Short Communication

Serum zinc levels in hemodialysis and peritoneal dialysis patients: A retrospective observational study

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Background: Zinc is vital for cellular functions, but kidney failure increases zinc deficiency risk. We compared zinc levels in hemodialysis (HD) and peritoneal dialysis (PD) patients in Isfahan, Iran. **Materials and Methods:** A retrospective study included 150 patients (75 PD and 75 HD). Serum zinc levels were assessed through photometry. Statistical analysis employed Chi-square, independent *t*-test, and correlation. **Results:** Serum zinc was below normal in both groups ($P < 0.01$). HD patients had lower zinc levels (70.85 ± 7.68 mg/dL) compared to PD (75.04 ± 13.55 mg/dL, $P = 0.021$), remaining significant after adjusting for confounders ($P = 0.011$). **Conclusion:** Zinc levels in PD and HD patients are lower than in the general population, with HD patients having lower levels than PD patients.

Key words: Hemodialysis, peritoneal dialysis, serum zinc

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INTRODUCTION

Zinc, the second-most abundant trace element in the human body, plays a vital role in the structure and function of numerous enzymes.[1] It is involved in DNA repair, immune function, and various physiological processes.[2]

Chronic kidney disease (CKD) is characterized by abnormal kidney structure or function for over 3 months, with significant implications for health.[3] Its progression to end-stage renal disease (ESRD) necessitates kidney replacement therapy (KRT) with hemodialysis (HD) and peritoneal dialysis (PD) being the two primary modalities.[4]

However, KRT is not without its complications, and electrolyte imbalances, including zinc deficiency, are among them.[5]

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ESRD patients are a unique population with specific risk factors and challenges, and it is essential to understand how different aspects of their health, including trace element levels like zinc, are affected by the type of KRT.

MATERIALS AND METHODS

This retrospective observational study was conducted in two Isfahan hospitals from March 21, 2019, to March 21, 2020. The research was approved by the ethics committee of Isfahan University of Medical Sciences. The study included 150 ESRD patients, equally divided into PD and HD groups based on specific inclusion criteria. These criteria required patients to be older than 18 years, all of them used to receive zinc supplements (nephrovit contains 25 mg of zinc), and be free of active infections in the past 6 months.[6] Patients who had undergone kidney transplantation were excluded from the study.

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Demographic data, including sex, the cause of ESRD, age, and time since the initiation of KRT, were collected after obtaining informed consent. Fasting blood samples were drawn from the HD group before their dialysis session and from the PD group in the early morning before breakfast. These samples were analyzed for serum zinc levels using photometry with an Olympus AU640 Chemistry Analyzer.

Zinc deficiency was defined as serum zinc levels lower than 70 mg/dL, in line with the criterion established by Gibson. In addition, various biochemical serum-based variables, including serum albumin, triglycerides, parathyroid hormone (PTH), phosphorus, total cholesterol, calcium, hemoglobin (Hb), and white blood cell count, were measured.

RESULTS

The study comprised 150 participants, with 75 in the PD group and 75 in the HD group. The mean age was comparable in both groups (PD: 59.64 ± 14.08 years, HD: 59.16 ± 15.49 years; $P = 0.843$), as were the proportions of male participants (PD: 57.3%, HD: 49.3%; $P = 0.33$). However, the distribution of ESRD causes significantly differed between the two groups ($P < 0.001$). Notably, the prevalence of diabetes mellitus as the cause of ESRD was higher in the PD group (74.6%) than in the HD group (48%). The mean duration of KRT was 5.40 ± 1.95 years for PD and 7.24 ± 5.09 years for HD, with statistical significance ($P = 0.004$).

In terms of basic clinical and demographic characteristics, no significant differences were observed between the two groups ($P > 0.05$) [Table 1]. A comparison of biochemical serum-based variables revealed that Hb levels were lower in the HD group ($P = 0.006$), while PTH levels ($P = 0.002$), calcium levels ($P = 0.002$), and albumin levels ($P < 0.001$) were significantly higher in the PD group. Some other serum-based variables, such as cholesterol and triglycerides, showed marginal differences between the two groups ($P < 0.1$).

Serum zinc levels were significantly lower in both the PD group ($P = 0.002$) and the HD group ($P < 0.001$) than the lower limit of the normal range for healthy individuals (80–120 mcg/dL). Inadequacy levels were assessed by comparing mean values with cutoff values of 74 mcg/dL for men and 70 mcg/dL for women. Among the PD group, women were the only subgroup with inadequate serum zinc levels compared to the 70 mcg/dL cutoff ($P = 0.025$).

Table 1: Basic demographic and clinical characteristics of patients in two study groups

Variable	PD group	HD group	*P**
Age	59.64±14.08	59.16±15.49	0.843
Sex, *n* (%)			
Male	43 (53.8)	37 (46.3)	0.326
Female	32 (45.7)	38 (54.3)	
Cause of ESRD, *n* (%)			
Diabetes	56 (60.9)	36 (39.1)	0.001
Hypertension	13 (40.6)	19 (59.4)	
Others	6 (23.1)	20 (76.9)	
Marital status, *n* (%)			
Married	48 (63.2)	28 (36.8)	0.687
Single	15 (65.2)	8 (34.8)	
Widowed	5 (50.0)	5 (50.0)	
Employment status, *n* (%)			
Stay at home	27 (47.4)	30 (52.6)	0.062
Office work	1 (12.5)	7 (87.5)	
Retired	17 (53.1)	15 (46.9)	
Other	26 (65.8)	14 (34.2)	
Unemployed	4 (30.8)	9 (69.2)	
Education, *n* (%)			
Illiterate	15 (42.9)	20 (57.1)	0.051
High school dropout	41 (64.1)	23 (35.9)	
High school diploma	14 (46.7)	16 (53.3)	
University	5 (23.8)	16 (76.2)	
BMI (kg/m^2)	26.57±5.84	26.07±5.39	0.628
Time from the start of KRT (years)	4.40±1.95; 4 (3–5)	6.24±5.09; 4 (2–9)	0.004
Kt/V (mL/min)	1.90±0.51	1.86±0.45	0.746

