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Impact of CONUT Score at Admission on Prognosis in Older Patients with Acute Ischemic Stroke, Considering Ischemia Area: From Turkey's Second Region with the Oldest Population

Akut İskemik İnmeli Yaşlı Hastalarda İskemi Alanı Dikkate Alındığında Başvuru Sırasındaki CONUT Skorunun Prognoza Etkisi: Türkiye'nin En Yaşlı Nüfusa Sahip İkinci Bölgesinden

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ABSTRACT

Aim: The presence of malnutrition at admission in acute ischemic stroke (AIS) patients may cause poor outcomes in older patients. There are rare studies showing that Checking Nutritional Status (CONUT) score is a predictor of poor prognosis in AIS patients. We aimed to investigate the impact of CONUT score on the length of hospital stay (LOS) and intensive care need.

Materials and Methods: One hundred thirty-one of 230 patients older than 65 years old with a diagnosis of AIS were included. Patients with clinical correlation with diffusion-weighted magnetic resonance imaging examination were accepted as having ischemic stroke and classified by the Bamford classification. CONUT score was assessed within 24 hours after hospital admission.

Results: The mean age of patients was 78.15±6.9 years and 55.72% of patients were male, the mean LOS and the mean CONUT scores were 7.4±4.5 and 2.30, respectively. When patients were divided into two groups, as those requiring intensive care and with hospital stay >7 days and those with LOS <7 days, there was a significant difference between the two groups in terms of lymphocyte count, CONUT score, malnutrition level, and Bamford classification (p=0.007, p=0.002, p=0.004, p=0.030, respectively). In the crude regression model, CONUT score was determined to be possible risk factors for poor outcomes [odds ratio (OR): 1.38, p=0.002] and OR was 1.39 (p=0.003) in adjusted model for the Bamford classification.

Conclusion: Each unit increase in the CONUT score was associated with a greater risk of poor outcome in older AIS patients. Clinicians' evaluation of these patients with CONUT scoring may affect the prognosis.

Keywords: CONUT score, acute ischemic stroke, length of hospital stay, Bamford classification, older adults

ÖZ

Amaç: Akut iskemik inme (Aİİ) hastalarında başvuru sırasında malnütrisyonun varlığı yaşlı hastalarda kötü sonuçlara neden olabilir. Aİİ hastalarında Beslenme Durumunu Kontrol Etme (CONUT) skorunun kötü prognoz göstergesi olduğunu gösteren nadir çalışma vardır. Çalışmamızda CONUT skorunun hastanede yatış süresi (HYS) ve yoğun bakım ihtiyacı üzerine etkisini araştırmayı amaçladık.

Gereç ve Yöntem: Aİİ tanısı alan 65 yaş üstü 230 hastanın 131'i çalışmaya dahil edildi. Difüzyon ağırlıklı manyetik rezonans görüntüleme incelemesi ile klinik korelasyon gösteren hastalar iskemik inme olarak kabul edildi ve Bamford sınıflamasına göre sınıflandırıldı. CONUT skoru hastaneye yatıştan sonraki 24 saat içinde değerlendirildi.

Bulgular: Hastaların ortalama yaşı 78,15±6,9 yıl olup, %55,72'si erkekti. Ortalama HYS ve ortalama CONUT skoru 7,4±4,5 ve 2,30 idi. Hastalar yoğun bakım ihtiyacı olanlar ve HYS 7 günden fazla olanlar bir grup ve HYS 7 günden az olan grup olmak üzere iki gruba ayrıldığında, iki grup arasında lenfosit sayısı, CONUT skoru, malnütrisyon düzeyi ve Bamford sınıflandırması açısından anlamlı fark vardı (sırasıyla p=0,007, p=0,002, p=0,004, p=0,030). Ham regresyon modelinde CONUT skorunun kötü sonuçlar için olası risk faktörleri olduğu belirlendi [odds oran (OR): 1,38, p=0,002]. Bamford sınıflamasına göre düzeltilmiş regresyon modelinde OR: 1,39 (p=0,003) olarak tespit edildi.

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Sonuç: CONUT skorundaki her birim artış, yaşlı Aİİ hastalarında kötü sonuç riskinin artmasıyla ilişkilendirildi. Klinisyenlerin bu hastaları CONUT skorlaması ile değerlendirmesi hasta prognozunu etkileyebilir.

Anahtar Kelimeler: CONUT skoru, akut iskemik inme, hastanede kalış süresi, Bamford sınıflaması, yaşlı erişkinler

INTRODUCTION

Stroke is one of the major causes of disability and ranks as the second reason of mortality[1,2]. The relationship between stroke and mortality increases exponentially, especially after the age of 75 years[3]. Over the next 30 years, stroke is predicted to be more than quadruple due to the continuous rise in life expectancy[3].

