

Alteration of Some Heavy Metals and Kidney Function Tests in Serum of Crude Oil Station Workers

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Abstract

Some trace metals have no biological role, are toxic when in a certain form and concentration. The aim of the present study is to study the effects of exposure to the vapors of crude oil (vehicle fuel) on some trace elements value and kidney function tests in serum of crude oil station workers. The study includes (30) men crude oil station workers (group 1), and (30) men non crude oil station workers (group 2). The mean value of serum aluminum (Al), barium (Ba), zinc (Zn), manganese (Mn), iron (Fe), and vanadium (V) were significantly higher in (group 1) compared with (group 2) ($p < 0.05$), while the mean value of serum silver (Ag) in group 2 was significantly higher than that of group 1, while {mercury (Hg), and lead (Pb)} in group 1 no significantly higher than that of group 2, the serum creatinine and uric acid in group 1 was significantly higher than that of group 2, and serum urea in group 1 was non significantly higher than that of group 2. Based on the findings of the present study, it can be concluded trace elements in serum of crude oil station workers are abnormal and affect dramatically of kidney functions.

Keywords: crude oil station worker, trace elements, urea, creatinine, uric acid

1. Introduction

Crude oil (petrol) is a complex manufactured mixture that does not exist naturally in the environment. It consists mostly of several hundred hydrocarbons obtained by the fractional distillation of petroleum that have boiling points from approximately 40°C to 180°C. The hydrocarbons present in the gasoline mixture include alkanes, or straight chain C5 to C12 compounds or branched-chain compounds of the same size; alkenes, which are unsaturated linear and branched-chain hydrocarbon, also saturated cyclic hydrocarbons. Also included in the gasoline is aromatic compounds (principally benzene, toluene, ethyl-benzene, and xylenes) [1].

Exposure to crude oil occurs by: Breathing, drinking contaminated water and Being close to where gasoline has spilled or leaked into the soil. Certain workers have a greater risk of exposure to gasoline vapors. These include service station attendants, drivers of gasoline, and refinery workers [2].

Heavy metals are described as those metals which, in their standard state, have a specific gravity of more than 5 gm/cm^3 , and atomic weight of 63.5 - 200.6 [3]. The heavy metals are responsible for many pernicious effects on human health such as saturnism (lead contamination), immunodepression and skin diseases (zinc and copper contamination), cancer (cadmium), hyperkeratosis (arsenic), neurological disorders (manganese) or blood disorders (iron) [4].

When not digested heavy metals accumulate in the human body becomes toxic and cause many problems for human health, including damage to the nerves and the central, blood composition and many organs especially kidneys and these metals become toxic when an increase from the normal level allowed. As a rule, acute poisoning is more likely to result from inhalation or skin contact of dust, fumes or vapors, or materials in the workplace [5, 6].

Certain trace elements (TEs) are essential for life and health of the human, they are essential for the metabolism, growth and survival, there are an alteration in the levels TEs caused by air, water, and food contamination by environmental pollution [7].

A lot of TEs have an important influence on risk factors like disorders of blood pressure, blood lipids, glucose intolerance, coagulation and circulating insulin [8], high exposure cause defect of organs especially liver and kidneys.

The kidney is the first target organ of heavy metal toxicity. The extent of renal damage by heavy metals depends on the nature, the dose, route and duration of exposure. Both acute and chronic intoxication have been demonstrated to cause nephropathies [9].

The aim of the work is to obtain the effects of pollution by exposure (crude oil station workers) on serum heavy metals (Hg, Pb, Cd, Ag and V), trace elements (Al, B, Fe, Mn, and Zn) on kidney function tests (urea, creatinine and uric acid).

2. Materials and Methods

A. Subjects

This study was conducted over a period of one year, from January to December 2017, and the subjects included (30) men crude oil station workers (group 1), ages (43.46 ± 9.55), and (30) men non crude oil station workers (control) (group 2), mean ages (45.15 ± 6.5).

