THE EFFICACY OF NUTRITIONAL AND INFLAMMATORY MARKERS IN LENGTH OF HOSPITAL STAY AND MORTALITY PREDICTION IN SEVERELY MALNOURISHED PATIENTS

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ABSTRACT

Objective: *Malnutrition and inflammation parameters are strongly correlated with prospective length of hospital stay and mortality. In this study, we studied the predictive roles of NRS-2002 score, serum prealbumin, albumin, CRP and ferritin levels in length of hospital stay and mortality in severely malnourished patients.*

Material and Method: *A total of 397 intensive care unit patients with NRS-2002 score ≥3 and total parenteral nutrition supplementation were included in the study. Patients were divided into two groups based on whether they were discharged (group 1) or deceased (group 2). Patients were evaluated at hospitalization and prior to patients' discharge or death.*

Results: *Mean duration of intensive care unit hospitalizations in group 1 and 2 were 11.97±10.57 and 13.43±12.67 days respectively (p=0.45). In group 1, NRS-2002 score of the patients were found to be decreased during the final evaluation. The initial and final measurement of serum CRP levels of group 2 were significantly higher than the CRP levels of group 1. The initial and final prealbumin and albumin levels for group 2 were significantly lower than prealbumin and albumin levels for group 1. Albumin was found to be the most specific predictor for mortality determination with 91% specificity, and 86% sensitivity. Sensitivity of prealbumin was found to be 59% for assessing the malnutrition with a specificity of 70%. Specificity for using CRP as an indicator of mortality was 87% with 93% sensitivity. Ferritin levels did not show any significance in predicting prognosis. The logistic regression analysis of multivariable model yielded the risk factors for hospital mortality as high CRP at admission, and prealbumin levels.*

Conclusion: *Serum albumin, prealbumin and CRP levels were shown to be associated with mortality prediction.*

Key Words: *Malnutrition, prealbumin, albumin, CRP, ferritin, NRS-2002* ***Nobel Med 2013; 9(2): 79-85***

CİDDİ MALNÜTRİSYON HASTALARINDA NÜTRİSYONEL VE İNFLAMATUAR BELİRTEÇLERİN HASTANEDE KALIŞ SÜRESİ VE MORTALİTEYİ ÖNGÖRMEDEKİ ETKİNLİĞİ

ÖZET

Amaç: Malnutrisyon ve inflamasyon belirteçleri hastanede kalış süresi ve mortalite ile kuvvetle ilişkilidir. Bu çalışmada, ciddi malnütrisyonu olan hastalarda NRS 2002 skorunun, serum prealbumin, albumin, CRP ve ferritin düzeylerinin hastanede kalış süresi ve mortaliteyi öngörmedeki rolü değerlendirilmiştir.

Materyal ve Metod: NRS-2002 skoru ≥3 olan ve total parenteral beslenme uygulanan toplam 397 yoğun bakım ünitesi hastası çalışmaya dahil edildi. Hastalar taburcu olan (1. grup) ya da vefat eden (2. grup) grup olma durumuna göre iki gruba ayrıldı. Hastalar hastaneye yatışta ve taburcu ya da ölüm öncesinde değerlendirildi.

Bulgular: Yoğun bakım ünitesine yatış süresi ortalaması grup 1 ve 2 de sırasıyla, 11,97±10,57 ve 13,43±12,67 gündür (p=0,45). 1. gruptaki son değerlendirmede NRS 2002 skoru azalmıştır. 2. grupta ilk ve son ölçümlerdeki CRP düzeyleri, grup 1 CRP düzeylerinden anlamlı derecede daha yüksektir. 2. grupta ilk ve son prealbumin ve albumin düzeyleri, 1. grupta prealbumin seviyesinden anlamlı olarak daha düşüktür. Albuminin %91 spesifisite ve %86 sensitivite ile, mortalite belirlenmesinde en spesifik belirteç olduğu tespit edildi. Prealbuminin malnütrisyon değerlendirmesinde sensitivitesi %59, spesifisitesi %70 olarak bulundu. Mortalitenin belirleyicisi olarak CRP spesifitesi %87, sensitivitesi %93'tür. Ferritin düzeyleri prognozunda belirlemede anlamlılık göstermemiştir. Lojistik regresyon analizi ile çoklu değişkenli modelde belirlenen hastane mortalitesi risk faktörleri, başlangıçtaki yüksek CRP, düşük albumin ve prealbumin seviyeleridir.

