Journal of Medical and Surgical Practice (JMSP)
Vol. 08, No. 04, October-December, 2022

Assessment of Hemodialysis Adequacy in Adult Patients with End Stage Renal Disease in Karbala Dialysis Center

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Original Article

Abstract

Background:

Adequate and effective hemodialysis improves health-related quality of life and reduces morbidity and mortality in patients with end-stage renal disease.

Objective: To evaluate the adequacy of hemodialysis in adult patients with end stage renal disease on regular schedule.

Materials and Methods:

This was a cross-sectional study included 202 Iraqi patients undergoing hemodialysis in the hemodialysis centers of Karbala. Demographic, clinical and hemodialysis data were collected and analyzed using the statistical software (SPSS) and appropriate statistical tests were applied accordingly at a level of significance of ≤ 0.05.

Results:

There were 107 males and 95 females, age ranged between 20-85 years. Among the studied group 55.4% had inadequate and 44.6 % achieved adequate hemodialysis. Patients in the inadequate single-pool Kt/V group were older than those with adequate single-pool Kt/V group, (p <0.05). Males were more likely to have inadequate dialysis than females, 57.9% and 52.6% , respectively. A significant relationship was found between adequate hemodialysis and quality of life, duration of dialysis session, dialysis sessions per week, type of dialyzer, serum albumin level and serum phosphorus level, (p. value <0.05).

Conclusions:

Inadequate dialysis was more frequent among the studied group. Attempts to achieve the desired goals are necessary. Intensive follow-up and application of corrective measures may improve dialysis efficacy.

Keywords: *End Stage Renal Disease, Hemodialysis, Adequacy*

Received : October, 2022, **Published**: December, 2022

Citation: Ali H.A, , Jubara M.A, , Shawqi B.H.A, , Yahya M.S. Assessment of Hemodialysis Adequacy in Adult Patients with End Stage Renal Disease in Karbala Dialysis Center. JMSP 2022; 8 (4): 221-42

1. INTRODUCTION

End stage renal disease (ESRD) is the advanced stage of chronic kidney disease, it is a global burden and the major cause of morbidity and mortality.. ESRD is a serious complication of CKD and has a considerable burden on health-related quality of life and the use of medical services Renal replacement therapy, which includes HD, peritoneal dialysis (PD), and kidney transplantation, is the primary treatment for ESRD. Due to a limited availability of donor kidneys and the limited use of PD, HD is the most often utilized. In renal failure, maintenance hemodialysis (MHD) provides the best therapeutic benefit and it was linked to patient survival (1–9).

Hemodialysis is a procedure for removing accumulated solute from a patient who has lost near-complete or entire renal function Long-term dialysis, however, has an influence on nutritional status, and varied dialysis frequencies are likely to result in varying problems rates and complications like cardiovascular illness , infection and other complications, (10,11). Hemodialysis, usually conducted 2-3 times a week for a period of 4-5 hours (12–15). Although we now have a better grasp of what constitutes effective dialysis, our understanding is still limited since we do not completely comprehend the uremic syndrome (16).

Because of the particular circumstances induced by the therapy and the disease, patients undergoing hemodialysis suffer emotional, physical, and social challenges. As a result of these adverse effects, patients are more likely to be admitted to the hospital and have a higher death rate (17,18). Hemodialysis is commonly done three times a week in developed countries. Although increasing dialysis frequency may enhance quality of life (QOL) (19,20). An evaluation of QOL is an essential criterion for determining the efficacy of a particular HD technique (21,22).

Interventions that can enhance dialysis outcomes are desperately required. To enhance results, dialysis has been started at higher (GFRs), the frequency and/or duration of dialysis has been increased, new version membranes have been used, and supplemental or alternative hemofiltration has been used. (23). Despite an insufficient data from randomized controlled trials (RCTs) on the best timing to start RRT, there has been a tendency in the United States toward earlier dialysis beginning at greater levels of kidney function, which has leveled off since 2010. If early dialysis is found to be unsuccessful, this trend will result in increased resource use with little therapeutic benefit. The IDEAL (Initiating Dialysis Early and Late) experiment, which was published in 2010, investigated this problem, and the findings from this trial offer the greatest evidence for dialysis beginning timing (24).

