Original Article

Assessment of Hemodialysis Efficacy in Patients with End-Stage Renal Failure in the Erbil Hemodialysis Center

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Abstract

Background: Adequate and effective hemodialysis (HD) improves health-related quality of life and reduces morbidity and mortality in patients with end-stage renal disease (ESRD). The efficacy of dialysis procedure applied on patients diagnosed with ESRD was evaluated in the current investigation. **Materials and Methods:** In the present pre- and post-test cohort study, out of 375 patients, 120 patients (46 males and 74 females) on thrice-weekly chronic HD program were followed up over 6 months for evaluation of dialysis efficacy and possible outcomes. The efficacy of HD was measured through the Kt/V method and urea reduction ratio (URR). **Results:** The current study showed that the studied population (thrice-weekly HD patients) represents a minority of patients, i.e., 35.2% (132 of 375), and all other receiving insufficient HD treatment usually on twice weekly around 3 h for each session (64.8%). The study showed that the dialysis adequacy of the patients reached an adequate level by Kt/v and URR, 73.3% and 68.3%, respectively; the dialysis adequacy was increased with an increase in blood flow rate ($P = 0.042$), dialysis session time ($P = 0.005$), and dialysis sessions ($P = 0.008$). Patients with lower body mass index and without comorbidities were more likely to have adequate dialysis ($P = 0.004$ and $P = 0.02$, respectively). **Conclusions:** HD treatment is suboptimal in Erbil Dialysis Center. Intensive follow-up and application of corrective measures may improve dialysis efficacy. Energetic efforts are required to examine and correct the reasons behind the dialysis inadequacy.

Keywords: Efficacy, hemodialysis, hemodialysis adequacy, urea reduction ratio

Introduction

End-stage renal disease (ESRD) is an irreversible condition not compatible with life in which the patients should undergo either dialysis or kidney transplantation. The ESRD is the main outcome of chronic kidney disease (CKD) and has a significant impact on health-related quality of life and utilizing medical services.[1]

Hemodialysis (HD) is defined as a process that removes accumulated solute from a patient with near-total or total loss of renal function. In the HD process, solute from blood is diffused into a physiological salt solution or dialysate. It is separated from the blood through a thin semipermeable membrane as the main component of the dialyzer.[2]

The most significant criterion for the HD process evaluation is a measurement of dialysis adequacy as the clinical feature alone has no reliability to confirm dialysis adequacy. Adequate HD raises the patient survival, health-related quality of life, and biochemical outcomes and lowers complications of disease and disease-related hospitalizations.[3] It decreases morbidity and mortality.[4]

The deficiencies in the delivered HD dose are not detected if frequent measurements are not performed, making delay in an implementation of a corrective action. The measurements could be done monthly as the patients are referred to blood testing each month.[5] The efficacy of dialysis is determined through the Kt/V and urea reduction ratio (URR) estimation method.[6]

It is vitally significant to monitor the dialysis process for overall quality improvement. Optimum timing treatment in patients with CKD is important as it prevents serious

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complications such as fluid overload, malnutrition, depression, bleeding, serositis, infertility, peripheral neuropathy, cognitive impairment, and increased vulnerability to infection.[2]

The efficacy of dialysis procedure applied on patients diagnosed with ESRD was evaluated in the current investigation. The authors predicted the effectiveness of dialysis procedure on urea reduction in the mentioned patients.

Materials and Methods

Study design and sampling

In the current pre- and post-evaluation cohort study, a total of 120 patients on thrice-weekly HD with a mean age of 49 years who underwent dialysis in the Erbil Dialysis Center were followed up for 6 months for the evaluation of dialysis efficacy and possible outcomes. The dialysis was undertaken by two different machines, GAMBRO (Healthcare Industry, www.gambro.com) and BELLCO (Italian company, Healthcare Industry), under dialysis membrane type 170H between January and June 2018. The total number of patients who underwent dialysis in GAMBRO machine was 70 and that of BELLCO machine was 62.

