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RESEARCH ARTICLE

ASSESSMENT OF HAEMODIALYSIS ADEQUACY AMONG ESRD IN SOKOTO USING UREA REDUCTION RATIO AND SERUM ALBUMIN CONCENTRATION

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ABSTRACT

Introduction: Among patients with end stage renal disease (ESRD) who are treated with haemodialysis, solute clearance and nutritional adequacy are determinants of mortality. The aim of this study was to assess the adequacy of haemodialysis among patients with ESRD in Sokoto.
Material and Methods: This was a prospective study that included fifty three (53) ESRD patients that are on maintenance haemodialysis. Each patient was dialyzed thrice using same dialyzer after reprocessing with 4% formaldehyde. Demographic and socio-economic data were obtained using questionnaires administered to each patient. Blood samples were collected at the baseline, before and after each haemodialysis session and the urea, albumin and total protein were estimated for. Urea reduction ratio (URR) was calculated and used as a measure of haemodialysis adequacy.
Results: The mean age of the patients was 40.49 ±2.00years. The mean urea reduction ratio was 57.83±0.83%, URR after first dialyzer use (i.e. 57.93 ±1.52%), was compared with URR after second and third use (i.e. 57.97 ±1.47% and 57.59 ± 1.35%) and p-values of no statistical significance ($p>0.05$) were obtained, pre-dialysis urea was significantly higher than post-dialysis urea ($p<0.05$). The mean BMI was 25.14±0.94kg/m^2, albumin and total protein concentrations were less than reference ranges right from baseline. There were no significant difference ($p>0.05$) between pre-dialysis and post-dialysis albumin and total protein concentrations.
Conclusion: The study showed that haemodialysis is inadequate in the studied population; use of same dialyzer up to three times was effective and safe. Albumin is not a reliable marker of malnutrition in ESRD patients.

INTRODUCTION

Haemodialysis is a form of treatment and is a process of removing waste and excess water from the blood, and is used primarily to provide an artificial replacement for lost kidney function in patients with total or near-total loss of kidney function using haemodialysis machines which utilize extracorporeal blood lines and artificial kidney referred as "dialyzer" (Ekrikpo *et al.,* 2011). It is indicated for the treatment of acute kidney injury, acute exacerbation of chronic renal failure and end-stage renal disease (Ekrikpo *et al.,* 2011). Dialysis adequacy refers to the delivery of a dose of dialysis considered high enough to promote an optimal long term outcome (Chijioke *et al.,* 2009). Urea reduction ratio (URR) is a method of measuring adequate dialysis that correlate with patient outcome.

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It is also a measure of adequacy of delivered dose of dialysis expressed as a percentage reduction in blood urea level after a session of dialysis (Chijioke *et al.,* 2009). Dialysis dequacy refers to the delivery of a dose of dialysis considered high enough to promote an optimal long term outcome (Chijioke *et al*., 2009). Quantification of the dialysis dose is an essential element in the management of chronic haemodialytic treatment because the adequacy of the dose has a profound effect on patient morbidity and mortality. It is now well recognized that an adequate delivery of haemodialysis dose (as measured by urea reduction) is a crucial determinant in clinical outcome of chronic HD patients. This requires both prescription of an adequate dose of HD and regular assessment that the delivered treatments are also adequate (Al Saran *et al*., 2009). The most common cause of death in patients with renal failure is due to the accumulation of excessive amount of urea, and other nitrogenous waste compounds in the blood, and low levels of serum albumin concentration. Study from developed countries have alluded to the fact that dialysis is inadequate in most patients receiving haemodialysis (Chijioke *et al.,* 2009).

Assessment of serum urea reduction ratio and serum albumin level would be beneficial for assessing and determining the adequacy of dialysis therapy given to patients in Sokoto. Results from this study apart from adding to knowledge, will provide valuable information that will aid in the management of dialysis patients in this environment.

MATERIALS AND METHODS

This was a prospective study of patients with end stage renal disease (ESRD) who were able to undergo three sessions of haemodialysis at the Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, Nigeria. The study was carried out at Renal Center of UDUTH in 2014. The choice of this Hospital (UDUTH) was based on the fact that UDUTH is a tertiary Hospital and serves as a referral centre for more than 10 million people of the Nigerian States of Sokoto, Zamfara and Kebbi; and neighboring Niger and Benin Republic in the West African sub-region. It attracts patients especially those with renal failure from every part of this region. We included fifty three (53) ESRD patients who were able to undergo three sessions of haemodialysis and who were not having any active infection or underlying diseases and who could give consent. Patients with other systemic disease apart from severe renal failure were excluded.

Each patient was dialyzed thrice using same dialyzer after reprocessing with 4% formaldehyde. The study protocol was approved and Ethical Clearance, for permission to conduct the study was obtained from the Ethics and Research Committee of Usmanu Danfodiyo University, Sokoto. Demographic and socio-economic data of respondents were obtained using structured interviewer administered questionnaires. Blood samples were taken just before the starting of haemodialysis for serum albumin, total protein, creatinine, urea and electrolyte. The pre and post dialysis blood samples were taken at the next index dialysis session according to the method described by Chijioke *et al.*, (2009) in which pre dialysis blood sample was taken before commencement of each dialysis session. Five milliliters (5ml) of blood sample was taken from each patient for the estimation of pre dialysis blood urea. At the end of each dialysis session, the blood sample for post dialysis urea estimation was taken about three minutes after dialysis from the arterial sampling port in order to avoid the effect of access recirculation.

