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Aldicarb: A Case Series of Watermelon-Borne Carbamate Toxicity

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ABSTRACT. Improper use of pesticides on food plants can result in significant toxicity. In spite of regulations, enforcement, and prior episodes of poisonings, poisonings from misapplication of pesticides continues to occur. The objective of this study was to present a case series of toxicity resulting from ingestion of watermelon inappropriately treated with the carbamate insecticide aldicarb. A restrospective review of medical records, impounding the suspected watermelons, and chemical analysis of the watermelon samples using liquid chromatography and mass spectroscopy were carried out. Seven farm workers shared a watermelon and presented to a rural emergency department with symptoms of cholinergic poisoning. They were treated empirically with atropine and pralidoxime. The farmer denied use of insecticides other than rat poison on the watermelon patch. Chemical analyst verified aldicarb in the watermelon samples from the field, but none in control samples. Despite government regulations, application of restricted pesticides such as aldicarb continues to occur and cause significant poisonings.

KEYWORDS. Aldicarb, food poisoning, insecticides, poisonings

INTRODUCTION

Aldicarb is a carbamate insecticide introduced in the agricultural community over 40 years ago.[1,2] It is absorbed into the soil and taken up into the roots, stems, and leaves of crops. For this reason, aldicarb is currently registered for use only on cotton, potatoes, citrus, peanuts, soybeans, sugar beets, pecans, tobacco, sweet potatoes, ornamentals, alfalfa, grain sorghum, dry beans, and sugar cane.[1] Aldicarb is not approved for use in most fruits.

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Fruits with high water content, such as watermelon, tend to absorb aldicarb in greater concentrations. Watermelon is an important cash crop in North Carolina, with 7400 acres of crop harvested in 2007 with a value of over $12 million.[3] A significant loss of income from contaminated watermelon could be devastating to the economy of North Carolina.

Aldicarb poisoning from watermelon consumption was documented in June of 1985 when the Oregon State Health Division was notified of multiple patients experiencing symptoms consistent with anticholinesterase poisoning.[4–6] It was discovered that each of these patients had ingested watermelon exposed to aldicarb. After further analysis, it was discovered that all the fruit had originated from California, which resulted in the destruction of all watermelon originating from the state.[4–6] This case helped to increase physician suspicion and vigilance and has likely assisted in preventing similar future episodes. Other such cases have occurred, from ingestion of tainted watermelon, as well as contaminated cucumbers from Canada.

Carbamate poisoning has occurred in other scenarios such as its illegal application as a rodenticide. The United States has strict regulation on the use of aldicarb and similar products. However, because this is not true worldwide, there is potential for importation of contaminated food. This possibility is underscored by the 25 individuals poisoned in New York City between 1994 and 1997 from exposure to a rodenticide called Tres Pasitos aquired in the Dominican Republic and Mexico.[7] These patients presented with symptoms associated with anticholinesterase poisoning that was found to result from aldicarb, much like the experience of the farm workers presented below. This case series is reported because despite government regulations, applications of restricted pesticides such as aldicarb continue to occur and can result in significant toxicity.

METHODS

This is a retrospective case series of patient charts with symptoms consistent with carbamate or organophosphate poisoning on a single day. There were seven charts reviewed of patients suspected of carbamate poisoning. This retrospective review is exempt from institutional review board (IRB) review.

The watermelon ingested by the patients, a whole watermelon from the field in question, and a control watermelon (as a negative control for the chemical assay) from another farm were collected by the medical toxicologist and stored at −20°C. Chain of custody procedures and technical conduct of the analysis followed sound practice standards. The samples were shipped to Pyxant Labs, Inc. (Colorado Springs, Colorado). These analyses were performed according to the Pyxant Proprietary analytical method, "Determination of Aldicarb, Aldicarb Sulfone, and Aldicarb Sulfoxide in Urine and Whole Blood by LC/MS/MS," METH 1384.00. Samples were extracted and analyzed using electrospray ionization. The analytical batch for the samples contained the following: seven calibration standards with concentrations ranging from 0.5 to 100 mg/mL for each analyte, duplicate reagent blank samples, duplicate unfortified control samples for watermelon, duplicate control samples for watermelon fortified at 1.0 mg/mL of each analyte, duplicate control samples for watermelon fortified at 20.0 mg/mL of each analyte, and duplicate analyses of each of the unknown samples.

