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Original Article

Extent of Achieving KDOQI Targets For hemodialysis Adequacy in Libyan dialysis patients: A Multicentre Cross-Sectional Study

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ABSTRACT

Dialysis is a therapy to maintain the lives of end stage renal disease patients (ESRD), and the adequacy of hemodialysis is essential as it can improve patient's survival, quality of life and biochemical profiles. This study aimed to evaluate the extent of achieving Kidney Disease Outcomes Quality Initiative (KDOQI) targets for dialysis adequacy, haemoglobin level, mineral bone disorders and nutritional status among hemodialysis patients. patients and method: This study was carried out on 286 regular haemodialysis adult patients from eleven hemodialysis centers in Libya. Patients subjected to BMI calculations. Blood samples collected for complete blood count, serum albumin, blood urea pre and post dialysis session, serum creatinine, total serum calcium, serum phosphate, serum alkaline phosphatase, C reactive protein, and serum iPTH levels. Targets measures based on the KDOQI Clinical Practice Guidelines. **Result**: Mean Kt/V was 1.31±0.40.only 174 (60.84%) patients had adequate dialysis dose (Kt/V>1.2). Mean iPTH was 490.08±694.7. According to the KDOQI, guideline 19.2% of the patients was within the target range for parathormone level. 26.92 % of studied patients had a haemoglobin level of 11gm/dl or more. Mean serum albumin is 3.81±0.64, hypoalbuminemia (albumin <3.5g/dl) was in 27.98% of studied patients. Conclusion: According to KDOQI guidelines 39.16% of the studied patients did not achieve the target dose for adequate clearance, 73.08% did not achieve the target haemoglobin level; and, only 19.2% of the studied patients were within the target range for parathyroid hormone level. According to BMI as nutritional markers, 14.0% of studied patients were underweight and 27.98% were with serum albumin below (3.5 g/dl).

Keywords: hemodialysis, adequacy, KDOKI targets, Libya

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Introduction:

End-Stage Renal Disease is prevalent worldwide, and the numbers of newly diagnosed patients have been rising annually across most countries [1]. ESRD (End-Stage Renal Disease) carries great morbidity, mortality, and huge expense of resources. Dialysis is essential to maintain the life of ESRD patients and haemodialysis is the main modality used worldwide as renal replacement therapy. Adequacy of haemodialysis is very important as it can improve patient's survival [2,3], quality of life, biochemical profiles[4], and minimize disease complications and hospitalizations[5]. Assessment of haemodialysis adequacy is one of the key factors in evaluating the health service system. The most widely accepted measures of urea clearance is Kt/V, which is the ratio between the product of urea clearance (K, in ml/min) and dialysis session duration (t, in minutes) divided by the volume of distribution of urea in the body (V, in mL) and urea reduction ratio, which is derived solely from the percentage fall in serum urea during a dialysis treatment. Kt/V is the most tested measure of the dialysis effect on hemodialysis patient survival and is the most frequently applied measure of the delivered dialysis dose [6]. Kt/V has been expressed in several different ways [7]. The National Kidney Foundation Disease Outcomes Quality Initiative (KDOQI) guidelines recommend that the minimum adequate dose of haemodialysis given three times per week to patients with Kr less than 2 mL/ min/1.73 m2 should be a single-pool Kt/V of 1.2 per dialysis. For treatment times less than 5 hours, an alternative minimum dose is a urea reduction ratio (URR) of 65%.

The aim of this study is to evaluate the hemodialysis adequacy and extent of achieving KDOQI targets for dialysis adequacy, haemoglobin level, mineral bone disorders and nutritional status among patients on maintenance haemodialysis in Libya.

Patients and method

A cross-sectional study was carried out on 286 randomly selected regular hemodialysis adult patients from eleven hemodialysis Centres in Libya. An informed consent was collected from all included patients, the study started in September 2019, ended in March 2021. All patients subjected to dry body weight and height measurements for BMI calculations. Medical records revised for aetiology of ESRD. Blood samples collected immediately from arterial fistula needle after insertion without tourniquet before starting haemodialysis for complete blood count, serum albumin, predialysis blood urea, serum creatinine, total serum calcium, serum phosphate, serum alkaline phosphatase, C reactive protein, and serum iPTH levels. At the end of the dialysis session, blood samples collected according to KDOQI guideline were collected to calculate urea clearance.

