Hemopoietic System in Traffic Police Exposed to Urban Stressors

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Abstract: The aim of the study is to evaluate if occupational exposure to urban stressors could cause alterations in red blood cells (RBC), hemoglobin (HGB), hematocrit (HCT), mean cell volume (MCV), mean cell hemoglobin (MCH), mean corpuscular hemoglobin concentrations (MCHC) in traffic police compared to a control group. 694 subjects were included in the study: 347 traffic police and 347 controls matched by sex, age and length of service after excluding the subjects with the principal confounding factors. The levels of RBC, HGB, HCT were significantly higher in male (respectively \( p < 0.001, p < 0.05, p < 0.01 \)) and in female (respectively \( p < 0.05, p < 0.001, p < 0.01 \)) traffic police than in controls. The authors hypothesise that occupational exposure to urban stressors in traffic police can alter hemopoietic system.

Key words: Traffic police, Red blood cells, Hemoglobin, Hematocrit, Urban stressors

Introduction

Urban workers, such as traffic police, are daily exposed to chemical, physical (i.e. noise) and psycho-social stressors. Studies in literature have suggested that urban pollutants as lead (Pb)\(^1,2\), sulphur dioxide (SO\(_2\))\(^3\), cobalt (Co)\(^4\), manganese (Mn)\(^5\), nickel (Ni)\(^6\), carbon monoxide (CO)\(^7\), methanol (CH\(_3\)OH) and methyl-ter-butyl-ether (MTBE)\(^8\) may cause alterations of red blood cells (RBC), hemoglobin (HGB) and hematocrit (HCT) values. The class of workers investigated in this study was constituted by traffic police of a big Italian city, for whom we have already studied the environmental and biological levels of some urban pollutants in previous researches. In these studies, exposure dosage to benzene and toluene was significantly higher in traffic police vs. control group\(^9-15\) and consequently we did not repeat the exposure dosage study in this work. The Municipality of the city in question monitored during the period October-December 2000 concentrations of particulate matter 10 micrometers in diameter and smaller (PM\(_{10}\)) in fixed stations located in districts with different intensities of vehicle traffic, registering mean monthly min/max values respectively of 44–76 \( \mu \text{g/m}^3 \) and 43–76 \( \mu \text{g/m}^3 \) in a municipal park. Besides the above mentioned urban stressors it is known that traffic police are exposed to psycho-social stressors, which both interact and add onto urban chemical ones. Our previous research has ascertained, through the compilation and elaboration of a questionnaire, a greater subjective stress in traffic police compared to a control group. Sources of psychosocial stressors for traffic police may be found in the relations with the public, exposure to episodes of criminality, and the need to maintain high levels of service performance in various contexts.

The aim of this study is to evaluate if traffic police exposed to urban stressors could be at risk of alterations...
in red blood cells (RBC), hemoglobin (HGB), hematocrit (HCT), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean corpuscular hemoglobin concentrations (MCHC) compared to a control group.

