The association of serum magnesium with serum triglyceride and cholesterol levels in hemodialysis patients

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Abstract

Introduction: Dysregulated lipid profile has been described in patients with chronic renal failure. Objectives: In the present study, we investigated the association of serum magnesium level with serum triglyceride and cholesterol levels in a group of hemodialysis individuals. Patients and Methods: This cross-sectional study was carried out on hemodialysis patients referred to the Hajar hospital of Shahrekord (2015). Patients who have been on hemodialysis for at least three months and had a stable condition for the last two months were recruited. Serum levels of magnesium, cholesterol, and triglyceride were measured, and the data was analyzed. Results: Of 52 patients, 61.5% were males. The mean age of the patients was 60.17 ± 48.70 (range; 13-78) years and the mean dialysis duration was 44.39 ± 05.52 months. Serum magnesium was inversely and insignificantly correlated with serum cholesterol and triglyceride levels. Serum magnesium was significantly associated with serum albumin and parathormone. Conclusion: We found non-significant and inverse correlations of serum magnesium with serum cholesterol and triglyceride levels. The association between serum magnesium and dyslipidemia is contradictory, and further studies are required to divulge the role of other contributing factors.

Implication for health policy/practice/research/medical education:
In an investigation on 52 hemodialysis individuals, we found, non-significant and inverse correlations of serum magnesium with serum cholesterol and triglyceride levels. The association between serum magnesium and dyslipidemia is contradictory, and further studies are required to divulge the role of other contributing factors.

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Introduction
The mortality rate due to cardiovascular diseases is 20 to 40 times higher in dialysis patients than the general population (1,2). Dysregulated lipid profile has been described in patients with chronic renal failure (3,4). Hypertriglyceridemia occurs in 50–75% of patients with chronic renal failure. Although hypercholesterolemia is rare in patients with uremia and those undergoing dialysis, the decreased level of high-density lipoprotein (HDL) cholesterol has been reported in these patients (5,6). Magnesium retention is also a common problem in patients under hemodialysis. Several epidemiologic studies have reported an association between low serum magnesium level and the risk of ischemic heart diseases such as coronary artery disease and arteriosclerosis, as well as mortality in hemodialysis patients (7-9). According to the study by Robles et al, magnesium deficiency has been associated with perturbed lipid metabolism affecting several lipid parameters in both non-uremic and uremic patients (6). A relationship has been suggested between serum magnesium and risk factors of ischemic heart diseases such as lipid parameters, diabetes, and serum albumin, phosphorus, and parathormone in hemodialysis patients (2). Nevertheless, there is few published data on the association of serum magnesium and these parameters in hemodialysis patients in Iran.

Objectives
The aim of this study was to examine the association between serum magnesium level and lipid (i.e. serum triglyceride and cholesterol levels) and other biochemical parameters in Iranian hemodialysis individuals.

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Patients and Methods

Study design
This cross-sectional investigation was carried out on 52 individuals referring to the hemodialysis section of Hajar hospital in Shahrekord (2015). Patients who were under regular dialysis for at least three months and had a stable condition for the last two months were recruited. Patients with severe infections, malignancy and history of parathyroidectomy were excluded. Blood samples were collected from all the patients and transferred to the hospital laboratory. Serum levels of magnesium, cholesterol and triglyceride were measured using photometry method. The duration of dialysis was also recorded for all the patients.

Ethical issues
The research followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all the patients. This study was approved by the Ethics Committee of Shahrekord University of Medical Sciences (Ethical code # IR.SKUMS.REC.1394.192).

Statistical analysis
The results were presented as means ± SD. Descriptive statistics, Pearson's correlation coefficient, and regression analysis were applied to analyze the data. Accordingly, P value <0.05 was considered as the statistical significance level.

Results

Patients' characteristics
Of 52 patients, 61.5% were males. The mean age of the patients was 60.17 ± 48.70 (range; 13-78) years and the mean duration of dialysis was 44.39 ± 05.52 months (Table 1).

Biochemical Parameters
The levels of the biochemical parameters assessed in hemodialysis patients have been shown in Table 2.

Association between serum magnesium level and other biochemical factors
As shown in Table 3, the inverse and insignificant correlations of serum magnesium with serum cholesterol and triglyceride levels were observed. The associations between serum magnesium, cholesterol, triglyceride, and other biochemical factors have been shown in Table 4.

Discussion
Mortality rates due to cardiovascular diseases are 20 to 40 times higher in dialysis patients than the general population (1,2,10-12). In several studies, dysregulated serum lipid parameters including triglyceride and cholesterol, as well as serum magnesium levels have been associated with the pathogenesis of cardiovascular diseases. In the present study, the association of serum magnesium with serum lipid and other biochemical parameters was examined.

Of 52 patients investigated in this study, 61.5% were males. The mean age of the patients was 60.48 ± 17.70 (range; 13-78) years and 64% of their patients were males (6). The results of these studies were similar to those of the present study.

In our study, serum magnesium, triglyceride and cholesterol levels were 2.2 ± 0.2 mg/dL, 98.82 ± 65.70 mg/dL and 130.42 ± 42.55 mg/dL, respectively. These results are in agreement with the findings of previous studies.

