Assessment of Serum Chromium and Zinc Levels in Patients with Chronic Renal Failure

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Abstract

Background: Chromium (Cr) and Zinc (zn) are very important in human nutrition. Many researchers reported that serum chromium and serum zinc are impaired in patients with chronic renal failure, (CRF).

Objectives: This study aimed to assess chromium and Zinc in chronic renal failure patients. Materials and Methods: This study was conducted at Khartoum state during November 2017 to May 2018. The study enrolled 35 patients with CRF and 40 healthy controls. Serum Chromium and Zinc levels were estimated using Atomic absorption spectrophotometry, (AAS), technique. Results: The current study demonstrated a highly significant a lower level of Cr in patients in contrast to healthy controls, (0.032 versus 0.147 mg/dl; respectively, P<0.001), and also of Zn level in patients as compared to healthy controls (0.165 versus 0.564 mg/dl; respectively, P<0.001). In contrary, the level of both Cr and Zn were significantly higher after dialysis as compared to their levels, before dialysis (0.137 versus 0.032 mg/dl; respectively, P<0.001) and (0.253 versus 0.165 mg/dl; respectively, P<0.001) for Cr and Zn, respectively. Conclusion: The present study revealed that, Zn and Cr levels decreased in CRF patients and increased after dialysis.

Key words: Trace elements. chronic renal failure. dialysis. Atomic absorption spectrophotometer.

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Introduction

Essential trace elements are involved in a number of metabolic activities including neuron conduction, transport and excretory processes. They play a vital role in cellular metabolism and the maintenance of homeostasis, acting as key co-factors for enzymes. Patients with CKD are potentially at risk of both essential trace element deficiencies, but also toxicity due to the failure to excrete other non-essential elements. The kidney is a target site for element toxicity, and the cells of the proximal renal tubule have an important role in the hemostasis of the essential elements. The trace elements are usually associated with enzyme or other protein as an essential component or cofactor. Multiple factors such as malnutrition, alcoholism, increased requirements and many diseases such as sickle cell anemia and renal diseases, which affect the concentration of trace elements in body fluids. The Kidney is an essential organ in hemostatic function. It is a regulatory organ for dietary intake and excretion. Those mechanisms responsible for the trace element disturbances found in renal failure patients are probably multiple and multi-factorial.

There are about one million nephrons per kidney, each of which is made up of five main functional segments. When the kidneys are damaged this affects the normal functions such as chronic renal failure (CRF). Chronic renal failure is characterized by progressive scarring that affects all infra-structures of the kidney. The relentless progression of CKD is postulated to result from a self-perpetuating vicious cycle of fibrosis activated after initial injury. In patients with renal failure, uremic symptoms, uncontrolled hyper-kalemia, and acidosis have traditionally been indications that the kidneys are unable to excrete the body’s waste products and a substitute method in the form of dialysis was necessary. Because the dialysis fluids which are used in the different dialytic treatments contain variable amounts of trace elements, so that dialysis contributes to an increase in many trace elements. The objective of this study was to measure serum chromium and Zinc in chronic renal failure patients.

Materials and Methods

This is a case controlled study, conducted in patients in Khartoum State within the period from November 2017 to May 2018. Venous blood samples (3ml pre and post dialysis) were collected from 35 patients diagnosed with chronic renal failure. The patients ranged from 19 to 78 years (age 45.34 ± 16.72 years), besides 40 healthy controls, who ranged from 19 to 78 years, were randomly selected from healthy volunteers during the same period. The diagnoses were based on ultra sound, renal function tests, biopsy and history. Informed consent was obtained from each participant and the study was approved by the Ethical Committee of Omdurman Islamic University and conducted accordance with the international ethical guidelines.

Data collection

A structured questionnaire was used to obtain
demographic data (age, gender and tribe). Blood samples (5 ml) were collected from all patients and controls. Samples were centrifuged for 10 min at 3000× g at 4 °C. Serum was stored at -20 °C until analysis.

Methods

Estimation of zinc and chromium levels:
Serum Chromium and Zinc levels were estimated using atomic absorption spectrophotometer. The serum was diluted (1:4), then atomized and vaporized, the atom absorbed light and spectrophotometer read the amount of absorption and gave levels of Zn, Cr.

Statistical analysis
Statistical analysis was performed using statistical software package. Student’s t test was applied to identify where significant differences lay. Correlations between variables were evaluated by Spearman’s correlation coefficient. The results were expressed as means ± standard deviation. Significance was set at P < 0.05.

RESULTS
Compression between level of serum chromium and zinc in patients and controls:

Statistical analysis indicated that mean levels of chromium (0.032 ± 0.010) and zinc (0.165 ± 0.052) were significantly lower in patients compared with Controls (0.147 and 0.564) (P<0.001) as shown in (Table 1)
Comparison between the level of chromium and zinc in patients before and after dialysis
The mean levels of chromium (0.137) and zinc (0.253) were significantly higher after dialysis as compared to that before dialysis (0.032 and 0.165), (P<0.001) (Table 2).

