Original Article

ASSOCIATION OF SERUM PREALBUMIN WITH NUTRITIONAL STATUS OF END-STAGE RENAL DISEASE PATIENTS UNDER MAINTENANCE HEMODIALYSIS

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ABSTRACT

***Background*:** End-stage renal disease (ESRD) patients undergoing maintenance hemodialysis often suffer from malnutrition. The primary objective of the study was to measure the level of serum prealbumin, assess the correlation of serum prealbumin with modified subjective global assessment score and determine a cut-off value for prealbumin that can estimate the nutritional status of the study population with highest accuracy, among ESRD patients under maintenance hemodialysis.

***Methods*:** A one year long cross-sectional study from July 2016 to June 2017 was conducted at hemodialysis unit of SSMC & MH, BSMMU, BIRDEM hospital and NIKDU, Dhaka, among 80 maintenance hemodialysis patients. Adult patients over the age of 18 years and on regular (≥2 sessions per week) hemodialysis for more than 3 months without any acute infection were enrolled. Nutritional status of the patients was evaluated using modified subjective global assessment score. Serum prealbumin level was compared with both anthropometric and biochemical parameters, as well as with modified SGA score. Using modified SGA score as gold standard, receiver operating characteristic curve was used to estimate best fitting cut-off value for serum prealbumin for nutritional assessment among ESRD patients under maintenance hemodialysis.

***Results*:** Mean age of study population was 52.3 years and 66.3% respondents were male. Most prominent primary renal diseases were diabetic nephropathy (48.8%). According to modified SGA score, 10% of the study population had normal nutritional status and 90% had mild to moderate malnutrition. Mean serum prealbumin was 27.8 mg/dl. Serum prealbumin showed significant negative correlation with age, modified SGA score and triglyceride; significant positive correlation was shown with BMI, serum creatinine and serum albumin. Using receiver operating characteristic curve, 32.6 mg/dl was found to be the best fitting cut-off value for nutritional assessment with 73.6% sensitivity, 62.5% specificity and 72.5% accuracy.

***Conclusion*:** Data obtained from this study strongly indicates that serum prealbumin can be used as a marker for nutritional assessment among ESRD patients undergoing maintenance hemodialysis.

JOPSOM 2021; 40(2):9-15
https://doi.org/10.3329/jopsom.v40i2.61791

Keywords: Hemodialysis; Biochemical profile; Malnutrition

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INTRODUCTION

End-stage renal disease (ESRD) patients undergoing hemodialysis often suffer from the co-occurrence of malnutrition [1-3], emergence of which drastically impact the treatment outcome and long term survival of such patients [4]. The dialysis procedure itself causes protein and nutrient loss into the dialysate, causing malnutrition among 39-50% of all the

maintenance hemodialysis patients [5-7]. Since poor nutritional status is associated with less than optimal treatment outcome and increased risk of death in patients under hemodialysis [8], using markers for early detection of malnutrition may lead to timely nutritional intervention, resulting in improving patients' health and desirable treatment outcome among hemodialysis patients [9-11].

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative clinical practice guideline for nutrition in end-stage renal disease (ESRD) has suggested careful evaluation of the relationship between nutritional status of the patients undergoing maintenance hemodialysis and the outcome of the treatment [12-13], further suggesting serum prealbumin as a useful marker for nutritional assessment among such patients [1]. Prealbumin, also known as transthyretin, is a hepatic secretory protein, that declines in response to inadequate protein intake [14] leading to its potential to be used as a marker for nutritional assessment. Prealbumin is also known as a sensitive marker for malnutrition due to its short half-life of 2–3 days [15-16].

Previous studies among patients with end stage renal disease under maintenance hemodialysis, have suggested that the serum prealbumin is associated with treatment outcome and have advocated the use of serum prealbumin as a marker for nutritional assessment among patients under maintenance hemodialysis [2,5,17–19]. Data on the role of serum prealbumin as a marker for nutrition assessment among maintenance hemodialysis is scarce and controversies regarding optimal serum prealbumin levels exist [17,20,21]. In this context, we examined a group of 80 maintenance hemodialysis patients with nutritional measures.

