ORIGINAL RESEARCH PAPER

Dermatology

A STUDY ON SYSTEMIC EFFECTS OF CHROMIUM AMONG CONSTRUCTION WORKERS WITH CONTACT DERMATOSES ATTENDING TERTIARY CARE HOSPITAL IN COIMBATORE

KEY WORDS: contact dermatitis, serum chromium, urine chromium

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ABSTRACT

AIM: To elicit the systemic effects and correlate with urinary and serum chromium levels among construction workers who presented with contact dermatitis.

MATERIALS AND METHODS: This was a prospective observational hospital- based clinical study, conducted among 50 construction workers who presented with skin and systemic manifestations to our OPD Dermatology from Oct2016 to Jan2017. The data containing demographic details, occupational details, clinical manifestation, systemic examination and co morbidities were collected. All routine and special investigations including, Urine routine, Hematological profile with Peripheral smear, Blood sugar, LFT, Serum Electrolytes, Blood urea creatinine, TFT, Lipid profile, Chest X ray, USGabdomen, ECG, Spirometry were done. Chromium levels in blood and urine were analyzed separately in all patients by Inductively Coupled Plasma Mass Spectroscopy Method(ICP-MS).

RESULTS: On Hematological evaluations, 40% showed abnormal findings which revealed Eosinophilia(24%), leucocytosis (12%), lymphocytosis and dimorphic anemia in each patient. On Spirometry, mild, moderate and severe restriction were observed in 14%, 18% and 20% respectively. On evaluation of other systems, LFT, RFT and ECG all showed no abnormalities.In our study, no abnormal levels of blood and urine chromium were made out. Only traces of chromium in ranges of 0.05 to 3 µg/L was noticed in most patients.

INTRODUCTION

Construction has emerged as a major sector of national economy in India. There is a sharp increase in construction projects almost in all states. People working in the building projects are invariably exposed to chemicals which induce various skin diseases and systemic effects. Hexa -valent chromium Cr(VI) is a well known contact allergen , and is able to elicit contact dermatitis and systemic effects. Cr(VI) enters many types of cells and under physiological conditions can be reduced by hydrogen peroxide (H2O2), glutathione(GSH) reductase and ascorbic acid to produce reactive intermediates, including Cr(V), Cr(IV), thiylradicals, hydroxyl radicals and Cr(III). Any of these species could attack DNA, protein and membrane bound lipids thereby disrupting cellular integrity and functions thus resulting in systemic toxicity.[1] Cement dust inhalation is associated with deleterious health effects. Molecules in cement dust in terms of health effects include 60–67% calcium oxide, 17–25 silicon oxide (SiO2), and 3–5%aluminium (Al) oxide, with some amount of iron oxide, chromium (Cr), potassium, sodium, Sulphur, and magnesium oxide.

AIMS AND OBJECTIVES: To elicit the systemic effects of chromium among construction workers who presented with contact dermatitis and to correlate the effects with urinary and serum chromium levels.

MATERIALS AND METHODS: This was a prospective observational hospital- based clinical study, conducted among construction workers who presented with skin and systemic manifestations to the Outpatient department of Dermatology in Coimbatore Medical College Hospital, Coimbatore district of Tamil Nadu state from Oct 2016 to Jan2017. After obtaining institute ethical committee clearance, 50 consecutive patients related to construction work were enrolled in our study based on the inclusion and exclusion criteria. The written informed consent was obtained from all patients. The inclusion and exclusion criteria of our study were as follows.

INCLUSION CRITERIA: Participants of both genders above the age of 18 years working for at least 1 year in construction field were recruited.

EXCLUSION CRITERIA:

Workers less than 18 years of age

Pregnant and lactating females

METHODOLOGY

The data were collected using a proforma giving due consideration to the workers' detailed information regarding demographic details, occupational details including their duration of employment, usage of protective devices, disease duration and symptoms. A thorough clinical history including systemic and skin manifestation, co morbidities were collected. Detailed systemic examination pertaining to respiratory system, cardiovascular system, gastrointestinal system and Central nervous system were carried out.

