive for conditions not resulting from pesticide exposure.

There were several limitations to this study. First, the large number of symptoms and signs combined with the relatively small sample number limited the complexity of the interactions that could be tested. Second, most of the data were self-reported, which could introduce a strong information bias if the facts had been distorted by persons involved, including employers, either in hope of secondary gain or to avoid adverse outcomes, such as being fired or investigated by the Agricultural Commissioner's office. In addition, 40 cases used in this study were generated by a single overspray incident, and their input could reflect a psychogenic group consensus rather than the individual's unbiased assessment.

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