B. Sampling

Four to six milliliters venous blood was withdrawn from each individual using disposable syringe. The samples after half hour centrifuged for [10] min at 3000 rpm, and the serum obtained was analyzed directly.

C. Estimation of serum heavy metals and trace elements

The sample was prepared by adding one milliliter of serum into disposable plastic (polystyrene) tube, then added 9 milliliters of 5% nitric acid (Already prepared from Nitric Acid, 67-70%, Fisher Scientific- CAS: 7697-37-2), mixed and incubate for 6 -10 hours at room temperature, centrifuged at 4000g for 10 minutes, separated clear supernatant solutions, used for determination of serum trace and heavy metals by using inductively coupled plasma optical emission spectrophotometer (ICP-OES, Optima 2100 DV, Perkin Elmer-USA).

Preparation of Standard curve

The calibration curve of trace metals were obtained from five different known standard solutions, as (1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L, and 5 mg/L) were prepared from a 100mg/L standard (or stock) solution and heavy metals were obtained from five different known standard solutions, as (1 ug/L, 10 ug/L, 30 ug/L, 50 ug/L, and 100 ug/L) were prepared from a 100ug/L standard (or stock) solution (ICP multi-element standard solution VIII, 1.09492 – Merck, Germany). 5% HNO₃ was used for dilution [10, 11].

The following table is limit of detection (LOD) (ug/L), limit of quantization (LOQ) (ug/L), and wave length for each element

Elements	Limit of detection (LOD) (ug/L)	Limit of quantization (LOQ) (ug/L)	Wave length (nm)
Ag	0.5	1.6	328.07
Al	162.2	540.6	308.213
Ba	0.3	1.0	233.523
Cd	3.9	13.2	317.935
Fe	2.7	9.0	259.943
Hg	3.7	22.4	198.023
Mn	0.5	1.2	220.352
Pb	3.4	11.3	196.026
V	0.2	0.5	292.402
Zn	1.1	1.7	213.858

d. Evaluation of kidney function test

The serum urea, creatinine and uric acid were estimated (enzymatic method) by using the Biolabo diagnostic kit with fully automated biochemical analyzer.

e. Statistical analysis

SPSS version 22 for windows was used in the analysis of the data obtained. Statistical analysis was assessed using student t-test. Mean \pm SD value was adopted in the determinations. P-values less than 0.05 were considered statistically significant.

3. Results

Mean \pm SD of estimated heavy metals are shown in table (I). The results obtained indicated that the mean serum Pb and Hg in group 1 were non significantly higher than that of group2 ($P > 0.05$), the heavy metal Cd not present in serum of both groups, the serum V in group 1 significantly higher than that of group 2 ($P < 0.05$), while serum Ag in group 2 was significantly higher than that of group 1 ($P < 0.001$).

TABLE I

HEAVY METALS IN CRUDE OIL STATION WORKERS AND CONTROL

Parameters	Control group	Exposure group	P value
Pb (ug/L)	11.4 \pm 6.2	13.3 \pm 4.7	$P > 0.05$
Hg (ug/L)	35 \pm 0.24	36 \pm 0.15	$P > 0.05$
V (ug/L)	1.4 \pm 0.57	2.8 \pm 0.93	$P < 0.05$
Cd (ug/L)	0.0	0.0	0.0
Ag (ug/L)	0.8 \pm 0.07	0.65 \pm 0.06	$P < 0.001$

Results expressed as Mean \pm SD

P value: probability value

Some serum trace element levels in crude oil station workers and control groups. Results in the table (II) showed the mean \pm SD of trace elements (Ba, Al, Fe, Zn, Zn and Mn) in sera of crude oil station workers and control groups. Significant elevation were found in all the trace elements in crude oil station workers compared with that in normal group with different probably values (Ba and Al $p < 0.05$), but (Fe and Zn $P < 0.01$), while the trace element in crude oil station workers was highly significantly ($P < 0.001$) higher than that of control group.

