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RESEARCH ARTICLE

THE EFFECT OF HEMODIALYSIS ON CALCIUM AND MAGNESIUM LEVEL AMONG CHRONIC RENAL FAILURE PATIENTS

Najla Omar Ishag[1] and Amar Mohamed Ismail[2*]

1. Department of Clinical Chemistry, Faculty of Medical Laboratory Science, Al-Neelain University – Sudan.
2. Department of Biochemistry and Molecular Biology, Faculty of Science and Technology, Al-Neelain University – Sudan.

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Abstract

The aim of this study was to assess the effect of hemodialysis (HD) on calcium and magnesium level among chronic renal failure (CRF) patients and its association with change in urea, creatinine, BMI and age. In a cross-sectional study included (n 80) patients (n 25 females and n 55 males) age ranged from (21 to 79) years old were enrolled. Timed pre and post-HD samples were collected, plasma calcium, magnesium, urea and creatinine were measured by using Cobas C311, and BMI was estimated. Paired *t*-test analyses showed significant decreases in mean magnesium, urea and creatinine level of post-HD samples (p = 0.000, 0.000 and 0.000) respectively, while significant increase was observed in calcium post-HD versus pre-HD sample (p =0.000). Pearson's correlation analysis showed no correlation between magnesium, calcium and study variables (creatinine, urea, age, BMI and duration of dialysis). In conclusion HD increase calcium and decrease magnesium thus could contribute to pathogenesis of related disorders in CRF patients under went HD.

Introduction:-

Chronic renal failure (CRF) is defined as the presence of kidney damage, which quantified by measured glomerular filtration rate (GFR) (1,2).CRF has emerged as a global public health burden for its increasing number of patients, high risk of progression to end-stage renal disease (ESRD), and poor prognosis of morbidity and mortality (3,4).HD is the main treatment of renal failure patient who is waiting for kidney transplantation (Dakshinamurty et al., 2002), also dialysis has been used as a life-saving technique for decades but has been universally available as a chronic therapy for only approximately 30 years (5,6,7). In addition dialysis could lead to depletion of biologically essential substances if they are not included in the dialysate (8). For example, removal of water-soluble vitamins is well known and all dialysis patients are given supplements to replace dialysis losses (9). In fact that, data are available regarding calcium in HD patients, little is known about the magnesium. Therefore, current study hypothized HD has an impact on calcium and magnesium among patient underwent HD two times a week. Peritoneal dialysis/hemodialysis patients have high prevalence of vascular calcification and cardiovascular disease both are the leading cause of death (10). The term (CRF-associated mineral and bone disorders) comprises abnormalities in bone and mineral metabolism and/or extra-skeletal calcification secondary to CRF pathophysiology (11,12). Renal osteodystrophy is the spectrum of histological changes, which occur in bone architecture of patients with CKD, which can be caused by either a high bone turnover state or a low bone turnover state (13).

*** Corresponding Author:- Amar Mohamed Ismail**
Address:- Department of Biochemistry and Molecular Biology, Faculty of Science and Technology, Al-Neelain University – Sudan.

Magnesium plays an essential physiological role in many functions (14), first its ability to form chelates with important intracellular anionic-ligands, especially ATP, second its ability to compete with calcium for binding sites on proteins and membranes (15). Calcium plays a key role in a wide range of biologic functions, either in the form of its free ion or bound complexes, the most important functions as bound calcium is in skeletal mineralization, which present in the skeleton as calcium-phosphate complexes and primarily as hydroxyapatite, which is responsible for much of the material properties of bone (16).

Materials and Methods:-

In this cross-sectional study, eighty diagnosed as CKD patients on regular HD 2 times a week, aged 21 to 79 years old, (25 females and 55 males) from different Sudanese hospital were included. Patients on calcium and or vitamin D supplement were excluded from this study. Two hour Pre-HD and immediately post-HD (5 ml) peripheral blood were withdrawn, using (Standard HD solution with 1.5 mmol/l calcium concentration). Serum was obtained by centrifugation of blood at 3000 rpm for 10 min and stored at –20^{o}C till used.

Ethical considerations:-

The study has been approved from local ethics committee of Al-Neelain University. All participants in the study were given their written informed consent considering the aims of the study and sample and clinical information's were used anonymously.

Measurement of BMI:-

Anthropometric data including weight and height were measured, and then Body Mass Index (BMI) was calculated as weight/kg divided by height/m^2.

Estimation of Calcium:-

Brief according to manufactured, calcium was combines with o-cresophthalein complex one to form a purple colored complex in alkaline media, the intensity of the color formed was directly proportional to the amount of calcium present in the sample, and colored formed was measured in 570 nm using full automated Cobas C311 analyzer.