Malnutrition has been a common problem in hospitalized older patients[4] and linked with poor outcomes, including increased mortality and morbidity in stroke patients who are most at risk for malnutrition because of dysphagia, diminished consciousness, abnormalities in perception, and cognitive deterioration[5,6]. On the other hand, compared to patients who are appropriately nourished, older adults who have had stroke and are malnourished at the time of admission are more likely to experience complications during their hospital stay, such as pneumonia, bedsores, and gastrointestinal bleeding, as well as a longer length of stay (LOS) and greater hospitalization expenditures[7]. Research indicates that malnutrition is frequently an underdiagnosed and undertreated condition[4]. Thus, the clinical nutrition guidelines advise an early evaluation of nutritional status upon admission to neurology services[5].

Different tools are used to assess nutritional status. One of the widely used practical and valid tools is the Checking Nutritional Status (CONUT) points system. The prognostic effect of the CONUT scoring system has been proven effective in cancers [8], coronary artery disease[9], heart failure[10], and atrial fibrillation[11]. Research has shown that in patients with ischemic stroke, malnutrition as determined by the CONUT score at admission is associated with mortality and length of stay[12-14]. However, there is no study on the effect of malnutrition assessed with CONUT at admission on the need for intensive care unit (ICU). Our goal was to find out how nutrition status, as measured by the CONUT score, affected longer LOS and the need for intensive care in a province with second oldest population in Turkey[15].

MATERIALS AND METHODS

Study Design and Population

The data of patients (65 years of age and older) who were hospitalized in a tertiary neurology clinic between July 2023 and December 2023 for acute ischemic stroke (AIS) treatment were enrolled retrospectively for this study. In total, 230 patients with stroke, who were older than 65 years, were registered in our study. The exclusion criteria were being at the age of <65 years, having lack of registered data, refusing treatment and leaving the hospital voluntarily, and having multiple hospital stay because of different causes. Figure 1 describes the flow chart of study population who were eligible for the study.

The Kastamonu Training and Research Hospital Research Committee granted approval and the study was conducted in accordance with the Declaration of Helsinki (no: 2023/KAEK-167, date: 20.12.2023). Written informed consent was not acquired from patients and/or relatives because of the retrospective nature of the study.

Diagnosing of Stroke

Patients who applied to the emergency department within the first 7 days after the onset of symptoms were included in the study. Computed tomography and diffusion-weighted magnetic resonance imaging (DW-MRI) examinations of all patients evaluated as having a stroke were assessed. On the other hand, those who could not undergo MRI for any reason (extreme obesity, MRI-incompatible implant, etc.) were excluded from the study. Patients with clinical correlation with DW-MRI examination, which is known to be highly sensitive in detecting the early changes and pathophysiological processes occurring in ischemic stroke, were accepted as having ischemic stroke[16]. Patients were evaluated as Total Anterior

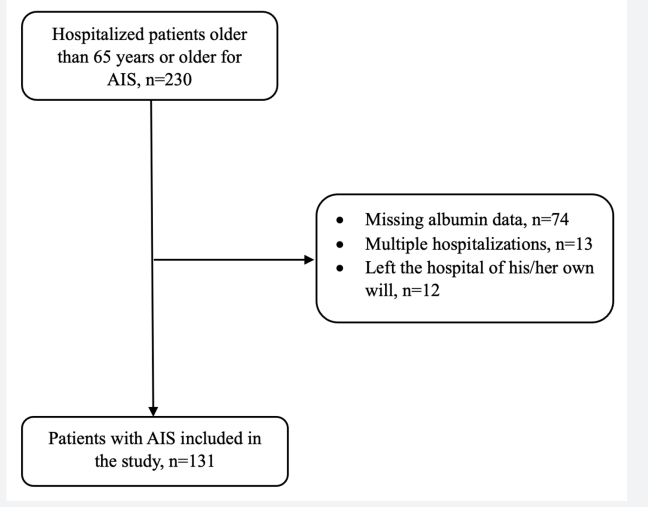

Figure 1. Flowchart of patient selection

AIS: Acute ischemic stroke, n: Number

Circulation Infarction, Partial Anterior Circulation Infarction (PACI), Posterior Circulation Infarction and Lacunar Infarction according to the Bamford criteria[17].

