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Nutritional Assessment of Renal Transplant Recipients Using DEXA and Biochemical Parameters

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Abstract

Introduction and Aims: Malnutrition is frequently encountered in patients with CKD. Despite successful renal transplantation, malnutrition ensues. We evaluated the relationship between serum albumin levels, and various indicators of nutritional status.

Methods: We did a retrospective study of 249 post-transplant patients who successfully underwent renal transplantation (between1995-2012) at a tertiary care center. Serum parameters such as albumin (bromocresol green Method) hemoglobin, electrolytes, creatinine, prednisolone dose and presence of diabetes mellitus were analyzed. Lifestyle factors such as smoking, alcohol and diet, BMI were also looked at. We classified Serum Albumin as <3-3. 4 g/dL, 3. 5-3.9 g/dL, and more than 4 g/dL. We classified BMI as per WHO guidelines. Dual Energy X-Ray Absorptiometry was used to evaluate body composition, including lean body mass, fat body mass and fat percentage. Descriptive statistics, co-relational statistics and Pearson's Chi-Square test was used.

Results: Among the 150 Males and 99 females, the mean age was 46 ± 13 years. The mean serum albumin value was 3. 6 ± 0.6 g/dL. 10% had a normal BMI, 62% Pre Obese, 21% Class 1 Obese, 5% Class 2 Obese, and 2% Class 3 Obese. A meat-based diet was ingested by 76% of our study group, and 24% were pure vegetarians. The mean dose of prednisolone taken was 20 ± 10 mg/day. 5% of the transplant patients were deceased and 1% had a failed graft. On follow up we found a significant positive correlation between serum albumin and hemoglobin (p=0. 002), LDL (p=0.046), Fat% (p=0.032) and a meat-based diet (p=0.032). A serum albumin value of>4g/dL was observed in 46% of those ingesting a meat-based diet, in contrast to 25% pure vegetarians. 66% of the vegetarians had a serum albumin value ranging from <3-3. 4 g/dL. There were negative correlations between prednisolone dose and serum albumin (p=0.005), FM (p=0. 006), Fat% (p=0. 002) and serum Creatinine (p=0.013). A positive correlation between hemoglobin levels and LDL (p=0.005), FM (p= 0.004), HCO3- (p=0. 015) and Cl-(p=0.012), and hemoglobin levels and potassium levels (p=0.015) were observed. No significant co-relation was observed between serum albumin and patient survivals.

Conclusions: Serum albumin varies with diet, and is significantly higher among those eating a meat-based diet following transplant. Post-transplant mild obesity was prevalent in 62% of our study group. A higher fat content was associated with higher serum albumin levels, which may reflect a better nutritional status. Lower maintenance doses of prednisolone may improve the Albumin Levels. A further randomized controlled trial looking at the role of protein supplementation in vegetarians following renal transplantation as well as evaluating the effect of lowered prednisolone dose is warranted.

Keywords: Protein-energy-wasting; End-stage-renal-disease; Chronic kidney disease; Maintenance hemodialysis; Dietary protein intake

Introduction

There is very less data on renal nutrition in the post-transplant period, among south-east Asian countries, including India. Nutritional status refers to the composite quantitative and qualitative assessment of visceral and somatic (muscle) protein stores and energy balance [1,2].

Among the many risk-factors that affect the outcomes of Chronic Kidney Disease (CKD), especially End-Stage-Renal-Disease, and on Maintenance Hemodialysis (MHD), Protein-Energy-Wasting (PEW) of CKD plays a major role [1-5]. Evaluating nutritional status is a critical component of physiologic health and fundamental to identifying PEW. Multiple studies indicate that PEW is closely associated with major adverse clinical outcomes, and is associated with increased hospitalization and death [2,6-8].

Although Serum albumin (S. albumin) is a marker of nutritional status, concerns have been expressed regarding its applicability [9]. S. albumin robustly associates with death and hospitalization, is easily and reproducibly measured, and responds to appropriate interventions [10].

Dietary Protein Intake (DPI), and diet composition has a direct influence on serum albumin concentrations, and inadequate DPI is characterized by a decrease in the rate of albumin synthesis [11].