Sonuç: Serum albumin, prealbumin ve CRP düzeylerinin mortalite öngörmede ilişkili olduğu gösterilmiştir.

Anahtar Kelimeler: Malnütrisyon, prealbumin, albumin, CRP, ferritin, NRS-2002 **Nobel Med 2013; 9(2): 79-85**

INTRODUCTION

Malnutrition is a serious health problem in hospitalized patients and it is associated with increased morbidity and mortality. A variety of anthropometric, biochemical and immunologic parameters as well as body composition methods have been used as indicators of malnutrition and inflammation and they are strongly correlated with prospective hospitalization duration and mortality.[1,2]

Albumin and prealbumin are affected by nutrition, whereas C - reactive protein (CRP) levels and ferritin levels are affected by inflammation and inflammation is known to affect the nutritional status of patients. Nutritional Risk Screening-2002 score (NRS-2002), body mass index (BMI) and mid-upper-arm circumference are frequently used for nutrition assessment in addition to these parameters.[3] CRP and ferritin are useful for the diagnosis of inflammation, but their prognostic value regarding mortality is unclear.[4,5]

We determined the relationship between nutritional and inflamatory status indicators such as serum prealbumin, albumin, CRP and ferritin levels and NRS-2002 score and mortality prediction and intensive care unit stay duration in severely malnourished patients.

MATERIAL and METHOD

This prospective, observational clinical study enrolled patients who were admitted to intensive care unit and were considered as malnourished according to Nutritional Risk Screening-2002 (NRS-2002) scoring system between November 2010 - May 2011 (7 months).[6] The study has been conducted in accordance with the Declaration of Helsinki and Good Clinical Practice Principles after approval of Institutional Ethics Committee. Informed consent was obtained from all subjects.

Setting

A 21-bed adult general intensive care unit in Istanbul Haydarpasa Numune Research and Training Hospital.

Patients

All adult patients' nutritional status were evaluated and patients with NRS-2002 score ≥3 and who were supplied with total parenteral nutrition (TPN) was included in the study. Nutritional supplementation was in accordance with ESPEN (European Society for Parenteral and Enteral Nutrition) guideline.[6] Patients were followed up without interfering with TPN which was determined according to ESPEN guideline.

Exclusion criteria included: enteral feeding, enteral feeding post TPN, and patients transferred to different hospitals. A total of 615 patients were enrolled. 218 patients were excluded from the study due to above exclusion criteria. The analysis was performed with 397 patients.

Nutritional Risk Screening (NRS-2002)

The NRS-2002 system was used to detect the presence of malnutrition and the risk of developing malnutrition in hospital setting. In NRS-2002, nutritional status was evaluated with weight loss in the last months, or BMI <18.5 with impaired general condition and amount of food intake in the last week. In the second part, severity of disease was evaluated.[6]

The NRS-2002 score is the total of the nutritional score, severity of disease score and age adjustment. Patients are classified as no risk=0, low risk=0-1, medium risk=3-4 and high risk=>5.[6]

The patients with score ≥3 were considered as nutritionally at-risk and a nutritional care plan should be initiated.[6]

Nutrition Unit

In our hospital, Nutrition Support Team (NST) is a multidisciplinary team that includes 3 specialist doctors (anesthesiologist, general surgeon and internal medicine doctor), 1 pharmacist, 2 dietitians, 3 nurses and 1 social worker.

