PERINATAL JOURNAL

Original Article

Perinatal Journal 2025; 33(2):581-586

https://doi.org/10.57239/prn.25.03320063

Calculating the levels of heavy metals and how they relate to people who have chronic renal failure

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Abstract

Every year, environmental pollution kills over 3.7 million people worldwide. In order to prioritize potential technical interventions to minimize pollution from industrial power generating sources and autos, measuring the burden of disease is crucial for research as well as for a thorough cost-benefit analysis. Blood samples were taken from 15–60-year-old patients with renal impairment who were admitted to Medical City hospitals. Over the course of three months in 2023, a total of fifty blood samples were obtained. They were contrasted with 50 samples of healthy individuals, ages 15 to 60, who made up the control group. Atomic Absorption Spectroscopy (AAS) is used to with a statistical mean for lead (Pb 2.37 ± 1.02), cadmium (Cd 1.17± 0.68 µg/L), and cobalt (Co) of 4.35± 3.33 µg/L, the study demonstrated a significant association between the concentrations of these heavy metals and chronic renal failure in some patients with the diagnosis. According to the statistics, there were different connections between the lead, cadmium, and cobalt concentration levels in individuals with renal insufficiency.

Keywords: Pollution from industry, Chronic renal disease, The impact of cobalt, Cadmium, and lead

Introduction

Heavy elements are non-dissolvable acquired environmental pollutants that enter the human body in multiple ways through the mouth, skin, and inhalation. They accumulate in the body and thus affect the body's organs, including the kidneys, where they are deposited and difficult to excrete outside the body, because most of them are not dissolved in water. Some of them (such as copper, selenium and zinc) are essential for human metabolism, an increase in their concentration leads to poisoning (such as lead, cadmium and cobalt) (Evans M & Elinder CG.2011).

These elements are deposited in the body, especially the kidneys, which are the filters of the body and because they are of high density and insoluble, and thus lead to a decrease in the efficiency of the kidneys Then symptoms of renal insufficiency appear gradually in some people. This study evaluated the ratios between the heavy elements under study with a selected group, And a study of the high concentrations of these elements in the human body from their normal level on the work, effectiveness and function of the kidneys. (Olsson IM, et al,2002).

Pollution with heavy elements is one of the important factors that must be detected and its impact on human life studied (Levey AS & Coresh J., 2012).This pollution differs as it is high in the city environment and lower than in the rural environment due to the continuous emissions from cars and the increase in the population, factories, fuel stations, waste incineration dumps, etc. (Järup L. ,2003). It is one of the most important factors of lead, cadmium and cobalt pollution. Man deals with these elements and is constantly exposed to them, as they are present in the soil, water and air, and thus the human body is affected by them. Heavy metals are divided into two types :

1- Essential heavy metals: They are necessary for the human body for the metabolism process, such as iron, but with a specific concentration, including cobalt, which consists of vitamin B2, copper, zinc and selenium, which is less toxic.

2- Non-essential metals: highly toxic and, in low proportions, cause severe toxic effects on living organisms, for example, including lead, chromium, cadmium, arsenic, and mercury. (Muntner P, et al.2003).

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The World Health Organization (WHO) has listed cadmium, lead, cobalt, mercury and arsenic among the ten most dangerous substances to health for the year 2018.

The term chronic kidney disease generally defines disproportionate disorders affecting the type, structure, location, and functioning of an organ. The 2002 guidelines identify and classify the disease as an important shift towards recognition that it is a global health problem that must be managed and treated in its early stages by medical professionals (Olsson IM, etc., 2002). Disease levels are distributed and managed by stage and severity, and can be The disease is evaluated by glomerular filtration rate "GFR", albuminuria, and medical diagnosis (cause and pathology), (Navas Acien A, et al., 2009). The disease is detected with some tests, and medications that prevent and slow its progression, as well as reduce the complications of low glomerular filtration rates "GFR" and reduce the risk of developing cardiovascular diseases, and help survival. In this research, we discuss the burden of disease and put forward some recommendations for evaluating It and manage the challenges coming in the future. We emphasize observational and clinical trial guidelines and approach areas of certainty.(Evans M ,et al, 2010) . When the kidneys suddenly become unable to filter waste from the blood, acute kidney failure occurs. Sometimes the kidneys lose their filtering function, which leads to increased levels of dangerous plaques and a disturbance in the chemical composition of the blood. Also called chronic kidney failure or acute kidney injury, people get sick quickly in a few days. It is more common among people already in hospital, especially those with a late-onset condition who require acute care. (Rutkowski M, etc., 2009), Acute kidney failure is potentially fatal and requires intensive treatment. He may be treated if his health is good, and his kidney function may return to normal or near normal (Kang HM, Ahn SH, Choi P,etc al, 2015).

