ARAŞTIRMAMAKALESİ/ORIGINALRESEARCH

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Dekompanse Kronik Kalp Yetmezliği Olan Hastalarda NRS-2002 Skoru ile NT-pro BNP Arasında Bir İlişki Var mı dır?

Is There a Relationship Between NRS-2002 Score and NT-pro BNP in Patients With Decompensated Chronic Heart Failure?

Gülay Aydın

Sağlık Bilimleri Üniversitesi Darıca Farabi Eğitim ve Araştırma Hastanesi, Kardiyoloji Bölümü, Kocaeli, Türkiye

ÖZET

GİRİŞ ve AMAÇ: Bu çalışmanın amacı, yoğun bakım ünitesinde yatan dekompanse kronik kalp yetmezliği (KKY) olan hastalarda Nutrisyonel Risk Tarama (NRS-2002) skoru ile N Terminal-Pro B tipi Natriüretik Peptit (NT-pro BNP) düzeyi arasında bir ilişki olup olmadığını araştırmaktır.

YÖNTEM ve GEREÇLER: Bu çalışmaya dekompanse KKY tanısı konulan ve beslenme durumu NRS-2002 skoru ile değerlendirilen ardışık 125 hasta dahil edildi. Hastalar iki gruba ayrıldı: NRS-2002 skoru <3 ve NRS-2002 skoru ≥3. NRS-2002 skoru ≥3 olan hastalar malnütrisyonlu olarak tanımlandı.

BULGULAR: 125 dekompanse KKY hastasının 93'ü (%74,4) NRS-2002 skoru ≥3 grubunda ve 32'si (%25,6) NRS-2002 skoru <3 grubundaydı. Hastaların %74,4'ünde malnütrisyon bulundu. NRS-2002 skoru ≥3 grubunda ortalama NT-pro BNP seviyesi 9327 (4927-15793) pg/mL ve NRS-2002 skoru <3 olan grupta ortalama NT-pro BNP seviyesi 3953 (2310-8939) pg/mL idi. İki grup karşılaştırıldığında, ortalama NT-pro BNP düzeyi, NRS-2002 skoru≥3 grubunda daha yüksekti ve bu bulgu istatistiksel olarak anlamlıydı (p=0,005). Bir yıllık takip döneminde NRS-2002 skoru<3 grubunda 7 (%21,9) hasta ve NRS-2002 skoru≥3 grubunda 28 (%30,1) hasta; toplam 35 (%28) hasta öldü.

TARTIŞMA ve SONUÇ: KKY, mortalite ve morbiditenin önde gelen nedenlerinden biridir. NT-pro BNP düzeyi, dekompanse KKY'li hastalarda NRS-2002 skoru≥3 grubunda NRS-2002 skoru<3 grubuna göre daha yüksek bulundu (p= 0,005).

Anahtar Kelimeler: kalp yetmezliği, mortalite, natriüretik peptid

ABSTRACT

INTRODUCTION: The aim of this study was to investigate whether there was a relationship between Nutritional Risk Screening (NRS-2002) score and N Terminal-Pro B type Natriuretic Peptide (NT-pro BNP) level in intensive care unit (ICU) patients with decompensated chronic heart failure (CHF).

METHODS: Consecutive 125 patients who were diagnosed with decompensated CHF and whose nutritional status were evaluated using NRS-2002 score were included in this study. The patients were divided into two groups: NRS-2002 score <3 and NRS-2002 score ≥3. The patients with NRS-2002 score ≥3 were defined as malnutrition. After evaluation, the patients were followed up for one-year.

RESULTS: Of the 125 decompensated CHF patients, 93 (74.4 %) were in the NRS-2002 score ≥3 group and 32 (25.6%) were in the NRS-2002 score <3 group. Malnutrition rate was found 74.4% of the patients. The median NT-pro BNP level was 9327 (4927-15793) pg/mL in the NRS-2002 score ≥3 group and the median NT-pro BNP level was 3953 (2310-8939) pg/mL in NRS-2002 score <3 group. When the two groups were compared, median NT-pro BNP level was higher in NRS-2002 score≥3 group and this finding was statistically significant (p=0.005). During the one-year follow up period, 7 (21.9%) patients in NRS-2002 score<3 group and 28 (30.1 %) patients in NRS-2002 score≥3 group; total 35 (28%) patients died.