Assessment of Nutrition

Serum albumin, total lymphocyte count, and total cholesterol concentration were used to construct CONUT scores, which were then categorized as normal, mild, moderate or severe for scores of 0-1, 2-4, 5-8 and 9-12, respectively (Table 1)[18]. The blood samples for the CONUT score were acquired within 24 hours after hospital admission.

Demographics and Medical Data

Participants' sociodemographic information (age and gender), comorbidity assessed by the Deyo-Charlson Comorbidity Index[19] and laboratory parameters such as hemoglobin (g/dL), albumin (g/dL), lymphocyte, total cholesterol (mg/dL) and glomerular filtration rate were provided from patient charts and electronic health records at admission to hospital.

Outcomes

Longer hospitalization or in need of intensive care during hospitality in the neurology clinic is considered poor outcome.

Statistical Analysis

Data were analyzed using IBM Statistical Package for the Social Sciences version 25.0 package program. Continuous variables were presented as mean±standard deviation, and categorical variables were presented as frequencies and percentages. The conformity of the data to the normal distribution was examined using the Kolmogorov-Smirnov test. The statistical significance of intergroup differences was assessed using χ^2 tests for categorical variables, and ANOVA test for continuous variables. Post-hoc analysis was conducted with Tukey in ANOVA test. The Mann-Whitney U test was applied for parameters that did not show normal distribution. Covariates with p≤0.05 in the univariate analysis were entered into the full logistic regression model. Results in the univariate logistic model and results in the model adjusted are presented as odds ratios (OR) and 95% confidence intervals for patients requiring intensive care or with longer hospital stay indicating poor outcome. We used "enter" method for regression models and evaluated the fit of the model with the omnibus test. Statistical significance was accepted as p<0.05.

Table 1. Assessment of Controlling Nutritional Status (CONUT) score

Parameter	Normal	Light	Moderate	Severe
Serum albumin (g/dL) Score	3.5-4.5 0	3.0-3.49 2	2.5-2.9 4	<2.5 6
Total lymphocytes (/mm^3) Score	>1600 0	1200-1599 1	800-1199 2	<800 3
Cholesterol (mg/dL) Score	>180 0	140-180 1	100-139 2	<100 3
Screening total score	0--1	2--4	5--8	9--12

RESULTS

The records of 230 hospitalized patients in neurology clinic older than 65 years because of ischemic stroke were reviewed. Seventy-four patients were excluded because of missing albumin data. Thirteen patients were excluded due to multiple hospitalization within 6 months and 12 patients were excluded because they had left the hospital voluntarily (Figure 1). One hundred thirty-one older adults with ischemic stroke were assessed for the study. The mean age of patients was 78.15±6.9 years and 55.72% of patients were men, the mean LOS and the mean CONUT scores were 7.4±4.5 and 2.30, respectively. Only 34.35% of patients had normal nutritional status on admission. PACI was the most common cause of ischemic stroke with a rate of 48.9%.

Firstly, 131 patients with ischemic stroke were divided into 3 groups, as those having hospitalization below the average, those with extended hospitalization stay and those who needed intensive care during admission (Table 2). The number of patients who stayed in the hospital for 7 days or less was 79, the number of those who stayed in the hospital for more than 7 days was 39, and the number of patients who needed intensive care during the hospitalization was 13. There was a significant age difference among three groups (p=0.013). The mean age of the group needing intensive care was significantly higher than the group LOS >7 (p=0.016) and the group LOS ≤7 (p=0.013) in post-hoc analysis results. Similarly, CONUT score differed among three groups (p<0.001). The highest mean CONUT score was 4.23 in patients requiring intensive care unit and it was significantly higher than in the group LOS >7 (p=0.013) and the group LOS ≤7 (p<0.001) in post-hoc analysis results. There was also a significant difference among the three groups when the nutritional status of the patients was staged according to the CONUT score (p=0.007). When the causes of ischemia were classified according to the Bamford, PACI was the most common in all groups, and there was a significant difference among the three groups (p=0.026).

