

# Dialysis Adequacy and Kidney Disease Outcomes Quality Initiative Goals Achievement in an Iranian Hemodialysis Population

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**Introduction.** We conducted this study to measure hemodialysis adequacy and determine to what extent some Kidney Disease Outcomes Quality Initiative (KDOQI) goals are achieved in our patients.

**Materials and Methods.** In a cross-sectional study in Fars province, Iran, we assessed 632 patients on hemodialysis in 15 dialysis centers. The Kt/V was calculated, and data on serum levels of albumin, cholesterol, and triglyceride, hemoglobin level, blood pressure, body weight, and body mass index were collected. The values were compared with the KDOQI recommended target values.

**Results.** The mean age of the patients was  $54.36 \pm 16.34$  years. The mean Kt/V was  $0.97 \pm 0.42$ , which was significantly higher in those who received 3 dialysis sessions per week than those on 2 dialysis sessions per week ( $P = .03$ ). Only 32.1% of all patients achieved the Kt/V goal. Seventy-four percent of the patients had a serum albumin equal or greater than 4 g/dL. Hemoglobin levels were between 4.6 g/dL and 16.8 g/dL, and half of the patients had attainment of the hemoglobin target. Cholesterol target was reached in 40% of patients. Only 43 patients (6.8%) attained all targets recommended by the KDOQI guidelines.

**Conclusions.** The target values, except for serum albumin, were not reached in our patients. We conclude that it is necessary to provide essential equipment of dialysis centers such as dialysis machine and trained staffs, and also to raise awareness of KDOQI goals among patients and physicians.

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## INTRODUCTION

Worldwide, the prevalence of end-stage renal disease (ESRD) is high.<sup>1-3</sup> Its prevalence in Iran is high, too.<sup>4</sup> The prevalence of renal replacement therapy patients in Iran was 238 per million people, hemodialysis being the most common renal replacement therapy modality.<sup>5</sup> The incidence of ESRD has been increasing in Fars province every year (18% increase from 2006 to 2007). The National

Kidney Foundation has formulated the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines to improve the care of patients with chronic kidney disease. These guidelines have led to improvement in the process of kidney disease care, as evidenced by improvement in clinical performance measures.<sup>6</sup> Attainment of accepted clinical performance targets for nutrition, anemia management, and dialysis adequacy (measured by

Kt/V, which is the only widely accepted method to quantify the dose of dialysis) led to fewer hospitalizations and decreased hospitalization costs, in addition to better patient survival.<sup>7-10</sup> However, reaching all the KDOQI goals is not always possible. Arenas and colleagues showed a large proportion of their patients failed to reach the KDOQI targets.<sup>3</sup> In Iran, Borzou and coworkers<sup>2</sup> showed that only 16.7% of their patients had a Kt/V higher than 1.3.

We studied hemodialysis adequacy and the extent of achieving some KDOQI targets among the patients with ESRD on hemodialysis in Fars province, Iran.

## MATERIALS AND METHODS

### Study Design

In a cross-sectional study, we measured hemodialysis adequacy and determined to what extent some KDOQI goals had been achieved in patients with ESRD on hemodialysis in Fars province of Iran between September 2008 and November 2008. The studied population consisted of 632 patients who were on treatment at 15 hemodialysis centers in 13 cities. Dialysis sessions were 3 times per week in 120 patients (19%), twice in 279 (44.1%), and once in 233 (36.9%). The mean of dialysis time was  $3.9 \pm 0.2$  hours. Seventy-two percent of the patients had an arteriovenous fistula, 8% had a catheter, and 20% had a graft. Informed consent was obtained from all of the patients.

### Data Collection

Blood samples from the patients on hemodialysis were collected from the arterial line immediately before a mid-week single dialysis session before heparin administration in a fasting state and centrifuged and frozen at  $-70^{\circ}\text{C}$  before the measurements. The following were measured in blood samples: hemoglobin, albumin level (BCG method, Brown Crezo Green), blood urea nitrogen level (enzymatic method, UV-Kinetic), and triglyceride and cholesterol levels (enzymatic method, End point). The Kt/V was calculated according to the Daugirdas formula.<sup>11</sup> The targets we selected for these measures, which were based upon the KDOQI Clinical Practice Guidelines<sup>12</sup> were: albumin,  $\geq 4.0$  g/dL; hemoglobin,  $\geq 11$  g/dL; cholesterol, 150 mg/dL to 250 mg/dL; and Kt/V,  $\geq 1.2$ . We also collected data on demographic and

clinical characteristics and measurements of systolic and diastolic blood pressure before the dialysis sessions were carried out. The measured height and weight were used to calculate body mass index.

### Statistical Analyses

All variables had a normal distribution; therefore, we used parametric tests. We compared patient characteristics and clinical data using the chi-square test for categorical variables and 2-sided Student *t* tests, the Pearson correlation test, and the analysis of variance for continuous variables. Data were analyzed using the SPSS software (Statistical Package for the Social Sciences, version 15.0, SPSS Inc, Chicago, Ill, USA). A *P* value less than .05 was considered significant.

