Blood and Renal Affection Among Egyptian Car Painters

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Abstract

Background: Car painter workers usually suffer from long-term exposure to relatively high levels of mixture of solvents.

Objective: The aim of this work was to evaluate occupational exposure to organic solvents that entails a risk of haematological changes and renal dysfunction.

Subjects and Methodology: This study was conducted in two car repair shops in Maadi & El Manial in Cairo. The exposed group was 30 male workers, aged 17 to 35ys (26.8 ± 4.2), working 12 hours/day with one day off. None of the workers used any protective equipment.

A matched referent group of 30 male subjects aged 20 to 38 years (30.8 ± 4.9) and of the same socioeconomic status was also included in our work.

The following were performed after taking individual consent: (A) An occupational history; and full clinical examination (B) Serum creatinine and B 2 microglobulin in urine, Nacetylglucosaminidase, hippuric and methylhippuric acid and CBC.

Results: Showed a statistically high significant difference between the exposed and the control groups as regards serum creatinine, urinary B 2 microglobulin, N-acetylglucosaminidase, methylhippuric acid and CBC.

Recommendations: Pre-employment, periodic medical examinations. Personal protective equipment. Health education programs. Following recommended allowable concentrations Further investigations are needed to ascertain the correlation between solvent exposure and kidney and blood affection obtained in this study.

Key Words: Methylhippuric acid – Hippuric acid – Health hazards – Egyptian – Car painters.

Introduction

ADVERSE health effects of organic solvents have been well known for over a century. Approximately 200 000 workers worldwide are employed in paint manufacture. The total number of painters is probably several millions, a major group being construction painters. Other industries in which large numbers of painters are employed include manufacture of transportation equipment and metal products, automotive and other refinishing operations and furniture manufacture [1].

Thousands of chemical compounds are used in paint products as pigments, extenders, binders, solvents and additives. Painters are commonly exposed by inhalation to solvents and other volatile paint components. Inhalation of less volatile and non-volatile components is common during spray painting. Dermal contact is another source of exposure. Painters are commonly exposed to mixture of solvents, mainly petroleum solvents, toluene, xylene, ketones, alcohols, esters and glycol ethers. Chlorinated hydrocarbons are used in paint strippers and less frequently in paint formulations. Benzene was used as a paint solvent in the past but is currently found in only small amounts in some petroleum solvent-based paints. Titanium dioxide and chromium and iron compounds are used widely as paint pigments, while lead was used commonly in the past [2].

In metal and automobile painting, metal-based antirust paints and solvent-based paints are often applied by spraying; in addition, newer resin systems, such as epoxy and polyurethane, are commonly used [2].

Occupational exposure to mixtures of organic solvents has been evaluated in many activities, such as painting, paint spraying, floor-laying, shoe
making, laundries, graffiti removers, etc \cite{3}. Toluene and xylene are absorbed through the lungs and the skin, metabolized and excreted mainly as hippuric and methylhippuric acids, respectively in urine \cite{4}. Coexposures of these two solvents are very common in the industry \cite{5}. 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 \cite{6}.

**Aim of work:**

The aim of this work is to evaluate whether occupational exposure to organic solvents entails a risk of haematological changes and renal dysfunction among the Egyptian workers in car painting.

**Subjects and Methods**

This study was conducted in two car repair shops in Maadi & El Manial in Cairo. The study was accomplished during the months of May & June 2011. Written informed consents were obtained from all subjects.

The studied group comprised 30 male car repair painters exposed to a paint-based mixture of hydrocarbons working in car repair shops aged between 17 to 35 years (26.8 ± 4.2) working on the basis of 10 hours/day with one day off per week. None of the workers used any protective equipment during working hours. 12 workers were smokers.

A referent group (30 persons) matched for age that ranged from 20 to 38 (30.8 ± 4.9), socioeconomic status, smoking habits also were similar in terms of blood pressure were recruited among the relatives of the studied group they were not occupationally exposed to organic solvent or to hazardous chemicals. Detailed personal, medical, occupational history were fulfilled. Medical examination and blood pressure to exclude those who were suffering from acute and/or chronic illnesses (as hypertension, diabetic, cardiac, auto-immune diseases, renal diseases or other occupational diseases) were conducted for all subjects.

All participants were subjected to the following laboratory investigations:

**Urine sample:** A morning timed urine samples were refrigerated immediately, transferred to the analytical lab and kept frozen until analyzed. B 2 microglobulin in urine, N acetyl glucosaminidase, hippuric and methylhippuric acid (urinary parameters analysed are corrected per mmol(gr)creatinine excretion) in order to access renal subclinical dysfunction.

**Blood sample:** Five ml of peripheral blood samples drawn from the workers and control subjects and were left to clot at room temperature to separate sera after centrifuging for 10 minutes at 3000 r.p.m. Sera were divided into several aliquots and stored at –70°C until assay.

1- **Hemogram:**

Including red blood cell count, total leucocytic count, platelet count using Coulter counter and examination of Lishman or Wright-stained peripheral blood smears.

2- **Serum creatinine:**

Serum creatinine concentrations were measured by the Jaffé assay using Creatinine Companion (Exocell, Philadelphia, PA) (Heinegard 1973).

