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Case Report

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Aplastic Anemia in an Automotive Paint Shop Worker

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ABSTRACT

Various chemicals are known to cause aplastic anemia due to bone marrow toxicity. Long-term exposure to benzene in the workplace has been associated with hematological disorders (thrombocytopenia, aplastic anemia, acute myeloid leukemia, lymphoma). Although the use of pure benzene was banned and substituted with other solvents, benzene is still used in the form of mixtures. The automotive painting sector, in particular, is one of the areas where benzene and its derivatives are used more frequently. Benzene and its derivatives are used to increase the fluidity of paints and are included in paints, thinners, and varnishes. Hematotoxicity of benzene is related to the amount and duration of exposure. In Turkey, there are serious difficulties in the implementation of occupational health and safety measures in small-scale enterprises. In this case report, it was described how aplastic anemia developed in a patient who had worked in a small-size automotive painting business with inadequate occupational health and safety measures for 23 years might be related to occupational benzene exposure. It is recommended that such businesses should be inspected concerning occupational health and safety and necessary precautions should be taken in order to prevent such serious, preventable occupational diseases.

Keywords: Aplastic anemia, benzene, occupational disease

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INTRODUCTION

Benzene is among the most commonly known aromatic hydrocarbons, which is a colorless, liquid, and volatile substance with a sweet odor. Among the derivatives of benzene are toluene, xylene, acetone, ether, styrene, aniline, and hexane. Due to its volatility, benzene can be inhaled in environments with poor ventilation. In the industry, benzene is used in the adhesives for manufacturing leather goods and carton boxes, in cleaning metal tools, for dissolving paints and cleaning parts in printing, and for dissolving and diluting paints in car body and paint shops.[1]

Benzene enters the body through breathing (most commonly), skin absorption, and ingestion. The first chronic benzene toxicity was reported by Santesson in 1897 in Sweden, followed by the publication of cases with symptoms of the hematopoietic system.[2] Benzene has been defined as a group 1 carcinogen by the International Agency for Research on Cancer (IARC).[3] The IARC noted that benzene might cause acute myeloid leukemia, other subtypes of leukemia, and lymphoid neoplasms in humans.[4] Previous studies have linked prolonged exposure to benzene in the workplace to hematological disorders.[5–7]

The industrial use of benzene in Turkey dates back to the 1960s. Its usage has become increasingly common as benzene is a very cheap and effective solvent, and associated malignant diseases were reported from Turkey.[2] The toxicity of benzene being well established, the legislation restricting its use in the workplace, was introduced in 1973 in Turkey as in other countries.[8] According to the existing laws in Turkey, workplaces employing 50 or more

workers and operate in sectors categorized in dangerous or highly dangerous risk groups are required to instate occupational health and safety measures. A vast majority of the businesses in Turkey are small and medium-sized enterprises; thus, there are serious difficulties in the implementation of occupational health and safety measures in these businesses.

In automotive paint, it is necessary to increase the fluidity of the paint to be able to apply the paint easily with a spray gun. Thus, benzene-containing solvents are used. In addition, benzene and derivatives are used in water-based paints, thinners, and varnishes used in automotive painting.[9]

This report presents the case of aplastic anemia due to prolonged exposure to benzene in a car paint shop worker.

CASE REPORT

A 38-year-old male was admitted to the emergency department with complaints of fever, weakness, and cough continuing for four days. In his laboratory examinations, the patient was found to have pancytopenia. He had no history of the disease or drug use; he had no family history of hematologic disease. He was a smoker with 11 pack-years of smoking history; he had no history of alcohol use. In his physical examination, he was pale, had a fever of 38.5° C, had other vital signs stable, and normal systemic findings. The initial complete blood count revealed pancytopenia.

Table 1. Laboratory test results

Survey	Results	Unit	Reference values
Leukocyte	1200	uL	$4.2x10^3$-$10.6x10^3$
Neutrophil	500	uL	2.0-$6.9x10^3$
Lymphocyte	400	uL	0.6-$3.4x10^3$
Hemoglobin	8.9	g/dL	14.1-18.1
Hematocrit	27	%	43.3-53.7
Platelet	13000	uL	140.0×10^3-440.0×10^3
Blood Urea Nitrogen	29	mg/dL	17.0-43.0
Creatinine	0.9	mg/dL	0.8-1.3
Glucose	101	mg/dL	74.0-106.0
Aspartate Aminotransferase	15	U/L	0.0-50.0
Alanine Aminotransferase	14	U/L	0.0-50.0
Anti-Nuclear Antibody	Negative		
Rheumatoid Factor	<20	IU/mL	0.0-25.6
Folic Acid	8.1	ng/dL	3.1-19.9
Vitamin B12	266	pg/dL	126.5-505.0
HbsAg	Negative		
Anti Hbs	Negative		
Anti HCV	Negative		

The patient's laboratory results are shown in Table 1. No pathology was observed in the chest radiography, or high resolution computed tomography. Hepatosplenomegaly was not observed in the abdominal ultrasonography. Bone-marrow biopsy indicated hypocellular bone marrow (5%); histochemical studies indicated CD34 (+)<1%, mast extracellular CD117(+) ratio <1%, myeloperoxidase (+) and reticular fiber grade of 0. The patient was considered to have aplastic anemia, underwent successful hematopoietic allogeneic stem cell transplantation after three months in a private medical center, and followed up by our outpatient clinic for occupational diseases.

