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A Study of Hemodialysis Adequacy of Patients Visiting Ostad Motahari Hospital of Jahrom, Iran in 2015: A Descriptive, Cross-Sectional Study

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Abstract

Introduction: Dialysis inadequacy is one of the determinants of morbidity and mortality of hemodialysis patients. Raising dialysis adequacy improves the prognosis of hemodialysis patients. Since the hemodialysis efficiency depends on the dialysis adequacy, it is essential to investigate the factors affecting the hemodialysis adequacy and evaluate the extent of hemodialysis adequacy. Therefore, this article aimed to study the extent of hemodialysis adequacy of the patients visiting the hemodialysis center of Ostad Motahari Hospital of Jahrom, Iran. Method: This is descriptive, cross-sectional study. The study sample consisted of hemodialysis patients visiting Ostad Motahari Hospital of Jahrom, Iran. A total of 95 non-emergency hemodialysis patients entered the study in 2016. Demographic characteristics, age, gender, weight, pre-hemodialysis and post-hemodialysis blood urea nitrogen (BUN), and length of hemodialysis were taken into account. Hemodialysis adequacy was investigated based on kv/t and URR levels. The data were analyzed using SPSS21, descriptive statistics (mean and standard deviation), and inferential statistics (chi-square, Mann-Whitney, and Wilcoxon). Results: 54.7% of the patients were male and 45.3% were female. Chi-square test results showed that hemodialysis adequacy of men and women was different (P<0.001). 83.3% and 78.9% of patients had hemodialysis adequacy in terms of Kv/t and URR levels, respectively. Length of hemodialysis in each session had no significant relationship with hemodialysis adequacy; however, age and weight had a significant relationship (P<0.001). Conclusion: The results showed that 83.3% and 78.9% of patients had hemodialysis adequacy at Kv/t and URR levels, respectively. Therefore, hemodialysis adequacy was optimal in Jahrom, Iran.

Keywords: Hemodialysis Adequacy, Hemodialysis, Chronic Renal Failure

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Introduction

Long-term prognosis of chronic hemodialysis patients is affected by the hemodialysis adequacy. Therefore, hemodialysis adequacy is of great importance for hemodialysis patients (Lindsay et al., 2004). Recognition of dialysis adequacy is not yet complete. BUN measurement and monitoring do not seem sufficient because low BUN shows unfavorable conditions rather than adequate removal of urea by hemodialysis. Efforts were made in 1951 to determine the hemodialysis adequacy in which Urea Kinetic Modeling was employed. The model can be used to determine the real dose using prescribed hemodialysis dose. Urea Reduction Ration (URR) and Single pool Kt/v (SPKt/v) were used to investigate the hemodialysis adequacy. SPKt/v seems a better criteria and is a dimensionless unit showing the cleaned plasma volume divided by the volume of distribution of urea. According to the Urea Kinetic Modeling, minimum SPKt/v of 1.05 is considered for hemodialysis adequacy (Gotch and Sargent, 1985). Since 1993, RPA determined the minimum URR as 65% and SPKt/v greater than 1.2 for hemodialysis adequacy. A significant progress has been observed in hemodialysis of ESRD patients. NKF/DOQL advised the same values in 1997. According to the NKF/DOQI criteria in 2006, Kt/v target was 0.4 and Kt/v greater than 1.3 is considered the minimum acceptable value (Gilmore, 2006). Despite significant progress, 11% of the patients do not acquire the minimum standards of hemodialysis adequacy but are under dialyzed. 55% of under dialyzed patients are associated with hemodialysis under prescription (Franco, 2015). A number of factors are involved in the failure of 1.2 Kt/v including the presence of weak access which causes inadequate blood flow and resircular access. Repeated bouts of low blood pressure, angina and other complications associated with reduced blood flow during hemodialysis are other important factors