At least 60% of adult renal transplant recipients develop dyslipidemia, which occurs within one month of the initiation of immunosuppressive therapy and continues indefinitely unless treated. Cyclosporine, sirolimus, and prednisone are mainly implicated, and the lipid profile differs between individual agents [12]. There is a growing amount of evidence suggesting that dyslipidemias contribute to the

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very high incidence of cardiovascular disease after transplantation [13].

Transplant related immunosuppression can worsen the pre-existing medical conditions such as Diabetes Mellitus (DM), hyperlipidemia, hypertension and cardiovascular complications [14].

Metabolic acidosis, promotes PEW by increasing protein catabolism via suppression of insulin/insulin growth factor-1, signaling and activation of the ubiquitin-proteasome system [15].

Body Mass Index (BMI) has a very strong association with outcomes after renal transplantation independent of most of the known risk factors for patient and graft survival. The extremes of very high and very low BMI before renal transplantation are important risk factors for patient and graft survival [16].

We sought to evaluate the relationship between S. albumin levels and various indicators of nutritional status, and the variability of S. albumin among diabetics and non-diabetics, and those consuming a meat based and pure vegetarian diets.

Methods

We studied the database of 249 post-transplant patients, selected at random, which successfully underwent renal transplantation (Between 1995-2012) at a tertiary care center, in south-India. Written consent was obtained from all the patients, enrolled in this study, and this study was approved by the ethics committee of the center.

Data was collected retrospectively. Patient demographics such as age, sex, and a proxy of indicators of nutritional status were used: Serum assays such as S. albumin, hemoglobin (hb%), High-Density-Lipoprotein (HDL), Low-Density-Lipoprotein (LDL), Triglycerides (TGl), Serum Calcium (Ca), Inorganic Phosphate (PO4), and electrolytes: sodium, potassium, chloride, bicarbonate, and renal parameters: serum creatinine (S. Cr) were obtained from baseline blood investigation reports; lifestyle factors such as smoking, alcohol, primary diet composition, body mass index, the presence of DM and the mean dose of prednisolone received were obtained from hospital records and oral questionnaires. All serum parameters were assayed by modern automated laboratory techniques, and S. albumin was assayed using the modified bromocresol green colorimetric method.

Data was collected from lab reports and oral questionnaires at the time of follow up, which was done within the first 60 days, and subsequently, every 6 months after transplant. We considered the first month (baseline) and the 6th month reports, in this study.

All transplant recipients underwent a Dual Energy X-Ray Absorptiometry (DEXA)(General Electric® Lunar Prodigy®, USA -iDXA ME-200134) scan done initially, when the S. Cr was 1. 5mg/dL or less, with a stable graft function within the first 60 days after transplant, to evaluate body composition, including Lean Body Mass (LBM), Fat Mass(FM) and Fat Percentage(Fat%). They underwent a repeat DEXA scan, at 6 months, and 12 months. We used the first scan as a baseline, and the 6th month follow up scan to evaluate their nutritional and densitometry changes.

Patient outcomes (alive/dead/graft-failure/lost-to-follow-up) were recorded by telephonic questionnaires by the transplant department, by phone calls every 6 months. Patients who died on follow up, and those less than 18 years of age, were excluded from this study.

Nutritional interventions, in the form of dietary counseling by a renal dietician were done during the follow-ups, every 6 weeks.

Classifications

We classified S. albumin as ≤ 3.4 g/dL, 3. 5-3.9 g/dL, and ≥ 4 g/dL, and BMI as per WHO guidelines i. e. , Normal (18. 5-24. 99 kg/m^2), Pre-Obese (25-29.99 kg/m^2), Class 1 Obesity(30-34. 99 kg/m^2), Class 2 Obesity(35-39. 99 kg/m^2), Class 3 Obesity(≥ 40 kg/m^2) (Table2).

Patients were further classified as : Vegetarians (including ovo-lacto vegetarians; defined as consuming only plant based food, including dietary products including eggs) and those consuming a "Meat-Based Diet" (which includes at-least three servings of animal protein, including poultry, sea-food and not fitting into the description of "vegetarian").

