Clinical and paraclinical characteristics of patients undergoing hemodialysis

Sanaz Jamshidi1, Sepideh Hajian2*, Nafiseh Rastgoo1

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

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±3.47 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.

Key point
Factors like the number of dialysis per week, weight and blood urea nitrogen level can predict the level of creatinine.
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   | 1.15               |
| 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 | 218.47             |
| Kt/V              | 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             |
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 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           | 156.72|         |       |
| TIBC (µg/dL)           | Female | 311.72           | 152.51| -0.018  | 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|         |       |
| Kt/V                   | Female | 1.20             | 0.22  | 0.630   | 0.530 |
|                        | Male   | 1.10             | 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  |         |       |

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 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)|

**Table 5. Linear regression to predict the level of Cr**

| Variable                          | Unstandardized Coefficients | Standardized Coefficients | P value |
|-----------------------------------|-----------------------------|---------------------------|---------|
| 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. 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.

Ethical considerations
Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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