

Correlation of Serum Magnesium with Carotid Intima Medial Thickness in CKD Patients on Maintenance Hemodialysis

Pranay Dhurvey¹, Sudha Alawe^{2*}

¹Associate Professor, Department of Medicine, Hamidia Hospital and Gandhi Medical College, Sultania Rd Near Hamidia Hospital, Royal Market, Bhopal, Madhya Pradesh 462001, India

²Assistant Professor, Department of Medicine, Hamidia Hospital and Gandhi Medical College, Sultania Rd Near Hamidia Hospital, Royal Market, Bhopal, Madhya Pradesh 462001, India

DOI: [10.36347/sjams.2019.v07i09.055](https://doi.org/10.36347/sjams.2019.v07i09.055)

| Received: 20.09.2019 | Accepted: 27.09.2019 | Published: 30.09.2019

*Corresponding author: Dr. Sudha Alawe

Abstract

Case Report

Objective: This study was performed to determine the correlation between serum magnesium (Mg) with Carotid Intima Medial Thickness in CKD Patients on Maintenance Hemodialysis. **Material & Method:** This is hospital-based cross-sectional observational study was conducted at the Department of Medicine, Hamidia Hospital and Gandhi Medical College, Bhopal. Fifty patients with end-stage kidney disease on MHD treatment (29 males and 21 females) were studied. After overnight fasting, blood samples were drawn for complete hemogram, blood urea, serum creatinine, lipid profile and serum Mg. Carotid intima media thickness was measured by B mode ultrasound using a 75MHz transducer and was defined as distance between leading edge of first echogenic line (Lumen - Intima Interface) and second echogenic line (Media - Adventitia interface) of far wall. **Results:** Serum magnesium correlated significantly with mean CIMT ($p < 0.001$). Serum magnesium in CKD patients significantly correlated with Age ($P < 0.001$), systolic blood pressure ($P < 0.001$), serum Triglyceride levels ($P = 0.029$), PBS ($p = 0.04$) and Mean CIMT ($p < 0.01$). **Conclusion:** Our study supports the evidence for the possibility that low magnesium levels are associated with vascular calcification. Also suggest that long-term intervention with magnesium in dialysis patients may retard arterial calcification.

Keywords: Serum Magnesium, Hemodialysis, CKD Patients.

Copyright © 2019: This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

INTRODUCTION

Magnesium (Mg) is the fourth most abundant cation in the body, mainly located within bone and skeletal muscle. Approximately 60% of the total serum Mg is present as free Mg ions, the biologically active form. The kidneys play a principal role in Mg balance in the healthy state. Elevated Mg levels, have potentially harmful effects on nerve conduction Velocity, osseous metabolism and parathyroid gland function [1]. Low Mg levels have been associated with impairment of myocardial contractility, Intra-dialytic hemodynamic instability, and hypotension [1]. There is also evidence suggesting a significant role for hypomagnesemia in the pathogenesis of cardiovascular diseases in HD patients [2]. On the other hand, hypermagnesemia may play a protective role against the development and acceleration of arterial atherosclerosis in patients with chronic renal insufficiency [2], and magnesium supplements may play an important protective role against the progression of atherosclerosis

in patients on dialysis [3]. Cardiovascular disease is a main cause of morbidity and mortality in patients with chronic kidney disease (CKD), particularly those on dialysis [4] Atherosclerosis is the most frequent cause of cardiovascular morbidity in patients with CKD [5]. An increased carotid intima-media thickness (CIMT) and the presence of plaques reflect generalized atherosclerosis. Therefore CIMT measurement has been proposed as a method for establishing risk stratification for cardiovascular evenly in both the general and the dialysis population [6]. We aimed to Investigate the relationship between serum magnesium and Carotid intima Medial Thickness values in chronic kidney disease patients on dialysis.