DISCUSSION AND CONCLUSION: CHF is one of the leading causes of mortality and morbidity. NT-pro BNP level was higher in NRS-2002 score≥3 group than NRS-2002 score<3 group in patients with decompensated CHF (p= 0.005).

Keywords: heart failure, mortality, natriuretic peptides

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Correspondence: Uzm. Dr. Gülay Aydın, SBÜ Darıca Farabi EAH Kardiyoloji Bölümü 41700 Kocaeli - Türkiye
E-mail:drgulayaydin@gmail.com

INTRODUCTION

European Society of Clinical Nutrition and Metabolism (ESPEN) Guidelines for NRS-2002 were recommended for all patients, screened for nutritional risk at hospital admission(1). Patients with chronic heart failure (CHF)have high mortality, morbidity and reduced quality of life. Therapeutic management of CHF is complex and hospitalization is frequently needed(2). Patients with CHF still have high morbidity and mortality in spite of the developments in medical and surgical therapies(3,4). Predictors of mortality in CHF patients are older age(5,6), diabetes mellitus (DM)(5,6),reduced left ventricular ejection fraction (EF)(5,6), higher New York Heart Association (NYHA) classification(5), increased NT-pro BNP level(7,8), frailty (9)and cardiac cachexia(10,11).In hospitalized patients with heart failure, malnutrition prevalence has been found to be 57%(12). There are several nutritional screening methods(13) such as NRS-2002, Mini Nutritional Assessment (MNA), Malnutritional Universal Screening Tool (MUST) and Subjective Global Assessment (SGA). NRS-2002 is the recommended screening test for hospitalized patients(14). NRS-2002, which is thesuggested screening test by ESPEN,is used in our hospital(15,16) and we used this screening test in our study.

Body-mass index (BMI) of the patients were calculated using the formula: weight (kg)/ height x height (meters).After the necessary information was entered into the system, Acute Physiology and Chronic Health Evaluation II (APACHE II) score was calculated on the Internet.

NRS-2002 is determined by nutritional status and disease severity.The following questions were asked and the answers given by the patient or patient relatives were marked in the first screening: i) Is BMI below 20.5? ii) Has the patient lost weight in the last three months? iii) Has there been a decrease in the patient's food intake in the last week? and iv) Does he/she have a serious illness (cancer, severe trauma, organ failure, etc)?

The following questions were asked to determine the nutritional status deteriorationafter the last screening and appropriate score was marked: i) normal nutritional status -no score ii) weight loss over 5% within three months or food intake is 50-75% of normal requirement in the previous week-light score 1 point iii) weight loss over 5% or BMI 18.5-20.5 within two months +deterioration in general condition or food intake 25-50% of normal requirement in the previous week- middle score 2 point and iv) weight loss over 5%within one month (weight loss over 15% within three months) or BMI below 18.5+ deterioration in the general condition or food intake of 0-25% of normal requirement in the previous week-high score 3 point.

The following questions were asked to assess the severity of the disease and appropriate score was marked: i) normal nutritional needs-absent score 0 ii) chronic disease with especially acute complications (cirrhosis, chronic obstructive pulmonary disease (COPD), heart failure, chronic hemodialysis, DM, cancer, hip fracture, etc)- mild score 1 iii) major abdominal surgery, stroke, severe pneumonia, hematological malignancy- moderate score 2 and iv) head injury, bone marrow transplant, APACHE-II score >10 – severe score 3.

Nutritional status score ranges from 0 to 3. The score of severity of disease ranges from 0 to 3. 70 years and older patients get one additional score. The patient can have a total score from 0 to 7 (15,16). Patients with NRS-2002 score≥3 were includedin malnutrition category. All data were recorded in the automation system in our hospital. The system automatically calculated the marked data. The automation system sends a warning message to the screen that the nutritional support team should evaluate patients with a total score of ≥3. After the nutritional team and dietitian evaluated the result either the patients were not given supplementary or were given oral supplementary support, enteral support, parenteral support and combined support.

NRS-2002 has afair to good predictive valuefor inhospital mortality for adult patients(17). Kevin et al. reported that in hospitalized CHF patients, nutritional risk calculated by NRS-2002, was significantly associated with long term mortality(18).The primary aim of this study was to investigate whether there was a correlation between nutritional risk assessed with NRS-2002 score and prognosis and NT-pro BNP levels in ICU patients with decompensated CHF.

