

## **Hematological Parameters in the Volatile Substance Sniffers**

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### **Abstract**

*Glue sniffing is a frequent problem among teenagers. Various chemical substances, especially toluene and benzene, contained in the glues have been reported to be hematotoxic. The hematological parameters of 44 healthy teenagers who used to be chronic glue sniffers were investigated to detect any subclinic hematological damage. No abnormalities could be determined in the peripheral blood examination. The present results were discussed and compared with previous studies.*

**Key Words:** *Volatile substance abuse, hematotoxicity, adolescent.*

## **Uçucu Madde Koklayıcılarda Hematolojik Parametreler**

### **Özet**

*Yapıştırıcıların uygunsuz kullanımı adolesanlarda sık karşılaşılan bir problemdir. Yapıştırıcılar içerisinde bulunan çeşitli kimyasal maddeler, özellikle toluen ve benzen'in hematotoksik olduğu bildirilmiştir. Eskiden kronik yapıştırıcı bağımlısı olan 44 adolesanın hematolojik parametreleri, subklinik hematolojik hasarı tespit etmek üzere araştırıldı. Periferik kan muayenesinde herhangi bir anormallik bulunamadı. Bu çalışmanın sonuçları önceki çalışmalarla karşılaştırılarak tartışıldı.*

**Anahtar Kelimeler:** *Uçucu madde suiistimali, hematotoksosite, adolesan*

The abuse of volatile substances is an important social problem especially among teenagers. It is estimated that 3-4 % of teenagers engage in this activity on a regular basis (1-3). Most commonly, the agents are placed in a plastic or paper bag and the fumes inhaled. Another preferred method of administration is to soak a sock or cloth with the agents and to inhale through them, using the nose and the mouth (4). Glue/adhesives sniffing is the most common form of substance abuses. Their commercial products contain toluene, benzene, xylene, trichloroethylene, tetrachloroethylene, methylene chloride, trichlorethane, carbon tetrachloride, acetone, naphtha and n-hexane.

Toluene (methyl benzene) is usually considered the major active agent in the glues (5). The acute toxic effects of toluene include death due to cardiac arrhythmia or pulmonary or cerebral edema, cerebellar damage, renal and hepatic failure. Chronic toluene exposure can lead to muscle weakness, gastrointestinal disturbances, neuropsychiatric abnormalities, peripheral neuropathy, some renal, hepatic and hematological damage (6-8).

The other important agent in the glues is benzene. Acute exposure from ingestion or inhalation may produce irritation of the mucous membranes, restlessness, excitement, and convulsions followed by depression and at sufficient concentrations, death due to respiratory failure. Long-term exposure of humans by inhalation has been associated with hematotoxicity and hemopoietic dysfunction and is implicated in the development of pancytopenia, aplastic anemia, and leukemia (9-11).

In the present study, 44 teenagers who are glue abusers and have been recently quitted this addiction were investigated to detect subclinic hematological damage and the results were discussed.

### **Materials and Methods**

The present study was conducted in 44 boys who were chronic glue vapor sniffers in the past for a while and treated in the governmental rehabilitation center where inpatient and outpatient chemical dependency treatment and prevention program is applied. Their age ranged from 12 to 19 years (mean, 14.7 years). The duration of the

abuse before rehabilitation ranged from two to five years, with a mean of 3.1 years. All participants had quitted the habit at least one month prior to the study. They filled out a questionnaire requesting information on their occupational, demographic and health history. Subjects who had a current or prior history of diseases that could have affected the hematological system were not included in the study. None were drug dependent. All of them are smokers and consume alcohol rarely (when they have the possibility). All subjects had no sign or symptom of any disease, and were healthy at the time of sampling. Red blood cell (RBC) count, white blood cell (WBC) count, platelet count, hemoglobin, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), reticulocytes and sedimentation rate were measured in all cases. Smears were prepared for differential white cell count and examined microscopically in 25 cases.

An appropriate institutional review board approved the project and informed consent was obtained from both parents or legal guardian after the nature of the procedures had been explained fully.

### Results

The hematological parameters of 44 teenagers were within the normal limits. Leukocytes, band neutrophils, segmented neutrophils, lymphocytes, monocytes, basophils, and eosinophils counts determined by the microscopic examination of the smears in 25 cases also were within the normal range.