CASE SERIES

On July 21, 2009, seven male farm workers arrived at an emergency department with variable degrees of nausea, vomiting, diarrhea, abdominal cramping, and confusion (Table 1). Each worked on the same farm. In addition to a common work environment, they had shared a freshly picked watermelon immediately prior to the onset of symptoms. The farmer denied use of any pesticides on the watermelon crop other than rat poison. Medical toxicology consultation was obtained, a presumptive diagnosis of cholinesterase inhibitor poisoning was made, and the workers were treated with antiemetics, pralidoxime, and atropine with good response. Six of the seven were observed for less than 24 hours then discharged. A

TABLE 1. Patient Symptoms, Treatment, and Disposition

Patient	Age	Symptoms	Treatment	Disposition
1	38	Abdominal cramping, vomiting, altered mental status	Suction, oxygen, Zofran, normal saline (NS) bolus, atropine, pralidoxime	Rapid improvement, 24-hour observation
2	22	Nausea, vomiting, abdominal cramping	Oxygen, Zofran, NS bolus, atropine	Rapid improvement, 24-hour observation
3	26	Nausea, vomiting, abdominal cramping	Oxygen, Zofran, NS bolus, pralidoxime	Rapid improvement, 24-hour observation
4	34	Nausea, vomiting, diarrhea, abdominal cramping	Suction, oxygen, NS bolus, Zofran, atropine	Rapid improvement, 24-hour observation
5	38	Nausea, vomiting, abdominal cramping, altered mental status	Suction, oxygen, Zofran, NS bolus, atropine	Rapid improvement, 24-hour observation
6	28	Nausea, vomiting, diarrhea, abdominal cramping	Oxygen, Zofran, NS bolus, atropine	Rapid improvement, 24-hour observation
7	53	Nausea, vomiting, abdominal cramping, altered mental status	Oxygen, Zofran, NS bolus, atropine, potassium supplementation*	Inpatient hospital admission for electrolyte abnormalities

Note. NS = normal saline. *Secondary to medication and not aldicarb.

53-year-old man with diabetes, hypertension, and hypokalemia required admission. All recovered without apparent sequela. Description of what happened in the field was not recorded in the documents reviewed, and the patients were not available after the initial encounter.

Samples of the watermelon ingested, a second watermelon from the same field, and a control watermelon from another source were analyzed for aldicarb on the medical toxicologist recommendation. Aldicarb, aldicarb sulfone, and aldicarb sulfoxide were found in the uningested portion of the watermelon that was eaten. The whole watermelon sample from the same field had detectable levels of aldicarb sulfone and sulfoxide; an aldicarb peak was present but at levels scored as statistically negative. Samples of watermelon fortified with 1.0, 20.0, and 500 mg/mL of aldicarb, aldicarb sulfone, and aldicarb sulfoxide, respectively, as well as watermelon fortified with 10,000 mg/mL of aldicarb sulfoxide were analyzed to determine recovery percentages. Further action included farm owner prohibition of on-site gardens and education of workers regarding restricted pesticides and the danger associated with inappropriate application. The contaminated watermelon patch was tilled under and the watermelons were quarantined then destroyed. The state Pesticide Board cited the certified pesticide applicator for the farm with violations of the state Pesticide Law regarding pesticide use inconsistent with its label and he was also issued a monetary penalty.

CONCLUSIONS

Despite government regulations, application of restricted pesticides such as aldicarb continues to occur and can result in significant toxicity. This case series highlights and provides further evidence of the significant health risk associated with consumption of watermelon grown in aldicarb-exposed soil. In this event, prompt recognition and action by the emergency physician, medical toxicology service, and Regional Public Health Surveillance Team I, the state Department of Agriculture and Consumer Services, and the state Health and Human Services aided in limiting adverse health effects and provided important prevention training and awareness.

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