The urea reduction ratio for each index dialysis session was calculated using the formula i.e. $(1-U_{post}/U_{pre}) \times 100$, where U_{pre} = pre dialysis urea concentration and U_{post} = post dialysis urea concentration. Urea reduction ratio (URR) was calculated and was used as a measure of haemodialysis adequacy. At the same time the blood samples collected at the baseline, pre- and post- haemodialysis session were used for the estimation of biochemical variables including, serum urea, creatinine, electrolytes, albumin and total protein using standard laboratory techniques. Data collected was analyzed using statistical package for social sciences (SPSS) version 20. Frequencies and percentages were calculated, Student t test (independent t test and paired sample t test) and ANOVA were used for comparison of data. The mean plus or minus standard error of mean (Mean ± SEM) of numerical variable were generated.

RESULTS

Total of 53 haemodialysis patients were included in the study. There were 39 (73.6%) male and 14 (26.4%) female patients. Mean age of the patients was 38.80 ± 3.37 years with males older than female patients (42.38 ± 2.38 vs 35.21± 3.43 years). Each patient was dialyzed thrice using the same dialyzer after manual reprocessing with 3% hydrogen peroxide and 4% formaldehyde. The distribution of the patients based on educational status shows that, 16 (30.2%) had tertiary education, 15 (28.3%) had either secondary or primary education while 22 (41.5%) had no formal education. Thirty nine (73.6%) of the patients were either civil servants or business men/women while the remaining 14 (26.4%) were students, farmers or unemployed (Table 1). As shown in Table 2, chronic glomerulonephritis 17 (32.1%), closely followed by hypertensive nephrosclerosis 15 (28.3%), diabetic nephropathy 9 (17.0%), obstructive uropathy 8 (15.1%) and to a lesser extent, drug induced nephropathy 4 (7.5%) were the main causes of end stage renal disease in Sokoto.

Table 1. Demographic Characteristics of the Study Population

Characteristics	Number of Subjects (n)	Percentage (%)
Gender		
Male	39	73.6
Female	14	26.4
Age group (years)		
10-29	12	22.6
30-49	28	52.8
50-59	11	20.8
>70	2	3.8
Education		
Tertiary	16	30.2
Secondary	9	17.0
Primary	6	11.3
Non-formal Education	22	41.5
Occupation		
Civil Servant	18	34.0
Business	21	39.6
Student	6	11.3
Farmer	4	7.5
Unemployed	4	7.5

Values are number (n) of subjects and expressed as percentage (%)

Table 2. Etiology of End Stage Renal Disease in the Study Population

Clinical Diagnosis	Number of subjects (n)	Percentage (%)
CGN	17	32.1
HN	15	28.3
DN	9	17.0
OU	8	15.1
DIN	4	7.5

Values are number of subjects (n) and expressed as percentage (%)
CGN= Chronic Glomerulonephritis; HN= Hypertensive Nephrosclerosis, DN= Diabetic Nephropathy; OU= Obstructive Uropathy, DIN= Drug Induced Nephropathy

Table 3 shows the baseline characteristics of patients with ESRD (pre-dialysis patients) according to age and biochemical measurements. Statistically significant differences ($p<0.05$) were observed in the age, those patients with hypertensive nephrosclerosis (49.53 ± 4.06 years) were older while those with obstructive uropathy (34.36 ± 3.17 years) were younger. There was no statistical significant ($p>0.05$) difference among other biochemical parameters measured at baseline.

Table 3. Baseline Characteristics of Pre-Dialysis Patients

Characteristics	Group A (CGN) (N = 17)	Group B (HN) (N=15)	Group C (DN) (N= 09)	Group D (OU) (N= 8)	Group E (DIN) (N= 4)	P value
Age (years)	37.12±2.78	49.53±4.06	35.67±3.17	34.38±6.47	44.00±6.00	<0.05
Urea (mmol/l)	26.25±2.03	25.61±2.86	30.8±3.39	23.29±2.31	24.20±6.12	>0.05
Creatinine (µmol/l)	1101.88±163.38	971.52±156.13	1101.07±204.46	966.21±225.56	888.42±239.24	>0.05
Sodium (mmol/l)	136.99±1.89	135.94±2.63	134.27±2.67	137.93±3.04	139.13±4.16	>0.05
Potassium (mmol/l)	4.71±0.33	4.67±0.32	4.780±0.30	5.11±0.42	4.68±0.74	>0.05
Chloride (mmol/l)	105.88±3.10	103.33±2.46	106.56±2.23	100.38±6.76	95.75±5.02	>0.05
Bicarbonate (mmol/l)	20.22±1.46	19.85±1.40	20.91±0.92	30.13±2.32	25.80±2.61	>0.05
Albumin (g/l)	27.82±1.85	23.53±2.31	28.00±2.29	30.61±4.17	24.75±4.42	>0.05
Total protein (g/l)	59.50±5.30	58.50±6.90	56.20±4.70	56.50±4.40	58.30±4.29	>0.05

Values are mean ± standard error of mean; n= number of subjects; Level of significance is considered when p<0.05.
CGN= Chronic Glomerulonephritis; HN= Hypertensive Nephrosclerosis;
DN= Diabetic Nephropathy; OU= Obstructive Uropathy;
DIN= Drug induced Nephropathy

The impact of sex on biochemical parameters of pre dialysis patients (Table 4) shows that serum urea was higher in males (27.14±1.54 mmol/l) than females (23.73±2.42 mmol/l), though the differences were not statistically significant (p>0.05). The differences of other baseline biochemical parameters among males and females were also not statistically significant (p>0.05).

