Petroleum Poisoning In Two Rural Families

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The family physician is on the front lines of environmental illnesses, but the illness might not be readily defined without intense investigation outside the office. It can be months before the full extent of the exposure is understood. In the meantime, the physician must take steps to stop the exposure, decontaminate, define the extent of the illness, and treat.

Environmental medicine dates back to the Renaissance when Ramazzini[1] described toxic injuries to workers. During the Industrial Revolution Pott[2] described scrotal cancer in chimney sweeps. In the modern era Alice Hamilton,[3] the first woman professor of Harvard Medical School, described environmental illness in workers and their families.

Environmental health issues reached the public in Rachel Carson's *Silent Spring*.[4] A slowly growing groundswell of public opinion led to the creation of the Environmental Protection Agency, the Clean Water Act, and the Federal Water Act.[5]

Case Report

The accident occurred at a general store that had been in continuous operation in Tulare County, California, since the 1880s. Underground gasoline storage tanks were installed just before World War II.[6]

In the 1980s all petroleum storage tanks in the county were tested, including those at the general store. There were two tanks: a 4000-gallon tank for regular and a 3000-gallon tank for unleaded fuel. Both leaked.[6]

In March 1991 the tanks were removed and adjacent soils tested. The soils were contaminated with benzene, toluene, xylene, ethylbenzene, and total petroleum hydrocarbons. The Tulare County Health Department reported the store as a hazardous waste site to the State Water Resources Control Board.

Submitted, revised, 25 March 1996.

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In coordination with the State Water Resources Control Board, the Tulare County Health Department contacted the store owners and ordered them to clean up the site. Test wells discovered a plume of petroleum penetrating an aquifer. The State Water Resources Control Board sent warnings and explanatory letters to the two families living in the area. The families concentrated only on the statement that the water was contaminated with benzene, a carcinogen.

Distantly related, family L rented a house and family G a trailer west of the general store. They received water from two wells piercing the contaminated aquifer. Family L consisted of a father, mother and 2 sons. Family G consisted of a father and 2 daughters.

In early 1990 all noticed a foul odor coming from the water and complained to the property owner, who also owned the store. The odor subsequently went away for all the 7 people. Mr. L left town for 2 months to work outside the state. Upon returning, he noticed the odor was more intense and complained to the Tulare County Health Department.

In the fall of 1991 the Tulare County Health Department sampled the wells and reported contamination with benzene, xylene, toluene, and other petroleum distillates. The Tulare County Health Department advised the families to see their family physician.

ML, a 48-year-old man, complained of chronic crampy abdominal pain, nausea, vomiting, depression, anger, and frontal headaches. The symptoms appeared when the water turned "foul," and upon drinking bottled water the symptoms disappeared. Findings on his physical examination were normal except for an enlarged liver and elevated liver function studies. Six months after he started drinking bottled water, he developed crampy abdominal pains again and was told by physicians at the Veterans hospital that he had diverticulitis. He was concerned that the liver problems were related to the contamination.

WL, a 41-year-old woman, had the same complaints. Furthermore, she experienced fatigue and vaginitis. Findings on her examination and laboratory tests were entirely normal including vaginal cultures and a wet mount. She douched with tap water, and when she switched to bottled water for drinking and douching, all symptoms including the vaginitis disappeared. She was concerned that the uterine tumors leading to a hysterectomy were due to the contamination.

JL, a 21-year-old man, experienced crampy abdominal pains, nausea, vomiting, bleeding gums, rashes, epigastric abdominal pain, flatulence, heart palpitations, "memory flashes," and headaches. Findings from his physical examination, laboratory tests, electrocardiogram, and sperm count were completely normal except for a papular rash on his arms and trunk. All symptoms disappeared when the family switched to bottled water, and the rash disappeared when they moved to another home. Follow-up examinations and test results were normal.

CL, a 17-year-old man, experienced nausea, vomiting, diarrhea, crampy abdominal pain, and a rash. Findings on the physical examination and results of his laboratory tests were normal except for an erythematous papular rash on his trunk, groin, legs, arms, and face. The symptoms disappeared when he switched to bottled water, and the rash disappeared when he moved.

GG, a 44-year-old man, experienced nausea, vomiting, diarrhea, headaches, and rash. The symptoms appeared the same time as they did for the other family. Findings on his physical examination and results of his laboratory tests were normal except for a papular rash covering his trunk. The symptoms and rash resolved when the family switched to bottled water and moved.

SG, a 12-year-old girl, complained of the same signs and symptoms as GG in the fall of 1991. On examination she had no positive findings except for a rash. All symptoms and the rash disappeared when the family switched to bottled water and moved.