METHODS

This was a cross-sectional study conducted from July 2016 to June 2017 at hemodialysis units at SSMC&MH, BSMMU, BIRDEM hospital and NIKDU, Dhaka, among 80 maintenance hemodialysis patients. Adult patients over the age of 18 years and on regular (≥2 sessions per week) hemodialysis for more than 3 months without any acute infection were enrolled.

Data were collected through face-to-face interview using a pre-tested data collection sheet. Before preceding the data collection, the detail of the study was explained to each eligible patient and written consent from the patient was obtained. The relevant socio-demographic data along with biochemical data of the patients were collected and recorded. Computer based statistical analysis were carried out with appropriate techniques and systems. Quantitative data were expressed as mean and standard deviation and qualitative data were expressed as frequency distribution and percentage. Statistical analysis was performed by using Statistical Packages for Social Sciences (SPSS® version 22) for Windows®.

For nutritional assessment, modified subjective global assessment was performed by using 7 point modified SGA scale. The patient was then assigned a rating of well nourished, mild to moderately malnourished and severely malnourished. Anthropometric parameters, such as height (cm), weight (kg), BMI (kg/m^2), waist circumference (cm), hip circumference (cm) and waist to hip ratio were recorded. Biochemical profile of the subjects was recorded. Serum albumin and prealbumin were measured by using fully automated chemistry analyzer Mindray-BS-230. Serum creatinine was determined by alkaline picrate method (Jaffe reaction). Serum total cholesterol and triglyceride were measured by enzymatic colorimetric methods in the laboratory. Adequacy of hemodialysis was measured by Kt/V. serum hemoglobin and serum urea were also measured.

RESULTS

Mean age of the patients was 52.3±14.6 years. Men were 66.3% of the study population and women were 33.8% of the study population. Causes of chronic diseases were diabetic nephropathy (48.8%), glomerulonephritis (28.7%), hypertension (12.5%), polycystic kidney disease (1.3%) and cardiovascular diseases (8.8%). Mean SGA score was 12.2±3.0 for the study population, with 10% having normal nutritional status and 90% being mildly to moderately malnourished. Detailed anthropometric and biochemical profile of the patients are described in Table 1.

Table 1. Baseline demographics of the maintenance hemodialysis patients (n = 80)

Variables	Value
Age (years)	52.3 ± 14.6
Sex	

JOPSOM 2021; 40(2):9-15 https://doi.org/10.3329/jopsom.v40i2.61791

	Male	53 (66.3%)
	Female	27 (33.8%)
Chronic Kidney Diseases		
	Diabetic nephropathy	39 (48.8%)
	Glomerulonephritis	23 (28.7%)
	Hypertension	10 (12.5%)
	Cardiovascular diseases	7 (8.8%)
	Polycystic kidney disease	1 (1.3%)
SGA Score		
	Normal (<8)	8 (10.0%)
	Mildly to moderately malnourished (8 - 34)	72 (90.0%)
	Severely malnourished (35)	0(0%)
Anthropometric Parameters		
	Height (cm)	158.0 ± 8.9
	Weight (kg)	59.7 ± 13.1
	BMI (kg/m^2)	23.8 ± 4.6
	Waist	89.7 ± 15.5
	Hip	89.9 ± 10.5
	Waist to hip ratio	0.9 ± 0.1
	Modified SGA Score	12.2 ± 3.0
Biochemical Parameters		
	Hemoglobin (gm/dl)	8.6 ± 1.4
	Serum Creatinine (mg/dl)	7.6 ± 2.6
	Serum Albumin (gm/dl)	3.7 ± 0.5
	Serum Prealbumin (mg/dl)	27.8 ± 12.2
	Triglyceride (mg/dl)	156 ± 82
	Total cholesterol (mg/dl)	149 ± 38
	Pre hemodialysis urea	100.8± 42.7
	Post hemodialysis urea	44.6 ± 25.6
	Kt/V	0.99 ± 0.47

Data are presented as n (%) or mean ± SD.

BMI, body mass index; SGA, subjective global assessment, Kt/V, efficacy of a hemodialysis session.