Table 4. Impact of Sex on Biochemical Parameters of Pre-Dialysis Patients

Parameter	Males (n=39)	Females (n=14)	P value
Age (years)	42.38±2.38	35.21±3.43	>0.05
Urea (mmol/l)	27.14±1.54	23.73±2.42	>0.05
Creatinine(µmol/l)	1068.48±105.71	916.20±114.68	>0.05
Sodium (mmol/l)	136.24±1.45	137.35±1.90	>0.05
Potassium (mmol/l)	4.87±0.18	4.48±0.40	>0.05
Chloride (mmol/l)	104.87±2.06	100.35±2.48	>0.05
Bicarbonate (mmol/l)	21.32±0.89	18.79±1.32	>0.05
Albumin (g/l)	26.41±1.41	28.00±2.32	>0.05
Protein (g/l)	60.00±3.14	57.00±6.64	>0.05

Values are mean ± standard error of mean; n= number of subjects; Level of significance is considered when p<0.05

In this study, the differences in the pre- and post-dialysis serum urea concentrations in ESRD patients for the 3 haemodialysis sessions were statistically significant (p<0.05) (Table 5). However, the differences between the pre- and post-dialysis serum urea concentrations between the 5 etiological factors of ESRD patients for the 3 haemodialysis sessions were not statistically significant (p>0.05) (Table 6). Within an etiological group, statistically significant difference (p<0.05) was however observed with higher values of serum urea in pre dialysis than post-dialysis session.

Table 7: shows the comparison of the urea reduction ratio among the study population for three (3) haemodialysis sessions. The mean urea reduction ratio after first dialyzer use (57.93±1.52%) was compared with the urea reduction ratio after second and third dialyzer use (57.97±1.47% and 57.59±1.35% respectively) and p values of no statistical significance (p>0.05) were obtained.

When the result of the urea reduction ratios of the three haemodialysis sessions were compared among the five etiological causes of ESRD, no statistically significant differences in the urea reduction ratios were observed in the 3 haemodialysis sessions among the groups (Table 8). Similarly when the result was delineated according to sex (Table 9), the urea reduction ratios of the 3 haemodialysis sessions in female patients (62.50±2.51%, 59.02±2.38%, and 60.43±1.75% respectively) were slightly higher than the corresponding values observed in male patients (56.29±1.80%, 57.59±1.82%, 56.57±1.70% respectively) but not statistically significant (p>0.05).

Table 5. Statistical Comparison of the Pre-dialysis and Post-dialysis Serum Urea Concentration (mmol/l) of the Subjects for Three Haemodialysis Sessions

Dialysis session	Pre dialysis urea, (n=53)	Post dialysis urea (n=53)	P value
Session1	26.24±1.31	10.76±0.59	<0.05
Session 2	22.71±0.91	9.34±4.04	<0.05
Session 3	19.82±0.75	8.48±0.43	<0.05

Values are mean ± standard error of mean; n=number of subjects; Level of significance is considered when p<0.05

Table 6. Statistical Comparison of Serum Urea Concentration (mmol/l) Based on the Etiology of ESRD in the Study Population

Session of dialysis	Group A CGN(n=17)	Group B HN(n=15)	Group C DN(n= 9)	Group D OU(n= 8)	Group E DIN(n=4)	P value
Pre dialysis urea 1	26.25±2.03	25.61±2.86	30.80±3.39	23.29±2.31	24.20±6.12	>0.05
Post dialysis urea 1	10.37±2.00	9.91±0.93	14.49±1.73	9.11±1.21	10.35±1.94	>0.05
P value	<0.05	<0.05	<0.05	<0.05	<0.05	>0.05
Pre dialysis urea 2	24.44±1.87	21.09±1.34	20.54±1.22	24.07±2.50	23.58±5.35	>0.05
Post dialysis urea 2	9.62±0.86	9.41±0.75	9.49±0.64	8.61±1.16	9.13±1.38	>0.05
P value	<0.05	<0.05	<0.05	<0.05	<0.05	>0.05
Pre dialysis urea 3	20.44±1.01	18.73±1.12	21.06±2.40	21.06±2.84	15.98±1.26	>0.05
Post dialysis urea 3	8.08±0.53	7.87±0.48	10.26±1.55	9.30±1.71	6.08±0.29	>0.05
P value	<0.05	<0.05	<0.05	<0.05	<0.05	

Values are mean ± standard error of mean; Level of significance is considered when p<0.05 n= number of subjects;
CGN= Chronic Glomerulonephritis; HN= Hypertensive Nephrosclerosis; DN= Diabetic Nephropathy;
OU= Obstructive Uropathy; DIN= Drug induced Nephropathy.