The medical records of the patients were reviewed by the authors for the eligibility criteria which were all HD patients on thrice-weekly dialysis sessions for at least 6 months. Patients who received less than three HD sessions/week were excluded from the study. Of the total 375 HD patients at Erbil Dialysis Center, of 132 patients recruited in the study, six patients were subsequently excluded because of unwillingness to participate or difficult to trace and other six patients died during the study period. The information of the remaining 120 patients was analyzed.

Over the study period, the patients skipped some sessions of dialysis owing to different physical and logistic factors such as vomiting, diarrhea, high/low blood pressure, cramping, discomfort from vein punctures, personal time conflicts, waiting time for treatment, feelings of being tired of dialysis, and difficulty in transportation.

The study was conducted according to Helsinki ethical guidelines and approved by the local Ethical Committee of Kurdistan Board for Medical Specialties. The written consent forms were taken from all patients prior to recruitment in the study, and complete guarantee was given for confidentiality of their personal information.

The studied patients were subjected to the full clinical history, clinical examination, and relevant laboratory investigations. The diagnosis of the renal clinical conditions was established according to the latest guidelines of the National Kidney Foundation.[7]

The sociodemographic aspects of the patients were collected through the self-reported technique, including age, gender, having current chronic diseases, kidney transplantation history, and dialysis vintage. Vascular access was arteriovenous fistula for all patients. The dialysis procedure parameters were represented in number of session, blood flow rate (BFR) (ml/min), ultrafiltration (UF) volume (liter), and dialysis session time (hours).

Body mass index (BMI) was calculated by the following formula: BMI = weight (kg)/height (m^2).

The efficacy of dialysis procedure was calculated by the measurement of Kt/V determined through the single-pool urea kinetic modeling using the Daugirdas formula as mentioned below:[6]

$$\frac{K.t}{V} = -Ln(R - 0.008t) + (4 - 3.5R)\frac{UF}{BW}$$

Where R is the ratio of postdialysis blood urea nitrogen (BUN) ($BUN = BU/2.1422$) to predialysis BUN, t is time on dialysis in hours, BW is (postdialysis) body weight in kilogram, and UF is ultrafiltration blood volume in liter.

According to the Kt/V values, the patients were divided into two groups, including adequate dialysis dose (Kt/V ≥1.2) and inadequate dialysis dose (Kt/V <1.2).[8]

The mean Kt/V of three sessions was estimated for each patient in the 1st month and repeated at last month.

The URR was measured by the following equation:

$$URR = U_{pre} - U_{post} / U_{pre} * 100\%$$

Where U_{pre} is the predialysis urea level and U_{post} is the postdialysis urea level.

The URR ≥65% was considered as adequate URR and <65% as inadequate.

Statistical methods

The descriptive purposes of the study were determined by the frequency and percentage or mean and standard deviation. The difference in efficacy of dialysis among different sessions was measured through the analytical statistical tests such as independent t-test, Chi-squared test, and Fishers' exact test. The statistical calculations were performed using Statistical Package for the Social Sciences version 24 (SPSS, IBM Company, Chicago, USA). $P < 0.05$ was considered as the statistically significant difference.

Results

The study showed no statistically significant difference between the adequate dialysis group compared to inadequate group regarding age ($P = 0.728$), dialysis vintage ($P = 0.459$), fistula duration ($P = 0.777$), and dialysis machine ($P = 0.044$) [Table 1].

The study revealed that the female patients and those with a lower BMI were more likely to reach the adequate HD ($P = 0.004$ and $P = 0.046$, respectively), while those patients who underwent kidney transplantation were less likely to receive the adequate HD ($P = 0.001$) [Table 1].