We also classified our patients, as DM (defined as a fasting glucose level of ≥ 126mg/dL, or a 2-h plasma glucose ≥ 200 mg/dL, and non-diabetics (fasting glucose <126 mg/dL and 2-h post-prandial glucose level <200mg/dL). We also classified them under, Smokers (including those who stopped smoking; we considered a minimum of three cigarettes per week) and Non-smokers, and those who ingested Alcohol (minimum of 60 mL of 80-proof ethanol per-day) and Non-drinkers.

Statistics

Descriptive and co-relational coefficients, employing Pearson's Chi-Square test (two-tailed approach), was used to determine the influence of serum albumin over all the other variables. Paired samples T-test were done, to analyze the changes in the nutritional parameters, including-S. Albumin, Hb%, HDL, LDL, S.Ca, HCO, BMI, fat%, FM, and LBM, and prednisolone dose, before and after transplant. The results were considered to be statistically significant if the alpha error was less than 5% ($p<0.05$). All statistical analysis was performed using the IBM SPSS Statistics software package v. 16. 0.

Results

Among the 150 males and 99 females recipients studied, the mean age of the transplant recipients were 46 ± 13 years. Our patients were on a hemodialysis for a mean period of 7. 2 ± 8 months, before transplant. Five percent of the transplant patients, who were followed up, died.

Table 1 shows the various descriptives analyzed, along with mean and standard deviation. The mean s. albumin value was 3.67 ± 0.6 g/dL. The mean dose of prednisolone was 20 ± 10 mg/day. The mean Hb% was 10.5 ± 2gm%. The means of other serum assays and electrolytes were in the normal range, as shown in (Table 1). Fifty percent of our cohort had Hb% levels ≤ 10.9 gm%.

Fifty six percent of our study group was diabetic. 11% gave a history of consumption of Alcohol. 31% were smokers and 76% ate a meat-based diet, 24% were vegetarians.

(Table 2) shows the distribution of S. Albumin among the diabetic's and euglycemics the mean s. albumin levels among the diabetics and non-diabetics were 3. 65 ± 0. 56 g/dL and 3. 89 ± 0. 44g/dL respectively. An s. albumin value of ≥ 4 g/dL was observed in 38% of the diabetics and 75% of the non-diabetics respectively. An s. albumin value <3-3. 4g/dL was observed in 38% of the diabetics and 19% of the non-diabetics respectively. Twenty-four percent of the diabetics and 6% of the non-diabetics had serum albumin values ranging between 3. 5 g/dL and 3. 9g/dL. (p=0. 076)

Thirty percent of our cohort had bicarbonate levels <22mEq/L.

	N	Min	Max	Mean	SD	Significance
Age	249	18	76	45.980	12.898	0.304
Albumin (gm/dL)*	198	1	5	3.670	0.613	
Prednisolone Dose	209	2	50	18.810	10.888	0.005
Haemoglobin (gm/dL)	113	4	15	10.630	2.380	0.002
HDL (mg/dL)	47	22	80	49.620	13.505	0.135
LDL (mg/dL)	47	32	175	90.850	31.584	0.046
Triglycerides (mg/dL)	45	21	305	113.800	57.592	0.238
Calcium (mg/dL)	206	6	12	8.810	0.849	0.002
Phosphate (mg/dL)	193	2	7	3.230	1.047	0.512
Sodium (mEq/L)	205	106	149	133.790	5.768	0.474
Potassium (mEq/L)	207	3	6	4.210	0.646	0.805
Chloride (mEq/L)	202	88	143	104.000	5.997	0.069
Bicarbonate (mEq/L)	202	16	31	23.650	2.893	0.476
BMI (kg/m²)	215	15	37	23.330	4.129	0.183
Fat %	238	5	56	29.650	10.799	0.032
Fat Mass (kg)	144	3	52	19.330	9.594	0.807
Serum Creatinine (mg/dL)	168	1	2	1.200	0.403	0.692
Lean Body Mass (kg)	144	22	71	41.590	7.000	0.234

Table 1: Correlation analysis of Albumin and the other variables (Descriptive statistics to find out the mean ± SD, and Pearson's chi squared test to test the significance between s.albumin and various parameters).

	Serum Albumin (g/dL)			
	<3.4	3.5-3.9	≥ 4g/dL	Significance: p value=0.076
Diabetic	38.1%(8)	23.8%(5)	38.1%(8)	
Non Diabetic	18.8%(3)	6.2%(1)	75.0%(12)	

Table 2: Co-relations between Serum Albumin and diabetic status, using a cross-tab, and Pearson's chi square test.

