Assessment Changes in Hematological Parameters for Iraqi Individuals That are Working in Petrol Refineries

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Abstract
The attention has been increased to assess the hematological toxic effects of petroleum products from refineries especially the volatile chemical contaminants (VCC) like benzene. Petrol pump operators are workers frequently exposed to petroleum products that has been occasionally associated with large incidences of hematological disorders and adverse health effects as a result of damage to the haemopoietic system accompanied by depletion to the bone marrow. This study was made to evaluate the hematological parameters among petrol refinery workers according to the duration of exposure. A cross sectional study was done in Al Najaf -refinery for petrol. It involved 101 petrol pump operators, thirty one (31) healthy male office workers who were considered as the control group and two groups of seventy (70) male petrol pump operators as the study group. The samples of blood were collected from both study and control groups and tested for red blood cells count (RBC), hemoglobin concentration (Hb), white blood cell count (WBC), packed cell volume (PCV) level and platelet count (Plt). Chronic exposure to volatile chemical contaminants has a harmful effects on refinery workers with increasing the risk of developing hematological disorders due to the deleterious effects on the bone marrow.

Keywords: hematological disorders, petrol pump operators, volatile chemical contaminants

Introduction
The refineries of petrol is consider the main source of volatile organic hydrocarbons like benzene which may cause a serious health risk upon exposure to it.1

Petrol pump operators are occasionally exposed to benzene as highly volatile substance and a major product of petrol refining. The toxic effect of benzene is due to the metabolism of it in the body.2

Benzene that has been emitted from refining operations of petrol are associated with increasing the oxidative stress by formation of the hydroxyl radicals, superoxide radicals and other reactive oxygen species, resulting in a possible deterioration of many systems especially the hematological system by biochemical changes and oxidative stress.3

The relationship between blood profile of petrol pump workers and benzene exposure is depend on the duration of exposure which have a substantial effects in changing the hematological parameters with a significant variations in hemoglobin, leukocytes, erythrocyte, hematocrit levels and platelet count as compared to control group.4

The mechanism of hematotoxicity upon a higher exposure level to benzene is represented by two steps as illustrated in (figure 1), these steps including the metabolism of benzene in the liver as a first metabolic pathway during which benzene is hydroxylated by H2O2 leading to the formation of phenol, the second metabolic pathway characterized by the rearrangement of benzene oxide to yield phenol, followed by hydroxylation of phenol which ending with the production of hydroquinone and catechol, these compounds is transferred to bone marrow and oxidized to benzoquinone that is covalently bind to hematopoietic stem cells and result in the formation...
of oxidant species that leading to the oxidative stress, so these evidence demonstrate the effect of benzene metabolites on the petrol pump operators health by the oxidative damage to cellular macromolecules and the interference in the cell cycle.5

Refinery workers are more affected people by the volatile chemical contaminants than other populations due to their experience to a high level of evaporated benzene which enter the body by respiration or absorbed through the skin.6

In countries with hot climates like Iraq, the exposure of petrol refinery workers to benzene vapour has increased health concerns. This is mainly due to increased vaporization of a volatile chemical contaminants at higher environmental temperatures associated with increased risk of greater exposure to these toxic contaminants either by inhalation or dermal absorption.7

Hence, the current study was undertaken to evaluate the effects of volatile chemical contaminants like benzene on the hematopoietic system on male petrol pump operators of Al Najaf- refinery for petrol and to educate them to use personal protective equipments for prevention of chemical hazards.

**Material and Methods**

**Patients and samples**

This study was accomplished in Al-Najaf refinery for petrol on petrol pump operators (n=70) in the age of 25-50 years who were sub divided into two groups according to years of exposure in the refinery, thirty four (34) of them with duration of exposure less than 5 years while thirty six (36) of the same study group with duration of exposure more than 5 years, in addition to apparently healthy office workers of the same age group consider as a control subjects (n=31).