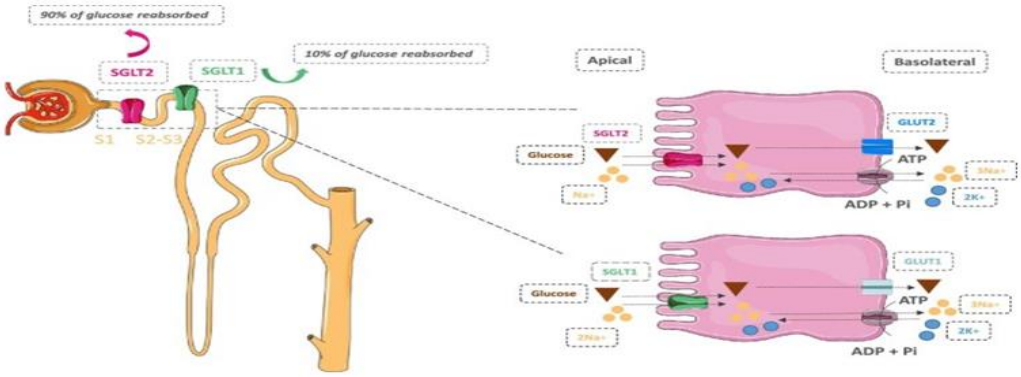

Figure 1: Total reabsorption of 160-180 g of pure glucose from the distal tubules to the apical membrane as SGLT2 in "S1 & S2" (90%) and through SGLT1 in S3 (10%). Glucose is released into the bloodstream by " GLUT1 & GLUT2" are available in the basement membranes of tubule cells due to a concentration gradient

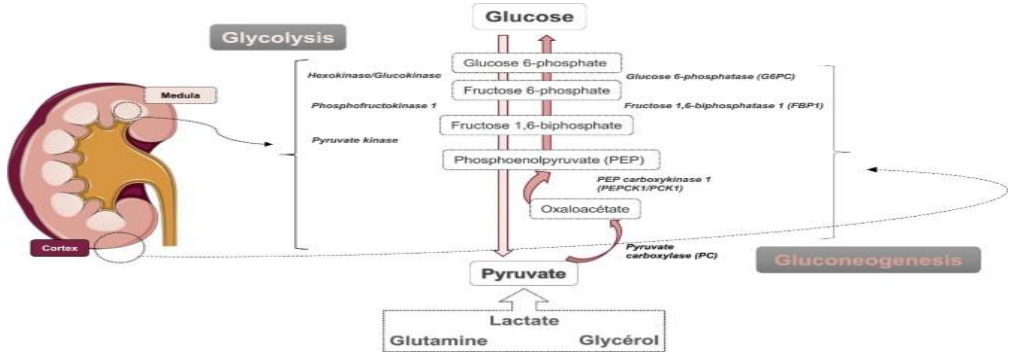

Figure 2: Showing the gluconeogenesis and gluconeogenesis pathways is a passage of 10 reactions, the final product of pyruvate and three fusions activated by hexokinase /glucokinase, phosphofructokinase, and rate-limited pyruvate kinase. It is a reversible gluconeogenesis reaction with four specific reactions catalyzed by G6Pase, FBP1, PEPCK, & PC).

There is a clear interest in recent years to examine the proportions of elements present in human blood and tissues and whether the concentrations of these elements can change in malignant diseases and other diseases, including renal failure. Significant changes have been observed in the concentrations and rates of some metals. particularly lead, cadmium, and cobalt, which are known to occur in many pathological conditions. (Hallan SI, Stevens P.J Nephrol ,2010).These changes also occur in patients with malignant diseases such as (Hodgkin's disease , Hodgkin's lymphoma, acute leukemia, and bronchopulmonary cancer).(Fagerberg.B,et al ,2015) Studies conducted to determine the concentrations of these elements for a group of patients with different diseases, including patients with kidney failure, showed changes in their concentrations and the disease and its association with this increase in metal concentrations. (Evans M & Elinder CG ,2011). Lead (lead) is often one of the most dangerous elements that can be present in various environments (Buser, M.C. et al , 2016).