Correlation between chromium level, zinc level and other studied variables
An insignificant correlation was found between the mean of chromium level and age, gender, duration of disease and medication. The same result was found for zinc. While significant correlation (P<0.05) was found between the mean of chromium level and the levels of zinc. On the other hand, positive and significant (P<0.05) relationships was found between levels of chromium and zinc (Table 3). The result showed that, for each one unit increase in zinc level, chromium level increased by 0.074 (data was not shown).

Table 1: Comparison between level of chromium and zinc in patients and controls

<table>
<thead>
<tr>
<th>Variables</th>
<th>Patients</th>
<th>Controls</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium (mg/l)</td>
<td>0.032</td>
<td>0.147</td>
<td>0.001**</td>
</tr>
<tr>
<td>Zinc (mg/l)</td>
<td>0.165</td>
<td>0.564</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

** Significant correlation at 0.001
Table 2: Level of chromium and zinc before and after dialysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before dialysis</th>
<th>After dialysis</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium (mg/l)</td>
<td>0.032</td>
<td>0.137</td>
<td>0.001**</td>
</tr>
<tr>
<td>Zinc (mg/l)</td>
<td>0.165</td>
<td>0.253</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

** Significant correlation at 0.001

Table 3: Correlation between chromium level, zinc level and other studied variables (age, gender, duration and medication).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chromium</th>
<th>Zinc</th>
<th>Age</th>
<th>Gender</th>
<th>Duration</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium (mg/l)</td>
<td>r 1 0.371*</td>
<td>0.085*</td>
<td>-0.029ns</td>
<td>-0.043ns</td>
<td>0.004ns</td>
<td></td>
</tr>
<tr>
<td>Zinc (mg/l)</td>
<td>r 0.028</td>
<td>0.008*</td>
<td>0.105ns</td>
<td>0.145ns</td>
<td>0.214ns</td>
<td></td>
</tr>
</tbody>
</table>

* Significant correlation at 0.05, ns: No significant correlation.

DISCUSSION
The changes in body composition in chronic hemodialysis patients before and after hemodialysis have been reported \(^3\). In the present study, zinc (Zn) level decreases significantly (P<0.001) in patients with chronic renal failure more than control (0.032 versus 0.147). In renal failure, patients have disturbances in acid base balance leading to acidic blood pH, therefore low zinc levels in these patients are believed to be due to the shift of zinc into red cells under acidic conditions. In addition to that zinc present in serum is combined with plasma proteins, especially with albumin. Proteinuria in renal failure leads to excessive excretion of zinc \(^3\). On the other hand, the present study found that Zn level was significantly increased after dialysis, this results agrees with Hosokawa et al., in 1985 \(^9\), who found that serum zinc concentration increases after dialysis.
In contract most of authors reported low Zn concentration in the serum of patients undergoing hemodialysis (HD), Dvornic et al., 2006 \(^10\) and Neto et al., 2016 \(^11\) found that 78% of patients on HD had low plasma Zn concentration. That may be due to three different reasons: changes in elements reservoirs in the body, decreased absorption by gastrointestinal tract, dialysate composition which gave the osmolarity difference, allows abundant Zn
excretion during the filtration process. Also Toneli et al., 2009\(^{(12)}\) reported that Hemodialysis patients have lower level of Zn than people in the general population and Zn deficiency is a leading cause of diseases in developing countries.

Also the present study found that chromium (Cr) level decrease significantly (P.V<0.001) in patients with chronic renal failure more than control (0.165 versus 0.564), this result disagree with Haese et al., in 1996\(^{(13)}\) who had reported that serum Cr concentration increased in CRF patients compared with those subjects with normal renal function and referred that to Cr, which enters the body via the dialysis fluid. On the other hand, the present study found that Cr level was significantly increased after dialysis. That increased Cr levels in dialysis population are of clinical significance, which is not clear, nor is it elucidated, if the increased serum Cr in the patients is accompanied by an increase in body burden of the element. Furthermore, Minami et al in 1986\(^{(14)}\) had found that chromium tended to decrease during dialysis, when chromium level in the dialysis fluid was measured, it was significantly higher than before dialysis. This result showed that chromium was transported from serum to the dialysis fluid. After 1 hour when measured chromium level in serum presumed the increase once more.

**Conclusion**

The current study demonstrated that, Zn and Cr levels decreased in CRF patients and increased after dialysis.

**References**


and Fonseca F. The role of zinc in chronic kidney disease patients on hemodialysis, 2016; (8): 345.