3- **Urinary protein excretion:**

Beta-2 microglobulin detection is based on the principle of a solid phase enzyme-linked immunosorbent assay Cat. EA-0108, Biological Technology Co., Ltd. on Haixi Tang. The assay system utilizes a monoclonal anti-β2-MG antibody for solid phase immobilization on the microtiter wells (Hemmingsen et al., 1985).

4- **Urinary N-acetyl glucosaminidase:**

Urinary NAG was measured by colorimetric assay by using a commercially available kit (Roche Applied Science, Indianapolis, IN) according to the manufacturer’s protocol (Han et al., 2008).

5- **Urinary Hippuric (HA) & methyl-hippuric acid (MHA):**

The determination of Urinary HA and MHA were measured by high performance liquid chromatography according to National Institute for Occupational Safety and Health (NIOSH) method.

**Statistical methods:**

Statistical analysis was performed using computer statistical software package SPSS 16. Descriptive analysis was performed as mean ± standard deviation. Comparative analysis between different groups was applied using student’s t-test for parametric data. p-value was considered significant if $p < 0.05$. 
Results

The results are shown in Tables (1-3).

Table (1): General characteristics of the studied group.

<table>
<thead>
<tr>
<th></th>
<th>Exposed group (N: 30)</th>
<th>Control group (N: 30)</th>
<th>t-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31.00 ± 4.29</td>
<td>32.93 ± 4.98</td>
<td>-1.61</td>
<td>&gt;0.05</td>
</tr>
</tbody>
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Table (2): Results of laboratory investigations of the studied group.

<table>
<thead>
<tr>
<th></th>
<th>Exposed group (N: 30)</th>
<th>Control group (N: 30)</th>
<th>t-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine (0.7-1.2mg/dl)</td>
<td>1.68 ± 0.93</td>
<td>0.95 ± 0.16</td>
<td>4.24</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B2 microglobulin in urine (0-0.3 µg/ml)</td>
<td>145.10 ± 8.93</td>
<td>52.21 ± 13.59</td>
<td>31.27</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>N acetyl glucosaminidase (&lt;5U/g Creatinine)</td>
<td>4.96 ± 2.36</td>
<td>3.12 ± 1.39</td>
<td>3.74</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hippuric acid (0.2-2.0g/g creatinine)</td>
<td>2.56 ± 0.99</td>
<td>1.18 ± 0.59</td>
<td>6.54</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Methylhippuric acid (0.01-2.37g/g creatinine)</td>
<td>0.53 ± 0.41</td>
<td>0.23 ± 0.41</td>
<td>2.82</td>
<td>&lt;0.05</td>
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Table (3): Haematological parameters of the studied group.

<table>
<thead>
<tr>
<th></th>
<th>Exposed group (N: 30)</th>
<th>Control group (N: 30)</th>
<th>t-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucocyte count (WBC) (4-11x1000/cm³)</td>
<td>6.26 ± 1.86</td>
<td>5.68 ± 1.53</td>
<td>1.32</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Erythrocyte count (RBC) (4.5-5.6 million/mm)</td>
<td>3.46 ± 0.37</td>
<td>4.07 ± 0.77</td>
<td>-3.86</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Platelet count (150-400x1000/mm²)</td>
<td>203.67 ± 37.26</td>
<td>202.87 ± 23.36</td>
<td>0.10</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

Discussion

In this study we found renal and haematological affection among car painters exposed to mixture of organic solvents.

Our results showed a highly statistically significant elevation of serum creatinine level among exposed compared to control group as regards serum creatinine level (p<0.01), we demonstrated also a statistically significant difference between the exposed and the control groups as regards urinary B2 microglobulin. These results are in accordance with (Yaqoob et al., 1990) [6] study which showed microproteinuria and elevated serum creatinine level above the normal range workers (100umol/l). Our work revealed a highly statistically significant difference between the exposed and the control groups as regards the levels of N acetyl glucosaminidase in urine. These results go with Sonmez et al., (2002) [11] study which showed that a statistically significant difference between car painters and controls.

Elevated urinary retinol-binding protein and N-acetylglucosaminidase are thought to represent proximal tubular dysfunction. The early detection of renal changes induced by long-term exposure to nephrotoxic industrial chemicals has been reviewed by researchers [6,12]. It is interesting to observe the pattern of renal abnormalities in previous researches [13] who found a significant proportion of sprayers from both groups have elevated serum creatinine levels compared to controls, suggesting that renal impairment may result from chronic paint exposure. Urinary N–acetylglucosaminidase is known to be distributed more widely along the nephron and is released as a result of tubular damage. It has been shown to be a sensitive marker of active proximal tubular damage [14].

Our study demonstrated a statically significant difference between the exposed and the control groups as regards the excretion of hippuric acid. This result was in contrast to Hironobu et al.,
Health education programs in order to increase workers awareness of the potential risks by means of information and training. Periodic environmental monitoring of solvent exposure in car painting shops workers. Biological monitoring of early effects can help identify individuals susceptible to nephrotoxicity of this group of chemicals.

References


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