MATERIALS AND METHODS

The protocol was approved by the local ethics. This research was a retrospective study. 125consecutive acutely decompensated CHF patients over 18 years of age with NYHA class III-IV symptoms at admission along with congestion on chest X-ray, peripheral edema (ankle, leg, thigh, sacral), admitted and hospitalizedin our hospital's Cardiology Department Intensive Care Unit (ICU) between 01/11/2019 and 01/11/2020 were included in this study.Since there was no invasive coronary angiography laboratoryin our hospital, patients who developed acute heart failure due to de novo ST segment elevation myocardial infarction, non-ST segment elevation myocardial infarction and

unstable angina pectoris,were referred to othercenters, which hada Coronary ICU and could perform invasive coronary angiography.So that we excluded these patients from the study. In our hospital NYHA class I-II patients were followed up in cardiology ward, therefore, APACHE score was not calculated for these patients. We calculate APACHE score in Coronary ICU, other ICU and Newborn ICU not for those hospitalized in the wards.

The patients were classified into two groups as those with NRS-2002 score <3 and those with NRS-2002 score ≥3. Patients with NRS-2002 score≥3 were considered to have malnutrition.Demographic features of the patients such as age, gender, chronic diseases [DM, hypertension (HT), hyperlipidemia (HL), chronic kidney disease (CKD), chronic hemodialysis, chronic peritoneal dialysis, COPD, documented coronary artery diseases (CAD), atrial fibrillation, stroke history, cirrhosis] pneumonia, left ventricular EF, NRS-2002 score, APACHE II score and expected death rate were recorded.Laboratory data on admission (glucose, creatinine, sodium, potassium, white blood cell, hemoglobin, hematocrit, estimated glomerular filtration rates(mL/min/1.73 m2) (eGFR) and NT-pro BNP was recorded. We recorded the data of patients on admission to the hospital. We usedtransthoracicechocardiography for calculation of EF. EF was measured using Simpson method.Echocardiographers were blinded to the study plan. Echocardiography was conducted by four cardiologists at the Cardiology Department outpatient clinic.

The Coronary ICU nurses received information from patients and their relatives about the patients' weight lossand reduction in food intake. Nutritional status of the patients was evaluated within 24 hours after admission to the hospital. Patients in need of nutritional support were re-evaluated by nutritional nurses and dietitians. If there was a change in the nutritional status of the patients in the following days, re-evaluation was made.

In Turkey, all causes of deaths are registered in a central Death Declaration System. Causes of deaths are transmitted to the hospital administrative system electronically, based on the Turkish identity number. Electronic medical records from a standardized data collection form and patient's file from archive were used to collect all clinical, laboratory and outcome data. The research was ethically carried out in agreement with the Declaration of Helsinki. This study was approved by the local institutional review board and waived the requirement for informed consent.

All statistical analyses were carried out by IBM SPSS statistics v26 software. The Kolmogorov-Smirnov test was used to determine the normality of the variables. Chi-squared test and Fisher's exact test were performed to compare qualitative variables. When more than 20% of cells had expected frequencies less than 5, we used Fisher's exact test. When no more than 20% of cells with had expected frequencies less than 5, we used chi-squared test. Correlation was evaluated by Spearmans's test. The independent predictors of high NRS score were evaluated by using multivariable logistic regression analysis. P-values were two-tailed. Mann-Whitney U test was performed to compare medians (median, 25th-75th percentiles) of two independent groups. Student's t-test was conducted to compare means (mean±standard deviation) of two independent groups. A p-value of less than 0.05 was considered as statistically significant.

RESULTS

We included consecutive 125 decompensated CHF patients, 93 (74.4%) of them were in NRS-2002 score≥3 group and 32 (25.6%) of them were in NRS-2002 score<3 group. 65 (52%) of the patients were women, 60 (48 %) of the patients were men; statistically significant difference was not found between the two groups (p=0.577). The meanage was 73±12 (38-102) years. In NRS-2002 score≥3 group, the mean age was77±10 (56-102)years and in NRS-2002 score<3 group,the mean age was 61±11 (38-84) years. The age of patients in NRS-2002 score≥3 group was higher, which was statistically significant (p<0.001). The accompanying comorbidities of all the patients were as follows: DMin 44 (35.2%), HT in 63 (50.4%), HLin 22 (17.6%), CADin 39 (31.2%), COPDin 35 (28%), CKDin 72 (57.6%), AFin 65 (52%), stroke historyin 8 (6.4 %), cirrhosisin 5 (4%), peritoneal dialysis in 1 (0.8%), hemodialysis in 3 (2.4%), metallic heart valve prosthesisin 7 (5.6%), severe pneumonia in 7 (5.6 %), permanent pacemakerin 8 (6.4 %) patients.

