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Relationship between nutritional scores and 28-day mortality in critical patients who received mechanical ventilator support for non-surgical reasons

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ABSTRACT

Aims: Malnutrition may cause an increase in morbidity and mortality in intensive care patients. In this study, we aimed to investigate the relationship between nutritional scores and 28-day mortality in critically ill patients followed on a mechanical ventilator for non-surgical reasons.

Methods: 91 patients admitted to the intensive care unit for non-surgical reasons, followed up on mechanical ventilators, and whose data were available were included. The prognostic nutrition index (PNI), geriatric nutrition risk index (GNRI), nutritional risk index (NRI), and controlling nutritional status (CONUT) score were calculated from the data of the patients. Patients were divided into two groups survival and non-survival.

Results: NRI, PNI, and GNRI scores were statistically significantly higher in the Survivor group. Neutrophil lymphocyte ratio, LDH albumin ratio, CONUT, APACHE, and SAPS scores were statistically higher in the nonsurvivor group. In logistic regression analysis for nutritional scores, CONUT was found to be an independent risk factor for mortality. In the ROC analysis, the AUC value for CONUT was 0.925. The cut-off value for CONUT was 7.5, the sensitivity was 86.4%, and the specificity was 87.0%.

Conclusion: The CONUT nutrition score, which can be easily calculated from routine parameters and does not cause extra costs, can be used as an independent evaluation tool in determining the 28-day mortality of intensive care patients.

Keywords: Critical Patients, prognostic nutrition index, geriatric nutrition risk index, nutritional risk index, controlling nutritional status

INTRODUCTION

Malnutrition is defined as a nutrient deficiency resulting from inadequate food intake or inability to use and absorbed digested food.[1-3] It is essential to the treatment of patients. Malnutrition can lead to the deterioration or delay in wound healing, suppression of the immune system, regression in cognitive functions, and decreased functional capacities in general, resulting in severe clinical conditions.[4]

It has been reported that patients with malnutrition have a higher mortality and morbidity rate, more extended hospital stay, and more drug use than patients without malnutrition.[5] A study reported that malnutrition is an important problem in critical care units, with a rate of 78.1% in developing countries and 50.8% in developed countries.[6] In the study of Giner et al.[7] malnutrition was found in 42% of the patients in intensive care units. Another study found that 38% of patients receiving ventilator support had malnutrition.[8] In a study that included intensive care patients receiving mechanical ventilator support, malnutrition was found in all patients.[9] The most important point here is to determine intensive care patients' nutritional status early and start appropriate nutritional support. Studies report that mechanical ventilator dependence, length of stay, and mortality of intensive care patients will decrease. Conversely, malnutrition may cause complications such as infection and multi-organ failure in intensive care patients, resulting in a more extended stay in the intensive care unit and increased morbidity and mortality.[10] Many nutritional indices are used to evaluate malnutrition.[11] The prognostic nutritional index (PNI) is a simple, immuno-nutritional parameter calculated from serum albumin and total lymphocytes.[12] Geriatric nutrition risk index (GNRI), Body Mass Index (BMI), and serum albumin values are used for the same purpose, Nutritional risk index (NRI), body weight and serum albumin values, Controlling nutritional status (CONUT) score from serum albumin , total cholesterol, and serum albumin values calculated using total lymphocyte values.[13-15]

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In this study, we aimed to investigate the relationship between nutritional scores and 28-day mortality in critically ill patients who received mechanical ventilator support for non-surgical reasons.

METHODS

The study was carried out with the permission of Kastamonu University Clinical Researches Ethics Committee (Date: 14.02.20222, Decision No: 2022-KAEK-137). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patients with a history of leukemia/lymphoma or a diagnosis of malignancy, a history of major surgery in the last six months, a history of drug use that may cause bone marrow depression, a history of cirrhosis, pregnancy status, and renal failure were excluded from the study.

Demographic characteristics such as age, comorbidity, gender and 28-day mortality, Acute Physiology, and Chronic Health Evaluation (APACHE II) scores, The Simplified Acute Physiology Score (SAPS) scores, leukocytes, hemoglobin, thrombocyte, neutrophil-lymphocyte, C- reactive protein (CRP), albumin, creatine, urea, alanine transaminase (ALT), aspartate aminotransferase (AST), prealbumin, lactate dehydrogenase (LDH) values were recorded from the hospital information management system and patient file data. In addition, prognostic nutrition index (PNI), geriatric nutrition risk index (GNRI), nutritional risk index (NRI), and controlling nutritional status (CONUT) score calculations were made from the data of the patients. Patients were divided into two groups survival and non-survival.