Table 7. Statistical Comparison of the Urea Reduction Ratio (%) of the study Population for three Haemodialysis Sessions

Session of dialysis	Urea reduction ratio	P value
1	57.93±1.52	>0.05
2	57.97±1.47	
1	57.93±1.52	
3	57.59±1.35	>0.05

Values are mean ± standard error of mean; Level of significance is considered when p<0.05

presentation to the hospital, repeated blood transfusion, and inability to sustain the recommended thrice weekly haemodialysis due to poor finances as most of the subjects were either traders, retired civil servants, students, farmers or unemployed. This is consistent with findings of Allam-Muhammad (2006); Chijioke *et al*. (2011); Arogundade *et al*. (2011); Odufuwa and Fadupin (2011) and Okafor *et al*. (2012), who independently reported inadequacy of haemodialysis among patients with low socio-economic status.

Table 8. Comparison of the Urea Reduction Ratio (URR %) Based on Etiology of ESRD in the Study Population

Dialysis Session	Group A CGN(n=17)	Group B HN(n=15)	Group C DN (n=9)	Group D OU(n=8)	Group E DIN(n=4)	P Value
URR1	59.24±3.06	58.93±3.17	52.22±3.62	61.06±1.98	55.25±2.66	>0.05
URR 2	60.12±2.49	54.69±3.27	53.00±3.50	64.38±2.00	59.50±2.84	>0.05
URR 3	60.35±1.33	57.47±2.13	52.36±5.13	58.25±4.63	56.75±2.93	>0.05

Values are mean ± standard error of mean; Level of significance is considered when p<0.05, n= number of subjects; ESRD=End Stage Renal Disease.
CGN= Chronic Glomerulonephritis; HN= Hypertensive Nephrosclerosis;
DN= Diabetic Nephropathy; OU= Obstructive Uropathy; DIN= Drug induced Nephropathy.
URR1=serum urea reduction for 1st session of haemodialysis.
URR2= serum urea reduction for 2nd session of haemodialysis.
URR3= serum urea reduction for 3rd session of haemodialysis.

Table 9. Impact of Sex on Urea Reduction Ratio (%) in the Study Population

Session of dialysis	Male (n=39)	Female (n=14)	P value
1	56.29±1.80	62.50±2.51	>0.05
2	57.59±1.82	59.02±2.38	>0.05
3	56.57±1.70	60.43±1.75	>0.05

Values are mean ± standard error of mean; Level of significance is considered when p<0.05, n= number of subjects;

DISCUSSION

Haemodialysis is one of the accepted modalities for maintenance of life in patients with end stage renal disease (ESRD). In this study urea reduction ratio (URR) was used as a measure of adequacy of haemodialysis. The mean urea reduction ratio in this study is 57.83±0.83% which is below the Kidney Disease Outcome Quality Initiative guidelines (KDOQI) 2006 recommendation. According to the KDOQI for haemodialysis patients, the minimally adequate dose of dialysis should be a URR of at least 65% (Amini *et al*., 2011). The findings in this study therefore indicate inadequate haemodialysis dose in ESRD patients in Sokoto. The findings of inadequate haemodialysis in this study is in agreement though better than that reported by three other related studies in Nigeria, where Agaba *et al*. (2006) found a mean URR of 45.3±8.6% Amira and Mamvem (2007) found URR of 52.4±6.6% and Chijioke *et al*. (2011) found a mean URR of 41.8%. Our result also corroborated with the findings in Iran by Afshar *et al*. (2007), Pourfarziani *et al*. (2008) and Amini *et al*. (2011), which reported a URR of 61±11.8%, 55.3±7.05% and 62.6±12.8% respectively. Other findings from Nepal by Manandhar *et al*. (2008), and Shrestha *et al*. (2008) reported URR 57.27±10.89%, and 62.12±20.85% respectively and 61.8% found by Dordevic *et al*. (1999) in South Serbia are all similar to the findings of this study. However, the Findings in India by Sunanda *et al*. (2012) and Aggarwal *et al*. (2012), of URR 66.41±15.6% and 65.24±0.15 are in contrast with the findings in this study. The factors that appears to contribute to inadequacy of haemodialysis in this study, is probably the poor socio economic status of the patients which results into late