Evaluation Criteria

Patients were evaluated within 24 h after admission ICU and afterwards weekly by the same 2 co-workers of Nutrition Unit. The laboratory analysis and anthropometric measurements were performed. The daily visits of the dietitians and nurses together with physician consultations were noted in NRS-2002 follow-up sheet prepared by NST. Initial and final data obtained prior to patients' death or discharge were included in the analysis. NRS-2002 follow-up sheet and hospital medical reports were utilized to evaluate patients.

Patients' data were divided into two groups based on whether they were discharged (group 1) or deceased (group 2). Data on length of intensive care unit stay was obtained in group 1 from the patient hospital records after discharging from intensive care unit and transfering to other wards and in group 2, intensive care unit stay prior to death. →

Anthropometric measurements

All measurements were performed at hospital admission and repeated weekly. Body mass index and mid-upper-arm circumference were measured. Body mass index changes during intensive care unit stay together with laboratory parameters were noted. For BMI calculations, patients' were weighed with use of special intensive care bed with weighing machine ((Eleganze®. By Linet type: SBI-230, Model: GX-22121-12, Germany).

Laboratory measurements

Laboratory parameters, including serum CRP, ferritin, albumin and prealbumin levels were measured at the time of initial admission to hospital and afterwards weekly. The initial measurement and the final measurement before the patients' discharge from the intensive care unit in group 1 and before death in group 2 were analyzed. CRP levels were measured by immunochemistry system (Beckman Coulter IMMAGE, USA). Serum ferritin levels were analyzed by immunoassay system (Beckman Coulter UniCel® DxI 800, USA). A colorimetric method was used to measure serum albumin levels. The prealbumin levels were measured by immunoturbidimetric assay by PP module automatic analyzer (Roche Diagnostics Modular System, Germany).

Statistical Analysis

The statistical analysis was performed using Graph Pad Prism 5 (USA). Results were considered statistically significant if p value was less than 0.05. Comparisons between two groups were assessed by means of Mann-Whitney U test for non-normally distributed continuous variables. We used Spearman's correlation analysis for non-parametric variables. Receiver operating characteristic (ROC) curve analysis was used to calculate sensitivity and specificity levels. Risk factors for hospital mortality and hospital length of stay were evaluated using multivariable logistic regression analysis. Odds ratio and confidence limits are presented.

RESULTS

The demographic profile and baseline characteristics of the study population are depicted in Table 1. There was no significant difference between ages and gender distribution among the groups. Mean duration of intensive care unit hospitalizations in group 1 and 2 were 11.97±10.57 and 13.43±12.67 days respectively. There were also no statistically significant differences in duration of intensive care unit stay between two groups (p=0.45; Table 1).

Table 1: Characteristics of the patients

	Group 1 (n=293)	Group 2 (n=104)	P value
Age (years)	68 ± 17	72 ± 15	0.06
Gender (F/M)	160/133	52/52	0.42
Length of intensive care unit stay (days)	11.97 ± 10.57 (mean ± sd)	13.43 ± 12.67 (mean ± sd)	0.45
Primary admission diagnosis			
Respiratory	78	37	
Cardiovascular/vascular	37	18	
Sepsis	26	11	
Metabolic	17	4	
Gastrointestinal	63	13	
Neurologic	19	7	
Others	53	14	

Group 1: Discharged; Group 2: Deceased

Table 2: Anthropometric measurements of the patients

	Group 1			Group 2		
	Initial (n= 293)	Last (n= 157)	p value	Initial (n = 104)	Last (n = 53)	p value
BMI (kg/m²)	24.89±5.32	24.73±5.54	0.752	25.39±5.38	25.43±5.96	0.892
NRS-2002 score	3.44	3.14	<0.0001	3.88	3.60	0.06
Mid-upper-arm circumference	26.23±4.40	26.17±4.63	0.843	26.36±4.96	26.53±5.87	0.736

Data are shown as "mean ± standard deviation (sd)".