Secondly, patients were divided into two groups: one group with those requiring intensive care and having hospital stay >7 days, and one group with those with LOS ≤7 days (Table 3). Of 131 patients, 52 patients had poor outcomes (Table 3). There was a significant difference between the two groups in terms of lymphocyte count, CONUT score,

Table 2. Demographic and clinic data of study population

	Total	LOS ≤7 n=79	LOS >7 n=39	ICU n=13	p value
Age	78.15±6.9	77.66±6.67	77.39±6.23	83.46±8.6	**0.013**
Gender (male, %)	73 (55.72%)	48 (60.76%)	21 (53.85%)	4 (30.76%)	0.126
Total cholesterol (mg/dL)	175.63±43.98	178.76±44.73	173.31±34.90	163.38±62.03	0.470
Lymphocyte (/mm^3)	1707.25±859.78	1844.43±872.99	1615.90±823.73	1147.69±644.68	0.018
Albumin (g/dL)	3.72±0.41	3.77±0.34	3.70±0.43	3.49±0.65	0.074
Hemoglobin (g/dL)	12.75±1.86	12.96±1.81	12.61±1.85	11.97±2.13	0.182
GFR	75.74±28	78.11±26.92	72.51±27.03	71.07±37.16	0.489
CONUT score	2.30±1.93	1.86±1.61	2.56±1.96	4.23±2.39	**<0.001**
Malnutrition level					**0.007**
Normal	45 (34.35%)	35 (44.30%)	10 (25.64%)	0	
Light	75 (57.25%)	41 (51.89%)	23 (58.97%)	10 (76.92%)	
Moderate	10 (7.63%)	3 (3.80%)	5 (12.82%)	2 (15.38%)	
Severe	2 (1.52%)	0	1 (1.35%)	1 (7.69%)	
CCI	6.48+1.33	6.34±1.31	6.64±1.42	6.84+1.14	0.303
Bamford classification					**0.026**
LACI	26 (19.8%)	22 (27.85%)	2 (5.13%)	2 (15.38%)	
PACI	64 (48.9%)	33 (41.77%)	21 (53.85%)	10 (76.92%)	
POCI	31 (23.7%)	19 (24.05%)	11 (28.21%)	1 (7.70%)	
TACI	10 (7.6%)	5 (6.33%)	5 (8.11%)	0	

LOS: Length of hospital stays, ICU: Intensive care unit, GFR: Glomerular filtration rate, CONUT: Controlling Nutritional Status, CCI: Charlson comorbidity index, LACI: Lacunar Infarction, PACI: Partial anterior circulation infarction, POCI: Posterior circulation infarction, TACI: Total anterior circulation infarction

Table 3. Demographic and clinic data of study population according to hospital stay and poor outcome

	Total n=131	LOS ≤7 n=79	Poor outcome n=52	p value
Age	78.15±6.9	77.66±6.67	78±7.30	0.316
Gender (male, %)	73 (55.72%)	48 (60.76%)	27 (51.92%)	0.153
Total cholesterol (mg/dL)	175.63±43.98	178.76±44.73	170.83±42.79	0.312
Lymphocyte (/mm^3)	1707.25±859.78	1844.43±872.99	1498.85±803.28	**0.007**
Albumin (g/dL)	3.72±0.41	3.77±0.34	3.65±0.49	0.109
Hemoglobin (g/dL)	12.75±1.86	12.96±1.81	12.45±1.92	0.132
GFR	75.74±28	78.11±26.92	72.15±29.49	0.235
CONUT score	2.30±1.93	1.86±1.61	2.98±2.17	**0.002**
Malnutrition level				**0.004**
Normal	45 (34.35%)	35 (44.30%)	10 (19.23%)	
Light	75 (57.25%)	41 (51.89%)	33 (63.46%)	
Moderate	10 (7.63%)	3 (3.80%)	7 (13.46%)	
Severe	2 (1.52%)	0	2 (3.85%)	
CCI	6.48±1.33	6.34±1.31	6.69±1.35	0.141
Bamford classification				**0.030**
LACI	26 (19.8%)	22 (27.85%)	4 (7.76%)	
PACI	64 (48.9%)	33 (41.77%)	31 (59.61%)	
POCI	31 (23.7%)	19 (24.05%)	12 (23.07%)	
TACI	10 (7.6%)	5 (06.33%)	5 (9.61%)	

LOS: Length of hospital stays, ICU: Intensive care unit, GFR: Glomerular filtration rate, CONUT: Controlling Nutritional Status, CCI: Charlson comorbidity index, LACI: Lacunar infarction, PACI: Partial anterior circulation infarction, POCI: Posterior circulation infarction, TACI: Total anterior circulation infarction

malnutrition level, and Bamford classification. In the crude regression model, CONUT score was determined to be possible risk factors for poor outcomes (OR: 1.38, p=0.002) (Table 4). In adjusted model for the Bamford classification, CONUT score was determined to be possible risk factors for poor outcomes (OR: 1.39, p=0.003) (Table 4). The omnibus test confirmed that the model was highly significant (-2LL=156.212, $\chi^2(2)=19.787$, p<0.001).