Calculation of Malnutrition Scores

Calculation of the nutritional risk index: NRI= [1.519×serum albumin g/dL)+(41.7×body weight (kg)/ideal body weight (kg)]

NRI<83.5; major risk, 83.5–97.5; moderate risk, 97.5–100; mild risk, NRI >100; no risk.[14]

The PNI was calculated by a formula as follows. PNI Score: Serum albumin (g/dL)× 10+ total lymphocyte count (mm³) ×0.005.

The patients were evaluated in three groups. PNI > 38: normal, PNI of 35–38: Moderate, PNI < 35: Severe risk of malnutrition.[12]

The GNRI was calculated by a formula as follows. GNRI = Serum albumin (g/dL)× 14.89+ 41.7 × (body weight (kg)/ideal body weight (kg)).

GNRI threshold values were calculated as 4 degrees depending on nutrition: GNRI:< 82: Major risk, GNRI: 82 to <92: Moderate risk, GNRI: 92 to ≤98: Low risk, GNRI: >98: No risk.[13]

Body Mass Index (BMI) was calculated according to the following formula: BMI=weight (kg)/height² (m²).[16] The ideal body weight of the patients was calculated using the Lorentz formula.[13]

The calculation of the CONUT score is shown in **Table 1.**[17]

Table 1: CONUT scores

Parameters	Degree Of Malnutrition			
	Normal	Mild	Moderate	Severe
Serum Albumin (G/Dl)	≥3.5	3.0–3.49	2.5–2.99	<2.5
Point	0	2	4	6
Total Lymphocytes (103/Ul)	≥1600	1200–1599	800–1199	<800
Point	0	1	2	3
Total Cholesterol (Mg/Dl)	≥180	140–179	100–139	<100
Point	0	1	2	3
Total CONUT Scores	0-1	2-4	5-8	9–12

Statistical Analysis

Statistical analyzes were performed using SPSS 26.00 (SPSS Inc, Chicago, USA). The normal distribution of the data was checked with the Kolmogorov Smirnov test. Independent samples t-test was used for normally distributed data, and the Mann-Whitney U test was used for non-normally distributed data. Analysis of categorical data was done with the Pearson Chi-square test. Logistic regression analysis was applied for the nutritional scores that were found to be significant. ROC analysis was performed to determine the mortality status of the patients at the end of 28 days and the Area Under Curve (AUC), cut-off, sensitivity, and specificity values for Nutrition scores. The results were evaluated at the 95% confidence interval and the significance level of p<0.05.

RESULTS

A total of 91 patients were included in our study. The mean age of the patients was 70.44 (26.0-95.0) years, and 47 (51.6%) of all patients were women. While there was a statistically significant difference in age and BMI values between the survivor and non-survivor groups, there was no statistical difference between the two groups regarding gender, hospitalization diagnoses, and comorbidities (**Table 2**).

Table 2. Demographic characteristics of the patients.

Variables	Total N=91	Group Survival n= 69 (75.8%)	Group Non- Survival n= 22 (24.2%)	P
Age(Years)	70.44 (26.0-95.0)	67.67 (29.0-90.0)	79.14 (63,0-95,0)	<0.001
Gender				0.673
Female	47 (51.6%)	37 (53.6%)	10 (45.5%)	
Male	44 (48.4%)	32 (46.4%)	12 (54.5%)	
Hospitalization Diagnosis				0.498
Pneumonia	33 (36.3%)	23 (33.4%)	10 (45.5%)	
Asthma	2 (2.2%)	2 (2.9%)	0	
Chronic Obstructive Pulmonary Disease	11 (12.1%)	9 (13.1%)	2 (9.1%)	
İnfarct	20 (22.0%)	13 (18.8%)	7 (31.8%)	
Intra Cranial Hemorrhage	13 (14.3%)	11 (15.9%)	2 (9.1%)	
Epilepsy	3 (3.3%)	2 (2.9%)	1 (4.5%)	
Diabetic Ketoacidosis	5 (5.5%)	5 (7.2%)	0	
Hepatic Encephalopathy	4 (4.3%)	4 (5.8%)	0	
Additional Disease				0.567
None	11 (12.1%)	9 (13.1%)	2 (9.1%)	
Diabetes Mellitus	12 (13.2%)	10 (14.5%)	2 (9.1%)	
Hypertension	26 (28.6%)	21 (30.4%)	5 (22.7%)	
Neurological Disease	23 (25.3%)	14 (20.3%)	9 (40.9%)	
Respiratory Disease	15 (16.5%)	12 (17.4%)	3 (13.7%)	
Cardiac Disease	4 (4.3%)	3 (4.3%)	1 (4.5%)	
BMI	21.15 (16.2-30.7)	22.21 (16.8-30.7)	17.82 (16.2-20.1)	<0.001

