Impact of Diesel Oil Vapor Inhalation on Alkaline Phosphatase and Creatine Kinase in Male Rats

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Abstract—Studies show that there is association between air pollution and disturbances in normal function of various systems of body. The main aim of this study was to determine the effects of diesel oil vapor inhalation on serum alkaline phosphatase and creatine kinase level in male rats. Animals were randomly divided into control animals, and rats that exposed to diesel oil vapor for 1 hour/day, for 2 hours/day and for 3 hours/day. After a period of 6 weeks, blood samples were collected and serum level of creatine kinase and alkaline phosphatase was measured by spectrophotometry method. Data were statistically analyzed and compared between groups using ANOVA. Our findings indicated that there was no significant difference between serum alkaline levels of control and experimental rats. Serum creatine level was significantly increased in rats exposed to diesel oil for 1 hour/day, 2h/day and 3h/day (P<0.001, P<0.01 and P<0.001, respectively). We have shown that exposure to diesel oil vapor can bring about enhanced creatine kinase level, indicating the health risk caused by exposure to diesel oil inhalation.

Keyword— Diesel oil, CK, Alkaline Phosphatase, Rat.

I. INTRODUCTION

DIESEL oil is a fuel obtained from petroleum distillation that is used in diesel engines. Diesel combustion exhaust is a major source of atmospheric soot and fine particles, which is a fraction of air pollution implicated in human heart and lung damage. Diesel exhaust also contains nanoparticles. Although a study has observed that short term exposure to diesel exhaust does not result in adverse extra-pulmonary effects, effects that are often correlated with an increase in cardiovascular disease [1], there are reports indicating that exposure to diesel exhaust has known occupational hazard to truckers, railroad workers, miners and other workers using diesel-powered equipment in underground mines [2],[3]. Breathing fumes and evaporative and refueling emissions bring about serious toxic risks [4]. Neurotoxic effects of fume oil inhalation has been also established [5]. Traffic congestion increases vehicle emissions and degrades ambient air quality, and recent studies have shown excess morbidity and mortality for drivers, commuters and individuals living near major roadways [6]. Headache, fatigue, loss of memory, and dizziness were the common signs observed in subjects that have been exposed to vehicle emissions [7],[8].

Creatine kinase (CK), also known as creatine phosphokinase (CPK) is an enzyme expressed by various tissues and cell types. CK catalyses the conversion of creatine and consumes adenosine triphosphate (ATP) to create phosphocreatine. Enhancement of creatine kinase plasma level is prevalent in various conditions including heart or skeletal muscle damages [9]. This study was designed to evaluate the effects of diesel oil vapour inhalation on serum creatine level and serum alkaline phosphatase level in male rats.

II. MATERIAL AND METHODS

A. Animals

Adult Wistar rats weighting 200±30g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran). The temperature was at 23±2 °C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow.

B. Protocol of Study

Male Wistar rats were randomly divided into control animals, and rats that exposed to diesel oil vapor for 1 hour/day, for 2 hours/day and for 3 hours/day. After a period of 6 weeks, blood samples were collected in appropriate tubes by cardiac puncture technique 24 h after the last treatment. After collection, the blood samples left to clot at room temperature for 15 minutes and then centrifuged at 2500 r.p.m for 15 minutes. The serum layer was then separated and aliquoted into small test tubes and stored at -20 °C until enzyme activity determination. Serum level of creatine kinase and alkaline phosphatase was measured by spectrophotometry method. All animal experiments were...
carried out in accordance with the guidelines of Institutional Animal Ethics Committee.

C. Statistical Analysis

All values are presented as mean ± S.E.M. Statistical significance was evaluated by one way analysis of variance (ANOVA) using SPSS 19. Differences with P<0.05 were considered significant.

III. RESULTS

Table 1 shows serum creatine kinase and alkaline phosphates levels in male rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Alkaline phosphate (U/L)</th>
<th>P</th>
<th>Creatine kinase (UU/L)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>259.1±19.71</td>
<td>-</td>
<td>39.8±4.81</td>
<td>-</td>
</tr>
<tr>
<td>Diesel oil Vapor Receiving (1 h/day)</td>
<td>181.6±13.25</td>
<td>NS</td>
<td>60.8±4.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diesel oil Vapor Receiving (2 h/day)</td>
<td>303.8±28.92</td>
<td>NS</td>
<td>52.6±7.16</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Diesel oil Vapor Receiving (3 h/day)</td>
<td>241.1±19.75</td>
<td>NS</td>
<td>56.8±5.40</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

The data are indicated as mean ± SEM . P values are expressed in comparison with control group. N.S. represents non significant difference.

Our findings indicate that there was no significant difference between serum alkaline levels of control and experimental rats. Serum creatine level was significantly increased in rats exposed to diesel oil for 1hour/day, 2h/day and 3h/day (P<0.001, P<0.01 and P<0.001, respectively).

IV. DISCUSSION

Our study indicated that diesel oil vapor inhalation results in enhanced serum creatine kinase levels. In line with our finding, other research findings also indicate that breathing the evaporative and refueling emissions bring about serious toxic risks [4] which in turn, may give rise to elevated damages in tissues including muscular tissue resulting in increased serum creatine level. Occupational exposure to diesel oil vapor has also been associated with numerous signs health risks [1], [2]. The impacts of fume oil exposure on Na⁺, K⁺-ATPase, superoxide dismutase, acetylcholine esterase , total protein, reduced glutathione and lipid peroxidation in the cerebral cortex, and monoamine neurotransmitters dopamine , norepinephrine and serotonin in the cerebral cortex, hippocampus, cerebellum and hypothalamus were established [10]. Since fume oil exposure has effects on ATP dependent pathways in at cellular level, the effects of diesel oil vapor inhalation on creatine kinase is expandable. We did not observe any significant effect of diesel oil exposure on serum alkaline phosphatase level; however, other studies , particularly at cellular and molecular level, are required to carried out to confirm this finding.

V. CONCLUSION

We have shown that exposure to diesel oil vapor can bring about enhanced creatine kinase level, indicating the health risk caused by exposure to diesel oil inhalation.

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REFERENCES