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Original

Serum magnesium in association with parathyroid hormone levels in routine hemodialysis patients

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Abstract

Introduction: The homeostasis of magnesium (Mg) is perturbed in chronic kidney disease. It has been supposed that plasma Mg has a principal role to regulate the secretion of parathyroid hormone (PTH). Plasma Mg is capable of modulating secretion of PTH. Recent investigations showed that low serum Mg levels in patients with kidney disease have been linked to increased mortality.

Objectives: The aim of this study was to determine the relationship between serum Mg and PTH levels in hemodialysis patients.

Patients and Methods: This cross-sectional study was conducted on 56 hemodialysis patients in hemodialysis center of Hajar hospital of Shahrekord in 2015. Regular hemodialysis patients who had at least three months history of dialysis were enrolled to the study. The serum levels of Mg, calcium, phosphorus, intact PTH (iPTH), alkaline phosphatase, albumin and bicarbonate were measured.

Results: In this study, 61.5% of the 52 patients were male. Mean ± standard deviation (SD) of patients' age was 60.5 ± 17.7 years with median of 63 years old. The average duration of dialysis was 44±39.5 months (median 36 months). Additionally the dialysis dose was 517 ± 479 weeks (median; 414 weeks). Mean ± SD of serum iPTH and Mg were 360.1 ± 238.2 pg/mL and 2.2 ± 0.2 mg/mL respectively. In this study we found a significantly positive correlation of iPTH with serum Mg levels ($r = 0.28$, $P = 0.04$).

Conclusion: This study shows impact of Mg on parathormone secretion. Our findings require further investigations with larger and multicentric studies.

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Introduction

One of the most important disorders of chronic renal failure is chronic kidney disease–mineral bone disorder (1). Parathyroid hormone (PTH) is a principal parameter in the pathogenesis of bone disease in dialysis patients. The homeostasis of phosphorus, calcium, and magnesium (Mg) is distorted in chronic renal failure (2,3). Mg is largely excreted by kidney. The homeostasis of Mg is perturbed in chronic kidney disease. In fact, kidney has a fundamental role in the homeostasis Mg. The regulation of Mg metabolism is influenced by filtration and reabsorption (4). Hyperphosphatemia, hypermagnesemia and hypocalcemia are detectable in advanced chronic kidney disease. Disturbances in Mg metabolism in chronic renal failure may partly contribute to the development of chronic kidney disease–mineral bone disorder (5,6). It has been supposed that plasma Mg has a principal role to regulate the secretion of PTH. Plasma Mg is capable of modulating secretion of PTH. Recent investigations revealed low serum Mg levels in patients with kidney disease have been linked to increased mortality. It has been detected that that lower plasma Mg values are related to calcification of cardiac tissue and vessel walls which will increase mortality and morbidity in hemodialysis patients (5-9).

Objectives

The aim of this study was to assess the relationship of serum Mg with PTH in a group of hemodialysis patients.

Patients and Methods

Study population

The present cross-sectional study was conducted in the hemodialysis center of Hajar hospital of Shahrekord in 2015. Regular hemodialysis patients who had three months history of dialysis were included to the study. Exclusion criteria were any active or chronic infection and a history of malignancy. Around 52 eligible patients were included to the study.

Blood samples were collected to assess levels of calcium, Mg, alkaline phosphatase, intact PTH, albumin, and vitamin D using special standard kits. Plasma HCO3 was assessed by arterial blood gas. The serum calcium levels of blood was corrected with regard to the albumin levels.

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Implication for health policy/practice/research/ medical education

In a study on 52 hemodialysis patients, we found a significantly positive correlation of iPTH with serum magnesium levels.

Duration of dialysis and dialysis doses (calculated by sessions of dialysis per week × duration of dialysis; dialysis doses) was assessed too.

The efficiency of hemodialysis was calculated by assessing the urea reduction rate (URR) (10).

Ethical issues

The research followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all patients. This study was approved by Ethical Committee of Shahrekord University of Medical Sciences and extracted from M.D thesis.

Statistical analysis

For statistical analysis, descriptive data are expressed as mean ± SD. We applied Spearman's correlation coefficient for correlations. All statistical analyses were performed using SPSS version 18 (SPSS Inc., Chicago, IL, USA). *P* values less than 0.05 were considered as significant level and the data were reported as mean ± SD.

