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Acute Nonlymphatic Leukemia Among Deck Officers on Coastal Tankers: A Report of Two Cases

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Deck officers on coastal tankers may be exposed to high concentrations of cargo vapors during loading and tank-cleaning operations. Two cases of acute nonlymphatic leukemia are described. Both men had worked as chief officers on coastal tankers transporting benzene and other petroleum products.

Key words: benzene, marine cargo vessels, merchant seamen

INTRODUCTION

Exposure to benzene is a well-known cause of acute nonlymphatic leukemia (ANLL) [Cronkite, 1987]. An increased risk has been described mainly in shoe factories and in the rubber industry [Tsongas, 1985; Aksoy, 1985; Infante et al., 1977]. Although large amounts of benzene are transported on ships, this risk has not been described in seamen. Between 1982 and 1985, two seamen with nonlymphatic leukemia were referred to the Departments of Haematology and Occupational Medicine, Sahlgren Hospital, Göteborg, Sweden. This case report reviews these two cases and discusses the possible risk factors.

CASE 1

The patient, a 65-year-old man, had previously experienced a myocardial infarction and a carotid artery operation. Before the ANLL was diagnosed, he had not been treated with antineoplastic drugs or irradiation. In early 1982, he had several episodes of tonsillitis and epididymitis. In late January 1982, acute myeloid leukemia (M2) was diagnosed on the basis of a biopsy of the crista. In February 1982, he died of septicemia.

He had worked as a deck officer on a coastal tanker from 1968 to 1975. The ship was not equipped with automatic cargo level indicators, and gauging of unfilled capacity during top-off was done manually with a gauge rod. Pure or crude benzene

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was loaded approximately once a month. The rest of the time, the ship transported mainly light petroleum products such as gasoline and jet fuel and occasionally methanol and formalin.

CASE 2

A 41-year-old man, who had reported no previous illnesses other than throat infections, had repeated cutaneous infections followed by pneumonia in early 1985. Acute myelomonocytic leukemia (M4) with a high leukocyte count ($170 \times 10^9/\text{liter}$) was diagnosed in mid-1985. The patient has been treated successfully with cytostatic drugs followed by a bone-marrow transplantation.

Between 1958 and 1964, he worked as a seaman, mainly on tankers carrying petroleum products and solvents. Tank-cleaning operations were frequently part of his job. During this time, there was an incident of high exposure to trichloroethylene. From 1965 to 1971, he was a house painter and thus exposed to organic solvents such as thinner and white spirit, but probably not to benzene. In 1972 he became a deck officer on coastal tankers that carry mainly petroleum products such as gasoline, and in 1977 he began working on tankers that periodically transport pure benzene and refinery waste products with a high benzene content. Since 1978 he has been shipmaster and has only rare involvement in loading and tank-cleaning operations. Before 1980 all capacity gauging was done manually.

DISCUSSION

The cytological diagnoses and exposure histories of these two men indicate that these cases of leukemia may have been caused by exposure to benzene during their work as deck officers. As far as is known, there have been no epidemiological studies of the incidence of leukemia and other types of cancer in seamen working on tankers.

According to several reports, there is an increased risk of developing leukemia of the acute, nonlymphatic type, even if exposure to benzene is low or moderate [Yin et al., 1987; Aksoy, 1985; Infante and White, 1985]. Both patients described here were exposed to benzene as deck officers on coastal tankers carrying pure benzene and other petroleum products. Light petroleum products such as gasoline usually contain 2–5% benzene and also may have contributed substantially to benzene exposure. Other types of pyrolysis products from refineries also may have a high benzene content. These men also had been exposed to high concentration: of vapors from petroleum products such as aliphatic and aromatic hydrocarbons and vapors from other solvents, such as trichloroethylene and styrene.

As chief officers, these two men had been responsible for loading and tank-cleaning operations. Most of the ships they had been working on were not equipped with automatic cargo level indicators, which means that the men were heavily exposed to cargo vapors escaping from manholes. Especially during the final phase of the loading, the "top-off," which takes 5 to 20 minutes for each tank, exposure to benzene may have been very high. Measurements have shown concentrations of up to several hundred parts per million (ppm) during "top-off" of gasoline, according to investigations carried out in Sweden, Norway, and the United States [Mowe et al., 1977; Astleford et al., 1982; Gjorloff et al., 1982; Holmberg and Lundberg, 1985; Nordlinder and Ramnäs, 1987]. On coastal tankers, cargo is loaded into several

tanks, usually 10 to 30, each of which has to be topped off individually. The whole loading process usually takes between 5 and 10 hours and may be repeated two or three times weekly, which could indicate that these deck officers were exposed to some hundred ppm of benzene for several hours per week during certain periods.

Although exposure to benzene is highly variable in merchant seamen, some groups may be exposed to significant doses and have an increased risk of developing leukemia. Today some tankers are equipped with automatic loading surveillance systems, but the cargo-level indicators are not always reliable, and open gauging during topsff is often performed on such ships. Until all ships are equipped with reliable closed loading systems, it is important that the crews be kept aware of the risks and that they use protective equipment when necessary.

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