The anthropometric measurements of patients are shown in Table 2. There was no difference between initial and final measurements in BMI and mid-upper-arm circumference both in group 1 (24.89±5.32 kg/m²; 24.73±5.54 kg/m², respectively) and group 2 (25.39±5.38 kg/m²; 25.43±5.96 kg/m², respectively). Also the measurements did not differ between groups both in initial and at final measurements (Table 2). The initial NRS-2002 score in group 1 was 3.44 and last NRS-2002 score in group 1 was 3.14. It significantly decreased at final measurement (p<0.0001). In the group 2, initial NRS-2002 score was 3.88 and it was 3.60 in the final measurement. It did not show any significance (p=0.06; Table 2).

The initial albumin level for both group 1 (3.11±0.03 g/dL) and group 2 (2.92±0.04 g/dL) statistically significantly decreased at the final measurements 2.74±0.06 g/dL and 2.32±0.09 g/dL, respectively (p=0.0002, p<0.0001, respectively; Table 3). The albumin level for group 2 at final measurement (2.32±0.09 g/dL) was significantly lower than that of group 1 (2.74±0.06 g/dL; p<0.0001).

There was no statistically significant difference between initial and final prealbumin levels in both groups. The initial prealbumin level for group 2 (10.01±0.67 mg/dL) was significantly lower than →

Table 3: Biochemical parameters of the patients at initial and final measurements

	Group 1			Group 2		
	Initial	Last	p value	Initial	Last	p value
CRP (mg/dL)	8.01±0.52 (n=269)	7.61±0.63 (n=135)	0.463	10.87±0.99 (n=98)	14.68±1.70 (n=50)	0.02
Ferritin (ng/mL)	290.13±62.69 (n=250)	253.91±25.51 (n=111)	0.008	472.91±173.85 (n=87)	639.08±113.24 (n=35)	< 0.0001
Albumin (g/dL)	3.11±0.03 (n=288)	2.92±0.04 (n=151)	0.0002	2.74±0.06 (n=101)	2.32±0.09 (n=51)	< 0.0001
Prealbumin (mg/dL)	11.83±0.45 (n=179)	12.18±0.52 (n=120)	0.595	10.01±0.67 (n=64)	8.37±0.55 (n=42)	0.166

Group 1: Discharged group; Group 2: Deceased group

Table 4: Statistical data for the initial CRP, ferritin, albumin and prealbumin in the malnutrition patients

	AUC (CI 95%)	Cut-off	Sensitivity (%)	Specificity (%)	p value
CRP (mg/dl)	0.587 (0.504-0.670)	0.81	93	87	0.04
		0.92	93	86	
		1.15	89	83	
Ferritin (ng/mL)	0.563 (0.478-0.649)	304	35	23	0.14
		376	27	20	
		406	25	17	
Albumin (g/dL)	0.349 (0.264-0.433)	2.12	86	91	0.001
		2.45	62	84	
		2,71	54	74	
Prealbumin (mg/dL)	0.410 (0.326-0.494)	8.05	59	70	0.04
		9.1	50	62	
		10.1	40	55	

AUC: Area under curve, CI: Confidence interval

the initial prealbumin level for group 1 (11.83±0.45 mg/dL; p=0.03; Table 3). Also the final measurement of prealbumin in group 2 (8.37±0.55 mg/dL) was significantly lower than that in group 1 (12.18±0.52 mg/dL; p<0.0001).

In group 1 the CRP at admission was 8.01±0.52 mg/dL, and decreased to 7.61±0.63 mg/dL at final measurement (p=0.463). In group 2, the initial CRP level was 10.87±0.99 mg/dL, significantly increased to 14.68±1.70 mg/dL at final measurement (p=0.02; Table 3). When the initial CRP levels are compared between groups, initial CRP level for group 2 (10.87±0.99 mg/dL) was significantly higher than the initial CRP level for group 1 (8.01±0.52 mg/dL; p=0.001) and also the CRP levels of the final measurements were found to be higher in group 2 (14.68±1.70 mg/dL) than in group 1 (7.61±0.63 mg/dL; p<0.0001).

