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Kidney stones incidence and related factors in hemodialysis patients: a multi-center study of Iran southeast population

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Abstract

Introduction: In previous studies, kidney stones was reported as a common complication in general populations.

Objectives: This study aimed to evaluate kidney stone incidence and related factors in hemodialysis patients.

Patients and Methods: This descriptive-analytical study was conducted on 284 hemodialysis patients in the Zahedan. Demographic and clinical data were collected. The incidence rate of kidney stone was calculated. The correlation between kidney stone incidence with predicting factors was explored by multivariate logistic regression.

Results: Results demonstrated that most patients were male, with a mean age of 48.81 ± 16.84 years. The correlation between kidney stone incidence with gender, race, smoking, and blood group was not significant ($P>0.05$); however, its correlation with diabetes mellitus, urinary tract infection, age, and body mass index (BMI) was significant ($P<0.05$). The kidney stone incidence rate was 23.24%, while diabetes mellitus, urinary tract infection, older age, and higher BMI were the most common predictors.

Conclusion: Diabetes mellitus, urinary tract infection, older age, and higher BMI were the common predictors for kidney stone incidence in hemodialysis patients. Identifying kidney stone incidence predictors in patients with hemodialysis can be helping in lower complications.

Keywords: Kidney calculi, Renal dialysis, Hemodialysis, Body mass index, Diabetes mellitus, Urinary tract infection

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Introduction

Kidney calculi is a disease with high incidence in all populations (1, 2). This condition is the concretions of minerals in the kidney calyces and pelvis (3). Its prevalence is about 14.8% and the recurrence rate approximately 50% at initial five years of stone formation (4). Kidney stones include crystalline and organic ingredients, which formed due to the supersaturated urine of minerals (3).

Chronic kidney disease (CKD) is one of the most common diseases worldwide, with a growth of 5% to 6% annually (5). This disease is a worldwide health problem, and its prevalence in the United stated was reported from 12.3% in 1988-1994 to 14.0% in 2005-2010 (6). Hemodialysis is a common form of CKD disease with many complications (7), and its prevention is a major challenge (8). One of these complications is kidney stones, while previous studies demonstrated that, dietary and lifestyle parameters have key role in stone disease risks (1,9,10). Other studies have reported overweight (11), increasing blood pressure (10,12), diabetes mellitus (12,13), and metabolic syndrome (14) as the most common risk factors for kidney calculi in the general population.

Objectives

Due to the lack of previous studies, this study aimed to evaluate the kidney stone incidence rate and related factors in hemodialysis patients in a multi-center study in southeast Iran.

Patients and Methods

Study design and participants

This descriptive-analytical and multi-center study was conducted on 284 hemodialysis patients referred to Zahedan University of Medical Sciences from August

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Implication for health policy/practice/research/ medical education

A multi-center study on 284 hemodialysis patients demonstrated that the incidence rate of kidney stones in hemodialysis patients was 23.24%. Meanwhile diabetes mellitus, urinary tract infection, older age, and higher BMI were the most common predictors.

2020 to April 2023. Inclusion criteria included all hemodialysis patients referred to a teaching hospital in Zahedan province. Exclusion criteria included patients with incomplete information in the clinical documents.

Data collection

Demographic data were collected by the demographic characteristics questionnaire, including age, gender, blood group, race, and body mass index (BMI). Additionally, a clinical checklist, including underlying diseases such as diabetes mellitus, urinary tract infection (UTI), hypertension, history of alcohol addiction, smoking, kidney stone were conducted to collect the clinical data. The kidney stone incidence rate was calculated. The correlation between kidney stone incidence with predicting factors was explored.

Statistical analysis

For data analysis, the statistical package for social sciences (SPSS) version 26 was conducted. Quantitative data were reported as mean ± standard deviation (SD) and qualitative data as frequency (percentage). The Kolmogorov–Smirnov test was used for data distribution normality. Analytical tests such as chi-square, Fisher's exact test, independent samples *t* test, and multivariate logistic regression were conducted to evaluate the correlation between kidney stone with demographic characteristics and clinical findings. A P value < 0.05 was considered a significant value.

Results

Results demonstrated that most patients were male, with a mean age of 48.81 ± 16.84 years. The kidney stone incidence rate was 23.24%. Approximately one-third had UTI, and less than 40% had diabetes mellitus (Table 1).

Results showed that the correlation between kidney stone incidence with gender, race, alcohol addiction, smoking, and blood group was not significant ($P > 0.05$); while its correlation with diabetes mellitus, UTI, age, and BMI were significant ($P < 0.05$; Table 2).

When we adjusted variables for confounders, multivariate logistic regression showed diabetes mellitus, UTI, older age, and higher BMI were the most common predictors for kidney stone incidence in patients with hemodialysis (Table 3).

Table 1. Demographic characteristics and clinical findings of hemodialysis patients

Variables	N	%
Gender		
Male	151	53.2
Female	133	46.8
Race		
Fars	63	22.2
Balouch	221	77.8
Past medical history		
Diabetes mellitus		
Yes	109	38.4
No	175	61.6
Alcohol addiction		
Yes	4	1.4
No	280	98.6
Smoking		
Yes	55	19.4
No	229	80.6
Urinary tract infection		
Yes	82	28.9
No	202	71.1
Kidney Stone		
Yes	66	23.2
No	218	76.8
Blood group		
A	80	28.2
B	64	22.5
AB	23	8.1
O	117	41.2
	Mean ± SD	**Minimum -Maximum**
Age (y)	48.81± 16.84	9-92
BMI (kg/m^2)	24.39±5.49	17.71-39.49

BMI, body mass index; SD, standard deviation.