Kt/V was calculated using the second-generation Daugirdas formula [8]; Single-pool Kt/V = −In (R −0.008 × t) + (4 −3.5 × R) ×UF/W. where In represents the natural logarithm; R is the ratio of post-dialysis to predialysis BUN; t is the length of dialysis session in hours; UF is the ultrafiltration volume in litres, and W is the patients post-dialysis weight in Kilograms. Online medical calculators were used.

Hemodialysis prescription revised to detect, treatment time, vascular access, type of dialysis machine, dialyzer membrane properties, ultrafiltration volume, blood flow and dialysate flow.The targets of measuring dialysis adequacy were based on the KDOQI Clinic

al Practice Guidelines, Single-pool Kt/V > 1.2, URR ≥ 65% for adequate dialysis dose, haemoglobin 11.0–12.0

g/dl and iPTH 150 -300 (pg/ml)and body mass index(BMI) and serum albumin as nutritional markers.

According to the study result of Kt/V, patients classified into two groups according to KDOQI guideline; Group 1, who have adequate dialysis dose with Kt/V of at least 1.2, and Group 2 who have inadequate dialysis dose included patients with Kt/V less than 1.2. Data were analysed using Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were obtained for all continuous and categorical variables as appropriate.

Result

Of the 286 patients, 97 (33.92%) were female; mean age of the patients was 50.74± 14.62 years (range 18-86 years). The mean BMI was 25.71± 5.46, range (7.21–41.41) kg/m2. Diabetes mellitus is the main aetiology of ESRD (End-Stage Renal Disease) constitutes 36% of patients, followed by hypertension in 26%.

Figure 1 shows the pattern of aetiology of ESRD in the patients of the study, and Table 1 summarizes the statistics of all data.

