

Free radical and antioxidant enzyme levels at exposure of volatile organic compounds in workers

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Various effects of exposure to volatile organic compounds (VOCs) are currently a concern due to a widespread use of VOCs in industry. One occupation in which high exposure of organic solvents has been described is paint workers. Although the use of water-based paint (WBP) has changed the exposure conditions, painters due to the lower emission of VOCs than with a solvent based paints (SBP), still carry the risk of exposure, since SBPs contain more reactive compounds such as benzene, toluene, biocide, and glycol ethers. In addition, these workers are exposed to all of the solvents due to the processing of factory's manufacture schedule. The toxic effects of VOCs are caused by formation of reactive oxygen species (ROS). Free radicals are highly reactive species that is involved in cellular damage and can contribute to the conversion of normal cells. The ROS are believed to cause lipid peroxidation resulting in damage to biological membranes. Antioxidants such as enzymatic and nonenzymatic defense system are necessary to prevent cellular damage.¹ Studies on painters include the association between exposure and health effects, yet little is known of biomarkers of these disorders. Also, the levels of malondialdehyde (MDA), superoxide dismutase (SOD), and total antioxidant capacity (TAC) parameters have not been studied in paint workers. Therefore, this study was to examine the effects of VOC on lipid peroxidation and antioxidant enzyme activities in paint workers.

Twenty male paint workers were chosen as the exposure group and a similar number of healthy male, matched by age, were chosen as controls (Table 1). All painters were asked to answer a questionnaire that included questions regarding the age, smoking health, years worked as a paint worker, use of gloves, and personal respiratory protective equipment during working. The study was explained to the workers and approved by a local ethic commission. Venous blood samples obtained from the paint workers at the work site were codified and transported to the lab, where they were processed. Sera were separated and used without any treatment and erythrocytes were washed with 0.9% sodium chloride solution and centrifuged for 10 minutes. Washing was repeated 3 times. After a complete lysis, cellular particles were removed by centrifugation and the hemolysate was used for the determination of SOD activity. None of the paint workers in this study used gloves and protective

respiratory equipment. They used SBP and WBP due to the factory's schedule, and were therefore, exposed to a mixed type of solvent. All the paint workers had spent at least 5 years in the occupation. There were 9 smokers and 11 non-smokers in both the paint and control group (Table 1). The MDA concentration of paint workers was significantly higher than the control group (5.13 ± 0.72 nmol/mL versus 1.52 ± 0.45 nmol/mL, $p < 0.01$). The erythrocyte SOD activity was found to be higher in the paint group compared to the control group (1608.648 ± 48.98 U/gHb versus 1045.19 ± 14.75 U/gHb, $p < 0.01$). In the paint group, the serum TAC level was lower than the control group (189.340 ± 53.33 μ mol/L versus 244.72 ± 57.11 μ mol/L).

Organic solvents are a chemical class of compounds that are used routinely in commercial industries. They share a common structure (at least 1 carbon and 1 hydrogen), low molecular weight, lipophilicity, and volatility, and they exist in liquid form at room temperature. They differ in chemical structure yet generally share important characteristics. They will evaporate (form vapor) quickly and easily at room temperature. Free radicals are continuously produced during aerobic metabolism. Oxidative damage caused by free radicals is counteracted by many enzymes and vitamins. The imbalance between the rate of free radical production and the effect of protective antioxidants leads to oxidative damage, which is also known as oxidative stress. The ROS-induced lipid peroxidation is an oxidative process associated with membrane lipid destruction,² so that MDA is formed as an end of the lipid peroxidation. In our study, we found elevated MDA levels in the paint group compared to the control group ($p < 0.05$). Karagözler et al³ found similar results, and showed increased MDA levels in house painters compared to the control group. Superoxide dismutase is an enzyme extensively used as an indicator of oxidative stress. At the first step of the defense system against oxidative stress, it catalyzes dismutation of the superoxide anions into hydrogen peroxide. A significant

Table 1 - Characteristics of the groups studied.

Parameter	Paint	Control	<i>p</i>
Age (year)	31.75 \pm 2.51	31.35 \pm 3.12	>0.05
Length (m)	1.697 \pm 7.44	1.77 \pm 6.915	>0.05
Weight (kg)	77.9 \pm 13.42	80.05 \pm 11.93	>0.05
Smoking/year	13.87 \pm 5.051	9.88 \pm 6.25	>0.05
Amount/day (sigara)	9.42 \pm 4.40	21.87 \pm 7.52	>0.05
Working duration (year)	9.42 \pm 3.91		
Smokers/nonsmokers	9/11	9/11	

Data presented as mean \pm SD of 20 subjects in each group

increase in SOD activity in erythrocytes in our study might have occurred to neutralize the excess superoxide anions originating from volatile organic compounds such as benzene, toluene, and thinner. Halifeoglu et al⁴ also found increased MDA and SOD activity in a study sample working with paint thinner.⁴ The antioxidant system have many components. The antioxidant capacity may give more relevant biological information compared to that obtained by the measurement of individual components, as it considers the cumulative effect of all antioxidants present in plasma and body fluids.

We observed a significant decrease in the concentration of TAC in the paint group's sera compared to control. These findings showed that the other antioxidant defense mechanism is used versus oxidative damage. A plausible explanation could be that the solvent exposure may cause inhibition of enzymes or depletion of substrate molecule (glutathione, GSH and so forth) and an increase in the concentration of ROS. Our data indicate that smoking is not a confounder for the association between solvent exposure and changes in blood parameters. Also, Pinto et al⁵ reported that smoking or alcohol intake did not correlate positively with the cytogenetic damage observed in outdoor painters. As a result, elevated MDA levels in the paint group may indicate that increased lipid peroxidation at exposure to long-term organic solvents. Whereas elevated SOD activity in the paint group compared to control, it is shown that the antioxidant system is activated against lipid peroxidation. Beside this, decreased TAC level in the paint group may indicate that another antioxidant system is used. Whichever the case is, our results permit us to conclude that paint workers studied represent a risk group and should be medically followed up with more frequent periodic examinations. These workers should take antioxidants and use gloves and protective equipment.

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Synchronous occurrence of Philadelphia chromosome-positive chronic myelogenous leukemia and breast cancer

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The synchronous occurrence of non-treatment related Philadelphia chromosome positive (Ph-C+) chronic myelogenous leukemia (CML) and breast cancer (BC), is reported in this communication. The coincidental discovery of CML and BC is described in 2 patients, aged 37 and 39 years, who presented almost in a similar manner, where the diagnosis of chronic uncontrolled phase of CML was made upon working up the patient for radical surgery for a coexisting breast cancer. Both patients were treated with modified radical mastectomy with axillary clearance, which was followed by chemotherapy for both diseases. The first patient subsequently underwent autologous bone marrow transplantation, and is alive and well when last followed up nearly 27 months after the initial diagnosis. The second patient, who has a strong family history of breast cancer, died 18 months after initial diagnosis of uncontrolled metastatic breast cancer to the central nervous system.

A 37-year-old Caucasian, gravida 3, para 3 and otherwise healthy female teacher, was admitted to work her up for a recently diagnosed BC by fine needle aspiration biopsy (FNAB). The mass (in the upper lateral quadrant) was painless and was initially felt while taking a shower and was found to progressively increase in size. The first FNAB carried out 4 weeks after breast mass discovery, was erroneously interpreted as a fibroadenoma. As the mass continued to enlarge, a second FNAB was carried and revealed the definitive presence of adenocarcinoma. Family history for BC was negative. She was scheduled for mastectomy, for which she underwent as part of her work up an admission,