## Materials and Methods

Two groups were studied: traffic police exposed to urban pollutants who worked in shifts on parking, patrols, keeping passage-ways free, controlling traffic at crossings and on roads with intense flows of vehicles. Indoor subjects who carried out administrative and bureaucratic tasks, with a slighter level of exposure were used as control group. Traffic police and controls worked seven hours a day for at least five days per week. For the inclusion in this study a questionnaire with the physiological anamnesis, the remote and near pathological anamnesis and the previous and current working history was collected for all subjects. In order to avoid the influence of confounding factors, all the subjects referring the use of paints, solvents, and pesticides during leisure activities and reporting habitual consumption of alcohol and cigarette smoking habit were excluded. All the subjects were asymptomatic; nobody was affected by heart, lung and kidney diseases or have had hemorrhages recently. All subjects were not blood donors. Traffic police were matched with controls by sex, age and length of service (in terms of mean, SD, and distribution into classes). Consequently 694 subjects were included in the study: 347 traffic police (189 men and 158 women) and 347 controls (189 men and 158 women) (Table 1). All the subjects agreed their personal details being available, declaring that they had been made aware that these data are ranked as "sensitive information", and consented that the data arising from the research protocol should be treated in an anonymous and collective way, with scientific methods and for scientific purposes in accordance with the principles of the Declaration of Helsinki. A 10 ml sample of venous blood was taken from each worker between 8 and 10 a.m., before they had eaten and beginning their shift. Samples were kept in the workplace in a refrigerator at +4°C until they were transferred (by means of a container and at the same temperature) to the laboratory. The samples were taken in the period October-December 2000. The analysis laboratory executed the dosage of RBC, HGB, HCT, MCV, MCH and MCHC on samples of venous blood by means of hematological electronic analyser (Coulter Counter Model S Plus IV). These test has been performed immediately. The normal values for all the test were those ordinarily used by our laboratory: RBC 4.00–6.20 10^6/mm^3 for men, 3.9–5.2 10^6/mm^3 for women; HGB 14.0–18.0 g/dl for men, 12.0–16.0 g/dl for women; HCT 35.0–50.0% for men, 38.0–45.0% for women, MCV 77–100 µm^3 for men, 80.0–96.0 µm^3 for women.

### Table 1. Age, working life, RBC, HBG, HCT, MCV, MCH and MCHC values in traffic police and controls of both sexes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Male (n=378)</th>
<th>Female (n=316)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traffic police (n=189)</td>
<td>Controls (n=189)</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>27–61</td>
<td>44.8 (7.6)</td>
<td>45.1 (7.5)</td>
</tr>
<tr>
<td>Working life (yr)</td>
<td>17.0 (7.2)</td>
<td>17.2 (7.3)</td>
</tr>
<tr>
<td>RBC (10^6/mm^3)</td>
<td>5.1 (0.4)</td>
<td>4.9 (0.5)</td>
</tr>
<tr>
<td>HGB (g/dl)</td>
<td>15.1 (1.2)</td>
<td>14.8 (1.2)</td>
</tr>
<tr>
<td>HCT (%)</td>
<td>45.2 (3.3)</td>
<td>44.2 (3.7)</td>
</tr>
<tr>
<td>MCV (µm^3)</td>
<td>89.4 (5.7)</td>
<td>90.0 (5.1)</td>
</tr>
<tr>
<td>MCH (pg/dl)</td>
<td>29.9 (2.2)</td>
<td>30.2 (2.0)</td>
</tr>
<tr>
<td>MCHC (g/dl)</td>
<td>33.3 (1.2)</td>
<td>33.5 (1.3)</td>
</tr>
</tbody>
</table>

n.s.: not significant.
women; MCH 27–32 pg for men, 27–34 pg for women; MCHC 32–36 g/dl for both sexes. The laboratory staff did not know which blood samples came from the group of traffic police and which from the control group, although both the physicians and the technicians knew how the study was being carried out. For the methodological organization of data collection, there were used specific socio-communicative competences related to the development of tools suitable for the collection of information and analysis of data. Statistical analysis of the data was based on the calculation of the mean, standard deviation (SD), distribution, range and frequency according to the nature of the single variables. The differences between the means were compared by using Student’s t-test for unpaired data. Frequencies of the single variables were compared by using the \( \chi^2 \) test with Yates’ correction. The differences were considered significant when the \( p \) values were less than 0.05. The statistical analysis was performed using the statistical program SoloBMDPTM Statistical Software.