Results

In this study, 61.5% of 52 patients were male. Mean ± SD of patients' age was 60.5 ±17.7 years with median of 63 years old (minimum age; 13 years old, maximum age; 52 years old). The average duration of dialysis was 44 ± 39.5 months (median 36 months). Additionally the dialysis dose was 517 ± 479 weeks (median; 414 weeks). URR was 0.61 ± 0.16%. Mean±SD of serum iPTH and Mg were 360.1 ± 238.2 pg/mL and 2.2 ± 0.2 mg/mL respectively. The result of laboratory assessments are shown in Table 1. In this study we found a significantly positive correlation of iPTH with serum Mg levels ($r = 0.28$, $P = 0.04$, Figure 1).

Discussion

In this study we found a significant positive correlation of serum PTH with levels of plasma Mg. In a cross-sectional study on 41 hemodialysis patients, Baradaran et al detected an inverse correlation, albeit insignificant, between serum Mg value and levels of iPTH (r = -0.30 $P = 0.079$) (11). Likewise, in the study of Zeraati et al serum Mg levels was 1.00 + 0.14 mg/dL. They also found a weak and inverse relationship between Mg serum level and iPTH, which was not statistically significant. They observed an inverse significant correlation of Mg and PTH levels in patients with serum PTH of above 300 pg/ml. However, in patients with serum PTH levels less than 300 pg/mL, no correlation of serum Mg with PTH was detected (12). To find the association of serum Mg and intact parathormone levels in CKD patients just prior to beginning hemodialysis, Ohya et al conducted a study on 1231 patients in nine Japanese centers who had started hemodialysis for end-stage renal disease. They found serum Mg levels were significantly elevated in patients with low iPTH (13). Consistent with above-mentioned studies, Navarro et al also detected an inverse correlation of serum Mg with PTH levels. The study conducted on 110 hemodialysis individuals with mean age of 55 ± 14 years and the duration of dialysis was 35 ± 28 months (14). To find association of serum PTH and Mg levels in continuous ambulatory peritoneal dialysis subjects using low-Mg peritoneal dialysate, Cho et al detected that parathormone level was not associated with serum Mg level. They found patients whose serum parathormone was less than 300 pg/mL, serum parathyroid levels were inversely associated with serum Mg level (15).

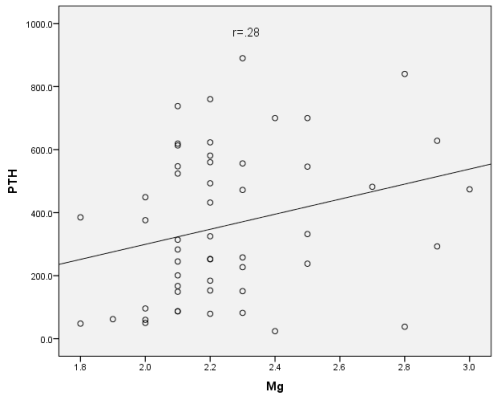

Figure 1. Relationship of serum Mg with levels of parathormone.

Table 1. The result of laboratory assessments in patients undergoing hemodialysis

Variable	Average ± SD
Calcium (mg/dL)	9.1 ± 0.53
Albumin (g/dL)	4.1 ± 0.36
Bicarbonate (mEq/L)	21.1 ± 2.8
ALP (IU/L)	266.2 ± 120.5
Phosphorus (mg/dL)	5.3 ± 1.1
Intact PTH (pg/mL)	360.1 ± 238.2
Mg (mg/dL)	2.2 ± 0.2
Vitamin D (ng/ml)	14.4 ± 5.5

Conclusion

To conclude, hypermagnesemia reduces PTH secretion, which is detected as a risk factor for calcification of vessel walls, hypertrophy of left ventricle and increasing mortality in hemodialysis. While numerous investigations have detected that patients with higher serum Mg tend to have lower PTH levels, some of these studies may have methodological limitations (16).

Limitations of the study

Proportion of hemodialysis patients is relatively small. We suggest larger multicentric investigations on this aspect of hemodialysis individuals.

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Authors' contribution
SM, SAS and MF conducted the researsh. AM conducted the statistical analysis. MF prepared the primary draft. SM revised and prepared the final manuscript. All authors read and signed the final paper.

Conflicts of interest
The authors declared no competing interests.

Ethical considerations
Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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