Clinical and paraclinical characteristics of patients undergoing hemodialysis

Sanaz Jamshidi¹ [ID], **Sepideh Hajian²*** [ID], **Nafiseh Rastgoo¹** [ID]

¹Qazvin University of Medical Sciences, Qazvin, Iran
²Department of Nephrology, Velayat Hospital, Qazvin University of Medical Sciences, Qazvin, Iran

Correspondence to:
Sepideh Hajian,
Email: s.hajian@qums.ac.ir

Abstract

Introduction: End-stage renal disease (ESRD) is an irreversible decrease in kidney function with severe consequences.

Objectives: The aim of this study was to investigate clinical and paraclinical characteristics of hemodialysis patients.

Patients and Methods: This study was a descriptive-analytical performed on 105 patients undergoing hemodialysis referred to Bou Ali and Velayat hospitals in Qazvin. The data were included age, gender, duration of dialysis, kind of vascular access, kind of catheter, site of catheters, weight, height, systolic and diastolic blood pressure, kind of flux, use of midodrine, kind of dialysis solution, number of dialysis per week, calcium (Ca), iron, total iron binding capacity (TIBC), ferritin, parathyroid hormone (PTH), Kt/V, blood urea nitrogen (BUN) and creatinine (Cr). The data were analyzed using SPSS version 21.

Results: The mean age of the patients was 60.97±15.13 years and 44.8% of the patients were females. The mean number of dialysis per week was 2.84 times with a mean duration of 3.90 years. The mean Cr level was 8.89±3.14 mg/dL. Males had higher level of BUN (55.91±16.06 mg/dL versus 65.24±17.53 mg/dL, $P=0.006$) and Cr (8.09±2.43 mg/dL versus 9.59±3.47 mg/dL, $P=0.010$). Arteriovenous fistula/AVF was the most common vascular access (76.2% of cases). With increasing BUN, number of dialysis per week and weight, the level of Cr increases significantly ($P<0.05$). In the younger patients, Cr showed low level compared to the older patients.

Conclusion: The number of dialysis per week, weight and BUN level is factors to predict the level of Cr and with increasing these factors, the level of Cr increases. The mean Cr level was high which showed inadequacy of hemodialysis in these patients. The level of Cr and BUN is higher in men.

Introduction

End-stage renal disease (ESRD) is a severe form of chronic kidney disease (CKD) and an irreversible decrease in kidney function that results in death without dialysis or kidney transplantation (1). In Europe, the annual incidence of ESRD is 171 people per million (2) and in the United States, 336 people per million (3). The incidence of ESRD in the United Kingdom is 100 people per million annually (4). It is estimated that there are currently 1.9 million people with ESRD in the world of which most of them undergo hemodialysis (5). According to statistics, the incidence of ESRD in Iran increased in recent years (6, 7).

Diabetes and hypertension are among the risk factors associated with the occurrence of the ESRD (8). Renal replacement therapy is a general term for different methods used in the treatment of renal failure and includes hemodialysis, peritoneal dialysis and kidney allograft transplantation (9). In Iran and

Key point

Factors like the number of dialysis per week, weight and blood urea nitrogen level can predict the level of creatinine.

many countries, hemodialysis is the most common treatment for the ESRD (10). If ESRD is not treated, it will have significant consequences including hyperkalemia, hypernatremia, increased susceptibility to infection, hypertriglyceridemia, sleep disorder, headache, seizures, muscle cramps, arrhythmia, and nausea and vomiting and itching (11). Long-term complications of dialysis include restless leg syndrome, pruritus, dementia, peritonitis, obesity and electrolyte disorder such as hyperkalemia, hypernatremia, hypernatremia and hypercalcemia (11).

Objectives

According to the results of some studies,

dialysis complications are associated with education, age, gender, diabetes and type of dialysis (12,13). The high proportion of patients with renal failure who need dialysis indicates the importance of conducting several studies on the subject. The aim of this study was to investigate clinical and paraclinical characteristics of hemodialysis patients.

Patients and Methods
Study design
This descriptive study was conducted on hemodialysis patients admitted to Bou Ali and Velayat hospitals in Qazvin, Iran in 2019. Using convenience sampling method, a total of 105 patients undergoing hemodialysis were enrolled in the study. Initially, the research team recorded the data of patients including age, gender, duration of dialysis, kind of vascular access, kind of catheter, site of catheters, weight, height, systolic and diastolic blood pressure, kind of flux, use of midodrine, kind of dialysis solution, number of dialysis per week, calcium (Ca), iron, total iron binding capacity (TIBC), ferritin, parathyroid hormone (PTH), Kt/V, blood urea nitrogen (BUN) and creatinine (Cr).