The age of the patients in this study is worth noting, as majority of patients are between 30-50 years of age which is known to be the productive years of life, this is in agreement with the findings of Alebiosu *et al*. (2006), Arogundade and Barsoum, (2008) Arogundade *et al*. (2011); Odufuwa and Fadupin (2011), and Odubanjo *et al.* (2011) Amoako *et al.* (2014) who all reported that ESRD is most common in the 3rd - 5th decade of life. This finding is in contrast with that of developed countries such as Japan, where Iseki *et al*. (1993), and Kurokawa, (2002) reported that ESRD mostly affects the elderly. The base line biochemical parameters in this study were similar to that reported by Minutolo *et al*. (2003), Alebiosu *et al*. (2006); Stolic *et al*. (2010); Ekrikpo *et al.,* (2011) and Amoako, *et al*. (2014). In this study it was observed that males are higher in number than females (73.6% vs 26.4%) this is similar to studies done in Nigeria, where Alebiosu *et al*. (2006); Ullasi and Ijioma (2010); Arogundade *et al*. (2011); Ekrikpo *et al.* (2011) Odufuwa and Fadupin (2011) all reported male vs female predominance of (58.8% vs 41.2%); (65.3% vs 34.7%); (70.3% vs 29.7%); (57% vs 43%); (65% vs 35%) respectively, in Ghana, Amoako, *et al*. (2014) and Eghan *et al*. (2009) reported (64.5% vs 35.5%) and (55% vs 45%) respectively, in Iran, Afshar *et al*. (2007), Pourfarziani *et al*. (2008) and Amini *et al*. (2011) reported (64.8% vs 35.2%); (57% vs 43%); (58% vs 41%) respectively, in India Sunanda *et al*. (2012) and Aggarwal *et al*. (2012), reported (80% vs 20%); (64% vs 36%) respectively, in Nepal Manandhar *et al*. (2008) reported (61.5% vs 38.5%), in Spain Goicoechea *et al*. (2005) reported a male predominance of (6.9% vs 39.1%), in United States of America, Agarwal and Light (2011) reported a male predominance of (61.2% vs 38.8%).

The male predominance might be a reflection of the fact that predisposing illnesses and risk factors of chronic kidney disease such as smoking and hypertension are commoner in males than females. Differences in the health seeking behaviours of males and females might also play a role in the observed difference of chronic kidney diseases prevalence in the two sexes. The major cause of ESRD in this study were,

chronic glomerulonephritis, hypertensive nephrosclerosis, and diabetic nephropathy in descending order, this is in agreement with the findings by Alebiosu *et al*. (2006); Arogundade and Barsoum, (2008); Chijioke *et al*. (2009); Odufuwa and Fadupin,(2011); Ekrikpo *et al*. (2011); Arogundade *et al*. (2011) Hoque *et al*. (2013) and Amoako *et al*., 2014. Most of the population of this study (41%) does not have formal Education; the remaining 59% had tertiary, secondary or primary education, this finding is similar to that of Odufuwa and Fadupin (2011). The significant difference between pre- dialysis and post- dialysis serum urea concentration is in agreement with the findings of Sunanda *et al*. (2012). Serum urea concentration was higher in males than females while URR was higher in females than males, this may be due to differences in body surface area and females have smaller body surface area. This is in agreement with the findings of Allam-Muhammad (2006); Depner, (2003), Sikole *et al*. (2007); Afshar *et al*. (2007); Manandhar *et al*. (2008) and Ekripko *et al.* (2011).

Urea reduction ratio in patients with Diabetic nephropathy was lower than that observed in other etiological factors of End stage renal disease, this might be due to hypoglycaemia generated during dialysis, which may lead to premature discontinuation of dialysis that affects urea clearance, and this is in agreement with the findings of Owen *et al*. (1993) and Allam-Muhammad (2006). This study shows no significant difference in the URR with up to 3 uses of same dialyser, this is consistent with findings of Kaye *et al*. (1984); Lioa *et al*. (1985); Ahmed *et al.* (2001); Lobo *et al*. (2001); Manandhar *et al*. (2009) and Aggarwal *et al*., (2012). The result of this study differs from that of Billiouw *et al*. (1985), Kadiri *et al*., (2001) and Amira and Mamvem (2007), who reported a significant drop in solute clearance after several reuse of dialyzers, this difference might be due to the differences in time the dialyzers were reused and also the technique used in reprocessing the dialyzers. In this study, manual method for reprocessing was followed using hydrogen perioxide as cleansing agent and 4% formaldehyde as disinfectant for 3 dialyzer reuse. Sherman *et al*. (1994) reported that dialyser reuse reduces dialysis delivery and the effect appears to be related to the specific methods and procedures of individual dialysis centres.

Liao *et al*. (1985) reported a decrease in solute clearance after 20^{th} use of filtryzer B dialyzers reprocessed manually using sodium hypochlorite as cleansing agent. Gagnon and Kaye (1985), reported increase usage of dialyzers when reprocessed with automated systems using sodium hypochlorite. Sodium hypochlorite plays an important role in dissolving proteins and fibrin thereby increasing the number of times dialyzers are reused; it also restores the complement activating capability of cellulose based membranes. However sodium hypochlorite has a disadvantage by causing a high incidence of blood leak due to etching of cellulose based membranes leading to increased protein loss in the dialysate (Dumler *et al*., 1987). Most of the patients in this study had both pre dialysis and post dialysis albumin and total protein concentration less than 35g/l, and 62g/l respectively, though the baseline BMI revealed that most of the patients have normal weight, this might be due to the fact that Serum albumin is no longer considered as a reliable index or indicator of malnutrition, this finding is in agreement with that of Axelsson *et al*. (2012) and other studies such as that of Jones *et al.* (1997) who reported in their study that 49.0% of normoalbuminemic persons were scored as malnourished and 54.0% of hypoalbuminemic persons scored as well nourished. Stenvinkel *et al.* (2002) reported having no significant difference in serum albumin levels between malnourished and well nourished ESRD patients. Manandhar *et al*. (2008) also found no correlation between malnutrition score and serum albumin. Several studies have reported that there are many causes of hypoalbuminaemia in end stage renal disease patients undergoing haemodialysis, such as plasma fluid dilution, urinary loss, Chronic metabolic acidosis and inflammation from concurrent illness (Leon *et al.* (2006); Manandhar *et al*. (2008); Friedman and Fadem,(2010); Don and kaysean,(2010); Sahay *et al*. (2014) and Kubrusly *et al*. (2012). There was no significant difference in pre dialysis and post dialysis albumin and total protein concentration with 3 uses of same dialyzer; hence this study shows that there was no significant albumin leak with dialyzer reuse. Similar observations have been made by Aggarwal *et al*. (2012) and Ahmed *et al*. (2001).