Significant positive correlations between s. albuminand Hb% (p=0. 002), LDL (p=0. 046), Fat% (p=0. 032) and a meat-based diet (p=0. 032) were observed.

Table 3 shows the distribution of S. albumin amongst the vegetarians and those consuming a meat-based diet. S. albumin values of ≥ 4g/dL were observed among 46% of those, who ingesteda meat-based diet. Only 25% of those consuming a pure vegetarian diet had s. albumin values of ≥ 4g/dL. 66% of the pure-vegetarians had ans. albumin value ranging from <3-3. 4 g/dL. Twenty-eight percent and 8% of the meat-based diet consumers and vegetarians (respectively) had a s. albumin value between 3. 5-3. 9 g/dL. (P value=0. 032)

Table 4 shows the distribution of S. Albumin and BMI. Ten percent, of our study sample had a normal BMI, 62% Pre Obese, 21% Class 1 Obese, 5% Class 2 Obese, and 2% Class 3 Obese. No significant co-relation between BMI and s. albumin was obtained (p=0. 91).

Positive correlations between Hb levels and LDL (p=0. 005), FM (p= 0. 004), HCO3- (p=0. 015) and Cl-(p=0. 012) were also observed.

Negative correlations between prednisolone dose and s. albumin (p=0. 005), FM (p=0. 006), Fat% (p=0. 002) and S. Cr (p=0. 013) and between Hb% levels and potassium levels (p=0. 015) were observed.

The s. albumin values were on the lower range among the diabetics. Thirty-eight percent of the diabetics, and 75% of the non-diabetics had s. albumin values >4 g/dL(0. 076).

Table 5 shows the results of the paired samples T-test, done on various parameters, comparing the means and standard deviations, on the first follow ups and the 6th monthly follow ups. The S. albumin level at the first follow up, post-transplant, was 3. 58 ± 0. 43 g/dL, and at 6 months was 3. 827 ± 0. 507 g/dL(p value = 0. 208). The mean dose of prednisolone ingested, at the first follow up and at 6 months, was 21 ± 12 mg and 10 ± 9. 75, respectively. The mean HCO at baseline and 6 months, was 23. 38 ± 3 and 25. 25 ± 2. 6 (p=0. 049). The mean BMI at baseline and 6 months was 22. 67 ± 10. 55 kg/m² and 23. 59 ± 3. 4 kg/m² (p=0. 051). The fat% at baseline and 6th month follow up was 26. 79 ± 10. 56% and 32. 44 ± 11. 14% (p=0. 003). The mean FM at baseline and the 6th month was 19. 48 ± 9 kg and 23. 91 ± 10. 70 kg (p=0. 44). The mean LBM at baseline and at 6th month was 44. 21 ± 5. 44 kg and 43. 963 ± 5. 767 kg (p=0. 763).

No significant co-relation was observed between S. albumin and DM, BMI, smoking and a history of ingesting alcohol.

Discussion

A number of factors affect the nutritional and metabolic status in CKD, leading to multiple adverse consequences (Figure 1) [17]. These factors may persist, despite transplantation [2,6-8].

According to other studies, S. albumin also predicts progression of co-morbid conditions like DM, hypertension, including advanced kidney disease [18,19]. For example, levels <2. 5 g/dL have been associated with a risk of death 20 times higher compared with a reference level of 4. 0-4. 5 g/dL in hemodialysis patients, and levels of 3. 5-4. 0 g/dL (considered to be within the normal range) were associated with doubling the risk of death [20,21].

Obesity

Weight gain, obesity, dyslipidemia and post-transplant DM and metabolic complications are common in the recipients of successful renal transplants. According to the UNOS data, approximately 34% patients who underwent renal transplant were overweight [8]. In comparison to our study, we found out that mild obesity was prevalent in 62% of our study group, the higher BMI could be attributed to post transplant increase in appetite, a sedentary lifestyle, a dietary implementation a high carbohydrate diet and steroid ingestion. They are at increased risk for post-transplant DM, hypertension, and dyslipidemia that require close monitoring [8,9].

