



Study of the relationship between lead level and biochemical parameters in the blood serum of gout patients in Mosul city / Iraq

Walaa A Al-Jawadi¹, Muna H. Jankeer²

¹Optics Technologies Department, Al- Noor University College, Iraq

²Sciences College, Biology Department, Mosul University, Iraq



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Abstract

Gout is a chronic disease that usually affects male adults and is more susceptible to it, and it is rare in children. The current study aimed to determine the level of lead bioaccumulation and its effect on some biochemical parameters in the blood serum of gout patients. The current study involved 70 patients (38 males & 32 females), whose ages range (20-60) years, after the disease was diagnosed by specialist doctors of Arthritis in city of Mosul/ Iraq, 40 healthy (20 males and 20 females) of the same age, was considered as a control group for comparison.

The results of this study showed a significant increase in the level of accumulated lead in the serum of patients in both genders, compared with healthy controls, if the ratio of lead in males was 158% higher than in females. The results also showed a significant increase in level of each of uric acid, creatinine, urea and sodium, and the ratio of high level of these parameters was higher in males than in females but associated with a significant decrease in level of potassium in the blood serum of patients in both genders, compared with healthy controls. We conclude from this study that continuous exposure to lead and its accumulation may cause a defect in kidney functions in patients with gout.

Keywords: Gout, Lead, Uric Acid, Creatinine, Urea, Sodium, Potassium, Mosul City/Iraq.

1. Introduction

Gout is a chronic disease that usually affects male adults and is more susceptible to it, and it is rare in children (1). This disease is caused by an increased concentration of uric acid in serum as a result of disturbances in purine metabolism (2,3).

Uric acid is an indication for gout, a non-enzymatic and endogenous antioxidant. Its presence in the serum helps diagnose gout. Its high level in the blood also leads to its deposition in the joints in the form of sodium urate crystals, which leads to severe pain and crystal arthritis, especially in the thumbs, feet or joints (4,5). One of the most important causes of an increase in the level of uric acid in the blood is an increase in the nucleic acids metabolism, accompanied by a decrease in the body's ability to dispose of it through urine. It accumulates in the body tissues.. It accumulates in the tissues of the body. Also, the increased consumption of foods rich in purines, such as red meats and seafood, which are converted in the body

to uric acid and increasing its formation for genetic or physiological reasons. Gout is classified into primary and secondary depending on the main cause of increase uric acid in the blood. Primary gout is caused by increase uric acid without any other diseases, while secondary gout occurs as a complication of other diseases causing increase uric acid in the blood (3,6,7,8).

Heavy metals such as lead, cadmium, copper, zinc, arsenic and other chemical environmental pollutants are widely spread in the basic environmental components (air, water and soil), as they reach the environment from various professions and factories that use these metals as raw materials and throw their wastes that later reach the lands and agricultural crops to be then transferred to living organisms after ingestion. Since continuous exposure to heavy metals poses a threat to human health, these metals have been studied extensively to know their negative effects on public health (9).

*Corresponding author e-mail: chem.mosul.research@gmail.com

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Lead is one of the most toxic heavy metals, and one of the most dangerous environmental pollutants. It is found in nature in an impure form associated with other metals such as cadmium (10). One of the most environmental pollutants in air and water, lead is widely used in many industries, such as the manufacture of nitrogen and phosphate fertilizers, pesticides and agricultural pests, the manufacture of batteries, rubber, plastics and dyes, and in the electronic and petroleum industries as gas oil, as it is added to car fuels in the form of lead compounds. Organics such as tetramethyl lead $Pb(CH_3)_2$ or tetraethyl lead $Pb(C_2H_5)_4$ to reduce pop during combustion. It is also used in alloying, mining, metal smelting, water pipes, household tanks and food storage cans (11, 12).

Therefore, the products of fuel combustion, factory waste, and what is emitted from automobile exhaust, as well as nature itself, play a role in the pollution of air, soil and water with lead, which paves the way for its transmission to plants and from them to animals that accumulate in their tissues, as animals are one of the main food sources for humans, meaning that they reach up to Human through the food chain (13), lead accumulates in the tissues of the lungs, liver, spleen, kidneys, central nervous system and especially in the brain. bones and teeth. Lead displaces calcium, causing its level to decrease due to the high similarity between lead and calcium ion (11,14). As a result of lead's ability to bioaccumulate in relatively high levels, it causes an imbalance in the physiological and structural properties of hepatocyte membrane proteins and lipids, accompanied by a decrease in the activity of membrane-bound enzymes, as well as a liver function disorder (15). A decrease in the ability of the liver to dispose of toxic substances occurs. Several studies indicated the toxic effect of lead on the urinary system, which is represented in causing a

defect in the urinary tubules and renal glomeruli, and what results from them amino acid urea, Which in turn leads to hypertension and gout, and in severe cases it may progress to renal failure (11,16). This study object to determine the level of accumulated lead, and to show the extent of the correlation between the level of lead and some biochemical parameters such as uric acid in patients with gout in Mosul city - Iraq.