Discussion

Our study results showed that there was no correlation between kidney stone incidence with gender, race, alcohol addiction, smoking, and blood group was no significant while a correlation between kidney stone incidence with diabetes mellitus, UTI, age, and BMI was observed. The kidney stone incidence rate was 23.24%, and diabetes mellitus, UTI, older age, and higher BMI were the most common predictors. Other studies investigated the relationship between various factors and kidney calculi incidence in patients, which reported different results. Taylor et al in a study of over 200 thousand population, found that diabetes mellitus is an independent risk factor for kidney calculi and stated that this condition may be due to insulin resistance mechanism in diabetic patients (13). Daudon and colleagues found that diabetes mellitus is associated with kidney stone due to insulin resistance (15). Diabetes mellitus can increase the risk of kidney calculi

Table 2. The correlation between demographic characteristics and clinical findings with kidney stone incidence

Variables	Sub-variable	Kidney Stone Incidence		*P* value
		No	Yes	
		No. (%)	No. (%)	
Gender	Female (n = 133)	102 (76.7)	31 (23.3)	0.979[a]
	Male (n = 151)	116 (76.8)	35 (23.2)	
Race	Fars (n = 63)	51 (81)	12 (19)	0.372[a]
	Balouch (n = 221)	167 (75.6)	54 (24.4)	
Past medical history				
Diabetes mellitus	Yes (n = 109)	73 (67)	36 (33)	0.002[a]
	No (n = 175)	145 (82.9)	30 (17.1)	
Alcohol addiction	Yes (n = 4)	4 (100)	0 (0)	0.576[b]
	No (n = 280)	214 (76.8)	66 (23.2)	
Smoking	Yes (n = 55)	41 (74.5)	14 (25.5)	0.665[a]
	No (n = 229)	177 (77.3)	52 (22.7)	
Urinary tract infection	Yes (n = 82)	54 (65.9)	28 (34.1)	0.006[a]
	No (n = 202)	164 (81.2)	38 (18.8)	
Blood group	A (n = 80)	64 (80)	16 (20)	0.321[a]
	B (n = 64)	50 (78.1)	14 (21.9)	
	AB (n = 23)	20 (87)	3 (13)	
	O (n = 117)	84 (71.8)	33 (28.2)	
		Mean ± SD	Mean ± SD	
Age (y)		46.95 ± 17.37	54.92 ± 13.35	0.001[c]
BMI (kg/m^2)		23.65 ± 5.6	26.8 ± 4.31	< 0.001[c]

BMI, body mass index; SD, standard deviation.
[a] Chi-square; [b] Fisher's exact test; [c] Independent samples T-test

Table 3. Factors predicting kidney stones incidence in hemodialysis patients using multivariate logistic regression

Kidney stone incidence	OR	*P* value	95% CI	
			Lower	Upper
Diabetes mellitus	1.80	0.043	1.068	3.353
Urinary tract infection	2.68	0.002	1.445	4.970
Age	1.02	0.034	1.002	1.043
BMI	1.06	0.036	1.004	1.127

BMI, body mass index; OR, odds ratio; CI, confidence interval.

incidence by alternating urine composition. Additionally, insulin resistance is a manifest feature of type 2 diabetes in ammonium production, which can cause kidney stones (16, 17). This mechanism is due to the increase of plasma-free fatty acids, which may enter proximal tubular cells and interfere with the use of glutamine in ammonium production (13).

Shavit et al stated that high BMI and overweight are risk factors for kidney stones by changing the urinary metabolic (18). Taylor et al in a study that evaluated the correlation between obesity and kidney stone, found that being overweight can be an independent risk factor for kidney calculi (11). Lieske and colleagues assessed the correlation between kidney and urinary tract calculus and related factors and reported that obesity and overweight are associated with higher kidney stones (12). Obese patients also are at risk of insulin resistance, and this mechanism can be a cause of stone formation (19). Furthermore, high BMI and overweight were approved to be associated with glomerular filtration rate and renal dysfunction, which causes kidney stone incidence (20).

The two other obtained risks factors for kidney stones in this study were older age and UTI; Wagner et al in a study, assessed the etiopathogenic factors related to kidney stones and reported that older people are at higher risk of kidney and urinary tract calculus (21). The correlation between kidney stone and UTI were approved in a study by Bauza and colleagues (22). Kidney calculus is also associated with an increased risk of CKD, suggesting that nephrolithiasis is a systemic disease. However, the reason for this correlation is still unclear (23). UTI with the accumulation and deposition of infectious waste materials in the urinary tracts and increasing the risk of stone deposition in the ducts increases the risk of stone formation in the kidney and urinary tracts. According to the high prevalence of UTI in the elderly people, with increasing age, the risk of UTI and as a result, the stone formation will increase.

Conclusion

Results showed that the kidney stone incidence rate in hemodialysis patients was 23.24%; and diabetes mellitus,

UTI, older age, and higher BMI were the most common predictors of kidney stone incidence. We conclude that identifying kidney stone incidence predictors in hemodialysis patients can be helping in lower complications.

Authors' contribution

Conceptualization: HM and FK.
Methodology: SS.
Validation: HS.
Formal Analysis: SS and MKh.
Research: RS.
Resources: NM .
Data Curation: SS and MA.
Writing–original draft preparation: SS, NM, RZ, and RS.
Writing–reviewing and editing: MKh, HS, FK, HM and MA.
Visualization: FK and MKh.
Supervision: SS.
Project Management: MA.

Conflicts of interest

The authors declare that there is no conflict of interest.

Ethical issues

The research followed the tenets of the Declaration of Helsinki. This study was approved by the Ethics Committee of Zahedan University of Medical Sciences (Ethical code #IR.ZAUMS.REC.1399.193). Accordingly, written informed consent was taken from all participants before any intervention. Besides, the authors have ultimately observed ethical issues (including plagiarism, data fabrication, and double publication).

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