## RESULTS

### Patients Characteristics

There were 632 patients on hemodialysis of whom 58.3% were men, 272 (43.1%) were 60 years or older. Table 1 shows the patients' characteristics and their laboratory data. The mean ESRD duration was  $22.4 \pm 15.0$  months. The mean Kt/V was  $0.97 \pm 0.42$  that was not different between men and women ( $1.00 \pm 0.43$  versus  $0.95 \pm 0.42$ , *P* = .19). However, the Kt/V was significantly higher in those who received 3 dialysis sessions per week than those on 2 dialysis sessions per week ( $1.40 \pm 0.50$  versus  $0.92 \pm 0.44$ , *P* = .03).

**Table 1.** Characteristics of Patients on Hemodialysis

Parameter	Mean $\pm$ Standard Deviation (Range)
Age, y	54.36 $\pm$ 16.34 (8.0 to 87.0)
Height, m	1.63 $\pm$ 0.10 (1.0 to 1.9)
Predialysis	
Body weight, kg	66.23 $\pm$ 13.85 (18.0 to 103.0)
Body mass index, kg/m <sup>2</sup>	24.89 $\pm$ 4.54 (13.4 to 38.9)
Systolic blood pressure, mm Hg	147.8 $\pm$ 25.6 (90 to 210)
Diastolic blood pressure, mm Hg	83.8 $\pm$ 11.1 (50 to 130)
Postdialysis	
Body weight, kg	64.14 $\pm$ 13.75 (18.0 to 100.0)
Body mass index, kg/m <sup>2</sup>	24.10 $\pm$ 4.48 (12.7 to 37.6)
Kt/V	0.97 $\pm$ 0.42 (0.1 to 2.1)
Time period of dialysis	3.94 $\pm$ 0.23 (2.0 to 4.0)
Serum albumin, g/dL	4.73 $\pm$ 1.46 (0.4 to 12.0)
Hemoglobin, g/dL	10.69 $\pm$ 2.08 (4.6 to 16.8)
Serum triglyceride, mg/dL	141.27 $\pm$ 64.51 (36.0 to 519.0)
Serum cholesterol, mg/dL	150.94 $\pm$ 34.20 (72.0 to 280.0)

A significant inverse correlation was found between Kt/V and serum triglyceride level ( $r = -0.09$ ,  $P = .02$ ), while the correlation between Kt/V and body mass index was direct ( $r = 0.09$ ,  $P = .01$ ). Also, there was a significant direct correlation between body mass index and hemoglobin level ( $r = 0.33$ ,  $P = .001$ ). Systolic and diastolic blood pressures were significantly higher in patients aged 60 years or older as compared to those younger than 60 years old ( $P = .04$ ).

### Achievement of Kidney Disease Outcomes Quality Initiative Goals

The proportions of patients achieving the KDOQI goals are shown in Table 2. Only 32.1% of all patients achieved the Kt/V goal who were predominantly women ( $P = .001$ ). Also, attaining the target Kt/V was more likely in patients that received more sessions of dialysis per week, but this was not significant ( $P = .18$ ). A higher proportion of patients (74%) had a serum albumin equal or greater than 4 g/dL, and more sessions of dialysis per week was associated with a higher frequency of attaining target albumin ( $P = .001$ ). Moreover, a larger proportion of younger patients (< 60 years) had an albumin level of target ( $P = .02$ ). Hemoglobin levels were between 4.6 g/dL and 16.8 g/dL, and only 50% of patients had attainment of the hemoglobin target, with no significant association between hemoglobin target attainment and dialysis times per week. Cholesterol target was reached in 40% of patients, and those with attained cholesterol target were significantly more frequent in the elderly than the younger patients ( $P = .02$ ).

There were positive significant correlations between attainment of the hemoglobin target and attainments of multiple targets (albumin, cholesterol, and Kt/V;  $P = .03$ ). Only 43 patients (6.8%) attained all targets recommended by the KDOQI guidelines.

### DISCUSSION

Hemodialysis is an established treatment of ESRD. It is the most common renal replacement therapy modality in Fars province. A study in United States showed that the mean Kt/V was  $1.3 \pm 0.29$ , and another study reported that the mean Kt/V was  $1.3 \pm 0.2$  in Japan.<sup>13,14</sup> However, some studies in Iran showed the mean Kt/V was  $0.97 \pm 0.25$  and  $0.94 \pm 0.37$ .<sup>15-17</sup> We had a mean Kt/V of  $0.96 \pm 0.40$  in Fars province of Iran. This indicator was significantly higher in those who received 3 sessions of dialysis per week. The ratio of patients to machines was 3.5:1, which was not equally distributed in all centers. The main reason of low Kt/V in our patients can be the limited number of hemodialysis machines in some centers that resulted in a short dialysis time, while the incidence of ESRD has been increasing in Fars province every year. Another reason is low blood flow and recirculation at fistula or double-lumen catheter (72% of our patients had an arteriovenous fistula, 8% had a catheter, and 20% had a graft). A less frequent reason could be noncompliance of the patients that may be caused by distant residence place to dialysis centers and low socioeconomic status of some patients. Our results suggest that for improving outcomes in patients on hemodialysis and promotion of their quality of life, increasing the Kt/V should be noticed by increasing in the number of available dialysis machines and longer dialysis duration, providing a better access (fistula or line), and scheduling more frequent dialysis sessions.

