



Research Article

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RENAL AND HEMATOLOGIC EFFECTS OF ORGANIC SOLVENTS IN IRAQI AUTO REPAIR SHOPS WORKERS WITHIN BAGHDAD DISTRICT AREA

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ABSTRACT

The present study was designed to evaluate the expected impact of exposure to car painting solvents on renal and hematological functions in Iraqi car painting workers relative to the duration of exposure within Baghdad District area. Blood samples were obtained from randomly selected auto repair workers and analyzed for serum urea, creatinine and hematological markers and compared with those from non-exposed subjects. Although significant changes were reported in most of the tested parameters, all were within the accepted normal ranges. In conclusion, Iraqi workers in auto repair shops did not reveal potential renal and hematologic toxicity due to occupational exposure to solvents used in car painting. However, due to sample size limitation, further larger studies are recommended.

Keywords: car painting, nephrotoxicity, hemotoxicity, exposure hazards

INTRODUCTION

Occupational exposures to hazardous chemicals are common in industries using solvent based materials as well as in indoor environments where people are exposed to volatile organic compounds from various sources¹. Although the rate of occupational diseases and injuries is very high in developing countries, and thousands of workers are routinely exposed to various chemicals, there is currently little or no survey data due to lack of proper reporting or monitoring procedures². One occupation in which high exposure to organic solvents has been described is car painting³. Despite the wide spread use of organic solvents in car painting and their serious consequences, a lack of insight in the relationship between exposure and diseases still exists due to uncertainties on health end points, underlying mechanisms and biologically relevant exposure^{4,5}. Occupational exposure to mixtures of organic solvents has been evaluated in many activities, such as painting, paint spraying, floor-laying, shoe making, laundries, and graffiti removers^{6,7}. Several studies have focused on car repair painters, since this class of workers usually suffers of long-term exposure to relatively high levels of many different solvents⁸. However, in the last 10-15 years, exposure to organic solvents has been reduced for car repair painters, due to amendments to the regulations concerning collective and personal protective equipment in car painting shops, and substitution or reduction of solvents use^{9,10}. There are many reported health adverse effects of organic solvents on hematological, neurological, immunological, respiratory systems and carcinogenicity¹¹. The present study was designed to evaluate the expected impact of exposure to car painting solvents on renal and hematological functions in Iraqi car painting workers relative to the duration of exposure within Baghdad District area.

STUDY DESIGN AND METHODS

The study population includes 30 randomly selected male workers employed in automobile body paint garages in two industrial areas within Baghdad city (Al-Sheikh Omar and Al-Rasheed camp regions) during the period from February to April 2013. Their mean age was (38.9±6.89) years (range: 22 to 53 years), and work experience (14.25±3.46) years (range: 10 to 40 years). Each worker was interviewed using a questionnaire, which included personal data, medical history, duration of exposure and the whole time they spend in this profession. This questionnaire was specifically designed for this study. It passed the validity and reliability test for this investigation. Exclusion criteria were respiratory disorders including asthma, cigarette smoking, maintenance on chronic medications and use of drugs that interfere with renal function and the hematopoietic system. All subjects were apparently healthy on enrolment. Fifteen non-exposed males, not exposed regularly to organic solvents during their lives and age matched with workers were included as control group. Each subject signed informed consent before enrollment and the study protocol was approved by the local ethics committee of the College of Pharmacy, University of Baghdad.

Estimation of Renal Function

Venous blood samples (10 ml) were obtained by vein puncture from the workers and control group subjects and immediately transferred into 2 tubes; 3.0 ml in a tube containing potassium EDTA anticoagulant and 7.0 ml in a plain tube for preparing serum; after clot formation the samples were centrifuged at 3000 rpm for 15 min to get the serum. The separated serum was utilized for estimation of urea and creatinine levels using readymade analytical commercial kits (Randox Laboratories, UK).

Estimation of Hematologic Parameters

The blood samples obtained in EDTA tube were analyzed for hematology markers using automated hematology analyzer (Coulter Swelab, Switzerland)¹².

Statistical Analysis

All values were expressed as mean±S.D; statistical analysis was performed using unpaired Student's *t*-test. *P* values less than 0.05 indicated significant differences. Pearson correlation test was utilized to evaluate the relationship between the exposure time and the affected parameters.