Conclusions

Our study had established a low haemodialysis adequacy in End Stage Renal Disease patients in Sokoto as compared with Kidney Disease Outcome Quality Initiative guidelines. The major contributing factors were cost, illiteracy and late presentation of the patients to the Hospital. Endstage renal disease patients in Sokoto also had low serum albumin and total protein concentrations; the study therefore highlights the rationale for reconsidering albumin as a marker of illness rather than only nutrition. Use of same dialyzer up to three times was also effective and safe.

Recommendations

We recommend the periodic assessment of haemodialysis adequacy in the dialysis unit in order to determine what degree of enough dialysis the patients are receiving during their treatments. Public enlightenment programs should be encouraged on the causes of renal failure, how the disease can be prevented and the need for early medical care. Provision of renal replacement therapy should be incorporated into the current National Health Insurance Scheme (NHIS), supported and subsidized by governmental and non governmental agencies.

REFERENCES

Afshar, R., Sanavi, S. and Izadi-Khah, A. 2007: Assessment of Nutritional Status in Patients Undergoing Maintainance Haemodialysis: A Single- Centre Study from Iran. *Saudi Journal of Kidney Disease and Transplantation,* 18(3):397-404.

Agaba, E.L., Lopex, A., Ma, I., Martinex, R. and Tzamaloukas, R.A. 2006: Inadequacy of Dialysis, Chronic Inflammation and Malnutrition in Nigerian Patients on Chronic Haemodialysis. *International Journal of Artificial Organ,* 29(1): 1067-1073.

Agarwal, R. and Light, R.P. 2011: Determinants and Prognostic Significance of Electrocardiographic Left Ventricular Hypertrophy Criteria in Chronic Kidney Disease. *Clinical Journal of American Society Nephrology*, 6(3): S28-S38.

Aggarwal, H.K., Jai, N.D., Sahney, A., Bansal, T., Yadav, R.K. and Kathuria, K.L. 2012: Effect of Dialyser Reuse on the Efficacy of Haemodialysis in Patients of Chronic Renal Disease in Developing World. *Journal of International Medical Academy,* 25(2):81-83.

Ahmed, M.H., Abed, J., Tarif, N., Alam, A., Wakeel, J.S. and Memon, N. 2001: Dialyser Reuse Impact on Dialyser Efficiency, Patient Mortality and Cost Effectiveness. *Saudi Journal of Kidney Disease and Transplantation,* 12(1): 305-311.

Alebiosu, C.O., Olugbenga O. A., Adigun, A. and Ina, O.A., 2006: Chronic Renal Failure at the Olabisi Onabajo University Teaching Hospital Sagamu Nigeria. *African Health Sciences,* 6 (3): 132-138.

Allam-Muhammad, A.H.R. 2006: Adequacy of Haemodialysis Among End Stage Renal Disease Patients at Al-Watani Hospital. Unpublished Master Thesis at An-Najah National University Nablus, Palestine Pp 38-47.

Al Saran, K., Sabry, A., Abdulghafour, M. and Yehia, A. 2009: Online Conductivity Monitoring of Dialysis Adequacy Versus Kt/V Derived from Urea Reduction Ratio: A Prospective Study from a Saudi Center *International Journal of Nephrology and Renovascular Disease,*2: 27–31

Amini, M., Aghighi, M., Masoudkabir, F., Zamyadi, M., Norouzi, S., Rajolani, H., Rasouli, M.R. and Pourbakhtyaran, C. 2011: Haemodialysis Adequacy and Treatment in Iranian Patients. *Iranian journal of kidney disease,* 5(2): 103-109.

Amira, C.O. and Mamvem, M. 2007: Effect of Dialyzer Reuse on Dialyzer Performance. *Nigerian Medical Journal*, 48(2):42-45.

Amoako, A.Y., Laryea, D.O., Beddu-Addo, G., Andoh, H. and Awuku, Y.A. 2014: Clinical and Demographic Characteristics of Chronic Kidney Disease Patients in a Tertiary Facility in Ghana. *The pan African Medical journal*, 18(1):274-279.

Arogundade, F.A. and Barsoum, R.S. 2008: CKD Prevention in Sub-Saharan Africa: A Call for Governmental, Nongovernmental, and Community Support. *American Journal of Kidney Diseases,* 51(3): 515-523.

Arogundade, F.A., Sanusi, A.A., Hassan, M.O. and Akinsola, A. 2011: The Pattern, Clinical Characteristics and Outcome of End Stage Renal Disease in Ille- Ife, Nigeria, Is There a Change in Trend? *African Health Sciences,* 11(4): 594 – 601.