PATIENTS AND METHODS

Fifty patients with diagnosis of chronic kidney disease who are on routine dialysis for more than 3 months Admitted to medicine department of Hamidia Hospital and GMC ,Bhopal.The morning urine sample

and blood samples were collected after 8 hours of overnight fasting for complete hemogram, blood urea levels, serum creatinine levels, serum electrolytes and lipid profile (Total cholesterol, Triglycerides and HDL) and serum magnesium, All the biochemical parameters were measured by standard laboratory technique. Glomerular filtration rate (GFR) was calculated by Cockcroft Gault Equation. Dialysis was performed using DIALOG + DIALYSIS MACHINE with ultra filtration rate from 500 to 800 ml/hr and temperature of dialysate to be maintained at 36.5 °C. the dialysate solution used was as follows; Sodium 7900 mmol/L, Potassium 2.00 mmol/L, Calcium 1.75mmol/L, Magnesium 0.75 mmol/L, Acetate 4.0 mmol/L and Chloride 86.0 mmol/L. Carotid intima media thickness was measured by B mode ultrasound using a 7.5MHz transducer. Intima Media Thickness was defined as distance between leading edge of first echogenic line (Lumen - intima interface) and second echogenic line (Media —Adventitia Interface) of far wall. Three measurements were taken 0.5, 1 and 2 cm below carotid bifurcation of common carotid artery on each side. The arithmetical averages of these were taken. The IMT of both sides (right and left) was calculated and average of these two values was taken and used for statistical analysis. CIMT measurement was always performed by single radiologist in plaque free arterial segments.

STATISTICAL METHODS

For different parameters, mean and standard deviation were calculated. The values of P which are < 0.05 were treated as significant. The qualitative variables (like sex, diabetes) were compared using χ^2 test. The statistical software SPSS Ver.20 was used for

statistical analysis. Univariate correlation analysis was used to confirm the significance of variables with serum magnesium levels.

RESULTS

The study included 50 cases of CKD Patients on dialysis; 29 male and 21 females. The mean age of the studied CKD patients was 45.46 ± 15.60 years (Range 18-76). Maximum patient in the study were in age group of 50 to 60 years. The mean hemoglobin was 8.86 ± 1.71 gm/dl, mean blood urea was 149.9 ± 60.81 and mean creatinine was 6.88 ± 3.24 mg/dl Diabetes Mellitus was the etiology of CKD in 28% patients. The serum magnesium was significantly correlated with diabetes in the study

CKD patients was in Stage 5. i.e. 43 cases. Total serum Cholesterol levels (>200 mg/dl) was found higher than normal in 15 cases and the mean was 174.1 ± 144.62 . The mean Serum Triglyceride levels were 144.54 ± 158.09 mg/dl in CKD patients and it correlated significantly with serum magnesium. The mean HDL-C levels were 39.26 ± 6.40 mg/dl were lower in CKD patients found. in 30 patients among 50 cases. The average of mean Carotid Intima Media Thickness was 0.78 ± 0.23 mm in CKD and was higher in patients in stage 4 of CKD. The Serum magnesium correlated significantly with mean CIMT ($p < 0.001$). Serum magnesium in CKD patients significantly correlated with Age ($P < 0.001$), systolic blood pressure ($P < 0.001$), serum Triglyceride levels ($P = 0.029$), PBS ($P = 0.04$) and Mean CIMT ($P < 0.01$).

Table-1: Genderwise Distribution of Patients [Total-50]

GENDER	TOTAL NO OF PTs	%
MALE	29	58%
FEMALE	21	42%

Table-2: Agewise Distribution of Patients [Total-50]

AGE[yr]	<20	21-30	31-40	41-50	51-60	>60
NO OF PTs	2	10	10	8	12	8

Table-3: Value of S. Magnesium in Patients [Total-50]