(Sehgal et al., 1998). According to United States Renal Data System (USRDS), every increase of 0.1 in Kt/v causes mortality reduction by up to 0.7%. Every 5% increase in URR causes 11% reduction of mortality (USRDS 1996 Annual Data Report, 1996; Owen et al., 1993). According to Hemodialysis Study (HEMO), Kt/v greater than 1.4 causes a reduction in mortality rate (Eknoyan et al., 2002). Despite the significant progress in hemodialysis adequacy in developed countries, most patients have dKt/V≤1.2 in developing countries including Iran. The study was conducted in hemodialysis centers in Ahvaz, Hamedan, Kurdistan, and Sari which showed that 86%, 90%, 100%, and 58% of the patients had dKt/V≤1.2 respectively (Shahbazian and Poorvays, 2002; Nadi, Bashirian and Khosravi, 2003; Delavari, Sharifian and Rahimi, 2001; Taziki and Kashi, 2003). The study by Hojat (2008) in hemodialysis center in Jahrom, Iran on 56 patients undergoing hemodialysis showed that only 17.64% of patients had hemodialysis adequacy (Hojjat, 2009). Type of hemodialysis has changed over time and high-flux filters are recently being used. Taking such changes in to account, it is essential to investigate the hemodialysis adequacy. Pulmonary hypertension has been reported as a prognostic factor of mortality in hemodialysis patients (Yigla et al., 2009; Abdelwhab and Elshinnawy, 2008). Pulmonary hypertension prevalence varies between 20% and 85% in various studies. The main cause of pulmonary hypertension is unknown. Different reasons have been reported on this with hemodialysis inadequacy been implicated as a potential reason (Ramasubbu et al., 2010; Dagli et al., 2009; Fabbian et al., 2011). Hemodialysis inadequacy is one of the most important factors of ESRD mortality rate. Numerous studies have shown the relationship between dialysis inadequacy dose and dialysis complications. Dialysis inadequacy increases the length of hospital stay and frequency and duration of dialysis. In addition to imposing costs on health system, the risks of transmission of infectious agents such as hepatitis B, hepatitis C, HIV, and other blood infections threatens the patients. This highlights effective hemodialysis. According to above mentioned issues and the fact that hemodialysis is a time-consuming and costly process as well as limitations in hemodialysis ward such as few number of devices, time, and high number of patients, cost-effective hemodialysis is performed to only improve the general health. Hemodialysis quality is an important and effective factor in reducing these problems which can be measured in order to reduce and deal with problems. Therefore, it seems essential to study the reasons of inadequate hemodialysis in most hemodialysis centers in Iran. In this regard, this article aimed to determine the hemodialysis adequacy in hemodialysis centers of Jahrom, Iran.

Method:

This is descriptive, cross-sectional study. The study sample consisted of 95 non-emergency hemodialysis candidates visiting Ostad Motahari Hospital of Jahrom, Iran in 2016. The end-stage chronic kidney patients who required hemodialysis were selected by a nephrologist. Census sampling was performed and the patients agreed to participate in the study.

Inclusion Criteria

- ✓ Age over 18
- ✓ Mental health
- ✓ Having an efficient arteriovenous fistula
- ✓ Being dialyzed for at least 6 months

Exclusion Criteria

- ✓ Confounding factors such as hypotension
- ✓ Emergency hemodialysis

All patients were investigated in terms of age, gender, weight, number of years being treated, weekly frequency of hemodialysis, and duration of each hemodialysis session. Medical files of the patients were used to collect demographic characteristics. In order to determine the hemodialysis adequacy, a form was completed including weight, ultrafiltration device, hemodialysis duration, filter clearance coefficient, and flow rate of hemodialysis solution. The amount of urea and the weight before the hemodialysis were measured. Then, hemodialysis was calculated according to the Daugirdas formula and URR indicator was also calculated. Data were analyzed using SPSS 21, descriptive statistics (mean and standard deviation), and inferential statistics (chi-square, Mann-Whitney, and Wilcoxon). Significance level was considered less than 0.05.

Results:

In this study, 54.7% of the patients were male and 45.3% were female. PS10 was the most widely used filter. The highest pump rotation (250) was used. The frequent disease in hemodialysis patients were HTN (45.3%) and DM (29.5%). Mean URR was 0.73±0.08. The minimum URR was 0.52 and the maximum was 0.89 (Table 1). Since Kt/v≥1.2 is the minimum acceptable value for hemodialysis adequacy, 83.3% of the patients had hemodialysis adequacy. Only 16.7% had no hemodialysis adequacy. In URR method, BUN reduction percentage is calculated compared to before the dialysis. If BUN after dialysis reduced to 65% or more, it means that dialysis adequacy is met. In this study, according to URR method, 78.9% of the patients undergoing hemodialysis had hemodialysis adequacy and only 21.1% patients had no hemodialysis adequacy.