The etiology of the disease, alternative therapy, synchronism of other diseases such as cardiovascular disease, and dialysis adequacy are all factors that influence survival in people with end-stage renal disease. Dialysis quality is a predictor of dialysis patient death. There is decreased morbidity in individuals with renal disease when there is sufficiently effective hemodialysis therapy, according to evidence (25). The KT/V standard (K: urea clearance, T: dialysis time, V: urea distribution) and the URR are the most often used techniques for measuring hemodialysis adequacy (HA) (26). The dialysis quality findings utilizing KT/V and URR are chosen by the Renal Physicians Association and the NKF disease outcomes quality program because they more correctly indicate urea removal. Several studies have demonstrated that raising the KT/V rate to 1.2 or increasing the URR to more than 65 percent improves the prognosis of dialysis patients. The Kt/V and URR are calculated by using standard equations and calculators (22,27,28) however, hemodialysis machines can do these measurements.

Today, proper and reasonable dialysis may prevent many difficulties, as well as improve QOL for dialysis patients (24,29,30). The primary objective of treatment for people with CKD stage 5 is to enhance their quality of life, reduces symptoms of uremia, with life extension being a secondary goal. Recently, hemodialysis adequacy (HA) has been confused with adequacy of other areas of patient treatment, with the mistaken belief that if HA is established, the aim of dialysis is satisfied. Dialysis patients require a variety of therapies that are either independent of or just partially dependent on dialysis, many of which were started long before the patient's dialysis began (24).

Age, gender, socio economic level, type of vascular access, dialyzer type, and dose and route of erythropoietin stimulating agents (ESA) utilized are only a few of the parameters that have been linked to HA (31). Furthermore, non-adherence has been linked to HIA, resulting in a considerable reduction in ESRD patients' quality of life (32)(33).

Patients who get a sub-optimal hemodialysis dosage have a higher risk of morbidity and death. Furthermore, HIA is widespread and is linked to poor patient survival as well as anemia, malnutrition, functional impairment, and frequent hospitalization, all of which result in higher health-care costs and a higher death rate. Again, a negative impact on the QOL of ESRD patients on maintenance HD is also apparent as a result of HIA (34). The most practical way to determine spKt/V is to use mathematical modeling of pre-dialysis and post-dialysis serum urea concentrations(35,36). This approach, also known as the "given HD dosage," gives an integrated or average clearance throughout the HD and is patient specific (37). To measure Kt/V, laboratories and dialysis clinics across the country have utilized a variety of approaches, including simpler explicit formulae, multi-compartment models, and on-line conductivity measurements. While ideal values have yet to be determined, dialysis doses reflected by Kt/V readings of less than 1.20 are commonly regarded as insufficient. Each 0.10 fall in Kt/V below this threshold is projected to raise the relative risk of mortality by 7%. The standardized Kt/V is a method for determining the clearance efficiency of HD with variable frequency, slow continuous renal replacement treatments, residual renal function (RRF), and any other scenarios where clearance from diverse ways is used (38). The synthesis, catabolism, and volume re-distribution, as well as trans- capillary exchange loss, all contribute to serum albumin concentration, which is commonly employed as a nutritional status measure (39).

The development and commercialization of hemodialysis equipment that measure solute clearance has enabled real-time monitoring of HA. Currently, this is performed using one of two technical ways, both of which rely on detecting material fluxes from blood into the dialysate: monitoring the effluent for urea surrogates by electrical conductance or ultraviolet (UV) absorption. Validating the efficacy of present approaches has been a recent emphasis. Despite concerns that interfering substances, inappropriate urea modeling, solute rebound, or errors in calculating urea volume (V) could skew results, the dialyzer clearance of urea (K), dialysis time (t), and urea reduction ratio clearance calculations from the various modalities have generally had excellent correlation. However, these 'appearance' estimates of dialysate urea have not been consistently recognized for HA quality assurance. Blood tests for urea 'clearing' are still required to validate the success of hemodialysis treatments (40,41). As a result, UV absorbance technology was used to construct nursing procedures that compare the predicted delivered dialysis dosage (spKt/V or URR) profile to the desired trajectory. Nurses would now have a new tool to autonomously apply physician-driven procedures to improve patient care, as minute-to-minute variations in treatment efficacy cannot be addressed by offshore physicians. When poor or declining clearance is detected quickly, measures such as increasing dialysis duration, changing blood or dialysate flow rate, adjusting needle position, improving anticoagulation, or replacing the dialyzer can be used. Patients who use catheters as their primary access should have real-time continuous monitoring since occasional irregular flow may not be recognized otherwise (42). More recently, observational studies have linked urea clearance below a spKt/V of 1.2 or a URR of 65 percent three times per week to an increased risk of death (43–45).