BMI has a very strong association with outcomes after renal transplantation independent of most of the known risk factors for patient and graft survival. The extremes of very high and very low BMI

	Serum Albumin (g/dL)			Total	Significance
	<3.4	3.5-3.9	≥ 4		p value=0.076
Meat Based	10	11	18	39	
Vegetarian	8	1	3	12	
Total	18	12	21	51	

Table 3: Correlation between serum albumin and dietary habits, using a cross-tab, and Pearson's chi square test.

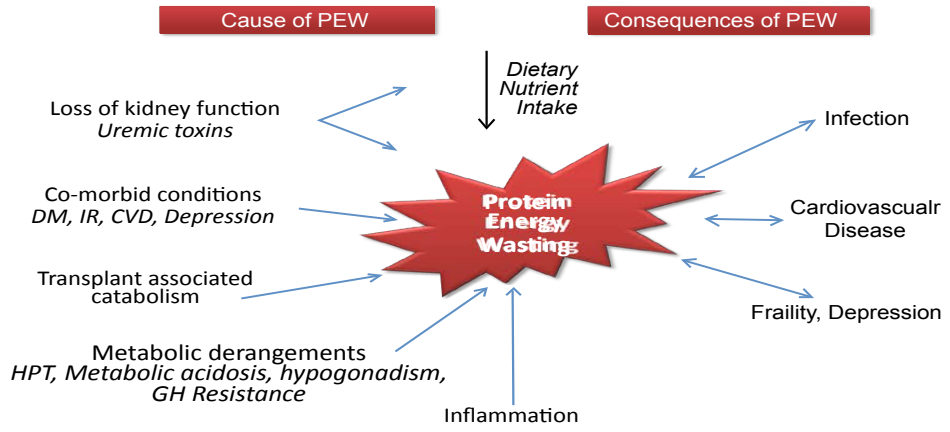
BMI	Serum Albumin (gm/dL)			Total	Significance
	<3.4	3.5-3.9	≥ 4		p=0.91
18.5-24.99	7	5	6	18	
25-29.99	36	24	46	106	
30-34.99	8	11	16	35	
35-39.99	2	3	3	8	
40+	1	1	1	3	
Total	54	44	72	170	

Table 4: Correlation analysis between serum albumin and BMI Distribution, using a cross-tab, and Pearson's chi square test.

	Mean	Std. Deviation	N	Std. Error Mean	Significance
Sr. Albumin (gm/dL) (1st Follow up)	3.583	.4301	18	.1014	.208
Sr. Albumin (gm/dL) (6th month)	3.828	.5074	18	.1196	
Pred. Dose (mg) (1st Follow up)	21.355	12.0031	22	2.5591	.002
Pred. Dose (mg) (6th month)	10.000	9.7590	22	2.0806	
Hb (gm%) (1st Follow up)	12.383333	1.4824529	6	.6052089	**.047**
Hb (gm%) (6th month)	12.783333	1.3467244	6	.5497979	
HDL (mg/dL) (1st Follow up)	48.67	6.028	3	3.480	.286
HDL (mg/dL) (6th month)	42.67	13.051	3	7.535	
Ca (mg/dL) (1st Follow up)	8.956250	.7999740	16	.1999935	.247
Ca (mg/dL) (6th month)	9.206250	.4905354	16	.1226339	
HCO(mEq/l) (1st Follow up)	23.380	3.0327	15	.7830	**.049**
HCO(mEq/l) (6th month)	25.253	2.6409	15	.6819	
BMI(kg/m²) (1st Follow up)	22.679981	3.9689091	18	.9354808	.051
BMI(kg/m²) (6th month)	23.590380	3.4501668	18	.8132121	
Fat % (1st Follow up)	26.792000	10.5657434	25	2.1131487	**.003**
Fat % (6th month)	32.444000	11.1425266	25	2.2285053	
Fat Mass (kg) (1st Follow up)	19.485733	9.0031264	15	2.3245972	**.044**
Fat Mass(kg) (6th month)	23.918333	10.7062466	15	2.7643410	
LBM (kg) (1st Follow up)	44.214400	5.4443011	15	1.4057125	.763
LBM (kg) (6th month)	43.963133	5.7678948	15	1.4892640	
Cr (mg/dL)(1st Follow up)	1.194118	.3210736	17	.0778718	.071
Cr (mg/dL) (6th month)	1.317647	.3107155	17	.0753596	