In the job history of the patient, it was found that he worked for 23 years in a car body paint shop without a painting booth or personal protective equipment and that he used or was exposed to automotive paint, thinner, primer paint, synthetic paint, cellulosic paint, acrylic paint, water-based paint, bathtub paint, varnish and hardeners at work. He did not have ongoing complaints when he was followed up by the outpatient clinic for occupational diseases. Physical examination found good general health, and vital signs were stable with all systemic examinations normal. Routine laboratory tests were normal. Benzene metabolite level in the urine was not investigated since the patient had quitted work five months before admission to the hospital. Material safety data sheets of the chemical substances or personal ambient air benzene exposure results could not be obtained as the patient had worked in a small business. It was considered as a case of aplastic anemia due to occupational benzene exposure in light of the current data and the patient's professional history.

DISCUSSION

The first chemical found to cause aplastic anemia is benzene.[10] Later, petroleum products, chlorinated hydrocarbons, organophosphates, toluene, organochlorine insecticides, pesticides, and disinfectants were also found to give rise to aplastic anemia.[11, 12] The use of pure benzene has been banned for years and substituted by other solvents. However, benzene is still used in various industries in the form of organic solvents (toluene, xylene, and thinner) that contain a certain amount of benzene.[13] Hematotoxicity of benzene is related to the amount and duration of exposure. While the incidence of aplastic anemia was approximately 1/10.000 at low exposure levels (10-20 ppm), the incidence increases to 1/100 at high exposure levels (>100 ppm).[14]

In a previous study, auto paint shop workers exposed to benzene have been shown to be at high risk for hematological diseases, such as leukemia and lymphoma.[15] Another study on auto paint shops measured aromatic hydro-

carbon exposure of personnel and found that the exposure to toluene was above the limit in two closed spaces. These values were lower compared with the values found by Odabaşı.[9, 16] This may be due to the developments in painting technology and the implementation of regulations for protecting human health. After the recognition of the damage caused by solvent-based paints both to the environment and the employees, the use of water-based paints in the automotive industry has increased significantly, and nowadays, water-based paints are commonly used in the industry.

Automotive paint booths are controlled environments designed for both quality paint process and employee health. Winder et al. showed that the measurements in the automotive paint booths were lower than the measurements in open areas.[17] Thus, the paint job must be carried out in a booth. In addition, closing the doors and windows to create a controlled working environment in indoor areas is another factor increasing the exposure. In a study of a paint production plant, the cumulative exposures of the workers before and after the installation of a ventilation system were compared, and it was observed that the risk of leukemia decreased from 66.4 to 3.2 cases for the duration of the study.[18] A significant reduction in the risk of leukemia demonstrates the importance of engineering measures.

Employees may prefer unsuitable work clothes that leave their hands and arms exposed instead of overalls due to the high temperatures. Also, enough personal protective equipment, such as gloves and masks, usually are not used, which leads to increased exposure through inhalation and absorption from the skin. In addition, workers' use of paint thinner or gasoline to clean the paint residues increases benzene exposure. According to the legal regulations, benzene can be found up to 1% in gasoline.[19] Among automechanics who use gasoline containing 2% benzene to clean engine parts and hands, the risk of leukemia was found 3.7-fold higher compared to those who do not use.[20] Lee et al. analyzed 70 different thinners used in the automobile production factory and found seven thinners with benzene concentrations less than 0.1%.[21] Hence, personal hygiene products that are harmless to human health should be preferred instead of using thinner and gasoline for personal cleaning.

To protect from benzene toxicity, it is necessary to carry out the measurements and analyses of occupational hazards, determine the risks in the workplace, and take necessary technical and administrative measures. The use of relevant personal protective equipment is very important for preventing benzene exposure. In the work-starting examination and the periodic examinations, hematological evaluation is necessary for those with occupational exposure to benzene. It has been shown that auto paint shop workers generally exhibit careless behavior towards the use of chemicals due to the lower education level.[22] Thus, in job training should be provided regularly offered for occupational health and safety and should be established awareness of workplace hygiene in workers.

CONCLUSION

Aplastic anemia, in this case, is most likely related to the exposure to benzene and derivatives during the painting process made without protective measures. Benzene exposure and associated preventable diseases continue to be a challenge in the automotive painting industry in Turkey. This situation shows that the uncontrolled working conditions in small-scale businesses continue to exist in Turkey's automotive industry. As a result, it is recommended that automotive paint shops should be evaluated concerning occupational health and safety and that the necessary changes are implemented quickly.

Disclosures

Informed Consent: Written informed consent was obtained from the patient for the publication of the case report.

Conflict of Interest: None declared.

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