While observational data from patients on thrice-weekly and daily hemodialysis suggests that even greater levels of urea clearance are linked to improved clinical outcomes, a well-designed, randomized research (HEMO study) (46) demonstrated no effect of a spKt/V goal of 1.65 versus 1.25. The primary results of this study indicate that, with a schedule of thrice-weekly dialysis, neither an increased dose of dialysis nor use of a high-flux membrane substantially improves survival, reduces the rate of hospitalization, or maintains serum albumin levels as compared with a standard dose and use of low-flux membranes. The prevention of frequent hospital hospitalizations, repeated HD sessions, increased strain for nurses, high economic expenses imposed on the health system, and a reduction in the risk of death among HD patients will all come from optimal hemodialysis adequacy. It is impossible to provide appropriate HD without first learning about the current state of HA among these patients and the factors that influence it, As a result, each city appears to need to review the appropriateness of HD (47). HD remains the renal replacement modality for the majority in Iraq. As a result, it is necessary to ensure that enough hemodialysis is achieved. Since as to date, no study has been done to establish the level of HA and its associated factors in all centers providing hemodialysis in Karbala.

2. PATIENTS and METHODS

This was a hospital based cross sectional study in the hemodialysis unit of Imam Hussein medical city, Karbala-Iraq. The study included patients with CKD who had regular hemodialysis sessions in hemodialysis unit during the period from January 2022 to May 2022.

Patients with CKD older than 18 years of age and of both genders were included in this study who performed hemodialysis sessions twice or three times per week and were on regular HD schedule for at least 3 months.

Patients who did not met the inclusion criteria , withdraw from the study after participation, uncooperative, having missed data and those whose HD sessions for less than three hours were excluded from the study.

Data were collected through interviewing individuals using data collection sheet including demographic , clinical variables and laboratory parameters. Before starting hemodialysis, a 2 mL blood sample was taken from the patient's arterial line and forwarded to the laboratory for B. urea testing. The blood pump round was then set at 50–100 ml per minute for 10–20 seconds, then paused, and blood samples for (post HD session urea value) were taken from the arterial line at the end of the same HD session. The Daugirdas equation was used to calculate spKt/V and URR (Daugirdas & Schneditz, 2015). The Kt/V ≥1.2 goals for the measurements were based on the KDOQI Clinical Practice Guidelines (if hemodialysis 3 sessions/week) and Kt/V ≥ 1.8 (if hemodialysis 2 sessions/week) , URR ≥ 65%, The patients' socio-demographic parameters, such as age, gender, current chronic medical conditions, kidney transplantation history, and dialysis vintage, were obtained using the self-reported technique. 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) and type of dialyzer.

Statistical analysis for the study was performed using SPSS Software (version 26 for Windows). Appropriate statistical tests were applied accordingly at a significance level (P.value) of < 0.05

3. RESULTS

A total of 202 patients with ESRD were included in the study. Mean age of participants was 52.4 ± 14.4 (range: 20 – 85) years.

Males were 107 contributed for (53%) of the studied group. However, all demographic and clinical characteristics of the studied group are shown in (**Table 1**).

Hemoglobin levels, Serum albumin and Serum phosphorus levels of the studied group are shown in (**Table 2**). Furthermore, Hemodialysis parameters are demonstrated in (**Table 3**).

Regarding the adequacy of hemodialysis, it was adequate (HA) in 90 patients (44.6%) while it was in adequate (HIA) in the remaining 112 (55.4%) patients, (**Figure 1**)

Comparison of age and weight of HA and HIA patients revealed that patients with HA were significantly younger than those with HIA; the mean age was 48.5 ± 14.0 years and 55.6 ± 14.0 years, respectively, (P. value <0.05). Also HA patients tend to have lower body weight , (P. value <0.05), (**Table 4**).