Sources (65% of food, 20% of water and 15% of air) where lead biosynthesis occurs, which it ingests mainly at depth. It is rooted in information driven by the body. (Lan.R, Geng .H, Singha .PK, et al ,2016). Cadmium element (Cd) is one of the heaviest elements dangerous to human health, as it is a highly toxic element for all living organisms, and interest in it as an environmental pollutant began in the late 1960s, and cadmium reaches humans through the food chain, especially through feeding on grains, fruits, and vegetables. Cadmium ranks seventh in the list of the most dangerous substances. (Sánchez Hernández & R.Nefrologia. , 2008).

Table 1. Concentrations of heavy metals in the body

Concentration	
mgm/kgm	Heavy metal
10	pb
1	Cd
0.1	Co

Aim

This study aims to identify some trace elements in the total blood of a group of patients with renal impairment using atomic absorption spectroscopy (AAS), to know the concentrations of these elements and to study their effect on the condition of patients and the progression of the disease. Research allows for an accurate identification of the role of the environmental or food factor and other sources in causing this effect, as well as early methods can be reached in determining the proportions of these elements for other diseases in order to help them get rid of the toxicity of heavy elements and reduce the pollution emanating from them.

Methodology

Collect models

1- Blood samples were collected from patients with renal failure lying-in hospitals of the Medical City, who are reviewed periodically and previously diagnosed by doctors, with different ages between 15 years to 60 years. The number of samples reached 50 blood samples that were collected over a period of 3 months. 50 samples were collected from normal people and ages Also different between 15 years to 60 years.

2- 3-4 ml of blood was drawn from patients as well as from normal people and placed in tubes containing an anticoagulant substance (Lithium heparin tube) and kept at a temperature of 4 C until the completion of sample collection.

3-Use an atomic absorption spectrometer to measure concentrations of heavy metals.(Minutolo R,et al,2008).

The method of work

1- 200 microliters of blood sample and 200 microliters of diluted Triton X-100 (1%) were drawn and placed in an Eppindorf tube.
2- Centrifuge for 4 min /10,000 rpm.
3- The upper part of the blood was taken from the plasma and placed in a small cup. These samples were analyzed by an atomic absorption spectrometer.
4- The inert gas used is argon gas, as well as oxygen gas under a certain pressure, and also the use of dihydrogen ammonium phosphate.
5- The blood samples with unknown concentrations are placed with the samples of the standard solutions in the atomic spectrophotometer, after which the device begins to draw the

standard curve of the elements and the unknown concentration of the sample read from the standard drawing.

6- Samples of the standard solution should be placed between every ten blood samples, in order to ensure the correctness of the device's readings.

7- The average of 3 readings is taken for standard solutions samples, as well as for blood samples.

Results & Discussion

Results are calculated as mean ± standard deviation or frequency. f Comparison of baseline characteristics with "Fisher's square test" for Categories for continuous and tested variables. We designed a weak regression model for multiple variables to identify factors associated with CKD. (Prozialeck WC, 2008). To calculate crude and adjusted odds ratios (OR) with 95% confidence intervals (CI) and P were analyzed for two-way polynomials (P< 0.05) was considered statistically significant. All analyzes were performed using SPSS PASW Statistics 18. (Kim R., Rotnitsky A, Sparrow.D,et al, 1996). The results showed that the proportions of the elements under study are less than the threshold.) In our study, examining patients after exposure to lead, we did not notice any effect on the kidneys or early injury. These at high levels of intraoperative exposure are known to be neph-rotoxic. Kidney damage may occur with varying levels of environmental exposure in the population. This indicator is controversial for study and associations with other CKD risk factors remain imprecise (Yu C., Lin J., Lin -Tan, 2004, Spector .J, 2011).