TOTAL	HYPOMAGNESAEMIA	NORMAL MAGNESIUM	HYPOMAGNESAEMIA
50	13	13	24

Table-4: Corelation With Respect To Serum Magnesium

Parameters	P	R
Age	0.001 [s]	-0.523
Height	0.551	-0.086
Weight	0.363	-0.131
BMI	0.692	-0.057
Pulse	0:288	-0.153
Systolic blood pressure	0.001 [s]	-0.459
Diastolic blood pressure	0.166	-0.199
Haemoglobin	0.157	-0.203
Fasting blood sugar	0.040 [s]	-0.397
Blood urea	0.366	0.131
Serum creatinine	0.749	-0.046
GFR	0.904	0.018
Number of dialysis	0.394	-0.122
SERUM ALBUMIN	0.908	0.017
HDL	0.245	0.167
Triglycerides	0.029 [s]	-0.310
Total cholesterol	0.079	-0.250
Mean CIMT	0.001 [s]	-0.536

Table-5: CIMT and Age Correlation in CKD Patients

AGE	<20	21-30	31-40	41-50	51-60	>60
MEAN CIMT	0.45	0.515	0.61	0.825	0.99	1.08

Table-6: Mean CIMT and Serum Magnesium Correlation

MAGNESIUM	HYPO	NORMO	HYPER
MEAN CIMT	0.97	0.82	0.66

DISCUSSION

In our study we found that, there was significant negative correlation of serum magnesium with CIMT (p value <0:001) with r value of -0.536. As the level of serum magnesium decreases, the value of CIMT increases significantly. In Feng Liu [7] 98 chronic Ha patients were recruited, they found that the incidence of carotid artery plaque and carotid innate medial thickness (p < 0.05) were higher in patients with low serum magnesium as compared to patients with high magnesium level. In meena *et al.*, [8] 44 end-stage renal patients disease (ESRD receiving peritoneal dialysis Half of the patients (n ½ 22) developed peripheral arterial calcifications (detected in the hands, ankles or feet) The arterial calcification group had significantly lower mean serum magnesium levels (_LSD) than the group without calcifications 11.11 ± 0.21. mmol/L (2.69 ± 0.52 mg/dL) and 1.241±021 mmol/L (3.02 ± 0.51 mg/dl), respectively; P < 0.001]. Ishimura *et al.*, [9] study conducted in 390 patients undergoing maintenance haemodialysis that excluded patients with diabetes, Carotid vessel calcification was detected in 52 patients (13%). Mean serum magnesium levels (_SD) were significantly lower in patients with vascular calcification [1.11± 0.12mmol/L (2.69 ± 0.28 mg/dl)] than in those without [1/14±0.14mmol/L (2.78 ± 0.33 mg/dL); P < 0.05]. Tazanakis *et al.*, [10] in a cross-sectional observational study of chronic. Haemodialysis patients (n ½ 56) in which 23 patients

(41%) had mitral annular calcification, magnesium levels were significantly lower in patients with calcification (P < 0.05). Further statistical analysis showed that patients with serum magnesium levels <1.23 mmol/L (3.0 mg/dL) were twice as likely to develop mitral valve calcification then those with magnesium level >1.23 mmol/L (3.0 mg/dL) (v2 ¼ 6.98; P ¼ 0.008). More recently, Tzanakis *et al.*, [2] in a cross-sectional study reported a negative association of both serum and intracellular magnesium levels with carotid intima thickness in patients undergoing haemodialysis, it compared 93 stable chronic haemodialysis patients with 182 control subjects. Intima media thickness was found to be significantly larger in the haemodialysis patients than the healthy controls (P < 0.001). Thus, for a 0.5 mmol/L (1.0mEq/L) change in serum magnesium concentrations, a 0.35-mm change in carotid intima—media thickness was observed (P ¼ 0.01) In hashimoto *et al.*, [11] Results from an observational study conducted within the general population in Japan (n ¼ 728) point to a similar direction. Lower serum magnesium levels were significantly and independently associated with greater mean intima—media thickness (P ¼ 0.004) and the risk of at least two carotid plaques (P ¼ 0.03) Polak JF *et al.*, [12] According to the Cardiovascular Health Study and NOMAS, normal CIMT ranges vary from 0.7 to 0.9 min in 45- to 75-year olds and the progression of CIMT—depending on risk factors — can range from 0.01 8 0.05 mm/year If low-serum magnesium can

potentially cause a significant increase in CIMT in women In this age range (similar to the pathological progression of CIMT), the risk of stroke incidence Increases as the CIMT rate of change increases , resulting in Increased cardiovascular morbidity and mortality.