Ethical issues
The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Qazvin University of Medical Sciences approved this study (IR.QUMS. REC.1397.128). The institutional ethical committee at Qazvin University of Medical Sciences approved all study protocols. Accordingly, written informed consent was taken from all participants. This study was extracted from research project at this university (Grant# 14003170).

Statistical analysis
SPSS 21 software was used for data analysis. Qualitative variables were described using frequency and percentage and quantitative variables were presented using means and standard deviation. Linear regression and independent t test were used for data analysis. P value less than 0.05 was considered significant.

Results
In this study, the mean age of the patients was 60.97 ± 15.13 years and 44.8% of the patients (n = 47) were females and 55.2% (n = 58) were males. The mean number of dialysis per week was 2.84 times with a mean duration of 3.90 years (Table 1).

The mean Cr level was 8.89 ± 3.14 mg/dL, which showed inadequacy of hemodialysis in these patients. The mean systolic and diastolic blood pressures were 122.43 ± 30.224 mm Hg and 74.13 ± 17.851 mm Hg, respectively. The mean calcium and TIBC were 12.5 ± 8.52 mg/dL and 312.02 ± 153.79 µg/dL, respectively (Table 2).

Regarding paraclinical characteristic across female and male patients, the results showed that males had higher level of BUN (55.91 ± 16.06 mg/dL versus 65.24 ± 17.53 mg/dL, $P = 0.006$) and Cr (8.09 ± 2.43 mg/dL versus 9.59 ± 3.47 mg/dL, $P = 0.010$) (Table 3).

The results revealed that AVF was the most common vascular access (76.2% of cases). Subclavian and jugular site of the catheter had the same percentage in these patients. Regarding kind of flux, there were 68 patients (64.8%) with high flux in this study. Just five patients were taking midodrine and 94.3% of the patients used hco3 as solution (Table 4).

Table 1. Clinical characteristics of the patients undergoing hemodialysis

Variable	Minimum	Maximum	Mean	Standard Deviation
Age (year)	24	92	60.97	15.13
Duration of dialysis (year)	1	19	3.90	3.15
Weight (kg)	40	135	67.15	13.88
Height (cm)	150	188	164.52	7.76
Number of dialysis per week	1	4	2.84	0.483

Table 2. Para-clinical characteristics of the patients undergoing hemodialysis

Variable	Minimum	Maximum	Mean	Standard Deviation
Calcium (mg/dL)	4.6	12.5	8.520	1.12
Iron (µg/dL)	17	885	108.31	149.84
TIBC (µg/dL)	52	1001	312.02	153.79
Ferritin (ng/mL)	14	1771	597.18	318.31
PTH (pg/mL)	16	909	359.77	238.47
KtV	.64	1.70	1.19	0.22
BUN (mg/dL)	18	108	61.06	17.44
Cr (mg/dL)	2.4	24.0	8.891	3.1422
Systolic blood pressure (mm Hg)	60	170	122.43	30.224
Diastolic blood pressure (mm Hg)	20	100	74.13	17.851

Table 3. Para-clinical characteristics of the patients undergoing hemodialysis across both genders

Para-clinical variables		Mean	Standard Deviation	t	*P* value
Calcium (mg/dL)	Female	8.70	0.92	1.507	0.135
	Male	8.37	1.24		
Iron (µg/dL)	Female	110.55	139.78	0.137	0.891
	Male	106.50	158.72		
TIBC (µg/dL)	Female	311.72	152.51	-.018	0.986
	Male	312.26	156.15		
Ferritin hormone (ng/mL)	Female	662.55	355.79	1.919	0.058
	Male	544.21	276.28		
PTH (pg/mL)	Female	379.70	237.81	0.769	0.443
	Male	343.62	239.84		
KtV	Female	1.20	0.22	0.630	0.530
	Male	1.18	0.22		
BUN (mg/dL)	Female	55.91	16.06	-2.815	0.006
	Male	65.24	17.53		
Cr (mg/dL)	Female	8.01	2.43	-2.635	0.010
	Male	9.59	3.47		

Linear regression showed that by increasing BUN, number of dialysis per week and weight, the level of Cr increases significantly ($P < 0.05$). In the younger patients, Cr showed low level compared to the older patients (Table 5).

Discussion

ESRD hazards all aspects of life in patients with CKD. We conducted a study to determine some clinical and para-clinical features of the patients undergoing hemodialysis referred to Bou Ali and Velayat hospitals in Qazvin. In summary, our results indicated that AVF was the most common method for vascular access. The level of Cr was higher in younger patients. Furthermore, BUN, number of dialysis per week and weight, were predictor of the level of Cr. Males had higher level of BUN and Cr. Most of the patients were men.