A relevant data (age, weight, height and sex ) were collected from each individual with a short-term general and physical examination was accomplished.

We excluded any worker who had been suffering from any systemic chronic diseases, cardiovascular disorders, chronic renal and respiratory diseases, in addition to subjects who had been using drugs affecting blood counts such as chemotherapy or corticosteroid therapy.

A volume of five ml of blood samples were collected from each worker for hematological assessment. Blood samples were gathered by venipuncture from participants and collected in EDTA tubes, then transported to the lab within few hours to be analyzed employing normal hematological procedures.

**Statistical Analysis**

The data collected at baseline and at the 5 month assessment was entered into SPSS software version 16 to be statistically analyzed and expressed as mean ± SD. The mean values of study and control groups were compared by two independent samples t test and p value ( below 0.05) was considered statistically significant.

**Results**

There was total three groups which made according to the duration of exposure. These groups were office workers [(control group) (n=31, age ± S.D. 39.9 ± 6.71yrs)], PPO exposed < 5yrs [(Study groups) (n=34, age ± S.D. 37.32 ± 6.53yrs], PPO exposed > 5yrs [(Study groups)(n=36, age ± S.D. 46.3 ± 3.59yrs )].

Anthropometric parameter of the individuals is shown in the table 1. All three groups were matched in all anthropometric factors. three groups didn’t differ significantly in these parameters. RBC count, WBC count, Hb concentration, PCV percentage and Plt count are shown in table 2.

RBC count was significantly increased in the petrol pump operators with the duration of exposure more than 5 years but no significant change was occur in this parameter in petrol pump operators with the duration of exposure less than 5 years. Another parameters which also showed a significant increase with both study groups is Hb concentration and PCV percentage, while WBC and Plt count was significantly decreased in both study groups.
Table 1: The mean anthropometric data in the study and control groups. Data collected were statistically non significant (P < 0.05)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Study groups (mean ± SD)</th>
<th>Control groups (mean ±SD)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PPO exposed &lt; 5yrs (n=34)</td>
<td>PPO exposed &gt; 5yrs (n=36)</td>
<td>Office workers (n=31)</td>
</tr>
<tr>
<td>Age (year)</td>
<td>37.32 ± 6.53</td>
<td>46.3 ± 3.59</td>
<td>39.9 ± 6.71</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.08 ± 4.85</td>
<td>163.32 ± 3.24</td>
<td>161.3 ± 2.27</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.67 ± 5.86</td>
<td>71.69 ± 3.8</td>
<td>68.83 ± 3.09</td>
</tr>
</tbody>
</table>

Table 2: Red blood cells count (RBC), haemoglobin (Hb), white blood cell count (WBC), hematocrit (PCV) and platelet count (Plt) in study and control groups

<table>
<thead>
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<td>PPO exposed &gt; 5yrs (n=36)</td>
<td>Office workers (n=31)</td>
</tr>
<tr>
<td>RBC count (106/mm3)</td>
<td>4.68 ± 0.4</td>
<td>5.7 ± 0.3*</td>
<td>4.52 ± 0.2</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>15.7 ± 0.4*</td>
<td>16.55 ± 0.2*</td>
<td>14.69 ± 0.5</td>
</tr>
<tr>
<td>WBC count (103/mm3)</td>
<td>6.55 ± 0.2*</td>
<td>4.86 ± 0.5*</td>
<td>7.17 ± 0.8</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>47.07 ± 2.1*</td>
<td>49.71 ± 1.2*</td>
<td>43.93 ± 3.2</td>
</tr>
<tr>
<td>PLT(103/mm3)</td>
<td>237.62 ± 13.6*</td>
<td>174.69 ± 19.2*</td>
<td>282.6 ± 54.7</td>
</tr>
</tbody>
</table>

* = p<0.05, significant change (comparison between control and the other two groups)

Discussion

This study was conducted in Al-Najaf refinery for petrol among petrol refinery workers to determine the effect of VCC on the hematological parameters according to the duration of exposure.