RESULTS

Table 1 showed that exposure of car painting workers to solvents and chemicals during their work results in non-significant increase in serum urea levels (22.1%); while serum creatinine level was significantly elevated (64.3%, *P*<0.05) compared to control subjects not exposed to such environmental conditions. Regarding the influence of car painting environment on the hematologic picture of the

workers, table 2 clearly showed that both Hb level and PCV value were significantly elevated (12.4% and 24.5%, respectively) compared to controls. Similarly, the erythrocytes sedimentation rate (ESR) and total WBC count values were also significantly elevated in car painting workers compared to control subjects (142.7% and 56%, respectively). Table 2 also indicated that the ratio (%) of neutrophils, lymphocytes, monocytes and eosinophils relative to total WBC count were significantly elevated in blood samples obtained from car painting workers compared to controls; while basophil ratio was non-significantly decreased (*P*>0.05) (Table 2). In an attempt to correlate the changes in renal function (in terms of serum creatinine level) with the duration of exposure to car painting solvents, Pearson's correlation results indicated that weak negative and non-significant correlation was reported in this respect (*r*= - 0.19, *P*= 0.314) (Figure 1). Similar results were obtained for the correlation between duration of exposure with Hb level, ESR value and total WBC count, where all showed weak and non-significant correlations (Figures 2, 3, and 4).

Table 1: Effects of exposure to organic solvents in Iraqi car painting workers within Baghdad District area on the renal function markers

Parameters	Control subjects n=15	Car painting workers n=30
Serum Urea (mg/dL)	38.9±0.72	47.5±29.7 ^{NS}
Serum Creatinine (mg/dL)	0.7±0.24	1.15±0.5*

Values are presented as mean±SD; n= number of subjects; * significantly different compared to controls (*P*<0.05); NS= non-significantly different.

Table 2: Effects of exposure to organic solvents in Iraqi car painting workers within Baghdad District area on the hematological indices

Parameters	Control subjects n=15	Car painting workers n=30
Hemoglobin (g/L)	12.9±0.72	14.5±1.0*
PCV (%)	36.8±9.6	45.83±3.1*
ESR (mm/hr)	19.0±9.8	46.13±31.8*
Total WBC count (cells/ml)	6167±1282	9620±3829*
Neutrophils (%)	55.9±4.4	60.13±6.3*
Lymphocytes (%)	24.13±4.3	33.8±5.4*
Monocytes (%)	1.9±0.9	3.7±1.2*
Eosinophils (%)	1.2±0.5	2.3±1.8*
Basophils (%)	0.66±0.4	0.38±0.2 ^{NS}

Values are presented as mean±SD; n= number of subjects; * significantly different compared to controls (*P*<0.05); NS= non-significantly different.

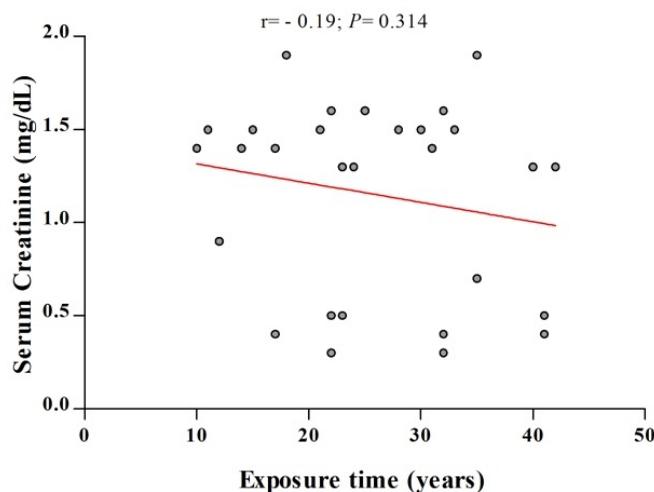


Figure 1: Correlation between serum creatinine levels and duration of exposure in Iraqi car painting workers (n=30)