The study did show that HD adequacy is significantly increased with intensive follow-up and application of corrective measures to ascertain an increase in BFR ($P = 0.042$), increase in dialysis

Table 1: Comparison of baseline characteristics of patients between adequate and inadequate hemodialysis groups

Patients' characteristics ($n=60$)	Frequency distribution Mean±SD, *n* (%)		*P* (two sided)
	Adequate dialysis	Inadequate dialysis	
Age (year)	55.00±12.60	54.19±10.74	0.728*
Time on dialysis (year)	3.35±2.53	3.84±3.38	0.459*
Fistula duration function (year)	3.03±2.34	2.90±2.16	0.777*
BMI categories			
Normal weight (18.5-24.9)	2 (100)	0 (0.0)	0.004***
Overweight (25.0-<30)	18 (81.20)	4 (18.8)	
Obese (≥30)	64 (66.7)	32 (33.3)	
Gender			
Male	30 (44.10)	16 (30.75)	0.046**
Female	38 (55.90)	36 (69.25)	
Kidney transplantation			
Yes	4 (4.5)	10 (31.3)	<0.001***
No	84 (95.5)	22 (68.8)	
Dialysis machine			
GAMBRO	46 (52.28)	14 (43.75)	0.044***
BELLCO	42 (47.72)	18 (56.25)	

*Independent *t*-test, **χ^2, ***Fisher's exact test. BMI: Body mass index, SD: Standard deviation

Table 2: Comparison of hemodialysis adequacy between the 1st and last months

	Mean of 1st month (%)	Mean of last month (%)	*P* (two sided)
Total dialysis adequacy			
Adequate	57	73.3	<0.0001*
Inadequate	43	26.7	
Total urea reduction ratio adequacy			
Adequate	56.3	68.3	<0.0001*
Inadequate	43.7	31.7	

*Fisher's exact test

sessions per week ($P = 0.008$), dialysis time ($P = 0.005$), and increase in UF volume ($P = 0.03$) [Tables 2 and 3].

The study revealed that those patients with comorbidities such as ischemic heart disease, heart failure, diabetes mellitus, infection, thyroid disorders, anemia, hypoalbuminemia, respiratory condition, and depression were less likely to receive adequate dialysis compared to the patients without comorbidities ($P = 0.02$) [Table 4].

The correlation of URR and total efficacy showed significant positive correlation, as shown in Figure 1.

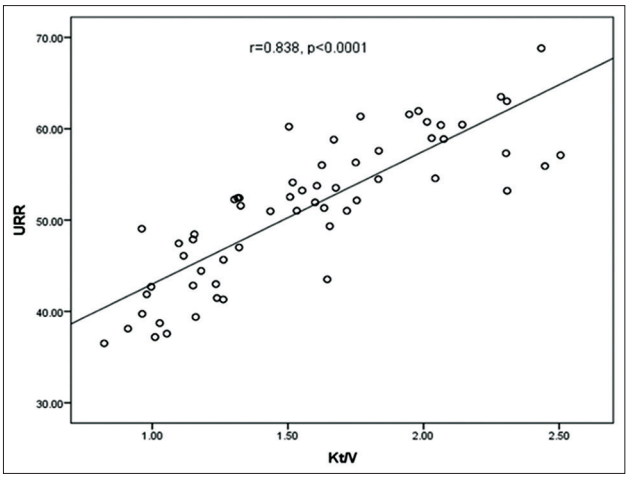

Figure 1: Correlation between Kt/V and urea reduction ratio

Discussion

The current study showed that the studied population (thrice-weekly HD) represented a minority of patients, i.e., 35.2% (132 of 375), and all other receiving insufficient HD treatment usually on twice weekly around 3 h for each session (64.8%). This may be attributed to various reasons such as financial constraints, accessibility to facilities, patient unwillingness, shortage of machines and appliances, time conflict, and difficulty in transportation.

The current study showed that the HD dose is more likely to be adequate with an increase in BFR, dialysis time, dialysis session, and UF volume ($P < 0.05$). Adequate and effective dialysis has an important role in the improvement of the quality of life and a reduction in kidney-related complications, subsequently resulting in a significant reduction in kidney failure-related mortality.[9]

The aim of the dialysis is to remove the excess material and toxins and stabilize the internal environment of the body. These excess materials are responsible for permanent injury.[10] Therefore, the findings of the present study are so important to patient safety, efficiency of dialysis, and to the health managers in this region.