### Discussion

In a study conducted in 24 patients who were abusing substances in which the only solvent was toluene, it has been found that five users had lymphopenia, three had lymphocytosis, and three patients (two were women) had a normocytic normochromic anemia (12). In a case whom developed acute oliguric renal failure following repeated toluene sniffing for about eight hours, bone marrow depression was observed (13).

On the other hand, some studies of the toluene toxicity on the hemopoietic system found no depressant effects on the bone marrow or peripheral blood cells (14-16). In an animal study comparing the toxicological potential of benzene with other aromatic hydrocarbons (xylene, toluene, and ethylbenzene), only benzene affected the hemopoietic system (17).

The main target organ of benzene toxicity is

the hemopoietic system. In animals, benzene has been shown to affect the hemopoietic precursor cells in the bone marrow, spleen and fetal liver resulting in decreases of circulating cells (18,19). In a multi-species inhalation study with mice, rats, guinea pigs, rabbits, cats, dogs, and monkeys exposed to benzene vapor between 361-388 ppm, 6 hours per day 5 days per week for 12 weeks, mice appeared to be most sensitive to benzene-induced hematological effects (20). The earliest clinical indicator of benzene toxicity in mice is a decrease in circulating WBC, especially lymphocytes and sometimes a transient granulocytosis. Depression of circulating RBC or anemia is observed at a later point (21). In humans, exposure to benzene is associated with various cytopenias, aplastic anemia and an increased risk of myelogenous leukemia (22).

Although benzene has been shown to target the entire hemopoietic system cell compartment, it has been suggested that the erythroid colony-forming unit, CFU-e, appears to be particularly susceptible to its toxic effects (23). It has been shown that RBC count, WBC count, hemoglobin, and platelet counts decreased and the level of MCV increased among persons working in areas with various levels of benzene (24). In an other study, it has been reported that WBC, hemoglobin, and platelet count were decreased. However, RBC count was normal, and MCV was not reported (25).

Some investigators also reported that the earliest changes in hematology from excessive benzene exposure were thought to be a decrease in lymphocytes count and increase in MCV, and other possible effects might include decreases in RBC, granulocytic WBC, and platelets. The reticulocyte is low for the degree of anemia, and this phenomenon showed the defect as a hypoproliferative state (26,27). The potential role of free radicals in benzene toxicity were emphasized, and it has been suggested that the relatively high level of myeloperoxidase and of other peroxidases are responsible for localization of benzene toxicity to the bone marrow (28)

On the other hand, some studies in the persons exposed to benzene found no differences between exposed and controls on RBC, WBC, and platelet counts, MCV, or hemoglobin levels (29-31).

In the present study, the results of blood screening of 44 teenagers who exposed to glue vapor (which contain toluene and benzene) were within normal clinical range. In the studies detected some toxic effects (23-27), the subjects

were exposed to high levels of benzene, whereas, in the studies which found no differences between exposed subjects and controls on the hemopoietic system (29-31), where the persons were exposed to low level of benzene. Although our study subjects were smokers (one of the sources of benzene is smoking), they may have had exposure to low level of benzene by inhalation of glue vapor.

The toxic effects in the hemopoietic system induced by toluene were found to be reversible after the exposure has been quitted (12,13). Most toxic effects induced by benzene in the hemopoietic system also result in complete recovery. In the present study, the subjects had quitted this addiction at least one month prior to study. They might have recovered from the possible toxicities of the glue sniffing.

It is well known that there is a positive association between cigarette smoking and WBC counts, MCV, red cell mass and hemoglobin levels. The smoking habits of our study subjects might have affected the manifestation of the toxic effects of the glue inhalation.

The role of ethanol in benzene toxicity has been extensively studied. It has been found that ethanol increases benzene-induced anemia and lymphocytopenia in peripheral blood and dramatically increases the levels of circulating nucleated red cells (32). Sharp contrast results also were reported (33). We believe that our subjects did not have the possibility to consume alcohol beverage enough to affect the hematotoxicity of glue vapors due to the economic limitations.

Metabolic interaction between toluene and benzene had been considered, and also, it has been shown that toluene is a competitive inhibitor of benzene (34). This interaction may have been effective in our cases.

Long delays have sometimes been noted between the cessation of benzene exposure and the manifestation or discovery of hematological disorders (35). So, it is necessary to examine periodically the treated addicts' hematological parameters in the future even after the cessation of the glue sniffing.

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