When the hospitalization laboratory values, NRI, GNRI, PNI, CONUT, APACHE II, and SAPS scores of the two groups were compared, lymphocyte, platelet, creatine, albumin, prealbumin, triglyceride, total cholesterol, total bilirubin, NRI, PNI, and GNRI scores were statistically significant in the Survival group. Neutrophil lymphocyte ratio, LDH albumin ratio, CONUT, APACHE, and SAPS scores were statistically higher in the non-survival group (Table 3).

When the subgroups of nutritional scoring were compared, the most common NRI, PNI, and GNRI subtypes in the Survival group were Absent, while in the Non--Survival, it was the severe type. The most common CONUT subtypes were Absent and Modarate in the Survival group, while Modarate and Severe types were in the Non-Survival group. When the four nutrition scores subtypes were examined, there was a statistically significant difference between the two groups (Table 4).

Table 4. Nutrition scores; NRI, PNI, GNRI, CONUT.

Variables	Total, n=91	Group Survival, n=69 (75.8%) n (%)	Group Non -Survival, n=22 (24.2%) n (%)	p
NRI				<0.001
1 Absent	27 (29.7%)	27 (39.1%)	0	
2 Mild	18 (19.8%)	18 (26.1%)	0	
3 Moderate	26 (28.6%)	17 (24.6%)	9 (40.9%)	
4 Severe	20 (21.9%)	7 (10.2%)	13 (59.1%)	
PNI				<0.001
1 Absent	39 (42.9%)	39 (56.5%)	0	
2 Moderate	22 (24.2%)	17 (24.6%)	5 (22.7%)	
3 Severe	30 (32.9%)	13 (18.9%)	17 (77.3%)	
GNRI				<0.001
1 Absent	29 (31.9%)	29 (42.0%)	0	
2 Mild	18 (19.8%)	18 (26.1%)	0	
3 Moderate	21 (23.1%)	13 (18.8%)	8 (36.4%)	
4 Severe	23 (25.2%)	9 (13.1%)	14 (%63.6)	
CONUT				<0.001
1 Absent	26 (28.6%)	26 (37.7%)	0	
2 Mild	22 (24.2%)	22 (31.9%)	0	
3 Moderate	26 (28.6%)	15 (21.7%)	11 (50.0%)	
4 Severe	17 (18.6%)	6 (8.7%)	11 (50.0%)	

In the logistic regression analysis for nutritional scores, CONUT was found to be an independent risk factor for mortality (Table 5). In the ROC analysis, the AUC value for CONUT was 0.925. The cut-off value for CONUT was 7.5, the sensitivity was 86.4%, and the specificity was 87.0% (Figure 1).

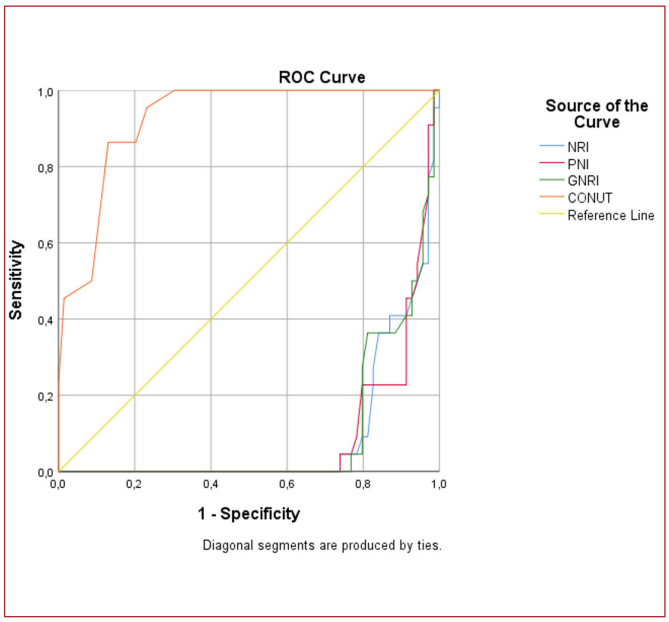

Figure 1. Roc curve

Table 5. Logistic regression analysis.