TG, an 11-year-old girl, complained of nausea, vomiting, diarrhea, crampy abdominal pains, headaches, blurred vision, and dizziness beginning when the water started to taste "icky." The symptoms disappeared when the family switched to bottled water, but a rash persisted until the family moved. Results of her physical examination and laboratory testing were normal and remained normal for the monitoring period.

The Tulare County Health Department provided a copy of water-testing reports documenting exposure. A search of the literature documented benzene, toluene, and xylene to be solvents capable of causing the patients' symptoms. In addition, benzene is a potential carcinogen.[7,8]

Copies of medical records were requested from the Veterans Administration and Mrs. L's former gynecologist. The patients were placed in a monitoring program, and every 6 months each member had a complete blood count and blood chemistry panel. To address the fears of the parents and yet minimize the number of procedures, a sperm count was done on only the older son.

Immediately following the first examination, the families were told to drink bottled water. Later, they were moved to another home. Their underwear was disposed of on a county hazardous materials pickup day, and the outer clothing was cleaned in uncontaminated water.

Review of medical records demonstrated Mr. L's liver disease was due to alcoholism and predated his move to the contaminated property. Mrs. L's hysterectomy predated their move to the property.

The families were monitored for 2 years with no positive findings. Unknown to the treating physician, Mr. G drank more contaminated water and bathed in it to see what the effect would be. The diarrhea, conjunctivitis, nausea, and rash returned.

Discussion

Chemical contamination of drinking water has become a major problem across the United States. A growing number of toxins and carcinogens are appearing in the nation's drinking water, and prevention of chemical water contamination has become a major political and public health issue.[9-12]

There are no reliable data on the prevalence of illness from contaminated water. In Tulare County, however, one quarter of all wells are contaminated in some manner.[6]

Causes of pollution can be siltation, nutrients, pathogens, pesticides, organic chemicals, metals, and suspended solids. The leading sources of water quality impairment are agriculture, municipal point sources, storm sewers, resource extraction, and industry.[10,12]

Gasoline, a distillate of petroleum, is a complex flammable mixture of paraffins, olefins, naphthenes, and aromatic hydrocarbons that serve as the principle fuel for internal combustion engines. The hydrocarbons are principally alkanes, aromatics, and alkenes with various additives including organic lead, ethylene dichloride, ethylene dibromide, and methyl tertiary butyl ether.[13]

Typically, gasoline exposure occurs on the skin or by the respiratory route. Eye irritation, rashes, dizziness, headache, nausea, and intoxication are the typical clinical findings. There is no specific antidote or therapy for hydrocarbon intoxication, and treatment is supportive and symptomatic.[13]

Kilburn and Warshaw[14] reported neurophysiological and neuropsychological impairments in 131 persons exposed to drinking water contaminated with motor oil and industrial wastes. Mood testing showed evidence of depression, anger, confusion, tension, and fatigue. Changes in balance and eye closure speed were also documented.

Guldberg[15] explored six scenarios for human exposure based primarily on measured air and water concentrations of contaminants. The researcher underscored the importance of removal from exposure, decontamination, extensive examinations of the exposed persons, and longitudinal medical monitoring.

Akland[16] reviewed gasoline exposure in the general population. Personal activities including refueling and commuting resulted in higher exposures but at shorter time intervals. The group with highest exposure includes those persons living near large service stations and those with contaminated water supplies.

It is by coincidence that two independent processes of discovery came together: the survey of leaking tanks and the perception of odors and symptoms by the patients. More often the person will perceive symptoms, and a mechanism to detect contamination will not be so readily available.

Although the odor of the water indicated the cause of the physical problems the family was having, they quickly became tolerant of the odor and no longer noticed it. When the father returned from an absence of several months, he noticed the odor and initiated the report to the Tulare County Health Department. Odor can be unreliable as an indicator of contamination when exposure is low level and extended.[1,4]

The vaginitis of Mrs. L responded to a change in douching from tap to bottled water. No other case of vaginitis from water contaminated by gasoline could be located in the literature.

Removal from contamination by changing to bottled water, destruction of the underwear, and moving to another house were all the steps necessary for treatment. The first shower in a clean environment provided decontamination. The treating physician might need to provide letters attesting to the necessity for decontamination before landlords, insurance companies, and attorneys can act.

Conclusion

The family physician must be aggressive in the face of an environmental illness. Affected patients need removal from exposure, decontamination, rapid definition of the patient's health status, appropriate care, and longitudinal monitoring. Documentation is important for legal purposes, and the physician might need to research the chemicals involved and work closely with government officials. The task could take years.

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