Estimation of Magnesium:-

According to procedure provided, serum magnesium ions react xylidyl blue in an alkaline solution to produce a red that was measured using spectrophotometery method, the intensity of color produced is directly proportional to magnesium concentration, calcium interference was virtually eliminated by used EGTA and a surfactant system was included to remove protein interference, color formed measured in 550 nm using full automated Cobas C311 analyzer.

Estimation of urea and creatinine:-

Urease catalyzes the conversion of urea into ammonia and CO_2, then ammonia released reacts with a salycilate in presence of anitroprusside and hypochlorite which gives a blue green coloured complex color formed measure in 578 nm. Creatinine reacts with picric acid under alkaline conditions to form a yellow orange complex, color formed measured in 500 nm, using full automated Cobas C311 analyzer for both urea and creatinine.

Statistical analysis:-

Data were expressed as Mean±SD, statistical analysis were carried out using SPSS software version 20.0 (SPSS Inc, USA). Change Pre-HD and Post-HD were compared by paired student's *t*-test. Person's correlation coefficients were employed to evaluate the relationships between study parameters and study variables. A *p*-value <0.05 was considered statistically significant.

Results:-

The frequency analyses of n 80 patients with CRF underwent HD two times a week, showed the CRF is common in males, (n 55) 68.75% than females (n 25) 31.25%.The effect of HD on calcium, magnesium were analyzed using paired *t*-test comparing pre-HD versus post-HD samples, mean level of magnesium, urea and creatinine were significantly lower post-HD in comparison with pre-HD samples with *p*-value (0.000, 0.000 and 0.000) respectively, while significant increase in mean calcium level was observed with *p*-value 0.000. Person's correlation analyses examined the association between the changes in calcium and magnesium level, which obtained by deduced pre-HD

from post-HD samples, there were no correlation of magnesium and calcium with study variables (urea, creatinine, BMI and age), while significant positive correlation of urea and creatinine was observed R =0.427 and *p*-value =0.006.