Variables	β	SE	P	OR	95% CI for OR	
					Lower	Upper
Constant	9.188	11.893	0.440	9779,709		
NRI	-0,056	0.237	0.813	0.946	0.595	1.503
PNI	0.127	0.409	0.756	1.135	0.5100	2.528
GNRI	-0.159	0.213	0.445	0.853	0.562	1.295
CONUT	0.526	0.242	0.030	1.691	1.052	2.720

Table 3. Laboratory, APACHE II, and SAPS Nutrition scores of the groups

Variables	Total n=91	Group survival n= 69 (75.8%)	Group Non-Survival n= 22 (24.2%)	p
WBC(103/ul)	11.40 (7.10-21.30)	11.29 (7.1-20.1)	11.74 (7.4-21.3)	0.597
Neutrophil(103/ul)	7.6 (3.1-15.6)	7.41 (3.1-15.6)	8.21 (3.3-15.6)	0.270
Lymphocyte(103/ul)	0.98 (0.6-1.3)	1.02 (0.6-1.3)	0.87 (0.6-1.3)	0.001
Platelets(103/ul)	246.08 (60.0-449.0)	259.58 (89.0-449.0)	203.73 (60.0-334.0)	0.040
N/L	8.19 (3.15-22.29)	7.63 (3.15-22.29)	9.92 (4.72-19.5)	0.029
P/L	254.99 (75.0-637.14)	261.17 (83.08-3637.14)	235.59 (75.0-383.78)	0.425
Creatinine (mg/dL)	0.67 (0.12-1.9)	0.77 (0.22-1.9)	0.37 (0.12-0.87)	<0.001
ALT(U/L)	14.12 (3.0-80.0)	13.75 (3.0-45.0)	15.27 (3.0-80.0)	0.233
AST(U/L)	14.81 (3.0-62.0)	14.54 (3.0-53.0)	15.68 (4.0-62.0)	0.320
CRP (mg/L)	36.63 (3.5-126.9)	35.21 (5.3-126.9)	41.1 (3.5-102.6)	0.673
Albumin(g/dL)	3.03 (2.3-3.86)	3.18 (2.3-3.86)	2.56 (2.3-3.2)	<0.001
C/A	12.64 (1.46-41.20)	11.44 (1.49-36.01)	16.39 (1.46-41.2)	0.211
Total Cholesterol (mg/dL)	152.88 (94.6-214.0)	160.12 (94.6-1241.0)	130.2 (98.0-168.0)	<0.001
Triglyceride(mg/dL)	123.65 (80.6-243.0)	131.99 (95.8-1243.0)	97.48 (80.6-134.0)	<0.001
Urea (mg/dL)	39.3 (10.3-133.0)	40.08 (10.3-133.0)	36.88 (11.6-65.2)	0.864
Total Bilirubin (mg/dL)	0.60 (0.12-1.4)	0.64 (0.12-1.4)	0.5 (0.2-1.2)	0.049
Prealbumin (mg/dL)	20.0 (6.5-28.7)	20.77 (6.5-28.7)	17.55 (16.2-21.3)	<0.001
LDH(U/L)	281.93 (146.0-789.0)	284.77 (159.0-489.0)	273.05 (2146.0-442.0)	0.475
LDH/Albumin	94.10 (51.22-172.66)	90.1 (51.22-154.0)	106.65 (52.52-172.66)	0.023
Sodium(mEq/L)	142.14 (124.0-159.0)	141.48 (130.0-159.0)	144.23 (124.0-155.0)	0.054
Potassium(mEq/L)	4.27 (3.1-5.6)	4.24 (3.1-5.6)	4.35 (3.1-5.6)	0.474
Procalcitonin	1.1 (0.05-12.9)	0.78 (0.05-5.6)	02.08 (0.05-12.9)	0.079
Lactate(mmol/L)	2.21 (0.4-7.9)	2.06 (0.4-7.9)	2.68 (0.8-5.4)	0.054
NRI	92.74 (79.5-105.5)	95.92 (80.0-105.5)	82.77 (79.5-87.9)	<0.001
PNI	37.12 (31.0-43.9)	38.16 (31.0-43.9)	33.87 (32.0-36.6)	<0.001
GNRI	90.95 (74.0-104.5)	94.12 (74.0-104.5)	81.01 (75.0-84.6)	<0.001
CONUT	4.63 (0-11.0)	3.28 (0-10)	8.86 (5.0-11.0)	<0.001
APACHE II	23.20 (12.0-42.0)	21.20 (12.0-32.0)	29.5 (15.0-42.0)	<0.001
SAPS	36.58 (20.0-58.0)	33.88 (20.0-58.0)	45.04 (29.0-58.0)	<0.001

DISCUSSION

Ninety-one intensive care patients with mechanical ventilator support for non-surgical reasons were included in our study. In addition, the relationship between nutrition scores and 28-day mortality during hospitalization in the intensive care unit was investigated. It was found that there was a statistical difference between the two groups in terms of nutritional scores, and CONUT was an independent risk factor for 28-day mortality.