In group 1, the ferritin level showed significant decrease (p=0.008) from initial level of 290.13±62.69 ng/dL to last level of 253.91±25.51 ng/dL, while in group 2 ferritin level showed significant increased from initial level of 472.91±173.85 ng/dL to final level of 639.08±113.24 ng/dL (p<0.0001; Table 3). There was no significant difference between initial ferritin levels of two groups (p=0.08) whereas the final ferritin analysis for group 2 was significantly higher than the final measurement of group 1 (p<0.0001).

In group 1, there was positive correlation between length of intensive care unit stay and initial CRP and initial ferritin levels (r=0.157, p=0.009; r=0.152, p=0.015, respectively). There was no significant correlation between length of intensive care unit stay and NRS-2002 score, albumin and prealbumin (r=0.09, p=0.100; r=-0.007, p=0.892; r=0.02, p=0.751, respectively).

In group 2, there was no correlation between length of intensive care unit stay and NRS-2002 score, albumin, prealbumin, CRP and ferritin (r=-0.157, p=0.104; r=0.017, p=0.85; r=0.06, p=0.59; r=-0.175, p=0.07; r=-0.136, p=0.195, respectively).

The roc curve for sensitivity and specificity of the serum albumin, prealbumin, CRP and ferritin in mortality prediction was shown in Figure1. Albumin was found to be most specific predictor of the determination of mortality in malnourished patients, with 91% specificity and 86% sensitivity (Table 4). The sensitivity of prealbumin was found to be 59% for assessing the malnutrition state in malnutrition patients, with a specificity of 70% (Table 4).

For the determination of mortality in malnutrition patients, the specificity for using CRP as an indicator of mortality was calculated to be 87%, with 93% sensitivity. Ferritin levels were not significant predictors of the prognosis in malnutrition (Table 4). The logistic regression analysis of multivariable model yielded the risk factors for hospital mortality as high CRP at admission, and low albumin and prealbumin levels (Table 5). No significant differences were observed in gender, age, BMI, NRS -score and ferritin levels.

The mean hospital length of stay in our hospital is 7.06 days, so we categorized the LOS in groups as <7.06 days and ≥7.06 days. Logistic regression analysis of variables affecting hospital length of stay revealed no significant difference in gender, age, BMI, NRS-score and laboratory parameters (Table 6).

DISCUSSION

Malnutrition characterized by reduced levels of albumin and prealbumin is a result of combined effects of →

inflammation and inadequate protein and calorie intake.[7] Presence of inflammation including comorbid conditions may further adversely affect nutritional status. Inadequate recognition and monitoring of malnutrition is associated with increased mortality during hospitalization.[8,9] Failure to determine these nutritional risk factors in patients at the beginning of hospital stay can cause serious health deteriotion and increase the length of hospital stay together with associated costs.[10-12] Hypercatabolic states associated with acute or chronic disorders are important determinants of malnutrition. It was reported that a number of studies have investigated serum protein levels association to nutritional status, however relationship between inflammation and protein status have not studied in most cases.[13] Thus we investigated the predictive roles of initial serum albumin, prealbumin, CRP and ferritin levels on mortality of patients with malnutrition.

We evaluated the nutrition status of patients by NRS-2002 scoring system which was used for identification of malnutrition and the patients at high risk of developing malnutrition in the hospital setting. Patients' NRS-2002 score was initially high in all patients indicating their malnutrition, NRS-2002 score significantly decreased in group 1, and it also decreased in group 2; while they were treated with TPN; however without statistical significance. Patients in group 2 had higher NRS-2002 score than that of group 1 in both evaluations. Additionally, anthropometric measurements were not different between groups.

Among the parameters used to identify patients' nutritional risk, serum CRP and ferritin levels were higher and serum prealbumin and albumin levels were significantly lower in group 2 (deceased patients) than those in group 1 (discharged patients).

