Protein toxicity in Kotri Paint industry workers exposed to Phthalic Anhydride and Trimellitic Anhydride

Sumera Qureshi1*, Allah Bux Ghanghro2, Shaista Khan3, Ambreen Shah4

Abstract

Background: Protein plays a significant role in the regulation of metabolism for normal functioning in human body. SITE AREA, Kotri paint industry workers are at high risk of hypersensitivity, sensitization of the respiratory tract (including asthma), skin diseases and allergy. Reactive Low molecular weight organic acid anhydrides (OAAs) like trimelitic anhydride (TMA) and phthalic anhydride (PA) are extensively used in local paint industries of SITE AREA, Kotri, Sindh - Pakistan. These both anhydrides may easily bind with high molecular weight proteins by forming complex (adducts) leading to metabolic disorders among the exposed workers.

Methodology: There is no study to differentiate protein status of workers compared with normal healthy group as compare in the past. In this regard, the total protein was determined in intravenous blood samples obtained from the exposed workers to TMA and PA with control group clinically by Microlab300 (Kit Method System).

Result: There is a significant decrease of protein level in paint industry workers as compared with healthy subjects, which never had exposed to TMA and PA.

Conclusion: These both allergenic organic acid anhydrides like TMA and PA may be associated for changing protein function status after forming complex (adduct) by long exposure at work. SITE Area, Kotri Paint workers may at high risk of asthma, exposed to TMA and PA.

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**Introduction**

The globular protein like albumin as major protein synthesized in liver and transferred into blood for different metabolic functions [1,2]. Since Allergy is a common disease and its complications play major role in the exposed workers to organic acid anhydrides [3-4]. The low molecular weight Organic acid anhydrides (OAAs) are widely used chemicals in SITE Area Kotri, which can lead to toxic effects like lungs problems, allergy and sensitization among exposed workers reported in many cases earlier [5,6]. The hazardous acid anhydrides might cause health issues like occupational hypersensitivity, asthma, skin irritation infection of hands and feet to exposed workers [7-10]. Contact dermatitis was also commonly found in workers population with more exposure makes them more attractive for studies of allergens [11].

Different OAAs have certain risk factors, and the key risk leading to asthma. As in case of TMA, may have caused by the dust powder shows effects of rhinitis and conjunctivitis among workers. Eye irritation, nose blockage, cough, sneezing and asthma are commonly symptoms induced by PA and TMA [12-14]. Even special animal models were developed to investigate the inhalation model and different mechanisms of diseases caused by OAAs [6,15]. Almost all of the OAAs may have certain hyper-sensitiveness to their reactivity with different protein like serum albumin (SA) and hemoglobin (Hb) to form conjugates (adducts) depending on their electrophilic activity [16-19].

**Methods**

The study includes 36 blood serum samples of paint workers and 30 samples from control group (aged 20-60 yrs for both groups). These workers were exposed to TMA and PA mainly by vapors inhalation and skin contact during work. All of the paint industry workers had been exposed for about 20 years as mentioned in Questionnaire taken by workers. The clinical data on paint industry workers of SITE area, Kotri workers and healthy groups are shown in table I.

**Sample Collection**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>n (Male)</th>
<th>Age (Mean ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint workers</td>
<td>36</td>
<td>28.6±7.7433</td>
</tr>
<tr>
<td>Control (Normal)</td>
<td>30</td>
<td>28.8±14.56632</td>
</tr>
</tbody>
</table>

Note: All values are expressed as (Mean ± Standard Deviation)

Table I: Clinical data of paint workers and control (normal)

This study was conducted from November 2013 up to December 2013. The SITE Area, Kotri industry workers gave consent for giving their samples by their own free will and recorded in confidential files. The intravenous blood samples (10ml) were collected and made to clot by Physician. After this serum was separated and centrifuged at about 4000 rpm for about 25 minutes. Finally serum was collected and stored at 40°C prior for total protein analysis.

**Sample preparation for serum samples**

All reagents are of high analytical grade of Merck (Germany). It was prepared by adding 1000μl of total protein reagent (Merck) in separate tube as blank and 20μl of standard in other test tube. Serum sample (20μl) was also taken in separate test tube and run on...
Microlab300 accordingly. The absorbance against reagent blank was noted.

**Results**

Total protein was found significantly lower in case of workers as compared to control (normal) group (as shown in table-2). This result suggests that protein in the serum blood of workers may be the cause of direct toxicity of various diseases. Since TMA and PA are harmful compounds that may cause severe health hazards and problems to paint industry workers in SITE AREA, Kotri, Sindh.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>n (Male)</th>
<th>Total Protein (Mean ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint workers</td>
<td>36</td>
<td>6.67±0.77349</td>
</tr>
<tr>
<td>Control (Normal)</td>
<td>30</td>
<td>7.220±0.48095</td>
</tr>
</tbody>
</table>

Table 2: Levels of total protein in healthy controls and plastic industry workers (All values are expressed as (Mean ± S.D.).

**Discussion**

Ehrenberg has firstly suggested the adduct (complex) between hazardous compounds OAAs and proteins as biomarkers of exposed industry workers [20]. TMA and PA are two highly allergenic compounds (causing asthma etc.) commonly used in most of the industries [21]. Previously lots of work has been done on analysis of adducts in plasma for serum albumin and Hemoglobin proteins [22,23]. It has been proved that adducts are stable in humans with a half-life of about 20 days with long exposure to OAAs [24,25]. However, in this study of total protein gives information about the amount of metabolic protein in workers rather than the actual uptake of OAAs-protein adducts by complicated and expensive methods for low levels. It was important to compare the total plasma protein with control (normal) group for variation. In the light of findings of this study, it is understood that decreasing total protein in most of paint workers and this parameter could be used as biomarker. It is essential to reduce/hazardous risk posed by harmful chemicals used in the local industry. The both of allergenic OAAs like TMA and PA may have strong association with total plasma protein as biomarker for studies.

**Acknowledgement**

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