Figuer1: Pattern of aetiology of renal disease

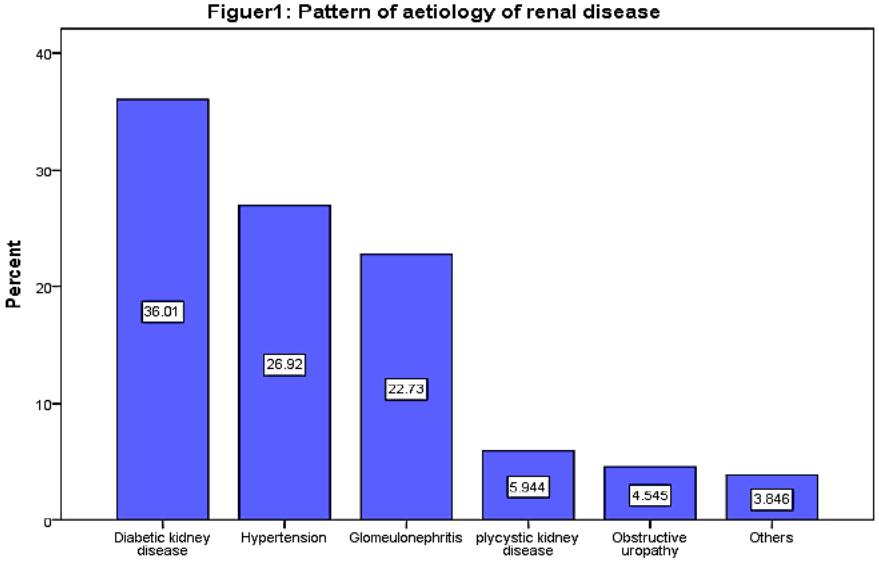


Table 1: Summary of all statistical data of patients in study

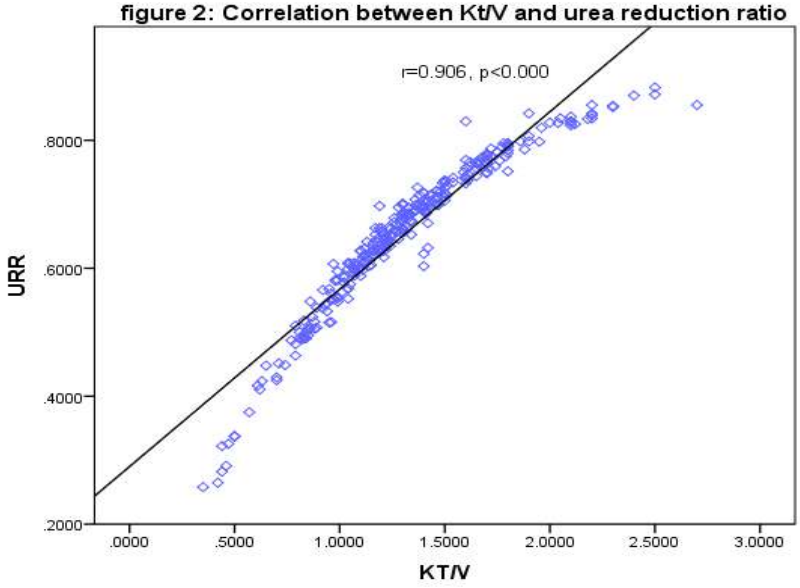
%	N	Minimum	Maximum	Mean	Std. Deviation
Age Years	286	18	86	50.74	14.62
Male (66.08%)	189	18	86	51.92	14.54
Female (33.92%)	97	18	75	48.44	14.56
BMI	286	7.21	41.41	25.71	5.46
Hb g/dl	286	5.00	14.50	9.71	1.745
HCT	286	16.60	47.00	29.22	6.08
Albumin g/dl	286	2.20	5.70	3.81	0.64
CRP mg	286	0.00	234.00	25.57	37.44
Calcium mg/dl	286	5.00	12.40	8.77	1.04
Phosphorus mg/dl	286	1.10	13.30	5.75	2.07
Alk mg/dl	286	2.36	1609.00	187.12	193.04
PTH pg/ml	286	4.81	5500.00	490.08	694.69
Treatment time min	286	150	270	228.53	20.80
Blood flow ml/min	286	170	450	269.30	40.31
Dialysate Flow ml/min	286	250	800	469.93	75.33
Dry body weight Kg	286	30.00	113.00	70.80	16.04
Urea predialysis mg/dl	286	68.00	350.00	136.08	52.14
Urea post dialysis mg/dl	286	12.00	172.00	46.65	24.90
URR	286	0.23	0.88	0.65	0.12
URR ≥ 65% (56.64%)	162	0.65	0.88	0.73	0.06
URR< 65% (43.36%)	124	0.26	0.65	0.55	0.09
Kt/V	286	0.35	2.70	1.31	0.40
Kt/V≥1.2 (60.84%)	174	1.20	2.70	1.55	0.31
Kt/V<1.2 (39.16%)	112	0.35	1.19	0.94	0.20

BMI: Body Mass Index. Hb Haemoglobin, HCT Haematocrit, CRP C Reactive Protein, ALK Alkaline Phosphatase, PTH Parathyroid Hormone, URR Urea Reduction Rate

g/dl and iPTH 150 -300 (pg/ml)and body mass index(BMI) and serum albumin as nutritional markers.

patients were on three sessions of hemodialysis per week, 269 (94.05%) patients were dialyzed from arterio-venous fistula with mean blood flow 269.30±40.31ml/min, mean dialysate flow 469.93±75.33 ml/min, calcium concentration in dialysis solution 1.75mmol/l for all patients, mean treatment time 228.53±20.80 min and the mean interdialytic weight gain was 2.31±1.11 L. Different dialyzers used, but all of them are highly efficient dialyzer (KoA for urea is more than 800ml/min) and surface area of more than 1.4 square meters, 183 (64%) patients were on high flux dialyzer and 103 (36%) patients on low flux dialyzers. The mean Kt/v was 1.31±0.40 and mean URR (urea reduction ratio) 0.65±0.12, the correlation between dialysis dose (Kt/V) and URR was statistically significant (P < 0.00) (Figure 2).

figure 2: Correlation between Kt/V and urea reduction ratio



174 (60.84%) patients are in the adequate group (Kt/V>1.2) and 112 (39.16%) patients in inadequate group (Kt/V<1.2) table 1. There was no significant association between haemodialysis adequacy and different age groups (P = 0.304) or BMI (P = 0.576).