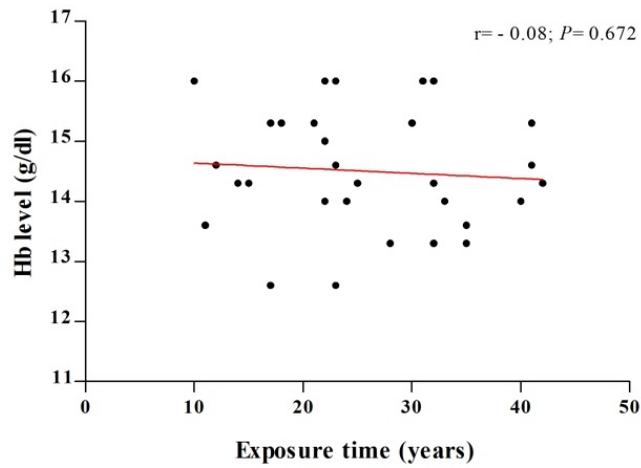


Figure 2: Correlation between Hb levels and duration of exposure in Iraqi car painting workers (n=30)

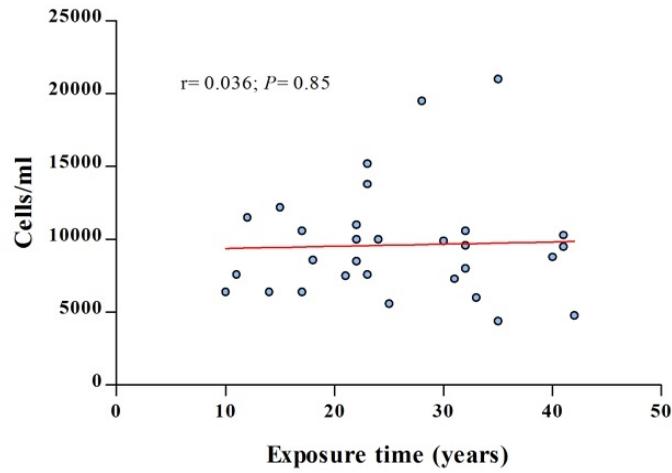


Figure 3: Correlation between total WBC count and duration of exposure in Iraqi car painting workers (n=30)

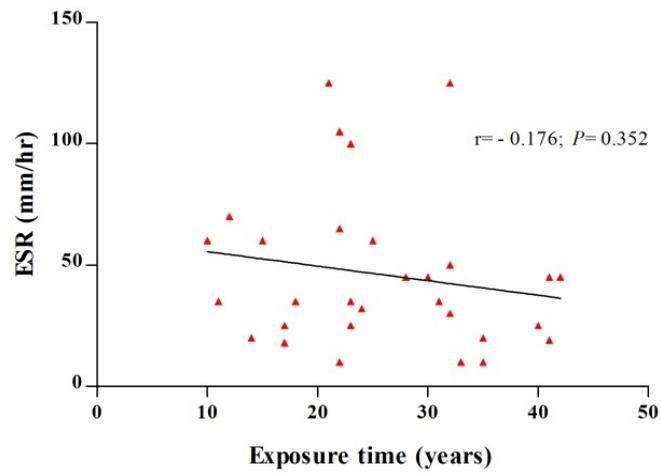


Figure 4: Correlation between ESR values and duration of exposure in Iraqi car painting workers (n=30)

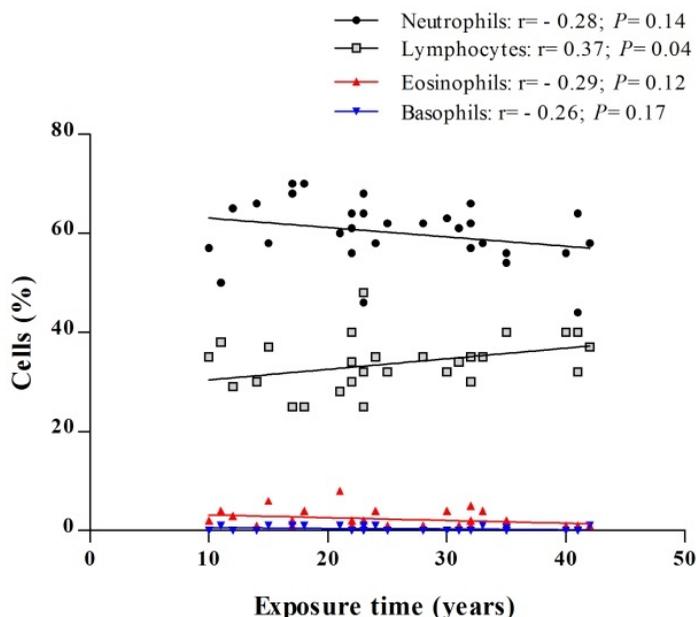


Figure 5: Correlation between differential WBC count ratios (%) and duration of exposure in Iraqi car painting workers (n=30)

However, correlation between the changes in different types of WBCs with the duration of exposure indicated that only the changes in lymphocyte's ratio was positively and significantly correlated with the duration of exposure ($r= 0.37$; $P= 0.04$), while the changes in % ratio of all other cell types (neutrophils, monocytes, eosinophils and basophils) were not significantly correlated with the duration of exposure (Figure 5).