Axelsson, T., Heimbürger, O., Stenvinkel, P., Bárány, P., Lindholm, B. and Qureshi, A.R. 2012: Serum Albumin as Predictor of Nutritional Status in Patients with ESRD. *Clinical Journal of American Society Nephrology,* 9: (7):1446-1453.

Billiouw, J.M., Vanholder, R., Piron, M., Veirman, R. and Ringoir, S. 1985: Automated Reuse of Capillary Hemodialyzers. *International Journal of Artificial Organs,* 8(2):83-88.

Chijioke, A., Aderibigbe, A., Rafiu, M.O., Olarenwaju, T.O. and Makusidi, A.M. 2009: The Assessment of Haemodialysis Adequacy among ESRD Patients in Ilorin Using Urea Reduction Ratio. *Tropical Journal of Nephrology* 4(2):115-119

Depner, T.A. 2003. Prescribing Hemodialysis: The Role of the Gender. *Advanced Renal Replacement Therapy,* 10(1*)*:71-77.

Don, R.B. and Kaysen, G. 2010: Serum Albumin Concentration and Chronic Kidney Disease. *US nephrology*, 5(1): 20- 27.

Dordevic, V., Stojanovic, M. and Stefanovic, V. 1999: Adequacy of Haemodialysis in a Large University Affiliated Dialysis Centre in Serbia. *The Scientific Journal Facts Universitalis* 6(1):107-111.

Dumler, f., Zasuwa, G. and Levin, N.W. 1987: Effect of Dialyzer Reprocessing Methods on Complement Activation and Haemodialyser Related Symptoms. *Artificial Organs,* 11(2):128-131.

Eghan, B.A., Amoako-Atta, K., Kankam, C.A. and Nsiah-Asare, A., 2009: Survival Pattern of Haemodialysis Patients In Kumasi, Ghana: A Summary of Forty Patients Initiated on Haemodialysis, At a New Haemodialysis Unit. *Haemodialysis International*, 13(4): 467- 471.

Ekrikpo, U.E., Udo, I.A., Ikpeme, E. E. and Effa, E.E. 2011: Haemodailysis in an Emerging Centre in a Developing Country: A Two Year Review and Predictors of Mortality. *Biomed central nephrology* 50(12): 1471- 2369.

Friedman, A.N. and Fadem, Z.S. 2010: Reassessment of Albumin as a Nutritional Marker in Kidney Disease. *Journal of American Nephrology* 21(1):223-230.

Gagnon, R.F. and Kaye, M. 1985: Dialyzer Performance over Prolong Reuse. *Clinical Nephrology* 24(1):21-27.

Goicoechea, M., De-Vinuesa, S.G., Gomez-Campdera, F., And Luno, J. 2005: Predictive Cardiovascular Risk Factors In Patients With Chronic Kidney Disease. *Kidney International*, 93: S35-S38.

Hoque, F., Begum, S., Latif, A., Begum, A. and Sultana, S. 2013: FVC, FEV1, FEV1/FVC ratio and FEF(25-75%) in End-stage Renal Disease (ESRD) Patients Undergoing Maintenance Haemodialysis. *Journal of Bangladesh Society of Physiologist,* 8(1): 33-36.

Iseki, K., Kawazco, N., Osawa, A. and Fukiyama, K. 1993: Survival Analysis of Dialysis Patients in Okinawa, Japan. *Kidney International*, 43(1): 404-409.

Jones, C.H., Newstead, C.G., Will, E.J., Smye, S.W., and Davison, A.M. 1997: Assessment of nutritional status in CAPD patients: serum albumin is not a useful measure. *Nephrology Dialysis Transplantation,* 12(1): 1406-1413.

Kadiri, S., Kehinde, Z., Arije, A., and Salako, B.L. 2001: The Influence of Cuprophan and Polysylfone Membranes on Dialyser Reusability and Intradialytic Complications. *African Journal of Medicine and Medical Sciences,* 30(3):191-194

Kaye, M., Gagnon, R., Mulhearn, B. and Spergel, D. 1984: Prolong Dialyzer Reuse. *Transactions- American Society for Artificial Internal Organs*, 30(1): 491-493.

Kubrusly, M., Oliveira, M.C., Santos, C.D., Mota, S.R. and Pereira, L.M. 2012: Comparative Analysis of Pre and Post Dialysis Albumin Levels as Indicators of Nutritional and Morbidity and Mortality Risk in Haemodialysis Patients. *Journal of Brasilian Nephrology,* 34(1):101-108.

Kurokawa, K., Nangaku, M., Saito, A., Inagi, R. and Miyata, T. 2002: Current Issues and Future Perspectives of Chronic Renal Failure. *Journal of the American Society of Nephrology,* 13(1): S3-S6.

Leon, B.J., Albert, M.J., Gilchrist, G., Kushner, I., Lerner, E., Mach, S., Majerle, A. porter, D., Ricanati, E., Sperry, L., Sullivan, C., Zimmerer, J. and Sehgal, R.A. 2006: Improving Albumin Levels among Haemodialysis Patients: A Community Based Randomised Controlled Trial. *American Journal of Kidney Disease,* 48(1):28-36.

Liao, L.T., Xu, Y.Z. and Cal, Z.H. 1985: The Reuse of Hollow Fibre Dialyzer: A Preliminary Report. *Chanese Medical journal,* 98(7): 485-488.