In NRS-2002 score≥3 group, CKD [59 (63.4 %) (p=0.024)], CAD[34 (36.6 %) (p= 0.027)]and AF [54(58.1 %) (p=0.021)] were higher than the NRS-2002 score<3 group. When other accompanying comorbidities were compared, no statistically significant difference was found between the two groups.

Median EF of all the patientswas 30 (30-55)%; median EF was 30 (25-56)% in NRS-2002 score<3 group and median EF was35 (30-55)% in NRS-2002 score≥3 group.When the EF of two groups were compared, no statistically significant difference was noticed between the two groups (p=0.320).

MedianAPACHE II score of all the patients was

12.9 (11.3-14.6)%; median APACHE II score was 9.3 (7.9-11.3)% in NRS-2002 score<3 group and median APACHE II scorewas 13 (12.9-16.5)% in NRS-2002 score≥3 group. MedianAPACHE II scorewas higher in NRS-2002 score≥3 group and it was statistically significant (p<0.001).

During the 1-year follow up period for all cause of mortality (ACM),7 (21.9%) from NRS-2002 score<3 group and 28 (30.1%)from NRS-2002 score≥3 group, total 35 (28%) patients died. When the two groups were compared, no statistically significant difference was found between the two groups for one year ACM rate (p= 0.371).

The basic clinical characteristics of the patients, including age, gender, comorbidities, EF, APACHE II score and non-survivornumber are listed in Table 1.

Table 1: The Basic Clinical Characteristics of the Patients

Variables	NRS-2002 score<3 score n=32(25.6%)	NRS-2002 score≥3 n=93 (74.4%)	Total n=125	p-value
Age mean ± SD (min-max)	61±11 (38-84)	77±10 (56-102)	73±12 (38-102)	**<0.001**
Gender Male/Femalen (%)	14/18 (43.8/56.3)	46/47 (49.5/50.5)	60/65 (48/52)	0.577
Hypertensionn (%)	12 (37.5)	51 (54.8)	63 (50.4)	0.091
Diabetesmellitusn (%)	11 (34.4)	33 (35.5)	44 (35.2)	0.91
Hyperlipidemian (%)	3 (9.4)	19 (20.4)	22 (17.6)	0.157
Coronaryarterydiseasen (%)	5 (15.6)	34 (36.6)	39 (31.2)	**0.027**
COPD n (%)	8 (25)	27 (29)	35 (28)	0.661
Stroken (%)	1 (3.1)	7 (7.5)	8 (6.4)	0.679
Chronickidneydiseasen (%)	13 (40.6)	59 (63.4)	72 (57.6)	**0.024**
Hemodialysisn (%)	2 (6.3)	1 (1.1)	3 (2.4)	0.161
Peritonealdialysisn (%)	0 (0.0)	1 (1.1)	1 (0.8)	1.0
Cirrhosisn (%)	0 (0.0)	5 (5.4)	5 (4)	0.327
Pneumonian (%)	2 (6.3)	5 (5.4)	7 (5.6)	1.0
Atrialfibrillationn (%)	11 (34.4)	54 (58.1)	65 (52)	**0.021**
Pacemakerimplantationn (%)	2 (6.3)	6 (6.5)	8 (6.4)	1.0
Valvereplacementn (%)	4 (12.5)	3 (3.2)	7 (5.6)	0.070
EF (%)median (IQR)	30 (25-56)	35 (30-55)	30 (30-55)	0.320
APACHE II score %median (IQR)	9.3 (7.9-11.3)	13 (12.9-16.5)	12.9 (11.3-14.6)	**<0.001**
Nonsurvivorsn (%)	7 (21.9)	28 (30.1)	35 (28)	0.371

n: number, SD: standard deviation, min: minimum, max:maximum,NRS-2002 score: Nutritional Risk Screening NRS-2002 score, EF: ejection fraction, APACHE II score:Acute Physiology and Chronic Health Evaluation II score, IQR: inter quantile range, COPD: chronic obstructive pulmonary disease

Median creatinine level was 1.0 (0.9-1.2) mg/dl in NRS-2002 score<3 group, 1.3 (1.0-1.6) mg/dl in NRS-2002 score≥3 group; 1.2 (1.0-1.5) mg/dl in total group. When the two groups were compared,median creatinine level was higher inNRS-2002 score≥3 group and these findings were statistically significant (p=0.005).