Comparison of Hemodialysis adequacy across other variables revealed no significant association with each of gender, total comorbidities, cardiovascular disease (CVD), and hypertension (HTN), in all comparisons, P. value >0.05. Diabetic patients were significantly less likely to receive adequate dialysis compared to non-diabetic, similarly, patients with hepatitis C (HC) received less adequate hemodialysis weather HC was alone or coexist with HTN and DM (P. value <0.05) , (**Table 5**)

Adequate hemodialysis appeared to be significantly associated good quality of life, longer duration of hemodialysis session, three sessions per week, type of dialyzer, normal albumin level and lower serum phosphorus level, in all comparisons (P. value < 0.05). HA was not significantly associated with each of UFV, BFR, type of access and hemoglobin level, (P.value >0.05), (**Table 6**)

Table 1. Demographic and clinical characteristics of the studied group

Variable		**No.**	**%**
Age (year)	25-44	49	24.3
	45-60	88	43.6
	>60	65	32.2
	Mean (SD)	52.5 (14.4)	-
Gender	Male	107	53.0
	Female	95	47.0
Weight (kg) mean (SD)		72.3 (16.8)	-
Comorbidities*	DM	90	44.6
	HTN	163	80.7
	CVD	41	20.3
	Hepatitis C	18	8.9
	None	16	7.9
Quality of life	Good	112	55.4
	Poor	90	44.6

**some patients had combined two or more comorbidities*
SD: standard deviation of mean

Table 2. Hemoglobin Serum albumin and Serum phosphorus levels of the studied group

Variable		No.	%
Hemoglobin level	Anemia	189	93.6
	Normal	13	6.4
Serum albumin level	Decrease	83	41.0
	Normal	111	55.0
	Elevated	8	4.0
Serum phosphorus	Decrease	9	4.5
	Normal	90	44.5
	Elevated	103	51.0

Table 3. Hemodialysis related parameters

Variable		**No.**	**%**
Hemodialysis sessions per week	Twice	95	47
	Thrice	107	53
Type of dialyzer	19 H	168	83.2
	17 H	8	4.0
	17 L	11	5.4
	16 H	13	6.4
	10 H	2	1.0
Type of access	DL	6	3.0
	AVF	196	97.0
Duration of hemodialysis (hours)	Three	43	21.3
	Four	159	78.7
Ultrafiltration (per liter)	Below 1 liter	15	7.4
	1 liter	9	4.5
	2	20	9.9
	2.5	8	4.0
	3	57	28.2
	3.5	10	5.0
	4	81	40.0
	4.5	2	1.0
blood flow (ml/min)	180	9	4.5
	200	34	16.8
	250	79	39.1
	300	10	5.0
	Others(in between)	70	34.6