(S. Albumin – Serum Albumin; Pred. Dose – Prednisolone Dose ingested; Hb – Hemoglobin; HDL – High density Lipoprotein; Ca – Serum Calcium; HCO – Arterial Sodium Bicarbonate; BMI – Body mass index; Fat% - Fat percentage as quantified by DEXA; Fat Mass)

Table 5: Paired samples T-Test – Comparing the means and standard deviations of the 1st follow up and 6th month follow up of various parameters.



DM – Diabetes mellitus; IR – Insulin Resistance; HPT – Hyper-parathyroidism; GH – Growth hormone

Figure 1: The conceptual model for etiology and consequences of PEW on CKD.

before renal transplantation are important risk factors for patient and graft survival [16].

There are several epidemiological studies, indicating that a higher BMI, regardless of its etiology (i. e. , increased LBM or adiposity) is associated with better survival in these patients [22,23]. If weight gain in one potential outcome of an intervention, gain in LBM should be a part of it, along with gain in fat mass. Fifty six Percent of our patients, were diabetic, and had a higher BMI. Increased s. albumin levels were also associated with higher fat content, reflecting a better nutrition. Diabetic patients, despite effective treatment, had lower s. albumin

levels, similar to other studies [24]. We observed, in our study that as the fat-content (fat% or FM) went higher, serum albumin levels also increased. A higher adiposity is associated with a better outcome and nutritional status in renal transplant recipients.

This calls for strict dietary counseling, lifestyle changes and exercise promotion after transplantation, with repeated strict monitoring of their nutritional status. Patients should be counseled and explained the health benefits to ensure compliance.

Diabetes

Gama-Axelsson et al. [25] report their findings regarding the predictive value of s. albumin as a nutritional marker in a large and well-phenotyped cohort of incident and prevalent maintenance dialysis patients. Their results show that serum albumin was significantly correlated with DM. However, in our study, S. albumin co-related poorly with the diabetic status, although, we observed that the diabetic patients had a lower S. Albumin level

CKD patients often have other co-morbid diseases that can significantly affect their nutritional status. These may persist despite transplant, owing to some genetic component implicated in their pathogenesis. Patients with CKD secondary to diabetes have a higher incidence of PEW, when compared with the non-DM patients [26]. Insulin resistance is detectable in MHD patients, even in the absence of obesity, and is strongly associated with increased muscle protein breakdown, even after controlling for inflammation [27-32]. Appropriate management for DM and insulin resistance is important for preventing further loss of LBM in these patients.

Diet

Successful transplantation enables the recipient to end the dietary restrictions imposed on them. This induces an overall sense of well-being and an increase in appetite and subsequently, causes weight gain. This might push the patient to become pre-obese or obese, which is associated with increased morbidity and mortality [16,33].

Dietary protein and energy intakes of 0. 6-0. 8 g/kg of ideal body weight per day and 30-35 kcal/kg of ideal body weight per day, respectively, are able to preserve their protein stores through the progression of kidney disease [34-36]. Accordingly, the levels of protein and calories should be adjusted when hyper metabolic conditions like acute illness and hospitalizations occur. Accordingly, the minimum protein and energy requirements for patients on hemodialysis and peritoneal dialysis are 1. 2 g/kg of ideal body weight per day and 30-35 kcal/kg of ideal body weight per day based on physical activity level [37]. Immunosupression and steroid use, and dyslipidemia

Our cohort of patients belonged to the upper or upper middle class, were predominantly non-vegetarians who underwent regular, uninterrupted hemodialysis, counseled adequately by the dietician in the dialysis unit pre and postoperatively. These patients were treated with recombinant erythropoietin, carnitine and iron supplements as required. The patients were on a triple drug combination of the following, in the decreasing order of frequency: prednisolone, cyclosporin, mycophenolatemofetil, azathioprine and sirolimus.