2. Material and Method

Collection of Sample: In the current study included 70 patients with gout which workers in different professions, non-smoker from both sexes (32 males and 38 females), whose ages range (20-60) years, who visited to the Arthritis Division at Salam Teaching Hospital and special laboratories in Mosul City, after the disease was diagnosed by specialist doctors through a set of test described by the American Society of Arthritis. 40 healthy (20 males and 20 females) of the same age, after being sure of being not infected in any case and it was considered as a control group for comparison.

Biochemical Parameters Tests: The blood specimens were collected from the patients and healthy, to obtain the serum for estimation the level of some biochemical parameters tests by using methods of estimation referred to in Table (1), as a number of ready test were used international. And determination of lead (Pb) level in blood serum by atomic absorption spectrophotometer type of PYE model SP 191 supplied by an Australian Company.

Statistical Analysis: Results were analyzed statistically by using the Complete Randomized Design (C.R.D.). Duncan Multiple range the results were used to test for differences among groups, differences were considered significant if ($P < 0.05$) applied by program ready (SPSS version 24 for window).

Table (1): The methods used for estimating the number of biochemical parameters in this study

| Measured parameters | Method used | Reference |
|---------------------|--------------------------------|---------------------|
| Lead level | Atomic absorption spectrometer | Femandz & Kahn (17) |
| Uric acid level | Urease enzymatic method | Newman & Price (18) |
| Creatinine level | Colorimetric method | Tietz, et al., (19) |
| Urea level | Enzymatic method | Searcy et al., (20) |
| Sodium level | Colorimetric method | Henry (21) |
| Potassium level | Colorimetric method | Henry (21) |

3. RESULTS AND DISCUSSION

Table (2) shows the results of lead accumulation significant in the serum of infected patients with gout at a rate of (46.199 ± 0.573) $\mu\text{g/ml}$ and in a percentage 147%, compared to healthy control at a rate (18.724 ± 0.195) in both genders. And table (3) also shows a significant increase in the lead level in the serum of males and females at a rate of (48.604 ± 0.731) , (43.546 ± 0.638) $\mu\text{g/ml}$ and in a percentage 158%, 134%

Table (2) : The levels of accumulated lead (Pb) and biochemical parameters in serum of gout patients and healthy control group for both genders

| Groups Parameters | Control (n = 40) | | | Patients (n = 70) | | |
|-----------------------------------|--------------------------|------------|-------------|--------------------------|------------|-------------|
| | Mean \pm SE * | % Level | % Change | Mean \pm SE * | % Level | % Change |
| Lead (Pb) ($\mu\text{g/ml}$) | 18.724 ± 0.195 E | 100 | - | 46.199 ± 0.573 C | 247 | 147+ |
| Uric Acid (mg/dl) | 3.228 ± 0.075 h b | 100 | - | 8.283 ± 0.271 F | 257 | 157+ |
| Creatinine (mg/dl) | 0.628 ± 0.019 H | 100 | - | 1.463 ± 0.072 Hg | 233 | 133+ |
| Urea (mg/dl) | 18.827 ± 0.361 E | 100 | - | $39..310 \pm 2.020$ D | 209 | 109+ |
| Sodium (Na+) (mM/l) | 135.172 ± 0.421 B | 100 | - | 149.517 ± 0.584 A | 111 | 11+ |
| Potassium (K+) (mM/l) | 4.172 ± 0.032 g | 100 | - | 3.113 ± 0.073 Hg | 75 | 25- |

* (+) It is means an increase.

(-) It is mean an decrease.

The number are followed by different letters horizontally indicate a significant difference at the

level of probability ($P \leq 0.05$) and correct reverse according Duncan's test.

Table (3) : The levels of accumulated lead (Pb) and biochemical parameters in serum of gout patients and healthy control group for males and females.

| Groups Parameters | Genders | Control (n = 40) | | | Patients (n = 70) | | |
|-----------------------------------|---------|-------------------------|------------|-------------|-------------------------|------------|-------------|
| | | Mean \pm SE * | % Level | % Change | Mean \pm SE * | % Level | % Change |
| Lead (Pb) ($\mu\text{g/ml}$) | Males | 18.866 ± 0.098 e | 100 | - | 48.604 ± 0.731 C | 258 | 158+ |
| | Females | 18.596 ± 0.417 E | 100 | - | 43.546 ± 0.638 C | 234 | 134+ |
| Uric Acid (mg/dl) | Males | 3.315 ± 0.109 H | 100 | - | 8.712 ± 0.391 F | 263 | 163+ |
| | Females | 3.157 ± 0.118 H | 100 | - | 7.970 ± 0.475 Fg | 252 | 152+ |
| Creatinine (mg/dl) | Males | 0.645 ± 0.031 H | 100 | - | 1.505 ± 0.106 H | 233 | 133+ |
| | Females | 0.598 ± 0.022 H | 100 | - | 1.410 ± 0.112 H | 236 | 136+ |
| Urea (mg/dl) | Males | 19.416 ± 0.645 E | 100 | - | 39.700 ± 2.699 D | 204 | 104+ |
| | Females | 17.916 ± 0.228 | 100 | - | 39.358 ± 3.073 | 220 | 120+ |