Patients were subjected to all routine investigations including, Urine routine, Hematological profile with Peripheral smear, Blood sugar - Fasting and postprandial, Liver function tests, Serum Electrolytes – Na, K, Blood urea, Serum creatinine. Special investigations like Thyroid function Tests, Lipid profile, Chest X ray (PA view), USG abdomen, ECG, Spirometry to find out any systemic involvement due to chromium toxicity were done. Chromium levels in blood and urine were analyzed separately in all patients by Inductively Coupled Plasma Mass Spectroscopy Method (ICP-MS). The data collected were entered in and analyzed using Statistical Packages for Social Sciences (SPSS) version 22.

OBSERVATION AND RESULTS

The result of the systemic evaluation done in 50 patients of constructional workers with contact dermatitis attending the OPD during the 4 months period [from October 2016 to January 2017] is discussed below.

Out of 50 patients, 78 percent were male, 22 percent were female.

The male to female ratio is 3.5:1. Out of 50 patients, 82 percent of the patients were 41 to 55 age group, 28 percent of the patients were 26 to 40 age group, and 18 percent of the patients were above 55 age. From the collected data, the majority of the patients belong to 41 to 55 age category.

Based on the complete blood examination and peripheral smear reports, hematological dysfunction was assessed. According to the peripheral smear (PS) report, 20 patients [40%] showed abnormal hematological findings. Eosinophilia was noted in maximum of 12[24%], leucocytosis was observed in 6[12%], lymphocytosis and dimorphic anemia was noticed in one patient each. [fig 1] The pulmonary function of all patients were analyzed by doing chest X ray and Spirometry. Among the 10 patients with abnormal Spirometry, severe restriction was seen in 1 and moderate restriction was seen in 2 and mild restriction was seen in 7patients. [fig 2] The chest X ray findings were normal for all except one who showed significant increase in vascular marking which correlates with mild restriction in Spirometry. All other systems were analyzed by doing LFT, RFT, USG, ECG etc. Ultrasonagram (USG) was done in all patients. Out of 50, 41patients showed normal study. Fatty liver was observed in 3 patients. Three with renal calculi and 1with Prostatomegaly were incidentally made out.

The liver function test and renal function test done for all patients showed no abnormalities. No abnormal ECG was made out for anyone. The chromium levels were determined both in urine and blood samples for all patients by ICP-MS method. The normal range is 0 - 50.1µg/L for urine chromium and 0 - 30µg/L for blood chromium. No abnormal levels of blood and urine chromium were made out in our study. Only traces of chromium in ranges of 0.05 to 3 µg/L was noticed in most patients. Blood and urine chromium levels of > 3 µg/L was noticed in 7(14%) and 2 (4%) patients respectively. [table 1]

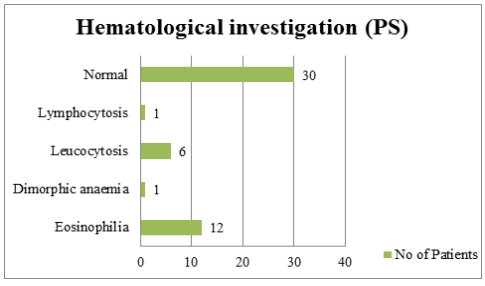

Figure 1. Distribution of patients according to Hematological investigation (PS)

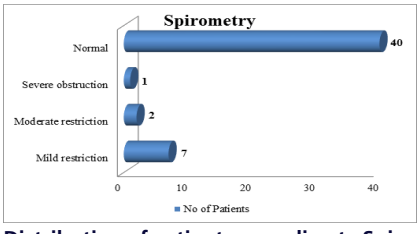

Figure 2. Distribution of patients according to Spirometry

Table 1. Distributions of patients according to Range of blood Chromium, Urine Chromium