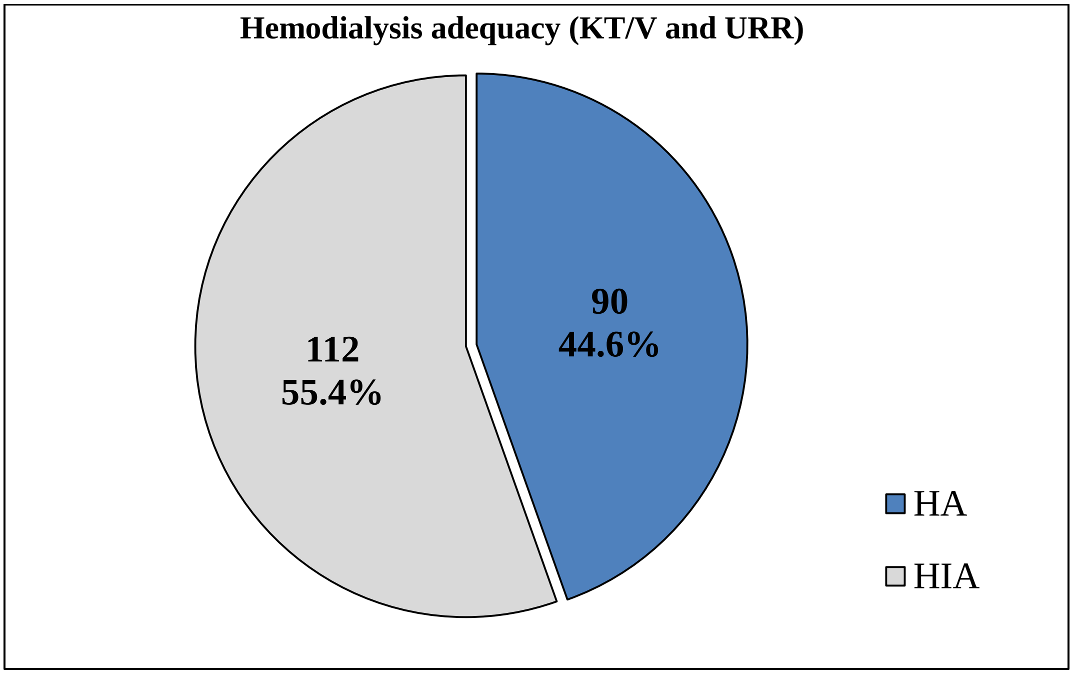

Figure 1. Distribution of the studied group according to the Hemodialysis adequacy

Table 4. Comparison of age and weight of HA and HIA patients

Variable	Hemodialysis adequacy		P. value
	HA (n=90)	HIA (n=112)	
Age (mean ± SD) year	48.5 ± 14.0	55.6 ± 14.0	<0.001
Weight (mean ± SD) kg	69.6± 14.5	74.5 ± 18.2	0.036

Table 5. Effect of comorbidity and baseline characteristics of Patients on hemodialysis adequacy

Variable	**Hemodialysis adequacy**		**P. value**
	HA (N=90)	**HIA (N=112)**	
Gender	**n (%)**	**n (%)**	
Male	45 (42.1)	62 (57.9)	0.448
Female	45 (47.4)	50 (52.6)	
Comorbidities			
With comorbidity	82(44.1)	104 (55.9)	0.684
Without comorbidity	8(50)	8(50)	
CVD	17 (41.5)	24 (58.5)	0.656
HTN	76 (46.6)	87 (53.4)	0.226
DM	31 (34.4)	59 (65.6)	0.010
DM & HTN	28(37.3)	47 (62.7)	0.113
DM &CVD	10 (35.7)	18 (64.3)	0.311
HTN & CVD	15 (41.7)	21 (58.3)	0.701
HTN with DM & CVD	10 (35.7)	18 (64.3)	0.204
Hepatitis C (HC)	3(16.7)	15(83.3)	0.013
HTN with HC	3 (18.8)	13 (81.2)	0.030
HTN with DM and HC	0(0.0)	9(100.0)	0.006

CVD: cardiovascular disease, HTN: hypertension, DM: diabetes mellitus, HC: Hepatitis C

Table 6. Impact of different parameters on hemodialysis adequacy

Variables		Hemodialysis adequacy		P. value
		HA (N=90)	HIA (N=112)	
		n (%)	n (%)	
Quality of life	Good	60(53.6)	52(46.4)	0.005
	Poor	30(33.3)	60(66.7)	
Duration of hemodialysis session	3 hours	10(23.3)	33 (76.7)	0.002
	4 hours	80(50.3)	79 (49.7)	
Session/week	Twice	15(15.8)	80(84.2)	0.0009
	Thrice	75(70.1)	32(29.9)	
UFV (liters)	Below 1	7(46.7)	8(53.3)	0.159
	1 - 2	7(33.3)	24(66.7)	
	2.5 - 3	29(47.4)	36(52.6)	
	More than 3	47(50.6)	46(49.4)	
BFR (ml/min)	Below 200	5(20.8)	11(79.2)	0.077
	200-250	60(41.8)	87(58.2)	
	Above 251	25(61.8)	14(38.2)	
Type of dialyzer	10 H	0(0.0)	2(100.0)	0.004
	16 H	1(7.7)	12(92.3)	
	17 L	2(18.2)	9(81.8)	
	17 H	2(25.0)	6(75.0)	
	19 H	85(50.6)	83(49.4)	
Type of access	DL	1(16.7)	5(83.3)	0.163
	AVF	89 (45.4)	107 (54.6)	
Hemoglobin level	Anemia	87(46.0)	102(54.0)	0.107
	Normal	3(23.1)	10(76.9)	
Serum albumin level	Decrease	28(33.7)	55(66.3)	0.002
	Normal	61(55.0)	50(45.0)	
	Elevated	1(12.5)	7(87.5)	
Serum phosphorus level	Decrease	8(88.9)	1(11.1)	0.0003
	Normal	56(62.2)	34(37.8)	
	Elevated	26(25.2)	77(74.8)	

4. DISCUSSION

Published evidence over the last 10 years has shown that dialysis patient survival is substantially linked to the dialysis dose administered. With increasing dialysis dosages, survival rates improved for all major causes of death, including coronary heart disease, other cardiac diseases such as stroke, and infection. This finding supports the theory that low- dose dialysis can lead to atherosclerosis, infection, malnutrition, and failure to thrive (48).