These noxious products especially benzene is consider the most dangerous chemical that may cause a long term harmful effect on individuals.8 The exposure to benzene may lead to many serious side effects depending on the doses and duration of exposure to benzene, several studies have observed that a high level of exposure increasing the risk to induce hematotoxicity, leukemia and aplastic anemia.9 Qing Lan et al 10 found that exposure to benzene leads to decrease RBC count and Hb concentration among workers, on the contrary our study showed that mean values of RBC count, haemoglobin concentration were significantly...
higher in the study groups as compared with the control group and the increase was higher in PPO exposed for more than five years.

This results supported by several studies such as those conducted by Nazia Uzma et al, Erslev et al and Mistry et al.\textsuperscript{11, 12, 13} They showed that a high level of RBC count and Hb concentration in the circulation may occur due to stimulation of erythropoietin which induce the erythropoiesis – a process triggering by the tissue hypoxia that resulting from exposure to high levels of petroleum products in the environment of the work.

After inhalation of VCC through chronic occupational exposure, the aromatic hydrocarbons like benzene were entered in blood circulation and resulting in reduce the generation of WBC (leukocytes) from bone marrow due to bone marrow suppression or destruction.\textsuperscript{14}

In the present study WBC and Plt count were measured in the two study groups and control group, their mean values were significantly lower in the both exposed groups than in unexposed populations. A concomitant reduce was observed as duration of exposure was elevated,

So that the decrease were higher in PPO exposed for more than five years as shown in Table 2.

Mohammed Aleemuddin et al conducted a study in 2015 on the hematopoietic system changes among fuel attendants that exposed to the fumes of petroleum products and concluded that, WBC count reduced significantly in individuals that exposed to the fumes of petroleum products and the reduction was higher in those exposed > 2 years, as a result of the effect of benzene on the hematological parameters and production of many changes represented by pancytopenia and bone marrow aplasia.\textsuperscript{15}

This result was agreed with our finding and also similar to the result of (Abia et al, 2019) which found that WBC counts were markedly decreased due to leukocytopenia, this occur because of occupational exposure to benzene which is known as a systemic toxicant in individuals at any concentration.\textsuperscript{16} To understand the mechanism of stimulation of bone marrow toxicity due to inhalation of benzene, researchers found that the workers potentially exposed to benzene are showed bone marrow morphology consistent and leading to initiation and progression of many diseases.\textsuperscript{17}

Furthermore, another observation in our study was that in both the exposure groups, PCV percentage remained higher in PPO than in the referent populations in all exposure periods.

on the contrary and according to (Udonwa et al, 2009), a packed cell volume is significantly lower in petrol attendants as compared to the general individuals due to benzene exposure for those at working place.\textsuperscript{18}

These differences in the results between various studies can be return to many factors that affecting the hematopoietic system such as alcohol consumption, nutritional status and the proportion of the petroleum pollutants which is vary according to the environment of the study.\textsuperscript{19}

**Conclusions**

Chronic exposure to volatile chemical contaminants has harmful effects on refinery workers with increasing the risk of developing hematological disorders due to the deleterious effects on the bone marrow. A small number of refinery workers as a participants was one limitation of this study. As well as the differences between the participants in diet and smoking habit in addition to other diseases which may affect the blood counts. The exact effects of benzene exposure depending on its doses which is present in Iraqi workers at petrol refinery remains uncertain, so that a further investigations is warranted with larger sizes of sample, longer duration of occupational exposure and sufficient follow-ups in order to evaluate the results and to prove them.

To avoid this hematological disfunctioning, a precautionary and preventive measures must be taken to protect the petrol refinery workers by providing them with effective masks to prevent inhalation of the volatile chemical contaminants and equipping workers by a protective equipments to prevent the absorption of these toxic substances through the skin.

Another strategy includes adding an air exchanger vents and keep them continually open during working hours.
Acknowledgment

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Conflict of Interest: None

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