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INFLUENCE OF END STAGE RENAL DISEASE IN ALTERATION OF SOME TRACE ELEMENTS IN SUDANESE PATIENTS

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ABSTRACT

Background: The role of trace elements in hemodialysis (HD) patients has not yet been clearly recognized. To minimize the health consequences of persistent HD, the levels of trace elements should be seriously adjusted.

Methods: The study was across-sectional conducted in Khartoum state ofSudan between August 2013 and April 2015 included 150patients with end stage renal disease treated with hemodialysis and 75 healthy volunteers as control group. Informed consent was assigned by each participant before taking the blood sample. All samples were analyzed for magnesium, zinc and copper.

Results: Compared with healthy controls, in hemodialysis patients average serum levels of zinc (Zn) (663 μg/L) and copper (Cu) (797μg/L) were insignificantly different; however, magnesium (Mg) levels (38.61 mg/L) were significantly increased. According to sex of ESRD patients, serum Mg level was increased significantly in females, while insignificant changes were observed in Cu level. This study stated that Zn, Cu and Mg levels were significantly increased in elder patients more than younger ones. Zn, Cu and Mg were increased as increasing duration of dialysis, changing significantly in serum Zn and Cu.

Conclusions: Our results concluded that in hemodialysis, aging, and sex have significant effects on Zn, Cu and Mg.

Key Words: Copper, ESRD, Hemodialysis, Magnesium, Zinc

INTRODUCTION

End-stage renal disease (ESRD) has a high prevalence and progression throughout the world and it is a common co-morbidity disease. Many people around the world suffer from ESRD and require long-term dialysis. Despite dialysis treatment, ESRD patients still have high morbidity and mortality rates[1]. Recent studies have suggested that the dialysis treatment is associated with some complications and inconvenient events [2].Chronic kidney disease (CKD) and end-stage renal disease (ESRD) are more common in certain patient populations, including the elderly, those with youth-onset diabetes mellitus, obese persons, some ethnic groups, and disadvantaged population [3]. Patients from low and middle income countries are often the least able to deal with the burden of ESRD and the health-care facilities of these countries least able to provide the demand for convinced access to renal replacement therapies [4]. ESRD patients are commonly suffered of malnutrition and/or inflammation [5]. The accurate assessment of nutritional status and body composition is of highly importance in providing nutritional care to patients with CKD and ESRD, as malnutrition and the trace elements wasting syndrome are among the strongest risk factors for morbidity and mortality [6]. Study of Guo *et al*.[1]mentions that long-term dialysis leads to significant changes in the concentrations of some trace elements.

The human body needs a number of minerals in trace quantities. These include iron, copper, magnesium and zinc. Usually mineral deficiency binds more than one, and these collective deficiencies have cumulative effect on health. Trace elements play important roles in human body because they serve a variety of functions. Some serve multiple functions ranging from representing as cofactors in enzyme reactions to organizing and contributing to the hardness of bone. Metal ions are always joined to particular proteins where they often play a crucial part in maintaining the protein's three dimensional structure [7].

Zinc is a cofactor in more than 100 enzymatic reactions, essential component of nuclear DNA binding proteins and serves in genes' codes for metallothioneins. Copper also is

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essential cofactor in several reactions concerning iron use, collagen synthesis, suppression of free radicals and serves in the expression of genes for several enzymes. While, magnesium in human body is needed for more than 300 biochemical reactions. It supports and helps to maintain normal functions of nerve, muscle, and healthy immune system, keeps the heart beat steady, and helps bones remain strong [8]. Many of the functions described above are vital metabolic functions. Deficiency of any of those trace minerals can produce a variety of diseases [7].

The aim of this study was to assess the levels of serum zinc, copper and magnesium among ESRD Sudanese patients before dialysis as affected by gender, age and duration.

MATERIALS AND METHODS

Study area: The study was conducted in Sudan, Khartoum state, in Omdurman Teaching Hospital and Khartoum North Center for dialysis**.**

Study design: This was across-sectional study.

Study period: The study was carried out between August 2013 and April 2015.

Sample size and study population: the study included 150 (75 males, 75 females) ESRD patients(already diagnosed patients with end stage renal failure under dialysis)**.** Mean age of patients was 33.14±4.58 years. Control group was consisted of 75 healthy volunteers whose mean age was matched (35.6±5.64). Any patient with disease can affect the results was excluded as well as the patients refused to participate in the study.

Ethical clearance: The ethical committee of Omdurman Islamic University approved the ethical clearance of the present study. Informed consent was obtained from each participant before taking the samples.

Data collection: data was collected using pre-prepared questionnaire which include age, sex, duration of renal failure, duration of dialysis, and patients health condition.

Sampling: 5 mL venous blood was obtained from antecubital vein by standard venipuncture technique without venous stasis, in serum separator tube. Serum was separated after 20 minutes and stored in -20^{o}C till time of analysis.

Methods of estimation: All samples were analyzed after warming to room temperature.Analysis of zinc and copper is carried in the center of researches, Information Technology College using Atomic absorption spectrometer (Thermo Scientific™ iCE™ 3300 AAS, USA) following the manufacturer procedure. Serum magnesium was measured using mass spectrometry (ICP-MS, Agilent 7700x, Agilent Technologies, Tokyo, Japan) as described by Harari *et al*[9].