Results of anthropometric indexes

Variables	Mean±SD	Range
Age/years	50.8±14.6	24 to 77
BMI	22.9±2.82	17.7 to 29.3

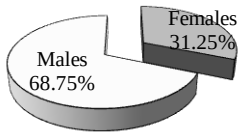

Fig. 1:- Mean concentration and percentage of anthropometric index

Mean concentration of study parameters of post-HD versus pre-HD

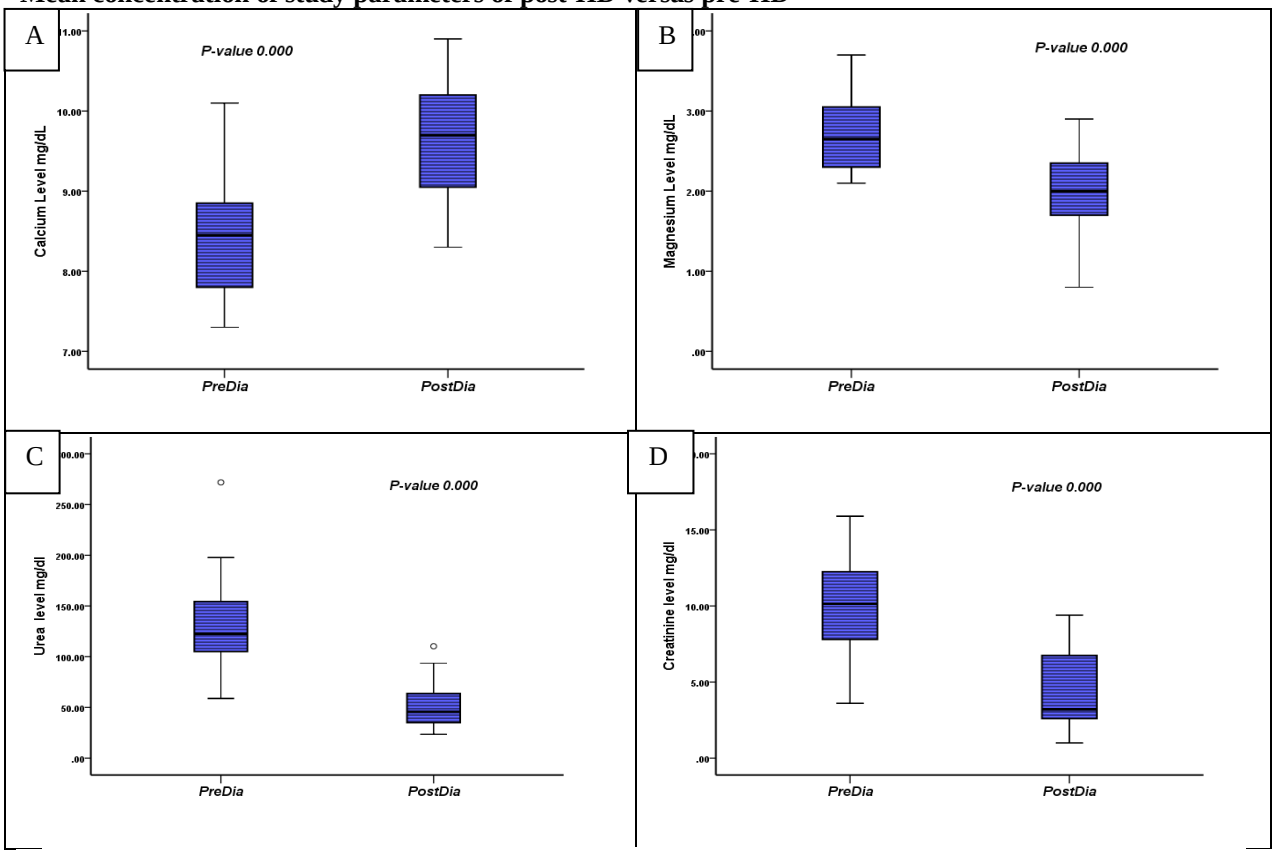

Fig. 2:- By paired t-test result of study parameters (A. Calcium, B. Magnesium, C. Urea and D. Creatinine) were analyzed, result expressed as Mean±SD, significant changes considered as *p*-value ≤0.000.

Association of study parameters:-

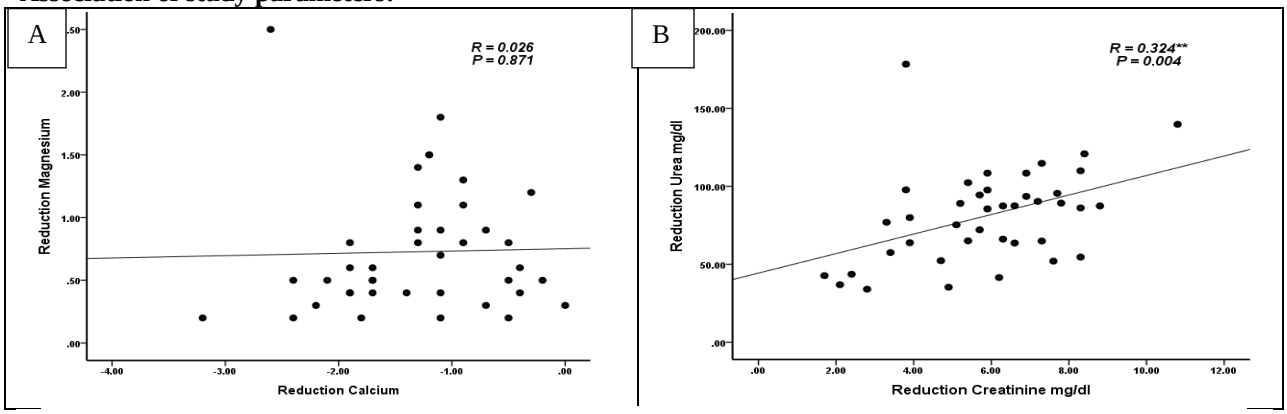

Fig. 4:- Dot plot results presented the associations between (A. Magnesium with Calcium and B. Creatinine with urea) in changed results which obtained by deduced post-HD from pre-HD samples.

Discussion:-

Despite the success of HD in treating CRF patients and reducing their mortality and morbidity rate, HD treatment might lead to increase or decrease of biologically function substances like trace elements and vitamins, therefore patients are at risk of both deficiency and accumulation of these elements (8).To study the impact of HD on calcium and magnesium of among CRF underwent two times a week HD, timed specific pre and post-HD sample were collected. Our main hypothesize HD treatment alter the concentration of calcium and magnesium in CRF patients.

Concurrently with the previous findings that, the increase or decrease of serum calcium level after HD is attributed to the types of dialysate and concentration of calcium in dialysis solution. Standard dialysis solution with 1.5 mmol/l calcium concentrations revealed rise in calcium level after dialysis (17). Standard solution with the same concentration has been used in the present study, which revealed significant increase of calcium level after HD with (p = 0.000). Thus calcium imbalance results in pathogeneses of arrhythmias during dialysis in CRF patients (18).

Several studies have investigated serum ionized and total magnesium in dialysis patients, some studies found reductionsin ionized magnesium, whereas others did not. Thus, the ionize magnesium fraction in dialysis patients seems to be variable, at ~60–70% of total magnesium (19). The present study found, significant lower of magnesium level after HD p= 0.000. Moreover, no relationship between change in calcium and magnesium level was observed (r = 0.026, p= 0.871). Which probably resulting from lack of magnesium in dialysate solution used in this study.