Lobo, V., Gang, S., Shah, L.J., Ganju, A., Pandaya, P.K. and Rajapurkar, M.M. 2001: Effect of Hollow Fiber Dialysers Reuse Upon kt/v(urea). *Indian Journal of Nephrology* 12(1):40-48.

Manandhar, D.N., Chetri, P.K., Pahar, L.R., Tiwari, R. and Chowdhary, S.K. 2008: Nutritional Assessment of Patients Under Haemodialysis in Nepal Medial College Teaching Hospital. *Nepal Medical College Journal,* 10(3):164-169.

Manandhar, D.N., Chhetri, P.K., Tiwari, R. and Lamichhane, S. 2009: Evaluation of Dialysis Adequacy in Patients Under Hemodialysis and Effectiveness of Dialysers Reuses. *Nepal Medical College Journal,* 11(1): 107-110.

Minutolo, R., Nicola, D.L., Bellizzi, V., Iodice,C., Rubino, R., Aucella, F., Stallone, C., Nappi, F., Avella, F., Maione, E., Conte, G. and Di Iorio, B.R. 2003: Intra- and Post-dialytic Changes of Haemoglobin Concentrations in Non-anaemic Haemodialysis Patients. *Nephrology Dialysis and Transplantation,* 18(1): 2606– 2612.

National Kidney Foundation Dialysis Outcome Quality Initiative, 1997: Measurement of Haemodialysis Adequacy in Guidelines for Haemodialysis. Adequacy, *American Journal of Kidney Diseases,* 30(3):S17-S21

Odubanjo, M.O., Okolo, C.A., Oluwasola, A.O. and Arije,A. 2011. Endstage Renal Disease in Nigeria, An Overview of the Epidemiology and Pathogenic Mechanism. *Saudi Journal of Kidney Disease and Transplantation*. 20(5):1064-1071.

Odufuwa, B. A. and Fadupin, G. T. 2011: Nutritional Status of Hemodialysis Patients in a Developing Economy: A Case Study in Nigeria. *Journal of Human Ecology,* 36(2): 111-116.

Okafor, U.H., Ekwem, I. and Wokoma, F.S. 2012: Haemodialysis Treatment for End Stage Chronic Kidney Disease and Acute Kidney Injury in Africa. *Nigerian Medical Journal,* 53 (1):47-50.

Owen, W.F., Lew, N.L., Liu, Y., Lowrie, E.G. and Lazarus, J.M. 1993: The Urea Reduction Ratio and Serum Albumin Concentration as Predictors of Mortality in Patients Undergoing Hemodialysis. *New England Journal of Medicine.* 329 (14): 1001-1006.

Pourfarziani,V., Ghanbarpour, F., Nemati, E., Taheri, S. and Einollahi, B. 2008: Laboratory Variables and Treatment Adequacy in Hemodialysis Patients in Iran. *Saudi Journal of Kidney Disease and Transplantation* 19(5):842-846.

Sahay, M., Sahay, R., Kalra, S. and Barua, M.P. (2014): Nutrition in Chronic Kidney Disease. *Journal of Medical Nutrition and Nutraceuticals*, 1(3): 11-18.

Sherman, R.A., Cody, R.P., Rogers, M.E. and Solanchick, J.C. 1994: The effect of dialyser reuse on dialysis delivery. *American Journal of Kidney Disease*, 24(1): 924- 926

Shrestha, S., Ghotekar, L.R., Sharma, S.K., Shangwa, P.M. and Karki, P. 2008. Assessment of Quality of Life in Patients of End Stage Renal Disease on Different Modalities of Treatment *Journal of Nepal Medical Association,* 47(169):1-6

Sikole, A., Nikolov, V., Dzekova, P., Stojcev, N., Amitov, V., Selim, G., Asani, A., Gelev, S., Grozdanovski, R., Masin, G., Klinkmann, H. and Polenakovic, M. 2007: Survival of Patients on Maintenance Haemodialysis Over a Twenty–year period. Contributions, Section of Biological and Medical Science 28 (2): 99–110

Stenvinkel, P., Barany, P., Chung, S.H., Lindholm, B. and Heimbürger, O. 2002: A Comparative Analysis of Nutritional Parameters as Predictors of Outcome In Male and Female ESRD Patients. *Nephrology Dialysis Transplantation,* 17(1): 1266-1274.

Stolic, R., Trajkovic, G., Stolic, D., Peric, V. and Subaric-Gorgieva, G. (2010): Nutrition Parameters as Hemodialysis Adequacy Markers. *Hippokratia,* 14(3): 193-197.

Sunanda, V., Santosh, B., Jusmita, D. and Prabhaker, B. 2012: Achieving the Urea Reduction Ratio (URR) as a Predictor of the Adequacy and the NKF- K/DOQI Target for Calcium, Phosphorus and Ca × P Product in ESRD Patients Who Undergo Haemodialysis". *Journal of Clinical and Diagnostic Research,* 6(2):169- 172.

Ullasi, H. And Ijeoma, C.K. 2010: The Enormity of Chronic Kidney Disease In Nigeria, The Situation In A Teaching Hospital In South-East. *Nigeria Journal of Tropical Medicine* 1: 501-957

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