Statistical analyses: The data obtained were expressed as mean values ± SD. Statistical analyses were performed using SPSS (Statistical Package for Social Sciences) version 19.00 (SPSS, Inc., Chicago, IL). Differences in mean values between groups were evaluated by a Student's t-test. P-value was statistically significant at P<0.05.

RESULTS

The results of the present study indicated that there is insignificant differences in zinc (Zn), and copper (Cu) between patients and controls with p-values of more than 0.05% for all results. While, magnesium (Mg) levels were significantly increased in ESRD patients.

Table 1: Comparison of Cu, Mg and Zn between control and ESRD patients pre-dialysis (Mean ± SD)

	Control	Patient	P-value
Number	75	150	N/A
Age (years)	35.6±5.64	33.14±4.58	0.725
Mg (mg/L)	21.28±6.10	38.61±5.71	0.000
Cu (µg/L)	874± 10.254	797± 21.223	0.217
Zn (µg/L)	672± 53.112	663± 99.007	0.099

In comparing the results of ESRD patients according to sex, the results showed insignificant difference between males and females in Cu levels. The results of Zn showed significant increase (p=0.013) in male patients comparing to female patients; while Mg levels in male patients were significantly decrease than in females (Table 2).

Table 2: Comparison of Mg, Cu and Zn according to sex among ESRD patients (Mean ± SD):

	Males	Females	P-value
Number	85	65	-
Cu (µg/L)	796.5± 13.82	949.2± 40.74	0. 132
Zn (µg/L)	702.9± 60.80	616.9± 39.43	0. 013
Mg (mg/L)	31.17± 5.06	46.05± 11.11	0.000

ESRD patients were classified according to age into two groups; one group included patients of less than 18 years and the other group included the patients of 18 to 40 years old. The results showed significant changes in all tested parameters (Zn, Cu & Mg) (Table 3).

Table 3: Comparison of Mg, Cu and Zn according to age groups of ESRD patients (Mean ± SD):

Age	< 18years	18-40years	P-value
Number	55	95	-
Cu (µg/L)	833.3± 115.98	985.7± 92.23	0.0259
Zn (µg/L)	606.9± 71.08	792.9± 100.58	0.0031
Mg (mg/L)	29.88 ± 11.00	47.34 ± 8.56	0.0166

Also, ESRD patients were classified according to duration of dialysis into two groups; dialysis for less than one year and for more than one year dialysis (Table 4).

Table 4: Comparison of Mg, Cu and Zn according to duration of dialysis (Mean ± SD):

Duration	< 1 year	>1 year	P-value
Number	67	83	-
Cu (µg/L)	834.5± 88.23	969.8± 124.02	0.002
Zn (µg/L)	355.8 ± 109.02	710.1 ± 88.9	0.000
Mg (mg/L)	37.09 ± 9.99	40.13 ± 6.32	0.101

DISCUSSION

Traceelements in human plasma are essential nutrients with many functions. Abnormalities of trace elements are primarily the result of CRF, and they may be sometimes greatly turned by the dialysis[10].

In the present study, magnesium levels in ESRD patients were increased significantly ($p = 0.000$) comparing to healthy control volunteers. This result was in contrast to Ortega *et al.*[11] who reported that in CKD magnesium levels show insignificant changes in patients comparing to controls. While the levels of copper and zinc showed insignificant variations between patients and control. These results were in agreement with Bhogade *et al.*[12]who reported that there is a significant decrease in CRF patients comparing to healthy control persons.

In this study, ESRD patients were classified into males and females. Accordingly, there was significant reduction of serum zinc levels in females when compared to males ($p< 0.05$). Furthermore, serum copper were insignificantly decreased in females ($p> 0.05$), but serum magnesium level were significantly increased in males more than females ($p< 0.001$). However, EL-Habibi *et al*.[13] showed that Cu and Zn are reduced insignificantly in ESRD females comparing to ESRD males; On the other hand, João *et al*.[14] showed no changes in serum magnesium levels ($p> 0.05$) between ESRD males and females patient.

The study revealed that serum levels of Zn, Cu and Mg in ESRD patients of less than 18 years old were significantly decreased when compared to ESRD patients of more than 18 years old ($p < 0.05$). The results of Kiziltas *et al*.[15] and Cunningham *et al*.[16]were in line with our results but with few differences in restriction and limitation of age groups.

Moreover, ESRD patients were classified according to duration of hemodialysis into two groups, patients who treated with hemodialysis for less than one year and more than one year.Comparing to patients who treated with hemodialysis for less than one year, Cu and Zn levels in serum of patients who treated for more than one year showed significant increase ($p < 0.05$) while serum Mg level showed insignificant increase ($p > 0.05$). Mastrangelo *et al*.[17] revealed that Mg, Cu and Zn concentrations in the blood increased with increasing the treatment time of dialysis. In contrast, Cunningham *et al*.[16] and Koca *et al*.[18] reported that CRF patients for more than five years experienced low results in Cu and Zn much less than patients who have started the dialysis treatment more recently.

CONCLUSIONS

Compared with healthy controls, in hemodialysis patients' average serum Zn and Cu were insignificantly different; however, Mg levels were significantly increased. According to sex, the results of ESRD patients showed significant increase in male patients, serum Mg level was increased significantly in females, while insignificant changes were observed in Cu level. This study stated that Zn, Cu and Mg levels were significantly increased in elder patients more than younger ones. Zn, Cu and Mg were increased as increasing duration of dialysis changing significantly in serum Zn and Cu.

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Conflict of Interests

The authors declare that they have no conflict of interests.

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