Research Article

Association between vitamin D level and metabolic syndrome in hemodialysis patients

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Abstract

Background: Vitamin D deficiency is common in patients with end-stage renal disease (ESRD) on maintenance hemodialysis. Metabolic syndrome has a high prevalence in hemodialysis patients. **Objectives:** In this study, the association between serum level of ٢٥ (OH) vitamin D and the prevalence of metabolic syndrome and its components in a group of ESRD patients undergoing maintenance hemodialysis was explored. **Subjects and Methods:** This cross-sectional study was carried out in the hemodialysis unit of Minia University Hospital. ٩٠ patients on maintenance hemodialysis were enrolled. **Results:** The prevalence of metabolic syndrome was ٣٥.٦٪. Reduced HDL-c emerged as the most frequent diagnosed abnormality affecting nearly ٦٧.٨٪ of the enrolled sample. The prevalence of vitamin D insufficiency (١٦-٣٠ ng/mL) and mild deficiency (٥ -١٥ ng/mL) in hemodialysis patients enrolled in this study was ٢١.١٪ and ٧٨.٨٪ respectively. Both vitamin D mild deficiency and insufficiency were significantly associated with central obesity (waist circumference ≥٩٠ cm in both sexes or BMI > ٣٠ kg/m٢). Hemodialysis patients who had vitamin D mild deficiency and insufficiency were found to have a significantly lower level of HDL-c. **Conclusion:** This study concluded that there is a lack of association between serum ٢٥(OH) vitamin D concentrations and metabolic syndrome in hemodialysis patients. However, Both vitamin D mild deficiency and insufficiency were found to be significantly associated with central obesity (waist circumference ≥٩٠ cm in both sexes or BMI > ٣٠ kg/m٢) and hemodialysis patients who had vitamin D mild deficiency and insufficiency were found to have a significantly lower level of HDL-c.

Key words: Hemodialysis**,** Metabolic syndrome**,** Vitamin D deficiency**,** Vitamin D insufficiency

Introduction:

The metabolic syndrome was defined by the International Diabetes Federation (IDF) criteria. Patients were diagnosed with metabolic syndrome in the presence of central obesity (waist circumference ≥٩٠ cm in both sexes or BMI > ٣٠ kg/m٢) plus at least two of the following four criteria: (١) raised triglycerides (≥١٥٠ mg/dL) or treatment for this lipid abnormality; (٢) reduced HDL-c (<٤٠ mg/dL in men and <٥٠ mg/dL in women) or treatment for this lipid abnormality; (٣) raised blood pressure (systolic blood pressure ≥١٣٠ mmHg or diastolic blood pressure ≥٨٥ mmHg) or treatment of previously diagnosed hypertension; and (٤) raised FPG (FPG ≥ ١٠٠ mg/dL) or previously diagnosed type ٢ diabetes. [Alberti K. G. M. M., et al. ٢٠٠٦]

Vitamin D deficiency plays a key role in the pathophysiology of risk factors of metabolic syndrome which affect cardio-vascular system, increase insulin resistance and stimulate rennin-angiotensin-aldosterone system that cause hypertension. [Prasad P. and Kochhar A., ٢٠١٦].

Metabolic syndrome has a high prevalence in hemodialysis patients and is a risk factor for cardiovascular disease, the leading cause of mortality in chronic kidney disease. [Kubrusly M., et al., ٢٠١٥]. Vitamin D deficiency and insufficiency are common in patients with end-stage renal disease (ESRD) on maintenance hemodialysis. Vitamin D deficiency is associated with increased morbidity and decreased survival in patients with ESRD. [Krassilnikova M., et al. ٢٠١٤]

As per National Kidney Foundation Kidney Disease Outcomes Quality Initiative guidelines, the following categories for vitamin D status were defined: severe vitamin D deficiency, ٢٥(OH) vitamin D < ٥ ng/mL; mild vitamin D deficiency, ٢٥(OH) vitamin D between ٥ ng/mL and ١٥ ng/mL; vitamin D insufficiency ٢٥(OH) vitamin D between ١٦ ng/mL and ٣٠ ng/mL, and vitamin D sufficiency, ٢٥(OH) vitamin D > ٣٠ ng/mL. [Eknoyan G., et al. ٢٠٠٣]

This study aimed to identify the relationship between serum concentrations of vitamin D and metabolic syndrome in hemodialysis patients.

Subjects and Methods

Patients: This cross-sectional study was conducted from July ٢٠١٦ to July ٢٠١٧ in the hemodialysis unit of Minia University Hospital. ٩٠ patients on hemodialysis were included in this study. Prior to enrollment, informed consent was obtained from all enrolled patients.