Results

In traffic police RBC, HGB, HCT mean levels were significantly higher compared to controls (respectively \( p<0.001\), \( p<0.05\), \( p<0.01 \) for male sex using Student’s t-test and \( p<0.05\), \( p<0.001\), \( p<0.01 \) using Student’s \( t \)-test for female sex) (Table 1). No significant differences were found comparing MCV, MCH and MCHC mean levels in traffic police vs. controls of both sexes (\( p>0.05 \) using Student’s \( t \)-test) (Table 1). The distribution of RBC values in male and female traffic police and controls was significant (respectively \( p<0.001\), \( p<0.05 \); using the \( \chi^2 \) test). No significant differences were found between traffic police and controls with RBC levels higher than our laboratory’s normal range (respectively \( n=2 \) traffic police and \( n=2 \) controls of male sex; \( p>0.05 \) using the \( \chi^2 \) test; \( n=4 \) traffic police and \( n=6 \) controls of female sex; \( p>0.05 \) using the \( \chi^2 \) test). The distribution of HGB values in male and female traffic police and controls was significant (respectively \( p<0.05\), \( p<0.001 \); using the \( \chi^2 \) test). Male traffic police and controls with HGB values outside our laboratory normal range were not present. Not significant differences were between traffic police and controls with HGB levels higher than our laboratory’s normal range (\( n=5 \) traffic police and \( n=2 \) controls of female sex \( p>0.05 \) using the \( \chi^2 \) test; none in male sex). The distribution of the HCT values in male and female traffic police and controls was significant (respectively \( p<0.05\), \( p<0.001 \); using the \( \chi^2 \) test). Not significant differences were between traffic police and controls with HCT levels higher than our laboratory’s normal range (\( n=7 \) traffic police and \( n=8 \) controls of male sex; \( p>0.05 \) using the \( \chi^2 \) test and \( n=18 \) traffic police and \( n=7 \) controls of female sex; \( p>0.05 \) using the \( \chi^2 \) test).

Discussion

Secondary polycythemia is characterized by an increase in the mature number of red cells in the blood. Every cause which impairs red blood cell’s ability to deliver oxygen to body tissues, can cause secondary polycythemia such as chronic heart disease, lung disease, hemorrhages, exposure to high altitudes, kidney cists, tumours of the brain, liver or uterus. In this study the principal confounding factors (also for polycythemia) have been excluded and the subjects investigated were matched by sex, age and working life. Consequently, it can be assumed that occupational exposure to urban stressors in traffic police can have an effect on hemopoietic system and in particular on RBC, HGB, and HCT levels. In this study we don’t measure directly chemical pollutants in the population studies and therefore the results should be interpreted with the caution and conservative tone. Moreover, the fact that the differences between RBC, HGB, HCT mean values in traffic police and controls of both sexes are significant suggest that these differences may have clinical validity, even if the deviation is not as wide as is often seen in medical pathology. Traffic police worked in shifts on parking, patrols, keeping passageways free, controlling traffic at crossings and on roads with intense flows of vehicles so, the duties performed by traffic police do not require repeated physical movement whit consequent dehydratation. Consequently this variable does not influence the alteration of HCT levels observed in traffic police. In literature has been observed an increase of HGB levels after chronic exposure to \( \text{CH}_3\text{OH} \) and MTBE, used as octane enhancer in fuels\(^8\). In male students exposed to \( \text{SO}_2 \), has been observed an increase in RBC, HGB and HCT levels\(^3\). A slight reduction of RBC and HGB levels were found in workers exposed to pure Co dust\(^4\). In subjects that living near to Mn mining district blood Pb and Mg were highly correlated; there was an inverse relation to HGB\(^5\). Erythropoietin controlled RBC production, whose synthesis in its turn is induced from the transcription of the Hypoxia Inducible Factor 1 (HIF-1). Beyond to the induction from hypoxia, metals as Co, Ni and Mn can increase erythropoiesis by a direct stimulation of the HIF-1\(^6\). Anemia is a well-known symptom of Pb poisoning. Schwartz e coll. (1990) have observed alterations in HCT levels in children living near to a primary Pb smelter. It found a strong non-linear, dose-response relationship between blood Pb level and HCT\(^2\). In a study on Cairo traffic police mean blood Pb level and HGB were significantly higher than in control group\(^1\). CO binds hemo-
globin 250 times more of the O$_2$ giving carboxyhemoglobin that in its turn produces hypoxia and this accelerates the erythropoiesis$^7$). Our results support the hypothesis that increase in RBC, HGB and HCT levels found in traffic police may be due to urban pollutants exposure. At the end, the increase in RBC, HGB and HCT concentrations could be a useful early biological marker of exposure to urban stressors.

References