The Kt/V ratio, which measures urea elimination during treatment, is currently used to assess HD dosing, and a spKt/V of 1.2 (3 sessions/week) and 1.8 (2 sessions/week) is considered acceptable. The National Cooperative Dialysis Study's original data revealed that Kt/V values below 0.8 were linked to a higher risk of morbidity, while Kt/V values between 1.0 and 1.2 were linked to a better outcome (49).

In terms of HA, this study found that about 55 percent of the study population had a Kt/V of less than 1.2, indicating that patients were receiving an inadequate dose. Similar findings from other developing nations, such as Brazil, Nigeria, Nepal, Pakistan, and Iran (about 55–65 percent of patients had a Kt/V 1.2) corroborated these findings (50). Conversely, in industrialized countries, such as the United States, over 90% of patients had a Kt/V >1.2 (51).

Regarding the relationship between Kt/V and URR, all patients with spKt/V of 1.2 had a URR of 65%. These findings were consistent with those of Afshar et al. (52). In contrast, our results disagreed that reported by De Oreo and Hamburger (53).

Among the factors affecting the HA was the patient’s age. The results showed that HA had an inverse relationship with age. Similar findings reported by Moura et al. (54). and Anees et al. (55). However, the results of some studies, such as Lambie et al., showed no significant correlation between hemodialysis adequacy and age (56)., this discrepancy could be attributed to the sampling method and the number of studied subjects. Moura et al. believed that URR was not an independent variable and was influenced by multiple factors including protein intake, and the increase in age resulted in poor nutrition conditions including hypoalbuminemia; these conditions usually reduce HA (54).

In our study, women had more satisfactory HA than men. This finding consistent with Hojjat study (57). In contrary, Tayyebi et al. showed no significant relationship between gender and HA.(58). This difference was due to the differences in gender distribution in various studies.

Factors such as muscle mass, less physical activity, and better compliance with dietary regimen in women led to more satisfactory HA (59).

Regarding patients comorbidities Diabetic and hypertensive nephropathy are the leading underlying etiologies of the ESRD and our findings are consistent with that reported in previous studies in different countries (60–62). Increased BFR was observed to be linked to a greater clearance rate. The observations of Kt/V values of 1.2 (200–250 ml/min, 41.8 percent, 251 ml/min and above, 61.8 percent) demonstrated this. There was no statistically significant variation in clearance rates across the various groups of BFRs. These results were in agreement with the study of Kim et al. (63), Borzou et al. (64), and Saeed et al. (65). Our findings, on the other hand, opposed the findings of Ghali and Malik in AlKadhimiya Teaching Hospital in Iraq (66). The findings are likely related to the effect of other factors affecting dialysis adequacy, such as malnutrition, anemia, brief dialysis sessions, premature end of HD sessions, infection, insufficient blood flow through vascular access, hypotension episodes, technical reasons, study design, and sample size, according to this study. In aspects of HD session duration , clearance was highly associated with a longer duration dialysis session. There was a considerable difference in clearance rates between the various duration periods. These findings matched the study of Lambie et al. (56). They found that HA was affected by time, emphasizing the importance of patients continuing on dialysis for the full recommended time (51).

In terms of frequency of dialysis, we found that increasing dialysis frequency improved clearance rates, which in line with earlier studies that showed a connection between improved clearance rates and increased dialysis frequency (67). Regarding, UF volume, an increase in UF rate was associated with an improvement in Kt/V values (within limitations, as a reduction in clearance rate was observed in patients with UF volume >4 Liters). Few researches have looked at the direct impact of UF value on HD patients' long-term results. Recently, the National Cooperative Study on HA found a relationship between high UF and mortality, which were unrelated to the amount of Kt/V urea provided (68).