The dialysis adequacy rates vary from one study to another one. For instance, a systematic review from Iran showed that the rate of dialysis adequacy is between 2.3% and 77.9% and that of URR is between 5% and 72.7% in Iran.[9] The reported findings in the present study are abet higher than that reported in some developing countries, for example, Egypt (45%),[8,11] Iran (43.3%), Nepal (25%), Brazil (50%), and Nigeria (45.3%),[12] and it is lower than that reported in the USA (90%) and France (84%).[13]

In congruence with the present study, other studies showed that an increase in BFR is significantly associated with an increase in dialysis adequacy.[14] This increase in dialysis adequacy comes from the calculations according to the Kt/V formula if BFR is 251 and above.

Our study revealed a positive correlation between dialysis session time and dialysis adequacy, and there is a trend even

Table 3: Impact of different parameters on hemodialysis adequacy

Dialysis characteristics	Frequency distribution		Total	*P* (two sided)
	Adequate dialysis, *n* (%)	Inadequate dialysis, *n* (%)		
BFR (ml/min)				
200-250	10 (55.6)	8 (44.4)	18 (15)	0.042**
251 and above	78 (76.5)	24 (23.5)	102 (85)	
Total	88 (73.33)	32 (26.7)	120 (100)	
Duration of dialysis session				
2.5-<3 h	2 (25.0)	6 (75.0)	8 (6.6)	0.005*
3-<3.5 h	46 (74.2)	16 (25.8)	62 (51.6)	
3.5 h and more	40 (80.0)	10 (20.0)	50 (41.8)	
Total	88 (73.33)	32 (26.67)	120 (100)	
Session/week				
Thrice	56	4	60	0.008**
Skip dialysis***	32	28	60	
Total	88 (73.33)	32 (26.67)	120 (100)	
UFV (liters)				
0-1	36 (64.3)	20 (35.7)	56 (46.66)	0.03**
>1-2	30 (78.9)	8 (21.1)	38 (31.66)	
>2-3	20 (83.3)	4 (16.7)	24 (20)	
>3 and more	2 (100)	0 (0.0)	2 (1.68)	
Total	88 (73.33)	32 (26.67)	120 (100)	

*χ^2, **Fisher's exact test, ***The significant = 0.008. Skip dialysis "who miss dialysis session at any point due to any reason." BFR: Blood flow rate, UFV: Ultrafiltration volume

Table 4: Effect of comorbidity on hemodialysis adequacy

Comorbidity	Frequency distribution		Total	*P* (two sided)
	Adequate dialysis, *n* (%)	Inadequate dialysis, *n* (%)		
Comorbidity	82 (74.5)	28 (25.5)	110 (91.66)	0.02*
No comorbidity	4 (40.0)	6 (60.0)	10 (8.34)	
Total	88 (73.3)	32 (26.7)	120 (100)	

*Fisher's exact test

to extend HD (longer duration and/more frequent HD sessions in a week) more than standard dialysis time (9–12 h per week) with better outcome, even the patients lose a substantial level of dialysis adequacy when lose 5 minutes of a dialysis session.[11,13]

In our study, repeated skip dialysis sessions (low adherence) decrease the dialysis efficacy; these findings regarding the frequency of dialysis are so important and are in agreement with the other study.[15] The factors attributed to the skip dialysis sessions by some patients in the present study include medical problems life tasks, transportation, and patient decisions.

We did find a significant association between dialysis inadequacy and patients' comorbidities ($P = 0.02$). Increasing age, cardiovascular diseases, diabetes mellitus, and poor nutrition are the most important comorbidities anticipating the worse outcomes of patients with ESRD.[16]

The mortality rate was 10%/year in the present study (only six patients/6 months). It is higher that a rate reported in Japan and lower than it reported in Germany (16.9%), Spain (13.4%), and the UK (18.0%).[17,18]

The discrepancies of mortality rate among different countries could be referred to patient selection methods and their comorbidities.

Limitations of the study

Limitations of the study include patients were followed up for a 6-month period precluding us to make a judgment on a longer period and the sample size of the present study does not allow us to generalize the findings to patients in other settings across the country.