DISCUSSION AND CONCLUSION

In Iraq, worker safety is largely neglected aspects and little information on contaminant exposure is available because surveillance studies have never been given priority. Our investigation therefore pioneers the monitoring of chemical exposure in selected occupations. In this effort, assessment of exposure to solvents and chemicals used in auto repair shops, including car painting, was carried out by measuring health hazards related to renal and hematological functions. The reactive nature of many organic solvents used during car painting has resulted in many cases of skin and respiratory sensitization and occupational asthma with repeated or prolonged exposure^{13,14}. The car painters involved in the present study are exposed to a mixture of solvents; however aliphatic isocyanates are considered as the major class of chemicals used in this provision, with significant toxicological impacts. In the present study, where randomly selected auto repair workers evaluated for possible renal and hematologic effects, the preliminary data indicated an increase in serum urea levels of exposed workers compared to non-exposed controls; however, the reported values are still within the normally accepted range (the upper normal value) and correlation study did not reveal significant relationship with duration of exposure (Figure 1). Isocyanates, the essential cross-

linking chemicals used to make polyurethane used in auto repair shops, are potent sensitizers and a common cause of occupational asthma. In addition, isocyanate (NCO) skin contact may contribute to the development of isocyanate asthma, and previous data has shown that unbound NCO can persist on recently spray coated auto body parts after appearing dry. The risk of substantial human isocyanate skin exposure from contact with the dry appearing (yet not fully cured) isocyanate coatings appears to be low, although other isocyanate coatings and tasks may pose a greater risk of NCO skin exposure¹⁵. Conjugation with proteins in the blood may contribute to the pathogenesis of chemicals-induced asthma by acting as protein carriers that present those chemicals to the immune system¹⁶. The possibility of precipitation of these protein conjugates in the renal tissues could be the reason behind the slow apparent deterioration in the renal function reported in the present study, but still such conclusion needs to be confirmed by extensive research in this regard. Toxic effects of organic solvents were reported to harm liver¹⁷, kidney¹⁸ and skin¹⁹. Accordingly, the hematopoietic system can be considered as potential targets for chemicals used in car painting as a result of direct or indirect occupational exposure. In the present study, table 2 clearly showed that most of the hematological markers are within the normal range (except for the ESR result which is significantly elevated), though the reported significant changes within the normal range might reveal pathological finding when sample size increased in future studies. Meanwhile, the elevated ESR value may be attributed to other disorders not related to the occupational exposure, since figures 2-5 did not reveal significant correlations between the tested parameters and duration of exposure. The fluctuation in daily exposure and other factors might be the reasons for

not reporting marked renal or hematologic toxicity in our sample. The reported results in the present study are in compliance with those reported by Moen et al (2000), where the exposure to organic solvents is low in the examined car-painting garages, and the risk of adverse health effects related to organic solvents is probably low in these workplaces within Norway²⁰. Several studies have focused on car repair painters, since this class of workers usually suffers of long-term exposure to relatively high levels of many different solvents^{21,8}. However, in the last years, exposure to organic solvents has been reduced for car repair painters, due to amendments to the regulations concerning collective and personal protective equipment in car painting shops, and substitution or reduction of solvents use¹⁰. In this regard, the limitation of skin exposure through protecting the exposed body parts could be a factor in limiting absorption through the skin and blood availability of isocyanates; though this idea needs to be confirmed by analysis of blood levels of the expected pollutants. Indirect evidence from a growing number of case reports and clinical and epidemiologic studies suggests that isocyanate skin exposure occurs in the workplace and can increase the risk for sensitization and isocyanate asthma. Although data confirming the risks of human isocyanate skin exposure remain limited, there is sufficient information to recommend prevention of skin exposure. Such recommendations are now being made in material safety data sheets and are beginning to appear in the medical literature²². In conclusion, evaluation of Iraqi workers in auto repair shops did not reveal potential renal and hematologic toxicity due to occupational exposure to solvents used in car painting. However, due to sample size limitation, further larger studies are recommended.

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