Table 4. Dialysis-related factors in the patients undergoing hemodialysis

Variable		No.	%
Kind of vascular access	Arteriovenous fistula/AVF	80	76.2
	Graft	1	1.0
	Catheter	24	22.9
Kind of catheter	None	83	79
	Continuous	17	16.2
	Temporary	5	4.8
Site of catheter	None	81	77.1
	Subclavian	10	9.5
	Femoral	4	3.8
	Jugular	10	9.5
Kind of flux	Low	37	35.2
	High	68	64.8
Use of midodrine	No	100	95.2
	Yes	5	4.8
Kind of solution	Hco3	99	94.3
	Acetate	6	5.7
Hypotension in home	No	94	89.5
	Yes	11	10.5

Hesari et al conducted a study to compare the serum levels of hormones and various biochemical parameters in the patients undergoing hemodialysis. From all patients, one blood sample before and one sample immediately after hemodialysis to measure T3, T4, free triiodothyronine (FT3), thyroid stimulating hormone, free thyroxine (FT4) and cholesterol, triglyceride, BUN, uric acid and fasting blood sugar (FBS) were taken. The results showed that the levels of FT3, FT4, and T3 had a significant increase

Table 5. Linear regression to predict the level of Cr

Variable	Unstandardized Coefficients		Standardized Coefficients	*P* value
	B	SE	Beta	
Gender	1.381	0.709	0.220	0.055
Duration of dialysis (year)	0.055	0.090	0.055	0.544
Kind of vascular access	-1.096	0.884	-0.295	0.218
Kind of catheter	0.867	1.099	0.148	0.433
Site of catheters	-0.158	0.669	-0.048	0.813
Weight (kg)	0.050	0.024	0.221	0.043
Height (cm)	-0.046	0.046	-0.114	0.324
Hypotension in home	0.438	1.064	0.043	0.682
Kind of flux	-0.147	0.759	-0.022	0.847
Use of midodrine	0.512	1.559	0.035	0.743
Number of dialysis per week	1.725	0.641	0.265	0.009
Calcium (mg/dL)	-0.317	0.270	-0.113	0.243
Iron (µg/dL)	0.001	0.004	0.029	0.879
TIBC (µg/dL)	-0.001	0.003	-0.030	0.860
Ferritin (ng/mL)	0.000	0.001	-0.038	0.675
PTH (pg/mL)	0.002	0.001	0.131	0.158
Kt/V	-1.450	1.411	-0.104	0.307
BUN (mg/dL)	0.040	0.017	0.220	0.024
Systolic blood pressure (mm Hg)	-0.010	0.020	-0.095	0.618
Diastolic blood pressure (mm Hg)	-0.007	0.032	-0.038	0.834
Age (year)	-0.046	0.020	-0.222	0.021

after hemodialysis. Cr, BUN and uric acid levels decreased following hemodialysis. However, cholesterol, triglyceride and FBS levels showed a significant increase. Dialysis can improve and increase the level of thyroid hormones in patients with renal failure. Hemodialysis, on the other hand, increases total cholesterol and triglycerides, and as a result, can increase the risk of cardiovascular disease (14). In dialysis patients, blood uric acid levels increase due to decreased clearance (15). Our study showed that ESRD caused high level of BUN. Serum levels of BUN and Cr decrease significantly after hemodialysis compared to before hemodialysis; however these factors are in high level (16). Alsaran et al (16) reported that FT3 and FT4 levels had increased significantly in the last three months after hemodialysis compared to before hemodialysis. However, TSH levels did not show a statistically significant difference before and after hemodialysis (17). In this study, the mean blood pressure was in the normal range. In a study by Rocco et al, 64.9% of hemodialysis patients had high blood pressure and 54.4% of patients had controlled blood pressure, of which 35.1% did not receive antihypertensive drugs and 20.6% of them received antihypertensive medication (18). Indeed the control of hypertension is depends on many factors such as drugs used to treat and lifestyle of the patients, therefore it cannot be compared exactly.

In a study, serum urea level was more than 200 mg/dL but following dialysis, 66% of the patients had urea level less than 200 mg/dL. Regarding Cr, most of the patients had Cr between 7-12 mg/dL before dialysis, while following dialysis the Cr level was decreased to <7 mg/dL (19). It shows that the level of Cr even in the patients undergoing hemodialysis is high and just hemodialysis it decreases a little.

Conclusion
According to the results, the number of dialysis per week, weight and BUN level are factors to predict the level of Cr and with increasing these factors, the level of Cr increases. The mean Cr level was high which showed inadequacy of hemodialysis in these patients. The level of Cr and BUN is higher in men.

Limitations of the study
Our major limitation in this research was small sample size. In the cross-sectional studies, due to confounding bias, it is suggested to select as large as possible sample size.