Assessment: All the study subjects were submitted to:
- Thorough clinical history.
- Measurement of weight, height and waist circumference. Body mass index (BMI) was calculated by the Quetelet formula as weight in kilograms divided by height in meter squared.
- Using an appropriately sized adult cuff attached to a standard sphygmomanometer, three blood pressure readings were obtained before, during and after dialysis. The readings were then averaged.

Laboratory evaluation: Routine chemistry tests (lipid profile [total cholesterol, HDL-c, LDL-c, and serum triglycerides], FPG, albumin, calcium and phosphorus) were assayed using fully automated clinical chemistry auto-analyzer system Konelab ٢٠١١ (Thermo electron incorporation, Finland). Serum concentrations of para-thyroid hormone (PTH) and ٢٥(OH)-vitamin D were determined by the enzyme immunosorbent assay (EIA) method using commercial kits.

Results

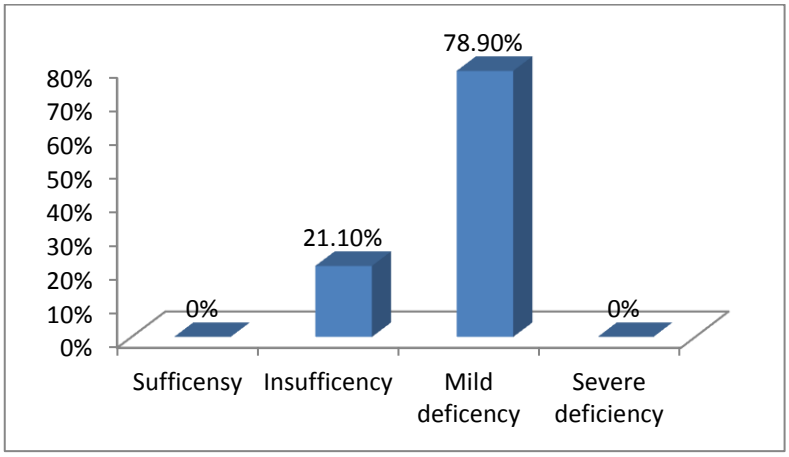
The prevalence of metabolic syndrome and its components among the hemodialysis patients enrolled in this study are presented in **table** ١. The overall prevalence of metabolic syndrome was ٣٥.٦٪. The most common diagnosed abnormality was reduced HDL-c (٦٧.٨٪).

Table (١) Prevalence of metabolic syndrome and its components:

Metabolic syndrome and its components	N (%)
Central obesity	٥٤ (٦٠٪)
Raised triglycerides	٣٠ (٣٣.٣٪)
Reduced high-density lipoprotein cholesterol	٦١ (٦٧.٨٪)
Raised blood pressure	٤٧ (٥٢.٢٪)
Raised fasting plasma glucose	٧ (٧.٨٪)
Metabolic syndrome	٣٢ (٣٥.٦٪)

As illustrated in **Figure** ١, the prevalence rates for vitamin D insufficiency and mild deficiency were ٢١.١٪ and ٧٨.٨٪ respectively.

Figure (١): The prevalence of vitamin D sufficiency, insufficiency and deficiency:



A comparison between demographic, clinical, and laboratory variables across the categories of vitamin D status among the hemodialysis patients enrolled in this study is shown in **table ٢**. When moving from the category of vitamin D mild deficiency to vitamin insufficiency, HDL-c linearly increased (P value for trend <٠.٠٥ by t-test. A linear decreasing trend in total cholesterol was identifiable, but not reaching statistical significance (P value = ٠.٠٧). Additionally age, triglycerides, LDL-c linearly decreased but not reaching statistical significance (P value = ٠.١ in all tests). For other variables examined; namely waist circumference, BMI, FPG, systolic, and diastolic blood pressure, no linear increasing or decreasing patterns across categories of vitamin D were identified.

Table (٢) A comparison between demographic, clinical, and laboratory variables across the categories of vitamin D status:

Variables	Vitamin D status		P value
	Insufficiency (n= ١٩)	Mild deficiency (n= ٧١)	
	Mean ± SD	Mean ± SD	
Age	٤٢.٥±١٥.٣	٤٨.٥±١٣.٦	٠.١
Waist circumference (cm)	٩٣.١±١١.٩	٩٣.٦±١٥.٥	٠.٨
BMI (kg\m^{٢})	٢٥.٩±٤.٩	٢٦.٢±٦	٠.٨
Cholesterol	١٦٨±٣٤	١٨٧±٤٢.٦	٠.٠٧
Triglycerides	١٢٤.٣±٤١.٣	١٤٦.٤±٦٢.٥	٠.١
HDL	٤٢.٣±٦.١	٣٨.٩±٦.٤	٠.٠٤*
LDL	١٠١±٣٤.٤	١١٨.١±٤٢.٣	٠.١
FBS	٨٥.٦±٢٧.٣	٧٩.٢±٢١.٨	٠.٢
SBP	١٣٤.٧±٢٥.٤	١٢٨.٧±٢٢.١	٠.٣
DBP	٨٣.١±١٤.١	٨٠.٢±١١	٠.٣

The association of vitamin D status with components of the metabolic syndrome among the hemodialysis patients enrolled in this study is explored using logistic regression as shown in **table ٣**. Both vitamin D deficiency and insufficiency were significantly associated with central obesity.