TABLE II

TRACE ELEMENTS IN CRUDE OIL STATION WORKERS AND CONTROL

Parameters	Control group	Exposure group	P value
Ba (mg/L)	0.47±0.1	0.58±0.18	P< 0.05
Al (mg/L)	0.98±0.21	1.39±0.46	P< 0.05
Fe (mg/L)	0.21±0.043	0.36±0.1	P<0.01
Zn (mg/L)	0.072±0.05	0.175±0.06	P<0.01
Mn (mg/L)	0.006±0.004	0.19±0.1	P< 0.001

Results expressed as Mean ±SD

Concentration of serum urea, creatinine and uric acid in crude oil station workers and control: -

Table (III) provided the mean S.urea, creatinine and uric acid in crude oil station workers and control groups. The results obtained indicated that the mean S.urea in group 1 was not significantly higher than that of group 2, the mean S.creatinine in group 1 was significantly higher than that of group 2, (P< 0.05), and the mean S.uric acid in group 1 was significantly higher than that of group 2, (P< 0.01).

TABLE III

UREA, CREATININE AND URIC ACID IN CRUDE OIL STATION WORKERS AND CONTROL

Parameters	Control group	Exposure group	P value
Serum urea (mg/dl)	27.35± 9.37	30.5± 7.33	P> 0.05
Serum creatinine (mg/dl)	0.53± 0.28	0.85± 0.18	P< 0.05
Serum uric acid (mg/dl)	4.6± 1.4	6.34± 1.25	P<0.001

Results expressed as Mean ±SD

4. Discussion

The toxicity effect of certain metals in some forms and doses on health, certain metals have no biological role, it means are not essential minerals, or are toxic when in a certain form [12], for example the heavy element lead in any amount will affect human health [13], which cause anemia and affect organs especially kidneys [4]. The heavy metals such as lead, mercury and cadmium, all have electron-sharing affinities that can result information of covalent attachments [14]. These attachments are mainly formed between

heavy metals and sulfhydryl groups of proteins [15]. In the present the metals the heavy metals Pb and V in exposure group (group 1) was not significantly higher than that of control group (group 2), the same results obtained by Adnan et al [16].

In current study all the trace elements Ba, Al, Fe, Zn and Mn in serum of exposure group were significantly higher than that of control group. Trace elements as Zn, Fe and Mn participate in the regulation of multiple biochemical metabolisms and physiological functions (e.g. nucleic acid and protein synthesis, enzymatic reactions, membrane stabilization, immune system function, antioxidant defenses, oxidative phosphorylation, etc.). These metals are effective at very low concentrations, and their concentration in body fluids must be tightly regulated: deficiency or excess both cause severe illness and death. Thus, urinary excretion by the kidney, together with the gastrointestinal absorption rate, plays an important role in regulating the plasma level of these elements. Although the renal handling of cations is not fully understood, it is probable that each segment of the nephron is involved in their reabsorption; even so 70% of the transport occurs along the proximal tubule [17, 18].

In current study analyzed kidney function tests (urea, creatinine and uric acid), obtained that serum urea and creatinine of exposure group were significantly higher than that of control group ($P < 0.05$), and uric acid in serum of exposure group were significantly higher than that of control group ($P < 0.01$), caused by the body is contaminated by heavy metals Hg, Pb and V, and also high level of trace elements Mn, Zn and Fe. Therefore, the kidney will be confronted with two problems;

- 1- The entry of the toxic metal into the renal cells
- 2- The concomitance of the essential trace elements entry due to competition with the toxin [19].

Renal failure occurs were the kidneys cannot ability to remove the body metabolic waste products (urea, creatinine and uric acid), leading to accumulate in the body fluids as a result of impaired renal excretion and lead to a disruption in endocrine and metabolic functions as well as fluid, electrolyte, and acid-based disturbances, all this participative in renal failure [20].

5. Conclusion

This study concluded that human exposure to crude oil cause increase heavy metals in blood circulation especially vanadium and lead, also increase serum essential elements (Mn, Zn and Fe), and each of (Ba and Al) non-essential trace elements was increased, and kidney function tests are elevated especially creatinine and uric acid.

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