Female patients showed better clearance rate (64.9%) while male patients (58.7%). Percentage differences for Kt/V values among male and female patients were statistically insignificant (P = 0.186) Table 2.

Table:2 Comparison between Kt/V values with respect to Gender

	Group 1		Group 2		Total	Fischer	
	N	%	N	%	N	exact test	*P*-value
Male	111	58.7	78	41.3	189	1.037	0.186
Female	63	64.9	34	35.1	97		
Total	174	60.84	112	39.16	286		

58.3% of patients who dialyzed with low flux high efficient dialyzers achieved target dose (Kt/V>1.2), and only 62.3% of patients who dialyzed with high flux high efficient dialyzers achieved target dose. dialyzer groups were statistically insignificant (P = 0.501).

There are significant association between

Table: 3 Comparison between Kt/V values with respect to treatment time								
Treatment time	N	%	N	%	N	%	χ2-test	
	Group 1		Group 2		total		χ2	*P*-value
3 hours	5	16.7	25	83.3	30	100	**31.66**	.000
3.5 hours	23	52.3	21	47.7	44	100		
≥4 hours	146	68.9	66	31.1	212	100		
Total	174	60.84	112	39.16	286	100		

Percentage differences for Kt/V values among both clearance and treatment time of dialysis session [(P = 0.000) table 3], and blood flow [(P =0.000) table 4].

Table: 4 Comparison between Kt/V values with respect to Blood Flow Rate								
BFR ml/min	N	%	N	%	N	%	χ2-test	
	Group 1		Group 2		Total		χ2	*P*-value
< 250	55	43.0	73	57.0	128	100	**31.235**	.000
250-300	107	75.9	34	24.1	141	100		
> 300	12	70.6	5	29.4	17	100		
Total	174	60.84	112	39.16	286	100		
BFR: Blood flow rate								

Table: 5 Distribution of the studied patients according to Laboratory mineral bone disorder indicators		
	N	%
PTH (pg/ml)		
<150	88	30.8
150-300	55	19.2
>300	143	50.0
Ca (mg/dl)		
<8.5	107	37.4
8.5 -9.5	125	43.7
>9.5	54	18.9
Pi(mg/dl)		
<2.5	18	6.30
2.5 -4.5	60	21.0
>4.5	208	72.7
Ca, calcium; Pi, inorganic phosphate; PTH, Parathyroid hormone.		

Mean iPTH was 490.08±694.7, according to the KDOQI guideline Hyperparathyroid bone disease was prevalent in 50% and low bone turnover in 30.8% of the studied patients. Hypocalcemia and hyperphosphatemia observed in 37.4% and 72.7% of the studied patients, respectively (Table 5)

The mean haemoglobin level is 9.71±1.74, only 26.92 % of studied patients had a haemoglobin level of 11gm/dl or more, 36.36% of patients had a haemoglobin level less than 9.0 g/dl. Mean serum albumin is 3.81±0.640, hypoalbuminemia (albumin <3.5g/dl) was found in 27.98% of studied patients.

Discussion

The mean age of the patients was 50.74± 14.62 years, similar to the Gulf Cooperation Council countries (GCC) [9], but less than the west European countries where the mean age is more than 60 years [10]. Diabetic kidney disease was the Maine aetiology of ESRD (37.86%), other aetiologies are as shown in figure 1, which is similar to the result of an old study[11] done in Libya in 2012.

Adequate dialysis is the cornerstone for the wellbeing of each patient, and achievement of the global goals is of paramount importance to improve quality of life, decrease healthcare costs and decrease morbidity and mortality rates in haemodialysis patients [3, 4].

Mean Kt/V is 1.31±0.40, Only 60.84% of the patients achieved the target dose, these results were in agreement with similar findings from Saudi Arabia [9], but less than that in the United States and European (DOPPS) countries (Mean Kt/V is 1.6 and more than 90% of patients reached target dose) [10], mean treatment time achieved is 228.53±20.8 which is similar to results from united kingdom, Italy and United State [11]. Although all dialyzers are high efficient dialyzer and treatment time achieved is near to that data in DOPPS 4 study, 39.16% of the patients did not achieve adequate dose, Blood flow is an essential determinant factor in clearance and Kt/V, 94.05% of the patients dialyzed from arteriovenous fistula but mean blood flow in our study is 269.30±40.3 mil/min, which is too low in comparison to European DOPPS country (300 – 360 ml/min) and United State (more than 400ml/min)[12].