Increased dialyzer surface area leads to higher Kt/V values [Table 7]. Findings corroborated prior research on membrane size and clearance rates conducted by Stivelman et al (69) and Pascual et al. Higher rates of urea clearance can be accomplished using bigger surface area dialyzers, which have the added benefit of enhancing blood purification by eliminating large and medium molecular weight solutes (70).

In terms of vascular access, in compared to patients dialyzed with DL access (16.7 percent of them exhibited a Kt/V 1.2), patients dialyzed with AVF access had the highest clearance rate (45.4 percent of them showed a Kt/V 1.2).72 these result disagree with studies by Shariati et al. (71) and Alison (72) which There was no evidence of a link between HA and access type.

In the current study, the mean Hb was 9.0 ± 1.39 g/dl . This result is lower than the KDOQI recommendation of 11–12 g/l Hb. In comparison to other countries, the mean Hb in our research population was lower: In Sweden, mean Hb levels were 12 g/dl; in the United States, Spain, Belgium, and Canada, they were 11.6–11.7 g/dl; and in Australia, New Zealand, Germany, Italy, the United Kingdom, and France, they were 11.1–11.5 g/dl. (73). The following reasons contribute to our patients' low Hb levels when compared to KDOQI guidelines and Hb levels in other countries: Blood loss, insufficient dialysis dose, and insufficient erythropoietin supply There is solid evidence that higher dialysis adequacy has resulted in improved anemia control and other dialysis-related parameters like hypertension and nutritional status (74). Anemia could also be a marker for inflammation and malnutrition, which can influence Kt/V, but this was not evaluated in this study. The positive correlation between albumin and adequacy is in agreement with the study of Azar (75), who discovered that serum albumin and Kt/V had a strong relationship. This data also implies that patients with chronic HD alter their protein intake automatically in response to the dose of HD administered, probably because to an increase in appetite when uremic symptoms in the gastrointestinal systems fade away (e.g., nausea, anorexia, and vomiting). Lindsay and Spanner (76) demonstrated that increasing protein intake in individuals undergoing HD was unsuccessful unless previous increases in the amount of prescribed HD were established first.

We found a strong correlation between dialysis dose (Kt/V) and quality of life (QOL). These findings matched those of Manns (77), who discovered that increasing dialysis dose was linked to a better quality of life and Benz (78), who discovered that increasing dialysis dose was linked to a lower number of night awakenings. As regard, there is strong association among serum phosphorus and HA (74.8% of the patients with elevated serum phosphorus had HIA, while only 25.2% had HA). It is known that hyperphosphatemia is a major risk factor for vascular calcifications and is independently associated with increased risk of death in HD patients (79,80). Dietary restriction and phosphate binding agents are usually used to control serum phosphate levels but have limited efficacy(81). Phosphate removal during HD is limited largely due to the intra-cellular location of most inorganic phosphorus and can be improved by hemodialfiltration, increased dialysis frequencies, and extended treatment times(82).

5. CONCLUSIONS

The majority of patients were not sufficiently dialyzed, and a high percentage of patients did not meet the goals. Major contributory factors to poor outcome may be due to unawareness, late presentation and poor socioeconomic status of patients or may be inappropriate hemodialysis prescriptions. Increasing dialysis time and frequency, dialyzer surface area, patient quality of life, and type of vascular access were all linked to better dialysis adequacy. Attempts to attain the targeted outcome are required. Dialysis adequacy can be achieved by increasing dialysis time and frequency, BFRs, UF volume, adequate patient comorbidity management, and well-functioning vascular access. It is important to evaluate whether targets are met in accordance with KDOQI guidelines in order to enhance long-term results in chronic HD patients.

And we advocate a multidisciplinary treatment strategy with skilled and well-trained physicians, nurses, dieticians, and clinical pharmacists to ensure sufficient dialysis.

Ethical Clearance:

Ethical issues were taken from the research ethics committee. Informed consent was obtained from each participant. Data collection was in accordance with the World Medical Association (WMA) declaration of Helsinki for the Ethical Principles for Medical Research Involving Human Subjects, 2013 and all information and privacy of participants were kept confidentially.

Conflict of interest: Authors declared none

Funding: None, self-funded by the authors

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