Table 1- Descriptive Indicators of Hemodialysis Adequacy

	Mean	Standard Deviation	Minimum	Maximum
Kt/v	1.62	0.38	0.88	2.64
URR	0.73	0.08	0.52	0.89

According to the normal distribution of pre-hemodialysis BUn (P=0.151, Z=1.136) and lack of normal distribution of post-hemodialysis BUN (P<0.001, Z=2.05), Wilcoxon test was used to compare the pre-hemodialysis and post-hemodialysis BUN. The results showed that a significant difference was found (P<0.001). This means that hemodialysis was effective in BUN of hemodialysis patients visiting the hemodialysis center of Ostad

Motahari Hospital of Jahrom, Iran. BUN declined by 8.17 units. Table 2 shows the effect of hemodialysis on BUN of the patients siting the hemodialysis center of Ostad Motahari Hospital of Jahrom, Iran.

Table 2- Determining the Effect of Hemodialysis on BUN of Hemodialysis Patients

	Mean	St. Deviation	Mean Difference	P-Value
BUN-Before	65.83	23.07	-8.17	P<0.001
BUN-After	18.54	11.62		

The results of Mann-Whitney test showed that a significant relationship was found between hemodialysis adequacy and weight (P<0.001) meaning that the weight of hemodialysis patients with adequate hemodialysis was less than that of those with unfavorable hemodialysis adequacy. The results of Mann-Whitney test showed that no significant relationship was found between hemodialysis adequacy and the length of each session of hemodialysis (P>0.001). The results of Chi-square showed that hemodialysis adequacy was different among the male and female patients (P<0.001). It was greater in women than in men, 97.6% opposed to 71.4% at Kt/v level. At URR level, hemodialysis adequacy was greater in women (92.7%) than in men (67.3%). The results of t-independent test showed that hemodialysis adequacy had no significant relationship with age at Kt/v level (P>0.05). However, hemodialysis adequacy had a significant relationship with age at URR level (P<0.05). The mean age of hemodialysis patients at URR level was grater by 0.65% than those with URR<0.65. In other words, the age of hemodialysis patients with optimal URR was greater than those of unfavorable URR. Logistic regression analysis showed that gender (OR=19.39) and HB (OR=0.645) had a significant effect on hemodialysis adequacy at Kt/v level. Hemodialysis adequacy risk at Kt/v level was greater in men then in women by 19.39 times. HB reduced the unfavorable hemodialysis adequacy risk among the males by 64.5% at Kt/v level. Table 3 shows the factors affecting the hemodialysis adequacy of hemodialysis patients at Kt/v level.

Table 3- Factors Affecting Hemodialysis Adequacy of Hemodialysis Patients at Kt/v Level

Kt/v Factor	B	Odds Ratio	Confidence Interval		P-Value
			Upper	Lower	
Gender	2.965	19.399	206.335	1.824	0.014
Age	0.034	1.034	1.091	0.981	1.034
UF	0.943	2.567	7.155	0.921	0.071
Weight	-0.009	0.991	1.063	0.924	0.809
Urea-Before	0.003	1.003	1.045	0.964	0.869
HB	-0.271	0.645	0.963	0.432	0.032

Logistic regression analysis showed that gender (OR=6.69) had a significant effect on hemodialysis adequacy at URR level. Hemodialysis adequacy risk at URR level was greater in men then in women by 6.6 times. Table 4 shows the factors affecting the hemodialysis adequacy of hemodialysis patients at URR level.

Table 4- Factors Affecting Hemodialysis Adequacy of Hemodialysis Patients at URR Level

URR Factor	B	Odds Ratio	Confidence Interval		P-Value
			Upper	Lower	
Gender	1.902	6.697	31.158	1.440	0.015
Age	0.044	1.045	1.092	1.000	0.053
UF	0.353	1.423	3.137	0.646	0.381
Weight	-0.010	0.990	1.047	0.936	0.724
Urea-Before	0.006	1.006	1.039	0.974	0.737
HB	-0.271	0.762	1.055	0.551	0.102