Our results were as follows, the means of blood, Pb 2.37±1.02 µg /dL, and Cd 1.17±0.68 µg/L, Co 4.35±3.33 µg/L in order. Interval levels of blood Pb, Cd, and Co, established by (WHO) ,were) 21, 5,5,µg /dL) sequentially. None of the previous results were higher than the limit established by the World Health Organization. (Wedeen RP,1975, Minutolo. R, et al. ,2008). The mean levels of Pb, Hg, and Cd in the blood count is higher in people with the disease compared to people who do not have this disease. No correlation was found between environmental changes in metal levels and patient samples. Where We performed multiple regression analysis to adjust the results for age, sex, etc , blood Pb (OR,(1.05; 95% CI),(0.85–1.30), (P=0.688), Cd (OR,(1.09 ; 95% CI), (0.81–1.47), (P= 0.567) , Co levels (OR,(1.02; 95% CI), (0.97–1.07),(P = 0.522), as well as note that elemental concentrations.

It has nothing to do with chronic kidney disease. Depending on the p. values and means, all of which were below the specified level (p. value < 0.05), (Table 2).

Table 2. The table shows the mean and standard deviation using the chi-square test, categorical variable: t-test type. p < 0.05 ,odds ratio (95% confidence interval))

OR	P. value	mean ± standard deviation	Heavy metal (µg /dL)
1.05	0.688	2.37 ±1.02	Pb
1.09	0.567	1.17±0.68	Cd
1.02	0.522	4.35±3.33 µg/L	Co (µg/L)

There are many studies in Western countries on the association of heavy metals and chronic kidney disease, but in Asian countries there is not enough data for this research.

In our present results, Low-dose environmental factors (lead, cadmium, and carbon) were not associated with CKD. There are few association and effect studies with diabetes or high blood pressure, and there is no continuity of work revealing element concentrations at different times. There are opposite reasons for interpreting Our findings were limited by difficulty in obtaining samples, patients, and other factors (such as general socioeconomic variability, dietary diversity, or environmental evolution). We estimated exposure to toxicological changes of heavy metals through their levels and concentrations in the blood. (Olsson IM, etc,2002).

Blood elemental levels It is the most widely used measure for calculating environmental pollution percentages in our study, but levels (blood lead and cadmium in addition to carbon) may not be similar to those found in sensitive tissues and could be considered as markers of short-term acute exposure.

The findings in the present study can be evaluated as the environmental effect of (Pb, Cd & Co) on CKD in patient models using well-characterized data, characterized by a huge sample size, and a well-designed study proseger in terms of its high quality., comprehensive monitoring, and standardized laboratory procedures. (Yasuda M. et al. 1995).

The values indicated a low environmental effect of (Pb, Cd and Co) and the effect on all populations There is no consistency with CKD. However, its deficiency harms kidney function, especially in adults with high blood pressure or diabetes. Reports indicate that the effects are weak at low levels, but exposure levels to various metals can cause damage to blood vessels and kidneys. Especially in patients with diabetes or high blood pressure. Given the widespread exposure to and increasing burden of chronic kidney disease worldwide, these findings have significant implications for the health of the general population.

Conclusion :

The results obtained in this research appear as a result of lower concentrations of toxic elements that were examined for patients with chronic renal failure compared to control samples, and it was confirmed to us that the effect of low concentrations of heavy elements on kidney function may be weak. . There is a high possibility of an effect on renal function when exposure to heavy metals is constantly increased and their toxicity to patients increases due to their accumulation in the renal pelvis.

The subject is still under control if exposure to these toxic elements is reduced or away from their sources to avoid patients from the risk of renal failure.

Recommendations

1-Heavy metals are among the important and harmful factors that must be detected and their impact on human life studied

2- Heavy metals are of biological importance within low concentrations, and are considered toxic elements, and their concentrations in the environment have increased with the increase in human activity and industries.

3-One of the reasons for the increase in lead in the body is the atrophy of the kidney tissues, which leads to kidney failure .It increases low IQ, behavioral problems, and aggressiveness by affecting the brain .Fertility disorders in men and women. Behavioral disorders in children. Therefore, you must be careful and stay away from prohibited areas.

4- Carrying out studies using different methods to determine the concentrations of these elements for a group of samples of patients with various diseases, as well as those with renal insufficiency, and to find the relationship between their concentrations and the state of the disease and its association with this increase in metal concentrations.

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