Conclusions

HD treatment is adequate in Erbil Dialysis Center. The study showed that intensive follow-up and application of corrective measures promote dialysis adequacy. Energetic efforts are required to increase dialysis adequacy with increased BFR, dialysis vintage, dialysis session, UF volume, low BMI, and proper management of patient's comorbidities.

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Conflicts of interest

There are no conflicts of interest.

References

1. Vanholder R, Davenport A, Hannedouche T, Kooman J, Kribben A, Lameire N, *et al.* Reimbursement of dialysis: A comparison of seven countries. J Am Soc Nephrol 2012;23:1291-8.
2. Gilmore J. KDOQI clinical practice guidelines and clinical practice recommendations-2006 updates. Nephrol Nurs J 2006;33:487-8.
3. Adas H, Al-Ramahi R, Jaradat N, Badran R. Assessment of adequacy of hemodialysis dose at a palestinian hospital. Saudi J Kidney Dis Transpl 2014;25:438-42.
4. Hojjat M. Hemodialysis adequacy in patients with chronic renal failure. Iran J Crit Care Nurs 2009;2:61-6.
5. Saei A, Mazhari M, Tayybi A, Ebadi A. The effect of continuous care model on dialysis adequacy in hemodialysis patients of selected Iranian army hospitals. Police Med 2012;1:105-12.
6. Daugirdas JT, Blake PG, Ing TS. Handbook of Dialysis: Philadelphia: Lippincott Williams & Wilkins; 2012.
7. Rocco MV, Berns JS. KDOQI clinical practice guideline for diabetes and CKD: 2012 update. Am J Kidney Dis 2012;60:850-86.
8. El-Sheikh M, El-Ghazaly G. Assessment of hemodialysis adequacy in patients with chronic kidney disease in the hemodialysis unit at Tanta university hospital in Egypt. Indian J Nephrol 2016;26:398-404.
9. Barzegar H, Moosazadeh M, Jafari H, Esmaeili R. Evaluation of dialysis adequacy in hemodialysis patients: A systematic review. Urol J 2016;13:2744-9.
10. Tayyebi A, Shasti S, Ebadi A, Eynollahi B, Tadrisi SD. The relationship between blood pressure and dialysis adequacy in dialysis patients. Iran J Crit Care Nurs (IJCCN) 2012;5:49-52.
11. Bacon B. Harrison's Principles of Internal Medicine. 19th ed. New York, NY: McGraw-Hill Education; 2015.
12. Amini M, Aghighi M, Masoudkabir F, Zamyadi M, Norouzi S, Rajolani H, *et al.* Hemodialysis adequacy and treatment in Iranian patients: A national multicenter study. Iran J Kidney Dis 2011;5:103-9.
13. Centers for Medicare and Medicaid Services, Kinney R. 2005 annual report: ESRD clinical performance measures project. Am J Kidney Dis 2006;48:S1-106.
14. Borzou SR, Gholyaf M, Zandiha M, Amini R, Goodarzi MT, Torkaman B, *et al.* The effect of increasing blood flow rate on dialysis adequacy in hemodialysis patients. Saudi J Kidney Dis Transpl 2009;20:639-42.
15. Lowrie EG, Li Z, Ofsthun N, Lazarus JM. Measurement of dialyzer clearance, dialysis time, and body size: Death risk relationships among patients. Kidney Int 2004;66:2077-84.
16. Prichard SS. Comorbidities and their impact on outcome in patients with end-stage renal disease. Kidney Int 2000;57:S100-4.
17. Goodkin DA, Young EW, Kurokawa K, Prütz KG, Levin NW. Mortality among hemodialysis patients in Europe, Japan, and the United States: Case-mix effects. Am J Kidney Dis 2004;44:16-21.
18. Rayner HC, Pisoni RL, Bommer J, Canaud B, Hecking E, Locatelli F, *et al.* Mortality and hospitalization in haemodialysis patients in five european countries: Results from the dialysis outcomes and practice patterns study (DOPPS). Nephrol Dial Transplant 2004;19:108-20.