Authors' contribution
SH, NR and SJ were the principal investigators in the research and prepared the concept and design of this study. All authors reviewed the manuscript before submission and approved the content of the manuscript.

Conflict of interest
There is no conflict of interest in this research.

References
1. Bond M, Pitt M, Akoh J, Moxham T, Hoyle M, Anderson R. The effectiveness and cost- effectiveness of methods of storing donated kidneys from deceased donors: a systematic review and economic model. Health Technol Assess. 2009; 13:1-156. doi: 10.3310/hta13380.
2. Meguid El Nahas A, Bello AK. Chronic kidney disease: the global challenge. Lancet. 2005;365:331-40. doi: 10.1016/S0140-6736(05)17789-7.
3. United States Renal Data System: Annual data report: incidence and prevalence of ESRD (2003). Am J Kidney Dis. 2003;42:S37-S173.
4. Ansell D, Feest T, eds. UK renal registry report 2004. Bristol: UK Renal Registry; 2004.
5. Jürgensen JS, Arns W, Hass B. Cost- effectiveness of immunosuppressive regimens in renal transplant recipients in Germany: a model approach. Eur J Health Econ. 2010;11:15-25. doi: 10.1007/s10198-009-0148-3.
6. Grassmann A, Gioberge S, Moeller S, Brown G. ESRD patients in 2004: global overview of patient numbers, treatment modalities and associated trends. Nephrol Dial Transplant. 2005;20:2587-93. doi: 10.1093/ndt/gfi159.
7. Barsoum RS. End-stage renal disease in the developing world. Artif Organs. 2002;26:735-6. doi: 10.1046/j.1525-1594.2002.00916.x.
8. Easterling RE. Racial Factors in the Incidence and Causation of End-Stage Renal Disease (ESRD). Trans Am Soc Artif Intern Organs. 1977;23:28-32. doi: 10.1097/00002480-197700230-00008.
9. U.S Department of Health and Human Services. National Instute of Health, National Kidney and Urologic diseases Information Clearinghouse. Treatment Methods for Kidney Failure Peritoneal Dialysis. National Instiute of Diabetes and Digestive and Kidney Diseases. NIH Publication No.06-4688 May 2006. Available at: https://www.niddk.nih.gov/.
10. Zhang Q-L, Rothenbacher D. Prevalence of chronic kidney disease in population-base d studies: systematic review. BMC Public Health. 2008;8:117. doi: 10.1186/1471-2458-8-117.
11. Braunwald A, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, eds. Harrison's Principles of Internal Medicine, 15th edn. New York: McGraw-Hill; 2001:1974-9.
12. Alashek WA, McIntyre CW, Taal MW. Epidemiology and aetiology of dialysis-treated end-stage kidney disease in Libya. BMC Nephrol. 2012;13:1-7. doi: 10.1186/1471-2369-13-33
13. Aslam N, Bernardini J, Fried L, Burr R, Piraino B. Comparison of infectious complications between incident hemodialysis and peritoneal dialysis patients. Clin J Am Soc Nephrol. 2006;1:1226-33. doi: 10.2215/CJN.01230406.
14. Hesari Z, Mansourian A, Ghasempour G, Ahmadi A. Assessing the changes in some biochemical parameters in hemodialysis patients before and after hemodialysis, in 5 Azar Hospital of Gorgan. Razi J Med Sci. 2018;25:84-9.
15. Zawada AM, Carrero JJ, Wolf M, Feuersenger A, Stuard S, Gauly A, et al. Serum uric acid and mortality risk among hemodialysis patients. Kidney Int Rep. 2020;5:1196-206. doi:

10.1016/j.ekir.2020.05.021.

16. Shamsadini S, Darvish MS, Abdollahi H, Fekri AR, Ebrahimi HA. Creatinine, blood urea nitrogen and thyroid hormone levels before and after haemodialysis. East Mediterra Health J. 2006;12: 231-5.

17. Alsaran K, Sabry A, Alshahhat H, Babgy E, Alzahrani F. Free thyroxine, free triiodothyronine and thyroid-stimulating hormone before and after hemodialysis in Saudi patients with end-stage renal disease: Is there any difference? Saudi J Kidney

Dis Transplan; 2011;22:917.

18. Rocco MV, Yan G, Heyka RJ, Benz R, Cheung AK. Risk factors for hypertension in chronic hemodialysis patients: baseline data from the HEMO study. Am J Nephrol. 2001;21:280-8. doi: 10.1159/000046262.

19. Amin N, Mahmood RT, Asad MJ, Zafar M, Raja AM. Evaluating urea and creatinine levels in chronic renal failure pre and post dialysis: a prospective study. J Cardiovasc Dis. 2014;22:1-4.