It has been reported that patients with malnutrition have a higher mortality and morbidity rate, more extended hospital stay, and more drug use than patients without malnutrition.[5] Malnutrition rates in hospitalized patients vary between 15% and 60%, depending on the type of hospital, the region of the hospital, and the population of the study.[18-20] Patients may be malnourished when admitted to the intensive care unit (ICU), or malnutrition may develop due to critical illness after admission. The prevalence of malnutrition in ICU patients varies between 30% and 50%.[7,10] Hill et al.[21] reported that 50% of patients undergoing major surgery had impaired nutritional status. In another study, malnutrition was found in 38% of patients receiving ventilator support.[8] In the study of Giner et al.[7] malnutrition was found in 42% of the patients in the ICU. Yi-Chia Huang et al.[9] detected malnutrition in all patients followed in the ICU with a mechanical ventilator. In our study, similar to the literature, there was 73% malnutrition according to NRI scoring, 61% according to PNI scoring, 71% according to GNRI scoring, and 74% according to CONUT scoring.

Malnutrition can lead to complications such as infection and multiple organ failure, prolonged stay in the intensive care unit, and increased morbidity and mortality in intensive care patients.[22] Most such complications can be evaluated with bedside ultrasonography.[23] Barr et al.'s[24] study stated that malnutrition was associated with increased mortality and morbidity in intensive care. Although malnutrition affects all ICU patients, its adverse effects are more dangerous, especially in patients with sepsis, trauma, and burn patients.[25] A multicenter study that included 2887 ICU patients found that increased energy and protein intake were associated with improved clinical outcomes in critically ill patients.[26] A prospective study including 48 critically ill patients showed that energy deficit one week after admission to the ICU was associated with infectious and other complications.[27] Another study reported a strong relationship between increased energy deficit and complications such as acute respiratory distress syndrome (ARDS), renal failure, need for surgery, and pressure sores.[28] In our study, the mortality rate was higher in patients with malnutrition, similar to the literature.

The Nutritional Risk Index (NRI), developed to evaluate patients' nutritional status in a practical way using objective parameters, is calculated by body weight and serum albumin level. NRI, used in many patient groups, has also been effective in patients with heart failure.[29,30] In addition to determining the nutritional status, the correlation between NRI score and poor disease outcomes suggests that the index may also guide the treatment planning of the disease. For example, according to NRI, the study of Aziz et al.[14] emphasized that the prognosis might be poor in patients with a high risk of malnutrition. Similarly, in our study, the mortality rate was increased in patients with a high risk of malnutrition, according to NRI.

Geriatric nutritional risk index (GNRI), is calculated by BMI and serum albumin value. The index was first used by Bouillanne et al.[13] to determine the relationship between malnutrition and mortality in hospitalized elderly patients. Then, in the study of Kinugasa et al.[31] it was found that there is a relationship between GNRI and mortality in patients with heart failure. The survey of Sze et al. showed that GNRI is an important marker in determining mortality. Similarly, in our research, GNRI values were lower in the group with a mortal course.

The parenteral nutrition index (PNI) is calculated from serum albumin and lymphocyte values and evaluating nutritional and infection conditions together.[12] In their study, Huang et al.[9] emphasized that low PNI values are associated with poor outcomes. In this study, PNI values were lower in the group with a mortal course.

Control of Nutritional Status (CONUT) screening tools that evaluate nutritional status using biochemical findings of patients are practical and easy to use in hospitalized patients. The first validity study of this scoring method was conducted in 2005, showing that it gave results compatible with proven ways.[32] In their study, Iwakami et al.[33] showed that CONUT is an independent assessment tool, especially for long-term mortality. Similarly, in our research, the CONUT score was significantly higher in the mortal group and CONUT was found to be an independent assessment tool for 28-day mortality in this patient group.

Limitations

The limitations of our study include the fact that it was a single-center study, different hospitalization diagnoses of the included patients, various comorbidities of the patients, and the limited number of patients.

CONCLUSION

The CONUT nutrition score, which can be easily calculated from routine parameters and does not cause extra costs, can be used as an independent evaluation tool in determining the 28-day mortality of intensive care patients.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kastamonu University Clinical Researches Ethics Committee (Date: 14.02.20222, Decision No: 2022-KAEK-137).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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