| | | | | | | | |
|--------------------------|---------|--------------------|-----|---|--------------------|-----|-----|
| | | E | | | D | | |
| Sodium (Na+) (mM/l) | Males | 136.0 ± 0.246 B | 100 | - | 150.3 ± 1.239 A | 111 | 11+ |
| | Females | 135.3 ± 0.376 B | 100 | - | 148.6 ± 0.142 A | 110 | 10+ |
| Potassium (K+) (mM/l) | Males | 4.233 ± 0.061 G | 100 | - | 3.433 ± 0.093 H | 81 | 19- |
| | Females | 4.133 ± 0.037 G | 100 | - | 2.833 ± 0.619 H | 69 | 31- |

* (+) It is means an increase. (-) It is mean an decrease.

The number are followed by different letters horizontally indicate a significant difference at the level of probability ($P \leq 0.05$) and correct reverse according Duncan's test.

Table (2) shows the results a significant increase in the level of serum uric acid in gout patients at a rate of (8.283 ± 0.271) mg/dl and in 157%, compared to healthy control at a rate (3.228 ± 0.075) mg/dl in both genders. And this results was showed in table (3) also that there were a significant increase in the level of uric acid in the serum of males and females at a rate of (8.712 ± 0.391) , (7.970 ± 0.475) mg/dl and in a percentage 163%, 152% respectively, compared to healthy control in males and females at a rate (3.315 ± 0.109) , (3.157 ± 0.118) mg/dl respectively. Also table (2) shows a significant increase in creatinine level in the serum of gout patients at a rate of (1.463 ± 0.072) mg/dl and in a percentage 133%, compared to healthy control at a rate (0.628 ± 0.019) mg/dl in both genders. While table (3) shows a significant increase in creatinine level in the serum of infected males and females at a rate of (1.505 ± 0.106) , (1.410 ± 0.112) mg/dl and in a percentage 133%, 136% respectively, compared to its level in healthy control at a rate of (0.645 ± 0.031) , (0.598 ± 0.022) mg/dl respectively. Table (2) shows a significant increase in the urea level in the serum of gout patients at a rate of (39.310 ± 2.020) mg/dl and in a percentage 109%, compared to healthy control at a rate (18.827 ± 0.391) mg/dl in both genders. While table (3) also showed a significant increase in the urea level in the serum of infected males and females at a rate of at a rate of (39.700 ± 2.699) , (39.358 ± 3.073) mg/dl and in a percentage 104%, 120% respectively, compared to its level in healthy control at a rate of (19.419 ± 0.649) , (17.9168 ± 0.228) mg/dl respectively.

This results are consistent with the level increase of creatinine, urea and uric acid with many studies (3,8,26-30), these studies indicated that exposure to lead may cause kidney dysfunction as to the two processes namely secretion firstly and absorption secondly, leading to increasing in those parameters or a weakness in the renal function as a minimum limit. These studies indicanted also to

fixed and continuous decreasing in the average of glomerular filtration and creatinine release (26,28,30,32).

Table (2) shows a significant increase in the level of sodium in the serum of gout patients at a rate of (149.517 ± 0.584) mM/l and in a percentage 11%, compared to healthy control at a rate (3.228 ± 0.075) mM/l in both genders. And this results was showed in table (3) also that there were a significant increase in the level of sodium in the serum of infected males and females at a rate of (150.3 ± 1.239) , (148.6 ± 0.142) mM/l and in a percentage 11%, 10% respectively, compared to healthy control in males and females at a rate (135.0 ± 0.246) , (135.3 ± 0.376) mM/l respectively. This results are consisten with increasing sodium level to what was found by (8,28,33-36). Table (2) shows a significant decrease in the level of potassium in the serum of gout patients at a rate of (3.113 ± 0.073) mM/l and in 25%, compared to healthy control at a rate (4.172 ± 0.032) mM/l in both genders. And Table (3) also shows that there were a significant decrease in the level of potassium in the serum of infected males and females at a rate of (3.833 ± 0.093) , (2.833 ± 0.619) mM/l and in 19%, 31% respectively, compared to healthy control in males and females at a rate (4.233 ± 0.061) , (4.133 ± 0.037) mM/l respectively.

Kolanjiappan et al., (37) pointed out that the high level of sodium and low level of potassium as a reaction to the inhibition the work of the sodium-potassium pump(Na^+ , K^+ ATPase) in the cell membranes due to the lipid peroxidation by free radicals caused by oxidative stress due to lead accumulation, which leads to the necrosis of the membranes and damage their systems, so sodium and potassium levels are disturbed. We conclude from this study that the exposure of patients working in different professions to a high level of lead led to gout and caused an imbalance in the physiological and metabolic processes.

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Ethical Clearance

The project was approved by the local committee (College of Science, University of Mosul, Iraq).

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