The hyperlipidemic effects of steroids have been well described. Immunosuppressive therapy in renal transplant patients leads to accumulation of triglyceride-enriched Very-Low Density Lipoprotein (VLDL) and LDL. Triglyceride enrichment in LDL indicates the accumulation of small, dense LDLs, which are known to bear enhanced atherosclerotic risk. [14]. Patients who were on a prednisolone-cyclosporin regimen, showed an improvement in the lipid profile, after conversion to azathioprine-prednisolone regimen [38]. The prevalence of hyperlipidemia after renal-transplantation varies from 16-60% [12]. Causes of dyslipidemia are usually multiple, but include immunosuppression (especially prednisone, cyclosporine and sirolimus), graft dysfunction (reduced glomerular filtration rate and proteinuria), and genetic predisposition [13]. We found the HDL (49. 62 ± 13. 505mg/dL), LDL(90. 850 ± 31. 584 mg/dL) and TGl(113. 8 ± 57. 592 mg/dL) levels in the normal limits on follow up. We also found that the s. albumin levels were higher among those with a higher LDL level, which may indicate a better nutritional status, among those patients.

Hemoglobin

Fifty percent of our cohorts were anemic, with Hb% levels less than 10. 9gm% which may be due to such as the latent malnutrition, immunosuppressant drug use, chronic blood loss or graft dysfunction [39]. If un-treated, it might contribute to cardiovascular events in these patients [40]. This calls for investigations to look for substrate deficiencies, such as iron, B12, folic acid, and the usage of erythropoietin is warranted.

Depression

Depression, socio-economic factors, acute concurrent illness, lifestyle and inadequate dietary prescription are the other factors that should also be addressed as causes of post-transplant malnutrition. Early recognition and treatment of depressive symptoms, which are common in CKD, ESRD and the post-transplant period, are linked to fatigue [41], and an unwillingness to eat [42], are important components to the prevention of PEW [43-45].

Metabolic acidosis

Thirty percent of our cohort, had bicarbonate levels <22 mEq/L, which would have a catabolic effect on the recipients, or even graft dysfunction. Metabolic acidosis is a common electrolyte abnormality, encountered in patients with progressive CKD; it promotes PEW by increasing protein catabolism via suppression of insulin/insulin growth factor-1, signaling and activation of the ubiquitin-proteasome system [15]. In addition, acidosis stimulates the oxidation of essential amino acids, and raises the protein requirements [46]. There are a number of studies indicating improvement in nutritional status with oral HCO supplementation [47]. However, data on post-transplant patients are very limited. Metabolic studies in PD patients showed that correction of a low serum HCO concentration will downgrade muscle proteolysis, although no appreciable effect is observed in net protein synthesis. HCO would have to be instituted to maintain it >22 mEq/L [48].

In our study, we found that the mean Hb%, S. Ca, HCO, BMI, Fat% was higher at 6 months, compared to baseline, which could be attributed to a better nutrition, or nutritional interventions and counseling during the follow up period. The mean Cr was higher 6months later, with respect to the baseline [24].

The predicted financial gains greatly overcome any cost associated with the various nutritional interventions for CKD, ESRD and post-transplant patients [49]. For this reason, careful attention to the nutritional and metabolic state of post-renal transplant patients is warranted in developing countries, with well-trained renal nutritionists, with appropriate follow up, and counseling.

Conclusions

Serum Albumin varies with diet, and is significantly higher among those eating a meat-based diet following transplant. A higher fat content was associated with higher Serum albumin levels, which may reflect a better nutritional status. Lower maintenance doses of prednisolone, and steroid-sparing regimens, may improve the S. albumin Levels and the lipid profile. Protein anabolism is determined by nutritional availability and the type of diet ingested. Dietary protein intake should be adjusted to daily needs, and other factors like, infections, hospitalization's, diabetes and insulin resistance and metabolic acidosis. Prevention of muscle-mass wasting is an important factor to be considered in nutritional counseling in the post-transplant period. Ineffective management of diabetes may lead to lower Serum albumin levels. Attention should be paid to the prevention of acidosis. This calls for a dietary counseling, and lifestyle changes advice to all transplant recipients, to prevent the development of diabetes, hypertension, and the general state of health, which may have an impact on the long term morbidity of these patients, most common being cardiovascular events. A further randomized controlled trial looking at the role of protein supplementation in vegetarians following renal transplant as well as evaluating the effect of lowered prednisolone dose is warranted.

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