*Obtained from independent samples *t*-test (or Mann–Whitney *U*-test) and Chi-squared. Data are presented as mean±SD for normal and nonnormal continuous variables and along with median (Q1=First quartile; Q3=Third quartile); respectively and frequency (%). PD=Peritoneal dialysis; HD=Hemodialysis; ESRD=End-stage renal disease; BMI=Body mass index; SD=Standard deviation; KRT=Kidney replacement therapy

To address the main study objective, we compared the mean serum zinc levels between the PD and HD groups. Serum zinc levels were 75.04 ± 13.54 in the PD group and 70.85 ± 7.68 in the HD group ($P = 0.022$) [Table 2]. After adjusting for potential confounders, the mean serum zinc level was significantly higher in the PD group than in the HD group ($P = 0.001$) [Figure 1].

DISCUSSION

This study provides valuable insights into the correlation between KRT modality and serum zinc levels in ESRD patients. Zinc deficiency is a common concern in this population, and the results suggest that the type of KRT may play a role in exacerbating this condition. HD patients, in particular, showed a higher prevalence of zinc deficiency and lower overall serum zinc levels compared to PD patients. These findings are consistent with previous research indicating that the HD procedure may lead to greater zinc removal from the body.[7] One explanation of this finding may depend on more removal of zinc through the HD procedure.

The differences observed in PTH levels between the PD and HD groups are noteworthy, as PTH is a critical factor in mineral bone disorder in CKD.[8] Lower PTH levels in the PD group could have implications for bone health.[9]

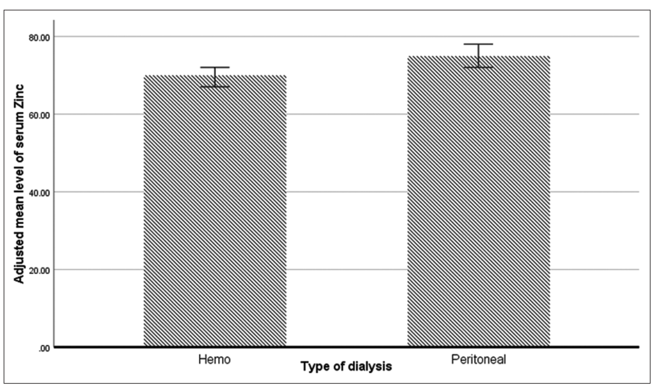

Figure 1: The adjusted mean of zinc level in two study groups ($P = 0.011$)

While other studies have reported variations in lipid and phosphate metabolism between PD and HD patients,[10] our study did not find significant differences in these aspects.

Notably, zinc supplementation could potentially impact nutritional status and the responsiveness to erythropoiesis-stimulating agents,[11] which is especially relevant for HD patients.

Our study was limited by the small sample size and its heterogenicity. The Iranian population is probably zinc deficient compared to other parts of the world.[12] Because we did not have a control group in our study, this rather high abundance of zinc deficiency in the Iranian population could make our study biased. We suggest wider studies done on larger sample sizes and using a healthy population as the control group.

In this study, we have shown serum zinc levels have a significant correlation with the RRT method.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Isfahan University of Medical Sciences (IR. MUI.RESEARCH.REC.1397.195).

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent to publish

Written informed consent was obtained from patients. Written formal consent ensures that the publisher has the author's permission to publish research findings.

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Table 2: Biochemical lipids and nephology serum-based data in two study groups

Variable	PD group	HD group	*P**
Albumin (g/dL)	3.56±0.48	4.05±0.39	<0.001
Triglyceride (mg/dL)	137.36±61.41	121.10±55.06	0.045
PTH (pg/dL)	202.78±163.29; 168 (126–236)	372.66±438.15; 247 (128–456)	0.003
Phosphorus (mg/dL)	4.60±1.00	4.47±1.05	0.245
Zinc (mg/dL)	75.04±13.54	70.85±7.68	0.022
Cholesterol (mg/dL)	159.97±49.00	141.50±38.82	0.053
Corrected calcium (mg/dL)	8.16±0.73	8.58±0.92	0.002
Hb (g/dL)	9.96±1.13	9.23±1.08	0.006
WBCs (*n*/μL)	6.90±0.639	6.60±1.593	0.144

*Obtained from independent samples *t*-test (or Mann–Whitney *U*-test). Data are presented as mean±SD for normal and nonnormal continuous variables and along with median (Q1=First quartile; Q3=Third quartile), respectively, and frequency (%). PD=Peritoneal dialysis; HD=Hemodialysis; SD=Standard deviation; PTH=Parathyroid hormone; Hb=Hemoglobin; WBCs=White blood cells main manuscript but unfortunately, lost her life in the COVID-19 pandemic.

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Conflicts of interest

There are no conflicts of interest.

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