CONCLUSION

Our study supports the evidence for the possibility that low magnesium levels are associated with vascular calcification. Several other observational studies suggest a relationship between increase serum magnesium concentration and better survival rates for patients receiving long-term dialysis treatment, also suggest that long-term intervention with magnesium in dialysis patients may retard arterial calcification. However, hard evidence is as yet lacking. In order to conclusively show the correlation of serum magnesium with other atherogenic factors and possible benefits of long-term intake of oral magnesium in patients with CKD, randomized controlled with larger study group should be studied.

REFERENCE

1. Navaira-Gozalez JF, Mora-Fernandez C, Garcia-Perez J. Clinical Implications of disordered magnesium homeostasis in chronic renal failure and dialysis. *Semin Dial.* 2009 Jan-Feb;22(1):37-44
2. Tzanakis I, Virvidakis K, Tsomi A, Mantakas E, Girousis N, Karefyllakis N, Papadaki A, Kallivretakis N, Mountokalakis T. Intra- and extracellular magnesium levels and atheromatosis in haemodialysis patients. *Magnes Res.* 2004 Jun;17(2):102-8
3. Turgut F, Kanbay M, Metin MR, Uz E, Akcay A, Covic A. Magnesium supplementation helps to Improve carotid linings media thickness in patients on hemodialysis. *Int Urol Nephrol.* 2008;40(4):1075-82.
4. Sarnak MJ, Levey AS. Epidemiology, diagnosis, and management of cardiac disease in chronic renal disease. *J Thromb Thrombolysis.* 2000; 10:169-80.
5. Kawagishi T, Nishizawa Y, Konishi T, Kawasaki K, Emoto M, Shoji T, Tabata T, Inoue T, Morii H. High-resolution B-mode ultrasonography in evaluation of atherosclerosis in uremia. *Kidney international.* 1995 Sep 1;48(3):820-826.
6. Lorenz MW, von Kegler S, Steinmetz H, Markus HS, Sitzer M. Carotid intima-media thickening indicates a higher vascular risk across a wide age range: prospective data from the Carotid Atherosclerosis Progression Study (CAPS). *Stroke.* 2006 Jan 1;37(1):87-92.
7. Liu F, Zhang X, Qi H, Wang J, Wang M, Zhang Y, Yan H, Zhuang S. Correlation of serum magnesium with cardiovascular risk factors in maintenance hemodialysis patients—a cross-sectional study. *Magnesium research.* 2013 Jul 1;26(3):100-108.
8. Meema HE, Oreopoulos DG, Rapoport A. Serum magnesium with cardiovascular risk factors in maintenance hemodialysis patients. A cross section study. *Magnes Research,* 2013 July-Sep; 26(3); 100-108
9. Ishimura E, Okuno S, Kitatani K. Significant association between the presence of peripheral vascular calcification and lower serum magnesium in hemodialysis patients. *Clin Nephrol,* 2007;68:222-227.
10. Tzanakis I, Pras A, Kounali D, Mamali V, Kartsonakis V, Mayopoulou-Symvoulidou D, Kallivretakis N. Mitral annular calcifications in haemodialysis patients: a possible protective role of magnesium. *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association-European Renal Association.* 1997 Sep 1;12(9):2036-2037.
11. Hashimoto T, Hara A, Ohkubo T, Kikuya M, Shintani Y, Metoki H, Inoue R, Asayama K, Kanno A, Nakashita M, Terata S. Serum magnesium, ambulatory blood pressure, and carotid artery alteration: the Ohasama study. *American journal of hypertension.* 2010 Dec 1;23(12):1292-1298.
12. Polak JF, Pencina MJ, O'Leary DH, D'Agostino RB. Common carotid artery intima-media thickness progression as a predictor of stroke in multi-ethnic study of atherosclerosis. *Stroke.* 2011 Nov;42(11):3017-3021.