One study reported the mean of body mass index was  $21.7 \pm 4.8$  kg/m<sup>2</sup> in patients on hemodialysis.<sup>18</sup> However, in the current study, the mean of body mass index was higher ( $24.89 \pm 4.54$  kg/m<sup>2</sup>). According to a Dialysis Outcomes and Practice Patterns Study, the mortality risk decreased as the body mass index of the patients decreased.<sup>1</sup> Our

**Table 2.** Baseline Characteristics of Patients in Relation With Attainment of Kidney Disease Outcomes Quality Initiative Targets\*

Attained Targets	All (n = 632)	Dialysis per Week			P	Sex		P
		1 (n = 120)	2 (n = 279)	3 (n = 233)		Male (n = 361)	Female (n = 258)	
Kt/V	203 (32.1)	31 (25.8)	82 (29.4)	78 (33.5)	NS	105 (29.1)	96 (37.2)	.001
Serum albumin	468 (74.1)	87 (72.5)	205 (73.5)	70 (75.5)	.001	266 (73.7)	189 (73.3)	NS
Serum cholesterol	253 (40.0)	48 (40.0)	116 (40.7)	89 (38.2)	NS	151 (41.8)	96 (37.2)	NS
Hemoglobin	313 (49.5)	62 (51.7)	136 (48.4)	115 (49.4)	NS	175 (48.5)	126 (48.8)	NS

\*Values in parentheses are percents.

results showed that there is a significant correlation between body mass index and Kt/V; it means the patients with higher body mass index have better Kt/V. Smaller patients were subject to greater risk of death than larger patients if their Kt/V were reduced.<sup>7</sup> A similar study showed mean the mean body mass index was 25.55.3 kg/m<sup>2</sup> and increase in body mass index was associated with reduced short-term relative risk of mortality.<sup>19</sup>

In this study, the mean serum albumin, cholesterol, and triglyceride were 4.7 g/dL, 150 mg/dL, and 141 mg/dL, and in a similar study of Lenz and colleagues, the mean values of these were 3.5 g/dL, 180 mg/dL, and 183 mg/dL, respectively.<sup>20</sup> Serum albumin level is one of the best predictors of nutrition in patients on hemodialysis, and a low serum albumin is linked with elevated relative risk of mortality. A strong inverse association was observed between mortality and serum albumin, with a mortality risk of 1.38 times higher for patients with a serum albumin concentration less than 3.5 g/dL.<sup>1</sup> A serum cholesterol value less than 160 mg/dL is also linked with elevated relative risks of mortality.<sup>6,19</sup> In our study, the albumin level was acceptable, despite low value for other nutritional markers, and we do not have any reason for that. Partial correction of anemia is associated with a decrease in the risk of death and hospitalization. Also, it is suggested that additional incremental improvements in mortality and morbidity rates may be realized when hemoglobin is maintained above the target range recommended by the KDOQI.<sup>21</sup> The mean of hemoglobin concentration for our patients was 10.7 g/dL, compared with 10.31.9 g/dL, and 121.1 g/dL in other studies.<sup>13</sup> About half of our patients had a hemoglobin concentration less than the KDOQI goal; if the minimum of hemodialysis treatment is not accomplished as 3 sessions and 10 to 12 hours per week, the goals of KDOQI will be impossible to reach. Thus, further research should be done for assessing anemia problem among hemodialysis patients. Recent reports in the United States have shown that 82%, 60%, and 31% of hemodialysis patients attained a Kt/V equal to 1.2 or higher, a hemoglobin level of 11 g/dL or higher, and a serum albumin level higher than 4.0 g/dL, respectively.<sup>6</sup> Also, Arenas and associates, after application of the KDOQI recommendations in their study group, showed a large proportion of their patients failed to reach

the proposed targets.<sup>3</sup>

In our cohort, the mean values of the dialysis quality indicators, except for albumin, were lower than the similar studies worldwide. Also, only 6.8% of the patients attained all the KDOQI targets. Performance target attainment is associated with better patient outcomes, including decreased hospitalization, hospital stays, associated costs, and also better survival and quality of patient's life. However, attainment of clinical performance targets in patients requires considerable time and effort on the part of providers and patients. A method is being attempted to move towards a better level of performance; in the first step, it is necessary to provide essential equipments for dialysis centers such as dialysis machine and trained staffs, to raise the awareness of the KDOQI goals among patients, and to perform measurement with feedback to providers.

## CONCLUSIONS

According to the KDOQI recommendations, a large percentage of our patients did not attain the targets. We conclude that it is necessary to provide a multidisciplinary method for achieving better dialysis adequacy and quality of life among our patients.

## CONFLICT OF INTEREST

None declared.

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