Regards the relationship between Kt/V and URR, the results of our study revealed that all patients with spKt/V at least 1.2 had URR of at least 65%, a statistically significant positive correlation between Kt/V and URR (P < 0.00) (Figure 2).

64.9% of female patients who included in our study achieved the adequate dose while only 58.7% of male patients reached target Kt/V, Further analysis of these percentages revealed the apparent difference is insignificant (P = 0.186) table 2.this result was in agreement with a similar study from Egypt[13].

Aanalysis of the results of the present study revealed that increased treatment time was associated with an increased rate of clearance. That was clear from the findings of Kt/V values of at least 1.2(3 hours, 16.7%; 3.5 hours, 52.3%; 4 hours, 68.9%). The difference in clearance rates among the various groups of treatment time was statistically significant [(P =0.000) table 3]. The results were in agreement with the study by Stewart et al[14], who showed that time still had a profound effect on dialysis adequacy. Higher blood flow rates were associated with better clearance, the adequacy of the haemodialysis is significantly associated with blood flow rate [(P =0.000) table 4]. These results were in agreement with the study by Kim et al [15] and Borzou et al [16].

According to KDOQI guideline (dialysis and non-dialysis patients with CKD receiving ESA therapy, the selected Hb target should generally be in the range of 11.0 to 12.0 g/dl), only 26.92 % of studied

patients achieved the target range (11.0 to 12.0 g/dl), 36.36% of patients had haemoglobin level less than 9.0 g/dl. These results reflect inappropriate anaemia management protocol.

CKD-MBD describes a broad clinical syndrome that develops as a systemic disorder of mineral and bone metabolism because of CKD, which can manifest with anyone or a combination of abnormalities: of Calcium, phosphorus, Parathyroid Hormone, vitamin D metabolism, abnormalities of bone turnover, mineralization, volume, linear growth, and strength. In addition to vascular or soft tissue calcification, numerous cohort studies have shown associations between disorders of mineral metabolism and fractures, cardiovascular disease, and mortality in patients with CKD [17-19].

80.8% of the patients had metabolic bone disorders, of which (30.8%) have low bone turnover, (50%) hyperparathyroid (high bone turnover), and only 19.2% of patients are within target range according to KDOQI guidelines [table5]. Hypocalcaemia and Hyperphosphatemia (37.4% and 72.7%) are markedly high in studied patients. Protein-Energy Wasting (PEW) is a relatively prevalent problem among adult haemodialysis patients. PEW is an important determinant of morbidity and mortality in haemodialysis patients. According to the KDOQI recommendations, bioelectrical impedance analysis of body composition and Dual-Energy X-Ray Absorptiometry (DXA) are the best tools for nutritional status assessment in haemodialysis patients. Body mass index (BMI) also is reasonable to assess the Nutritional Status of dialysis patients [20].

According to BMI; 37.1% of the patients are within the range of body weight, and 40 Patients (14%) are underweight. In contrast with serum albumin as a nutritional marker, hypoalbuminemia (serum albumin <3.5 g/dl) was present in (27.98%) of the studied patients.

Conclusion:

Mean Kt/V (1.31) in studied patients was lower than in western developed countries. (39.16%) of the patients who did not achieve the KDOQI target dose will be at increased risk of morbidity and mortality. The mean blood flow rate was 269.30ml/min, and the mean treatment time was 228.53min, increasing blood flow rates and treatment time will enhance more achievement of higher Kt/V. 73.08% of studied patients didn't achieve target haemoglobin level and will be at risk of all complications of anaemia. According to KDOQI guidelines for CKD-MBD, only (19.2%) of the studied patients were within the target range for parathyroid hormone level and (80.8%) had metabolic bone disorders either in the form of high bone turnover disease(50%) or low turnover bone disease (30.8%). According to BMI as a nutritional marker, only (14%) of studied patients was underweight, and (27.98%) were with serum albumin below (3.5 g/dl).

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