DISCUSSION

The fact that clinicians frequently do not have enough knowledge about nutritional support in the treatment of stroke patients causes patients to be deprived of nutritional support and accelerates the worsening of their stroke outcomes[20]. The American Heart Association and American Stroke Association advise that everyone be assessed for baseline nutritional status and that any malnutrition be treated as soon as feasible in their guidelines for the early care of patients with AIS[21]. Consistent with this recommendation, in our study, we have demonstrated that nutritional status, evaluated by the CONUT score on admission, plays an important role in the need for long-term hospital stay and intensive care in AIS patients.

Patients with ischemic stroke are known to be prone to dysgeusia and therefore malnutrition[5]. In addition, malnutrition that develops after stroke has been shown to be associated with poor outcomes[22]. However, there are rare studies showing poor outcomes in patients with AIS due to the presence of malnutrition at the time of hospital admission[14,22-24]. In a study conducted on patients with AIS over the age of 75 years, it was observed that those with CONUT score >5 had a longer hospital stay[14]. Similarly, CONUT score on hospital admission has been shown to be associated with 3-month functional deterioration in older patients with AIS[23]. In our study, we showed that only one third of the patients admitted on hospital with stroke were normal in terms of nutritional status and each unit increase in the CONUT score on admission increased the risk of poor prognosis, such as the need for intensive care and/or long-term hospitalization, by 1.4 in AIS patients over the age of 65 years. This significant effect continued even when adjusted for stroke location based on the Bamford classification.

Lower serum albumin levels in stroke patients were linked to worse outcomes, as several clinical investigations have shown[25,26]. Similarly, lower lymphocyte counts and a lower total cholesterol level were significant factors associated with the 3-month poor outcome in AIS[23]. In our study, while parameters such as lymphocyte, albumin and total cholesterol levels, which make up the CONUT score, did not influence prognosis alone, a significant effect of the CONUT score on poor outcomes was observed when these parameters were evaluated together.

Table 4. Association of CONUT score at admission with poor outcome

	Crude model		Model 1	
CONUT score	OR (95% CI)	p=0.002	OR (95% CI)	p=0.003
	1.38		1.39	

Model 1: Adjusted for the Bamford classification.
OR: Odds ratio, CI: Confidence interval, CONUT: Controlling Nutritional Status

Study Limitations

This study has several limitations. Firstly, the study was conducted at a single center with a small sample size. Secondly, due to its retrospective nature, it did not provide comprehensive nutritional data on dietary intake, weight changes, or physical examination results pertaining to fat and muscle. However, considering that CONUT is a proven prognosis nutritional assessment tool for cancers[8], coronary artery disease[9], heart failure[10], and atrial fibrillation[11], it can also be used in patients with ischemic stroke. What makes our study important from other studies is that, in addition to evaluating the need for intensive care, the Bamford classification was also considered when evaluating the CONUT effect. The fact that this study consisted of patients admitted to a tertiary hospital in the province with the 2nd oldest population in Turkey also makes our study valuable[15].

Our study results reveal that most patients presenting with AIS do not have normal nutritional status at admission to hospital and each unit increase in the CONUT score increases the risk of long-term hospitalization and/or the need for intensive care regardless of location of stroke. Considering that the incidence of malnutrition and ischemic stroke increases with age, and that malnutrition makes patients more prone to poor outcomes, evaluation of patients with the CONUT score on admission, which is an objective nutritional assessment tool that is easily obtained from blood, can help predict poor outcomes, and therefore, it will also guide clinicians and the determination of health policies. The study results need to be supported by studies with larger samples.

CONCLUSION

Patients with AIS do not have already normal nutritional status at the time of hospital admission and each unit increase in the CONUT score, was associated with a greater risk of longer LOS and/or need of ICU in AIS patients at the age of 65 years or older. Clinicians' evaluation of patients with AIS by CONUT scoring, which is a simple and valid method, may affect the prognosis of the patients.

Ethics

Ethics Committee Approval: The Kastamonu Training and Research Hospital Research Committee granted approval and

the study was conducted in accordance with the Declaration of Helsinki (no: 2023/KAEK-167, date: 20.12.2023).

Informed Consent: Written informed consent was not acquired from patients and/or relatives because of the retrospective nature of the study.

Authorship Contributions

Surgical and Medical Practices: S.K.D., O.D., Consept: S.K.D., O.D., Design: S.K.D., O.D., Data Collection or Processing: S.K.D., O.D., Analysis or Interpretation: S.K.D., Literature Search: S.K.D., O.D., Writing: S.K.D., O.D.

Conflict of Interest: The authors declare no conflict of interest in relation to this article.

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