Albumin as a possible prognostic indicator in nutrition was studied in several studies and hypoalbuminemia association with increased morbidity and mortality was documented.[13-15] In the investigation of Vellas et al. the relationship between nutritional status and albumin was investigated and it was reported that there was significant correlation between albumin and mini-nutritional assessment nutrition screening tool.[16] Also the serum albumin levels for all malnourished patients in our study were low and the initial and final serum albumin levels for group 2 were significantly lower than group 1 serum albumin levels. The predictive role of serum albumin level on mortality was also significant.

Similar to albumin which is traditional marker of nutritional status, serum prealbumin is another nutritional marker. Prealbumin half-life is short and its synthesis increases above baseline levels in short term. Therefore, level of prealbumin would be expected to change rapidly according to nutritional condition and the degree of inflammation. Determination of serum prealbumin level is thought to be a cost-effective and objective method for evaluation of disease severity in critically ill patients or patients with chronic diseases.[17-19] Robinson et al. studied 320 patients with malnutrition and found prealbumin to be a significant predictor of nutritional status.[20] In the study of Devoto et al., the feasibility, sensitivity and specificity of screening methods such as Subjective Global Assessment (SGA), prognostic inflammatory and nutritional index score, prealbumin and RBP were compared with Detailed Nutritional Assessment (DNA), which was used as a reference method. Among all methods investigated, they found that prealbumin showed the best concordance with DNA and had concluded that prealbumin was the best nutritional follow-up parameter.[21] In another study, prealbumin level was evaluated as a sensitive indicator of effectiveness of nutrition support and they found that prealbumin level did not respond sensitively to nutritional support and the increase in prealbumin level did not indicate better prognosis in critically ill patients.[22] The role of prealbumin in hemodialysis patients was found to provide prognostic value independent from serum albumin and other well known predictors of mortality in malnutrition patients.[23] In our study the initial and final prealbumin levels for group 2 were significantly lower than that of group 1. While prealbumin level improved in group 1, it was further decreased in group 2 in spite of TPN supplementation. The mortality predictive role of prealbumin was significant indicating higher prealbumin levels associated with less mortality risk.

The correlation between length of intensive care unit stay and nutritional parameters were also investigated in several studies. The length of hospital stay relation with albumin, prealbumin, lymphocytes, transferring and of →

Table 5: Risk factors for hospital survival of the malnutrition patients

Logistic Regression Model		
	Multivariable (odds ratio, 95% CI)	**p value**
Gender	0.65 (0.26-1.63)	0.36
Age	0.99 (0.97-1.02)	0.69
BMI (kg/m²)	0.99 (0.91-1.08)	0.83
NRS-score	0.66 (0.40-1.09)	0.10
CRP (mg/dl)	0.84 (0.78-0.92)	0.0001
Ferritin (ng/mL)	1 (1.00-1.00)	0.79
Albumin (g/dL)	3.13 (1.31-7.45)	0.01
Prealbumin (mg/dL)	1.17 (1.02-1.34)	0.02

CI: Confidence interval, BMI: Body mass index

Table 6: Risk factors for hospital length of stay (< 7.06 days; ≥7.06 days) in the malnutrition patients

Logistic Regression Model		
	Multivariable (odds ratio, 95% CI)	**p value**
Gender	0.67 (0.35-1.30)	0.24
Age	0.98 (0.96-1.00)	0.06
BMI (kg/m2)	1.00 (0.93-1.07)	0.91
NRS-score	0.93 (0.62-1.39)	0.73
CRP (mg/dl)	1.01 (0.96-1.06)	0.55
Ferritin (ng/mL)	1 (1.00-1.00)	0.69
Albumin (g/dL)	0.73 (1.38-1.40)	0.34
Prealbumin (mg/dL)	1.02 (0.94-1.11)	0.53