Range (µg/L)	Blood Chromium			Urine Chromium		
	No of Patient	Percent	Cumulative Percent	No of Patient	Percent	Cumulative Percent
- 0.50	1	2.0	2.0	12	24.0	24.0
0.51 - 1.00	10	20.0	22.0	10	20.0	44.0
1.01 - 1.50	12	24.0	46.0	11	22.0	66.0
1.51 - 2.00	11	22.0	68.0	8	16.0	82.0
2.01 - 2.50	8	16.0	84.0	6	12.0	94.0
2.51 - 3.00	1	2.0	86.0	1	2.0	96.0
Above >3	7	14.0	100.0	2	4.0	100.0

DISCUSSION

Haematological Evaluation: Hematological evaluations of workers occupationally exposed to chromium compounds have yielded equivocal results in many studies,

On Hematological evaluations, 40% showed abnormal findings which revealed Eosinophilia in 24%, leucocytosis in 12%, lymphocytosis and dimorphic anemia in each patient. This finding is comparable with the findings of a study conducted in 97 workers from a chromate plant which revealed leukocytosis in 14.4% or leukopenia in 19.6% of the workers and they also mentioned that the leukocytosis appeared to be related primarily to monocytosis and eosinophilia.[2] Lin et al. 2009 reported anemia and thrombocytopenia in an electroplating worker 5 days after exposure to chromic acid on legs.[3] Our study also showed a similar observation in one patient.

Respiratory System:

On Spirometry, restrictive lung functions were observed in 52%, out of which 14%, 18% and 20% showed mild, moderate and severe restriction respectively. These lowered lung functions in form of mild to severe restriction observed in our study is well correlated with the study of Bovet et al. 1977.[4] Based on the studies mentioned in health effects of chromium, statistically significant decreases in vital capacity, forced vital capacity (FVC), and forced expiratory volume in 1 second (FEV1) were also observed in the chromium workers.[2]

Other Systems:

On evaluation of other systems, liver function test, renal function test and ECG findings all showed no abnormalities. These are concurrent with the below mentioned studies.

According to Sassi et al, no abnormalities were found in electrocardiograms recorded in the workers who worked in the production of dichromate and chromium trioxide. [5]

As part of a mortality and morbidity study (Satoh et al.) of workers engaged in the manufacture of chromium, a complete series of liver function tests and kidney function tests were evaluated in 94 workers[6]. All values were within normal limits

Biomarkers to identify exposure to chromium

The chromium levels were determined both in urine and blood samples for all patients by ICP-MS method. The normal reference ranges was 0 - 50.1µg/L for urine chromium and 0 - 30µg/L for blood chromium. In our study, no abnormal levels of blood and urine chromium were made out. Only traces of chromium in ranges of 0.05 to 3 µg/L was noticed in most patients.

An analysis of the urine did not detect the hexavalent form of chromium, indicating that chromium (VI) was rapidly reduced before excretion[7]. Chromium(III) compounds were excreted rapidly in the urine of workers, following inhalation exposure to chromium(III) as chromium lignosulfonate had clearly detectable concentrations of chromium in the urine at the end of their shifts [0.011–0.017 µg/L][2]

Tannery workers had higher urinary chromium (III) concentrations in post shift and preshift urine samples taken, compared to controls.[2]

Workers exposed mainly to chromium (VI) compounds had higher urinary chromium levels than workers exposed primarily to chromium (III) compounds.[2]

Our study results are contrary to the results of above mentioned studies by showing normal chromium levels both in blood and urine.

CONCLUSION

Although a large number of studies were published on this subject worldwide, our study concluded the systemic effects of chromium along with serum and urinary chromium correlation. It was difficult to compare the results with other studies because the study

purpose, patient selection and methodology used for analysis varied considerably. This study was done only on the symptomatic patients with cement induced dermatitis attending the OPD. The overall prevalence of systemic effects of cement among the construction workers was not studied. This is the limitation of our study.

Health surveillance is needed to protect individuals and to identify as early as possible any indicators of systemic changes related to cement exposure. Thus it is recommended that these workers should be provided with some social security schemes with good occupational health services. Work place safety guidelines should be implemented strictly to protect the workers from health hazards. Proper education of the involved population and increasing awareness can definitely decrease the significant morbidity.

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