Table 1. The spectrum of age and hemodialysis duration in the studied patients

| No. | Minimum | Maximum | Means ± SD |
|-----|---------|---------|------------|
| Age (y) | 52 | 13 | 87 | 60.17±48.70 |
| Dialysis duration (mon) | 52 | 4 | 193 | 44.39±05.52 |

Table 2. Biochemical parameters measured in hemodialysis patients

| No. | Mean ± SD |
|-----|-----------|
| Magnesium (mg/dL) | 52 | 2.2 ± 0.2 |
| Cholesterol (mg/dL) | 52 | 130.42 ± 42.55 |
| Triglyceride (mg/dL) | 52 | 98.82 ± 65.70 |
| Serum calcium (mg/dL) | 52 | 9.1 ± 0.53 |
| Serum albumin (g/dL) | 51 | 4.1 ± 0.36 |
| Bicarbonate (mEq/L) | 52 | 21.1 ± 2.8 |
| Alkaline phosphatase (U/L) | 52 | 266.2 ± 120.5 |
| Serum phosphorus (mg/dL) | 51 | 5.3 ± 1.1 |
| Parathyroid hormone (pg/mL) | 52 | 360.1 ± 238.2 |
| URRa (%) | 52 | 0.61 ± 0.16 |
| Vitamin D (ng/dL) | 51 | 14.4 ± 5.5 |
| Dialysis duration (month) | 52 | 44 ± 39.5 |
| Dialysis doseb | 52 | 517.9 ± 479.4 |

a Urea reduction ratio; b Sessions of dialysis per week × duration of dialysis.

Table 3. The association of serum magnesium with lipid parameters in hemodialysis patients

| Magnesium (mEq/L) | Cholesterol (mg/dL) | Triglyceride (mg/dL) |
|-------------------|---------------------|---------------------|
| 1.00** (-) | -0.13 (0.3) | -0.03 (0.8) |
| Cholesterol (mg/dL) | -0.13 (0.3) | 1.00 (-) | 0.24 (0.08) |
| Triglyceride (mg/dL) | -0.03 (0.8) | 0.24 (0.08) | 1.00 (-) |

**The number in the first row for each factor represents the correlation coefficient (r) and the number in the second row in parenthesis represents P value.
Magnesium and lipids in hemodialysis

Table 4. The association of serum magnesium, cholesterol, and triglyceride with other parameters in hemodialysis patients

|                  | Parathyroid hormone (pg/mL) | Serum calcium (mg/dL) | Serum albumin (g/dL) | Bicarbonate (mEq/L) | Alkaline phosphatase (U/L) | Serum phosphorus (mg/dL) | Vitamin D (ng/dL) | URR (%) | Dialysis duration (month) | Dialysis dose |
|------------------|-----------------------------|-----------------------|----------------------|---------------------|----------------------------|--------------------------|---------------------|---------|--------------------------|---------------|
| Magnesium (mEq/L) | 0.28 (-0.04)*              | 0.04 (0.7)            | 0.50 (<0.001)        | 0.17 (0.22)         | 0.01 (0.9)                 | 0.14 (0.31)              | -0.23 (0.10)       | 0.18    | 0.25 (0.06)              | 0.27          |
| Cholesterol (mg/dL) | -0.12 (0.3)               | -0.16 (0.2)           | 0.04 (0.7)           | 0.02 (0.8)          | -0.06 (0.6)                | -0.07 (0.5)              | -0.02 (0.8)        | 0.004   | -0.22 (0.1)              | -0.20         |
| Triglyceride (mg/dL) | 0.11 (0.4)                | -0.25 (0.9)           | 0.005 (0.3)          | -0.12 (0.3)         | -0.12 (0.7)                | 0.11 (0.4)               | -0.03 (0.7)        | -0.23   | -0.24 (0.08)             |               |

*The number in the first row for each factor represents the correlation coefficient (r) and the number in the second row in parenthesis represents P value.

Overall, the association between serum magnesium and serum cholesterol and triglyceride levels is contradictory, and further studies are required to divulge the role of other contributing factors.

Conclusion
We observed inverse and non-significant correlations between serum magnesium and both serum cholesterol levels positively and significantly correlated with serum phosphorus and albumin (2). In the study of Khatami et al, patients with low serum magnesium level had also significantly lower serum albumin and cholesterol levels in comparison with patients who had higher serum magnesium levels. On the other hand, serum magnesium positively and significantly correlated with serum phosphorus level (2). In comparison, serum magnesium showed positive and significant correlations with albumin and parathormone in the present study.

Nasri et al reported a linear correlation between serum magnesium and triglyceride levels in hemodialysis patients (18). In comparison, we here observed inverse and insignificant correlations between serum magnesium with cholesterol and triglyceride levels. In another study, serum magnesium levels were lower, and serum cholesterol and triglyceride levels were higher in diabetic patients than general population indicating an inverse correlation between serum magnesium and serum cholesterol and triglyceride levels, showing a possible role for hypomagnesemia in the pathogenesis of vascular complications in diabetic patients (19). In the study of Verma et al, the association between serum magnesium and total serum cholesterol was insignificant, however, a statistically significant and inverse correlation was recorded between serum magnesium and triglyceride levels (13). Robles et al also suggested that magnesium may participate in the regulation of lipid metabolism in hemodialysis patients (6). It has also been reported that using magnesium salts as phosphate-binding agents can prevent vascular calcification. Furthermore, it has also been reported that parathyroid hormone secretion was inversely correlated with serum magnesium levels (20). Overall, the association between serum magnesium and serum cholesterol and triglyceride is contradictory, and further studies are required to divulge the role of other contributing factors.

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and triglyceride levels. On the other hand, serum magnesium significantly correlated with serum albumin and parathormone levels.

**Limitations of the study**
Our sample size was relatively low, limiting the power of our study. Therefore, more multicentric studies on larger populations are recommended to validate the repeatability of our results.

**Authors’ contribution**
SM, LHZ and MF conducted the research. AM conducted the statistical analysis. MF prepared the primary draft. SM revised and prepared the final manuscript. All authors read and approved the final paper.

**Conflicts of interest**
The authors declare no conflicts of interest.

**Ethical considerations**
Ethical issues (including plagiarism, misconduct, data fabrication, falsification, double publication or submission, redundancy) have been completely observed by the authors.

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