Table (٣): The association of vitamin D status with components of the metabolic syndrome:

	Vitamin D status			
	Insufficiency		Deficiency	
	OR (٩٥٪ CI)	P value	OR (٩٥٪ CI)	P value
	Adjusted for age and sex			
Central obesity	٠.١(٠.٠١-٠.٨)	٠.٠٢*	٨.١(١.٢-٥٤)	٠.٠٢*
Raised TG	٠.٥(٠.١-٢.٧)	٠.٤	١.٨(٠.٣-٩.٢)	٠.٤
Reduced HDL-c	٥.١(٠.٣-٦٨.٣)	٠.٢	٠.١(٠.٠١-٢.٥)	٠.٢
Raised BP	٠.٢(٠.٠٥-١.٢)	٠.٠٨	٤.٠١(٠.٨-١٩.٥)	٠.٠٨
Raised FPG	٠.١(٠.٠١-١.٠٤)	٠.٠٥	٨.٩(٠.٩-٨٣.٩)	٠.٠٥

Discussion

Our study showed that prevalence of metabolic syndrome was ٣٥.٦٪. Similar results were reported by Alswat K. A., et al., ٢٠١٧. In his study, the prevalence of metabolic syndrome in hemodialysis patients was ٣٨.٢ %.

In our study, the prevalence of vitamin D insufficiency and mild deficiency in hemodialysis patients was ٢١.١٪ and ٧٨.٨٪ respectively. These results were close to that reported by Marinelli A., et al., ٢٠١٣ who reported that prevalence of vitamin D insufficiency and deficiency was ٢٣٪ and ٧٣٪ of the patients on chronic hemodialysis respectively.

In our study, it was found that hemodialysis patients who had vitamin D mild deficiency and insufficiency were found to have a significantly lower level of HDL-c. Kim S., et al. ٢٠١٢ found that Serum ٢٥(OH) vitamin D concentration was inversely associated with the risk of having reduced HDL-C among Korean population. Yasein N., et al., ٢٠١٥ reported that vitamin D deficiency and insufficiency were significantly associated with higher level of serum triglycerides and serum LDL among osteoporotic postmenopausal Jordanian female patients.

In our study, both vitamin D mild deficiency and insufficiency in hemodialysis patients were significantly associated with central obesity (waist circumference ≥٩٠ cm in both sexes and BMI > ٣٠ kg/m٢). Shafinaz I. S., and Moy F. M., ٢٠١٦ found a that higher Body Mass Index and larger waist circumference were significantly associated with lower serum ٢٥(OH) vitamin D level among multi-ethnic adults in Kuala Lumpur, Malaysia.

In our study, we found a lack of association between serum ٢٥(OH) vitamin D concentrations and metabolic syndrome in hemodialysis patients. Bonakdaran S., et al., ٢٠١٦ found no significant difference in serum ٢٥(OH) vitamin D concentrations between individuals with or without metabolic syndrome in the Iranian population. In contrast to our results, Ahmadi, F., et al., ٢٠١٦ reported that both vitamin D insufficiency and deficiency were significantly associated with metabolic syndrome in Iranian patients on maintenance hemodialysis.

Our study has certain limitations. Firstly, it is a cross-sectional study and direct associations between the variables of interest could not be determined. Additionally, the lack of association between vitamin D status and metabolic syndrome can be attributed to the relatively small number of patients undergoing hemodialysis who were included. Furthermore, we could not consider factors such as amounts of sunlight exposure, calcium intake, and vitamin D intake – which could have affected the serum levels of ٢٥(OH)D – because of the limited data. Finally, measurements were performed only once for each participant, and serial measurements over a year would be required for more accurate studies.

Conclusion

This study concluded that there is a lack of association between serum ٢٥(OH) vitamin

D concentrations and metabolic syndrome in hemodialysis patients. However, Both vitamin D mild deficiency and insufficiency were found to be significantly associated with central obesity (waist circumference ≥٩٠ cm in both sexes or BMI > ٣٠ kg/m٢) and hemodialysis patients who had vitamin D mild deficiency and insufficiency were found to have a significantly lower level of HDL-c.

Recommendations

Inclusion of more hemodialysis patients is recommended for more information about the relationship between vitamin D level and metabolic syndrome in hemodialysis patients. Serial measurements of ٢٥(OH) vitamin D over a year would be required for more accurate studies.

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