CI: confidence interval, BMI: Body mass index

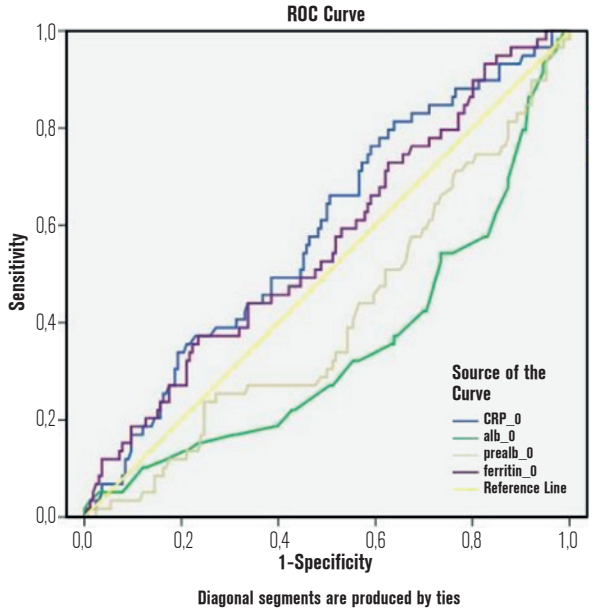

Figure 1: ROC curve for CRP, ferritin, albumin and prealbumin in the malnutrition patients

glucose was investigated by de Luis et al., and positive association was determined between only albumin and length of stay in nutritional assessment.[24] Delgado-Rodriguez et al. studied the relation between albumin, mortality and hospital stay length, and found that levels of albumin and cholesterol fractions were significant predictors of length of hospital stay and mortality.[25]

The predictive role of inflammatory markers such as CRP and ferritin levels were investigated in our study and only serum CRP levels were found to be significant in mortality prediction. In the study of Afsar et al. Subjective Global Assessment was used as reference assessment tool in malnutrition and they found that CRP and ferritin levels were positively correlated with malnutrition-inflammation score and correlations were better than with SGA. Malnutrition-Inflammation Score showed higher negative correlation with albumin, prealbumin, cholesterol levels than SGA.[26] The inflammation associated cytokines such as IL-6 and TNF-α were shown to have role in acute phase reaction with decreased serum albumin and prealbumin levels and increased CRP level.[27] In one study, nutritional status was determined by SGA for identifying patients at risk for malnutrition in patients with diabetic nephropathy and it was also shown by anthropometric and biochemical variables.[28]

Hepatic proteins have been accepted as indicators of inflammatory reactions increasing nutritional deterioration, not being correlated with nutritional status, but with morbidity and mortality and recovery from acute and chronic diseases.[13] Serum hepatic proteins can be used for determination of patients who are likely to develop malnutrition. Patients with low proteins are considered to require close monitorization of nutritional intervention.[13] After nutritional support, low serum proteins does not indicate insufficient nutritional support, but show that patient does not recover from primary problem underlying inflammatory metabolism or has developed a secondary problem such as infection.[13,27,29] Thus in our study the CRP levels for group 1 between initial and final measurements did not differ and in group 2, the final measurements were significantly higher than initial measurements and also the CRP levels between groups showed that, the levels were significantly higher in group 2 indicating predictive role of serum CRP levels.

Ferritin was also affected with inflammation together with CRP and, was shown to be associated with mortality independent of other risk factors.[30] Afsar et al. also showed that ferritin was as effective as CRP in nutrition status determination in their study.[26] In our study, ferritin levels were significantly higher in group 2 than that of group 1. The serum ferritin levels did not have role in mortality prediction in our study patients.

CONCLUSION

Analysis of nutrition assessment parameters and variables among group 1 (discharged group) and group 2 (deceased) revealed that, at admission, deceased patients had higher serum CRP and lower albumin and prealbumin, in comparison to discharged patients.

Serum albumin, prealbumin and CRP levels had predictive role on mortality in patients with malnutrition.

Conflict of interest declaration

There is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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