Table 2 shows the correlations of prealbumin with age and modified SGA score of the patients undergoing maintenance hemodialysis, along with anthropometric parameters and biochemical parameters. Age and modified SGA score showed significant negative correlation with serum prealbumin levels ($r = -0.412$, $p = < 0.001$ and $r = -0.256$, $p = 0.022$, respectively). Pearson correlation analysis demonstrated significant positive correlation between serum prealbumin level and BMI ($r = 0.232$, $p = 0.039$). Significant positive correlation was also found between serum prealbumin level and serum creatinine level ($r = 0.305$, $p = 0.006$).

Serum albumin level showed significant positive correlation with serum prealbumin level (r = 0.354, p = 0.001). Significant negative correlation was found between serum triglyceride level and serum prealbumin level (r = -0.335, p = 0.002), however total cholesterol did not show a significant correlation with serum prealbumin.

Table 2. Correlations of prealbumin with anthropometric and biochemical parameters for maintenance hemodialysis patients (n = 80)

Variables		Correlation coefficient with serum prealbumin level	*P Value
Age (years)		-0.412	< 0.001
Modified SGA Score		-0.256	< 0.05
Anthropometric parameters			
	Height (cm)	0.082	0.471
	Weight (kg)	0.165	0.144
	BMI (kg/m^2)	0.232	< 0.05
	Waist	-0.140	0.217
	Hip	-0.155	0.170
	Waist to hip ratio	-0.045	0.692
Biochemical parameters			
	Hemoglobin (gm/dl)	-0.095	0.401
	Serum Creatinine (mg/dl)	0.305	< 0.05
	Serum Albumin (gm/dl)	0.354	< 0.05
	Triglyceride (mg/dl)	-0.335	< 0.05
	Total cholesterol (mg/dl)	-0.026	0.818
	Pre hemodialysis urea	0.086	0.447
	Post hemodialysis urea	0.054	0.633
	Kt/V	0.012	0.915

* P values were calculated by Pearson bivariate correlation analysis.

Receiver operating characteristic curve was used to calculate the best fitting value for serum prealbumin for detecting malnutrition among maintenance hemodialysis patients, compared to the gold standard, modified SGA score (Figure 1). Serum prealbumin level 32.6 mg/dl was found to be the best fitting value for detecting malnutrition among maintenance hemodialysis patients. Study population was classified using the serum prealbumin cut-off value of 32.6 mg/dl and compared with modified SGA score (Table 3). Serum prealbumin level 32.6 mg/dl was found to be 73.6% sensitive and 62.5% specific for detecting malnutrition among maintenance hemodialysis patients, with a 72.5% accuracy for correctly diagnosing nutritional status among maintenance hemodialysis patients.

JOPSOM 2021; 40(2):9-15 https://doi.org/10.3329/jopsom.v40i2.61791

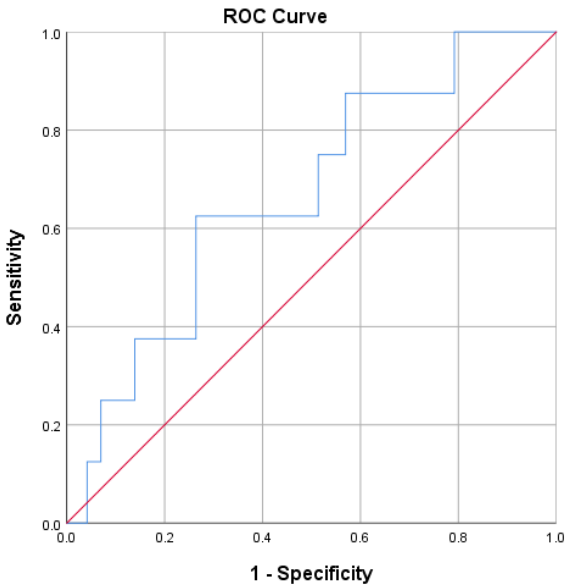

Figure 1. Receiver operating characteristic curve showing best fitting cut off value serum prealbumin level for detecting nutritional status among patients under maintenance hemodialysis, compared to modified SGA score.