The preventive and treatment effects of hemodialysis in CRF achieved by, during HD urea and creatinine, being small molecules, flow through membranes into the sterile solution and is removed due to the counter-current flow of the blood and dialysate which maximizes the concentration gradient of solutes between the blood and dialysate, which helps to remove more urea and creatinine from the blood (20).The present study revealed significant decreases of creatinine and urea in post-HD with (p = 0.000 and 0.000) respectively. In addition no correlation observed between change in urea, creatinine and calcium, magnesium level, while significant correlation between change in urea and creatinine was reported (r = 0.324, p = 0.004).

Conclusion:-

In conclusion, the results of the present study suggested that, HD increase calcium and decrease magnesium level. Therefore, magnesium deficiency might be due to lack of it in dialysate. Furthermore, magnesium deficiency could lead to pathogenesis related disorders. Thus supplementation treatment protocol is recommended.

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Conflict of interest:-

Authors declare no conflict of interest.

References:-

1. KDOQI. Clinical Practice Guidelines and Clinical Practice Recommendations for Anemia in Chronic Kidney Disease. KDOQI, National Kidney Foundation Am J Kidney Dis, 2006; 47:11-14.
2. Levey AS, Eckardt KU, Tsukamoto Y, Levin A, Coresh J, Rossert J, De Zeeuw D, Hostetter TH, Lameire N, Eknoyan G. Definition and classification of chronic kidney disease: a position statement from Kidney Disease: Improving Global Outcomes (KDIGO). Kidney Int. 2005 Jun; 67(6):2089-2100.
3. El-Nahas AM, Bello AK. Chronic kidney disease: The global challenge. Lancet 2005; 365: 331-340.
4. Levey AS, Atkins R, Coresh J et al. Chronic kidney disease as a global public health problem: Approaches and initiatives - A position statement from Kidney Disease Improving Global Outcomes. Kidney Int, 2007; 72: 247-59.
5. United States Renal Data System. The 2004 USRDS annual data report: precis. Hospital Physician August 2006.
6. Mosby's Dictionary of Medicine, Nursing, & Health Professions. 7th ed. St. Louis, MO. Mosby: 2006.
7. Pendse S, Singh A, Zawada E. Initiation of Dialysis. In: Handbook of Dialysis. New York, NY,4th ed, 2008;14-21.
8. Amar Mohamed Ismail, ShehabElzainBalla. Impact of Hemodialysis on Serum Zinc and Copper Level InCkd Patients. J App Pharm Sci, 2016; 6 (04): 165-168.
9. Wiesen P, Van Overmeire L, Delanaye P, Dubois B, Preiser JC Nutrition disorders during acute renal failure and renal replacement therapy. J Parenter Enteral Nutr, 2011; 35:217-222.
10. Foley RN, Parfrey PS Cardiovascular disease and mortality in ESRD. J Nephrol, 1998;11:239-245.
11. Moe S, Drueke T, Cunningham J, et al. Definition, evaluation, and classification of renal osteodystrophy: a position statement from Kidney Disease: Improving Global Outcomes (KDIGO) Kidney Int.2006;69:1945–1953.
12. Gal-Moscovici A, Sprague SM. Bone health in chronic kidney disease-mineral and bone disease.Adv Chronic Kidney Dis. 2007;14:27-36.
13. Joy MS, Karagiannis PC, Peyerl FW. Outcomes in chronic kidney disease and the direct costs of treatment. J Manag Care Pharm, 2007;13:397–411
14. Altura BM. Basic biochemistry and physiology of magnesium: a brief review. Mag TrEle, 1991;10:167-171.
15. Ryan MF. The role of magnesium in clinical biochemistry: Ann Clin Biochem, 1991; 28:19-26.
16. Wang L, Nancollas GH, Henneman ZJ: Nanosized particles in bone and dissolution insensitivity of bone mineral. Biointerphases, 2006; 1: 106–111.
17. Ciovicescu F, Vesa S C, Radulescu D, Crisan S, Duncea C. Haemodialysis-inducedelectrolyte variation (serum calcium, magnesium and bicarbonate) and intradialytic heart rhythm disorders. HVM Bioflux 2014;6(1):11-14.
18. Tong Y, Hou H. The alteration of QT dispersion in hemodialysis subjects. Kidney Blood Press Res 2006;29(4):231-236.
19. John Cunningham, Mariano Rodrıguez, Piergiorgio Messa. Magnesium in chronic kidney disease Stages 3 and 4 and in dialysis patients. Clin Kidney J 2012; 5: 39–51.
20. Mahomoodally M F, Nugessur H. Pre- and Post-Dialysis Correlations of Serum α-Amylase, Creatinine and Urea in Chronic Renal Failure Patients. Journal of Medical Research and Development (JMRD), 2014; 3(2): 151-160.