Mean GFR was 67±22 (17-103) in NRS-2002 score<3 group, 49±20 (8-92) in NRS-2002 score≥3 group; 54±22 (8-103) in total group. When the two groups were compared,mean GFR was lower in NRS-2002 score≥3 group and these findings were statistically significant (p<0.001).

The normal NT-pro BNP value in the laboratory results of our hospital was between 0-125 pg/mL. NT-pro BNP levels of all patients included in the study were above normal. Median NT-pro BNP level was 3953 (2310-8939) pg/mL in NRS-2002 score<3 group, 9327 (4927-15793) pg/mL in NRS-2002 score≥3 group; 8140 (3133-13723) pg/mL in the total group. When the two groups were compared, median NT-pro BNP level was higher in NRS-2002 score≥3 group and these findings were statistically significant (p=0.005).NRS-2002 score and NT-proBNP were mildly and positively correlated 0.254 (p=0.004). In multivariable logistic regression analysis, age (OR, 1.14 [95% CI, 1.01 to 1.28]), coronary artery disease (OR, 10.51 [95% CI, 1.25 to 88.03]), and APACHE II score (OR, 2.98; [95% CI, 1.54 to 5.79]) were independent predictors of high NRS score. Laboratory findings of patients on admission are shown in Table 2.

Table 2: Laboratory Findings of Patients on Admission

Variables	NRS-2002 score<3 score n=32 (25.6%)	NRS-2002 score≥3 n=93 (74.4%)	Total n=125	pvalue
Glucosemg/dL; median (IQR)	109 (99-154)	124 (103-150)	121 (102-150)	0.137
Creatininemg/dL; median (IQR)	1.0 (0.9-1.2)	1.3 (1.0-1.6)	1.2 (1.0-1.5)	**0.005**
SodiummEq/L; median (IQR)	137 (133-140)	137 (135-140)	137 (133-140)	0.588
Potassiummmol/L; median (IQR)	4.3 (4.1-4.7)	4.4 (4.1-4.9)	4.4 (4.1-4.8)	0.711
eGFRmean ± SD (min-max)	67±22 (17-103)	49±20 (8-92)	54±22 (8-103)	**<0.001**
NT-Pro BNP pg/mL; median (IQR)	3953 (2310-8939)	9327 (4927-15793)	8140 (3133-13723)	**0.005**
White bloodcellcount10^9/L; median (IQR)	8.4 (6.7-9.9)	9.1 (6.7- 11.5)	8.5 (6.7- 10.6)	0.494
Hemoglobin mg/dL; mean ± SD (min-max)	12.1±2.0 (8.5-16.2)	11.5±2.2 (6.3-17.7)	11.6±2.2 (6.3-17.7)	0.146
Hematocrit% mean ± SD (min-max)	37.8 ±6.3 (27.0-50.9)	35.7±6.5 (18.9-54.9)	36.2±6.5 (18.9-54.9)	0.116

n: number, SD: standard deviation, min: minimum, max: maximum, NRS-2002 score: Nutritional Risk Screening NRS-2002 score, eGFR : estimated glomerular filtration rate, NT-pro BNP: N Terminal-Pro B type Natriuretic Peptide

DISCUSSION

BNP is a peptide, produced by the ventricles when the myocytes are stretchedand/or there is pressure overload. BNP is discharged as an active hormone and as an inactive N-terminal fragment; NT-pro BNP (19). NT-pro BNP can be measured by immunoassay in human blood. In our hospital's biochemistry laboratory, NT-pro BNP level is studied and we use NT-pro BNP level to make decisions on hospitalization of patients with heart failure and to evaluate response to treatment.