Table 3. Sensitivity and specificity of serum prealbumin level for detecting nutritional status among patients under maintenance hemodialysis, compared to modified SGA score

Variables	Modified SGA Score >=8; Malnutrition	Modified SGA Score <8; Normal	P
Prealbumin < 32.6	53 (73.6%)	3 (37.5%)	0.048
Prealbumin ≥ 32.6	19 (26.4%)	5 (62.5%)	

DISCUSSION

Maintenance hemodialysis patients were predominantly male (66.3%). Male predominance (up to 59%) among hemodialysis patients have also been seen in older studies [22-23]. Mean age of the patients was 52.3 years, result consistent with a 2020 study [24]. Using Pearson correlation analysis, age was found to show significant negative correlation with serum prealbumin level; result consistent with Lee et al. [25] findings.

Most common primary renal disease was diabetic nephropathy (48.8%), followed by glomerulonephritis (28.7%) and hypertension (12.5%). Diabetic nephropathy has been identified as the prevalent underlying cause for chronic kidney disease leading to hemodialysis among 66.3% patients in previous studies [22], which is higher than current study finding, but this difference could be contributed to the different sample size and population of these studies.

Patients were classified into groups with normal nutritional stratus and groups with mild to moderate malnutrition, according to modified SGA score and 90% of the respondents were found to be malnourished. This finding is consistent with another study from India [26], where using modified SGA, malnutrition rate was 91% among hemodialysis patients.

Pearson correlation analysis showed modified SGA score to have significant negative correlation with serum prealbumin levels, meaning an increase in SGA score is associated with a decrease in serum prealbumin level, and this association is statistically significant ($p < 0.05$). This relation between serum prealbumin and SGA score is supported by older studies [27], where prealbumin level was shown to decrease with increasing SGA score, leading to the potential of prealbumin level to be used as an indicator for malnutrition among hemodialysis patients.

Among the anthropometric parameters, BMI showed significant positive correlation with serum prealbumin

levels. This is consistent to prior studies, where BMI was shown to have positive correlation with prealbumin level [28-29]. Height and weight showed positive correlation, waist circumference, hip circumference and waist to hip ratio showed negative correlation with serum prealbumin level.

Serum creatinine and serum albumin showed significant positive correlation with serum prealbumin, findings consistent with previous study [25], further supporting the potential of prealbumin to be used as an indicator for malnutrition among hemodialysis patients. Serum triglyceride and cholesterol showed negative correlation with serum prealbumin. Study on hemodialysis patients have shown higher concentrations of triglycerides to be associated with better nutritional status [30]; these difference in findings could be due to the dietary habits of the study population and needs further evaluation. Serum hemoglobin showed negative correlation with serum prealbumin, which is supported by older study [31], where prealbumin was found to have negative correlation with hemoglobin.

Higher Pre hemodialysis urea and post hemodialysis urea levels had positive correlation with serum prealbumin. Similarly, higher dialysis efficiency (Kt/V) also had positive correlation with serum prealbumin. Using modified SGA score as gold standard for measuring nutritional status among maintenance hemodialysis patients, receiver operating characteristic curve was used to estimate the best fitting cut off value for serum prealbumin for detecting nutritional status among patients under maintenance hemodialysis. Serum prealbumin level 32.6 mg/dl was found to be the best fitting value, with 27.8 mg/dl to be mean serum prealbumin level for study population. Serum prealbumin below 32.6 mg/dl was found to be associated with malnutrition. This finding is similar to other studies, where serum albumin level < 40 mg/dl was found to be associated with malnutrition, leading to increased mortality and morbidity among patients under maintenance hemodialysis [18,25,32]. Other studies have shown serum prealbumin level < 30 mg/dl, to be significantly associated with poor nutritional status of the patients under maintenance hemodialysis [17,20-21]. Mean serum prealbumin level for patients under maintenance hemodialysis in present study was also consistent with a US study on 959 patients with a mean prealbumin level of 26.5 mg/dl for maintenance hemodialysis patients [15].

CONCLUSION

Serum prealbumin can be used as a reliable tool for detecting malnutrition among ESRD patients undergoing maintenance hemodialysis and has the potential to be used as a screening tool for early detection of malnutrition. However more comparative and longitudinal studies are needed to confirm the validity of this marker among Bangladeshi population before recommending widespread use.

Acknowledgement

We are grateful to all the respondents for their co-operation.

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