Discussion

Mean Kt/v was 1.62±0.38. The minimum and maximum Kt/v values were 0.88 and 2.64, respectively. Mean URR was 0.730±0.08. The minimum and maximum URR values were 0.52 and 0.89, respectively. Given that Kt/v≥1.2 is considered the acceptable value for hemodialysis adequacy in hemodialysis ward, 83.3% had hemodialysis adequacy. In the study by Samakoush et al mean hemodialysis adequacy index was 1.15±0.31 according to Kt/v criteria. According to Kt/v, 41.7% of the patients had hemodialysis adequacy. In their study, according to URR 41.7% of the patients had URR≥65% which meant there was hemodialysis adequacy (Abedi Samakoosh et al., 2013). The study by Rouzi Talab et al showed that based on Kt/v criteria, 41.5% of the patients had optimal hemodialysis adequacy and 7.3% had hemodialysis adequacy close to optimal. According to URR, 26.8% of the patients had optimal hemodialysis adequacy and 24.4% had hemodialysis adequacy close to optimal. These results are consistent with ours (Roozitalab et al., 2010). The study by Raessi Far et al found that 2.3% of the patients had Kt/v≥1.2 and 6.6% had URR≥65%, showing lack of hemodialysis adequacy (Raiesifar et al., 2009). The study by Vahed Parast et al on dialysis adequacy of hemodialysis patients visiting the hemodialysis center of Busheher, Iran showed that no patient had optimal hemodialysis quality (Parast et al., 2008). The study by Hojat showed that the mean Kt/v was 0.93, showing low-quality hemodialysis (Hojjat, 2009). The studies by Borzou et al. (2006) and Delavari et al. (2001) indicated low-quality hemodialysis. Their results are inconsistent with ours. A significant difference was found between blood urea nitrogen before and after the study (P<0.001), meaning that hemodialysis was effective in the amount of blood urea nitrogen of hemodialysis patients visiting Ostad Motahari Hospital of Jahrom, Iran. The amount of blood urea nitrogen declined by 8.17 units. In the study by Samakoush et al., the blood urea nitrogen significantly declined compared to pre-hemodialysis, showing a statistically significant difference. The study by Rouzi Talab et al showed that pre-hemodialysis blood urea nitrogen had a significant difference with that of post-hemodialysis. Their results are consistent with ours (Abedi

Samakoosh, 2013). No relationship was found between the hemodialysis adequacy at Kt/v level and age. In the study by Samakoush et al no statistically significant difference was found between age and hemodialysis adequacy (Abedi Samakoosh, 2013). Another study by Mogharab Pour showed that age had no significant relationship with Kt/v which is consistent with the results of our study (Mogharab et al., 2010).

The results of our study showed that hemodialysis adequacy was different among men and women. It was greater in women than in men i.e. 97.6% opposed to 71.4% at Kt/v level. At URR level, hemodialysis adequacy was greater in women (92.7%) than in men (67.3%). The study by Hojat showed that hemodialysis adequacy had a significant relationship with gender (Hojjat, 2009). In the study by Samakoush et al, a significant difference was found between gender and Kt/v (Abedi Samakoosh et al., 2013). The study by Mogharab Pour et al showed that gender had a significant difference with Kt/v and hemodialysis adequacy was greater in women than in men which is consistent with the results of our study (Mogharab et al., 2010). The study by by Raessi Far et al however showed that gender had no statistically significant difference with hemodialysis adequacy (Raiesifar et al., 2009), which is inconsistent with our study. It is likely that it is associated with the women's lower BMI, less physical activity, and better compliance of diet.

The results of our study showed that hemodialysis adequacy had a significant relationship with weight. The study by Vehed Parast et al showed that no participants had the essential adequacy. Weight also had a significant relationship with hemodialysis adequacy (Parast and Ravanipour, 2008), which is consistent with our study. That is to say, the weight of hemodialysis patients with optimal hemodialysis adequacy is less than that of those with unfavorable hemodialysis adequacy.

On average, the length of hemodialysis was 3.48±0.10 per session, less than that of Taiwan (4.53), whole Europe (5.4), the USA (3.68), and Germany (3.7). Although time is considered an effective and independent factor in hemodialysis quality, frequency and number of alarms of hemodialysis device, device efficiency, and skills of staff are also of importance. Therefore, increasing the length of hemodialysis promotes the quality of hemodialysis. It should be noted that some staff working in hemodialysis center ignore it due to high number of patients in each shift and inadequate number of hemodialysis devices (Alquist and Bosch, 2008; Kuhlmann et al., 1999; Azar, 2009). The most comparable case with this study is the one by Hojat in Jahrom, Iran. The results showed that pernicious devices had greater efficiency compared to Gyomro devices. Yet, the results of our study showed that hemodialysis adequacy was optimal in Jahrom, Iran. This might be influenced by numerous factors. First, the quality of hemodialysis has improved in recent years because the number of beds increased and more personnel were employed. Old pernicious devices were replaced with Gyomro ones. Secondly, the employment of nephrology specialists was another factor in Jahrom University of Medical Sciences which increased monitoring of hemodialysis ward (Hojjat, 2009). The last factor is early selection of the patients for hemodialysis.

Conclusion:

It seems that early selection of patients for hemodialysis is one of the main reasons of hemodialysis adequacy. In general, the results indicated that hemodialysis adequacy is optimal in Jahrom, Iran.

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