Since NRS-2002 has been used to assess the nutritional status of patients in many areas such as chronic kidney failure, cardiorenal syndrome, hip fracture and in various types of cancer,we also used in CHF. CHF patientsare especiallyexposed to the detrimental effects of malnutrition. This is caused by systemic inflammation and tumor necrosis factor alpha (TNF-α) similar to other forms of disease related wasting observed with cancer or human immunodeficiency virus(20).TNF-α, originally known ascachexin, is relatedto all forms of disease-related cachexia(20). TNF-α has a direct depressant effect on myocardium(21). Additionally, TNF-α changes peripheral blood flow, which might have a role in thedecrease of exercise tolerance(21). Cytokine mediates cellular effects by nuclear factor–κB (NF-κB). Short-term activation of NF-κB stimulatescytoprotective pathways and decreases injury from ischemia/reperfusion. As a conclusion, long-term activationof NF-κB–dependent gene products are maladaptive and lead to dysfunction of myocardium and apoptosis(22-24). Cardiac cachexia, identified by protein-calorie malnutrition with muscle wasting and bilateral extremity edema, significantly reduces quality of life. Malnutrition includes malabsorption because of gastrointestinal tract edema, anorexia due to cytokine production, nutritional problemscaused by fatigue and increased work of breathing(20). β-adrenergic tone and B-type natriuretic peptidesare upregulated in CHF. Theyactivate lipolysis via stimulation of a hormone-sensitive lipase (22-25).

Rubio-Gracia J. et al. reported that in patients with acute heart failure and have more severe malnutrition,NT-proBNP concentrations and one-year all-cause mortality were higher(26). Similarly, in a meta-analysis, Li Huiyang et al. showed that malnourished patients with heart failure had a higher risk of all-cause mortality(27).

In our study, we presented the data on the clinical characteristics and course of consecutively125acutely decompensated CHF patients with lower EF and preserved EF. All patients had NYHA class III-IV symptoms and all received intravenous(iv) diuretic therapy. APACHE II score is calculated to determine the expected mortality rate for patients hospitalized in ICU in our country. Since we followed the patients in ICU, we calculated the APACHE II score. The APACHE II score and the percentage of expected mortality rate were not specified in similar previous studies(12-18). Expected mortality rate calculated using the APACHE II score in all patients were 12.9 (11.3-14.6)%but total 35 (28%) patients died during the one-year follow up period. In a previous study, while the malnutrition rate was 57%,we found it to be 74.4%(12).

In the previous studies on malnutrition research in hospitalized patients, albumin was examined except

for routine tests(28). We only measured the albumin in patients who did not respond to iv diuretic therapy. NT-pro BNPlevel was studied for all patients within 24 hours after admission. In this study, we found NT-pro BNP level of all patients to be elevated. As it is known, elevated NT-pro BNP levels predictmortality in patients with CHF. We found that median NT-pro BNP level was 3953 (2310-8939) pg/mL in NRS-2002 score<3 group, 9327 (4927-15793) pg/mL in NRS-2002 score≥3 group; 8140 (3133-13723) pg/mL in total group. When the two groups were compared, median NT-pro BNP level was higher in NRS-2002 score≥3 group and these findings were statistically significant (p=0.005). However, mortality in both groups was similar. There was a mild but weak positive correlation between the NRS-2002 score and NT-pro BNP (r=0.254, p=0.004). In multivariable logistic regression analysis, age, coronary artery disease, and APACHE II score were independent predictors of high NRS score.

This study has several limitations. Firstly, our study might have selection bias because it was a single-center and retrospective study. Secondly, when compared to the general population, the number of patients diagnosed withdecompensated CHF is low. Thirdly, NRS-2002 score and NT-pro BNP levels of patients NYHA class III or IV were not compared.

Conclusion

In our study, malnutrition rate was found to be very high (74.4%) in patients with acutely decompensated HF patients, who were hospitalized in the ICU. NT-pro BNP level was higher in NRS-2002 score≥3 group (malnutrition group) than in NRS-2002 score<3 group in patients with acutely decompensated HF (p= 0.005). Age, coronary artery disease and APACHE II score were independent predictors of high NRS-2002 score. At this extreme clinical picture, high NRS-2002 score is not predictive of one-year all-cause mortality. Being elderly and suffering from CAD seem to designate high NRS-2002 score.

Ethics Committee Approval: Ethical approval was obtained. Clinical Research Ethics Committee (08.07.2021 date and 2021/14 number)
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