Validation of the modified nutric score on critically ill patients with acute exacerbations of chronic obstructive pulmonary disease: A retrospective study

Guler Eraslan Doganay[1]*, Mustafa Ozgur Cirik[1], Gulsah Yurtseven[1], Ali Alagoz[1]

1 University of Health Sciences, Atatürk Chest Diseases and Thoracic Surgery Training and Research Hospital, Department of Anaesthesiology and Reanimation, Ankara, TR

* **Corresponding Author:** Guler Eraslan Doganay **E-mail:** gulerdoganay@hotmail.com.tr

ABSTRACT

Objective: In critical care patients, the nutritional status is related to many factors such as existing co-morbidities, nutritional history, and the current disease. It is crucial to apply a comprehensive nutritional assessment and to start nutritional support as soon as possible in intensive care unit(ICU) where malnutrition is common. There are many studies on the association between modified Nutritional Risk in Critical Patients (mNUTRIC) score and outcome in ICU patients but the effectiveness of tools for risk assessment is still remains unclear. We aimed to define the correlation between the mNUTRIC score and 28-day mortality in patients with chronic obstructive pulmonary disease (COPD) in ICU.

Materials and Methods: The admission of COPD patients to the respiratory ICU in 2018 were determined retrospectively. Demographic data of all patients, body mass index (BMI), mNUTRIC scores, Acute Physiology and Chronic Health Assessment II (APACHE II), Sequential Organ Failure Assessment (SOFA) scores, Charlson Comorbidity Index (CCI), time from patient ward to ICU admission, sepsis parameters including C-reactive protein (CRP) and procalcitonin, ICU length of stay (LOS ICU), vasopressor use, and 28-day mortality were recorded.

Results: 159 COPD patients were involved in the study. Age, CCI, day from patient ward to ICU admission, SOFA score, APACHE II score and 28-day mortality were detected to be statistically higher in patients with mNUTRIC $\geq$ 5 (p < 0.05).

Conclusion: The mNUTRIC score could be an proper method for nutritional risk to predict prognosis in critically ill COPD patients.

Keywords: Modified NUTRIC score, Chronic Obstructive Pulmonary Disease, Nutritional risk, Intensive care unit, 28-Day mortality

INTRODUCTION

Malnutrition in critical patients adversely affects the course of the intensive care unit (ICU) patients and also related with poor outcomes (**1, 2**). In patients ICU admission, the nutritional status is related to many factors such as existing co-morbidities, nutritional history, and the current disease requiring ICU. This is associated with a 5-25% loss of lean body mass, depending on the severity of the current clinical condition, within 10 days after admission to ICU (**2, 3**).

It is crucial to apply a comprehensive nutritional assessment and to start nutritional support as soon as possible in ICU where malnutrition is common. Although many nutritional assessment tools are practiced in clinical setting, the effectiveness of these tools is still controversial (**2, 4, 5**).

Various nutritional risk assessment tools such as Nutritional Risk in Critical Patients (NUTRIC) score, malnutrition universal screening tool (MUST), Nutritional risk assessment (NRS-2002) have been employed in critical patients (2, 3). MUST score is comprehended body mass index (BMI), in past six months percentage of weight loss, and disease effect. The NUTRIC score, first enhanced particularly for patients in ICU; to recognize who would advantage from aggressive nutrition by correlating starvations, inflammation, and consequences (**6**).

Initially, the parameters forming the NUTRIC score included IL6 level, but due to the difficulty and high cost of studying this parameter in the clinical setting, the modified NUTRIC (mNUTRIC) score was determined by removing IL6. The NUTRIC score consists of five parameters including age, comorbidities, length of stay ICU, Acute Physiology and Chronic Health Assessment II (APACHE II) and Sequential Organ Failure Assessment (SOFA) scores.

Many studies investigate the association between mNUTRIC score and outcome in heterogenous ICU patients. Chronic Obstructive Pulmonary Disease (COPD) is one of the most important chronic diseases which cause significant mortality and morbidity worldwide. Poor nutritional status is very common in COPD, and it affects the course of disease in negative way. Admission to ICU is quite common in COPD patients due to acute attack, and this situation, when combined with poor nutritional status, pessimistically affects the outcomes of the patients.

In this study, we aimed to define the correlation between the mNUTRIC score and 28-day mortality in COPD patients who have ICU admission due to acute exacerbations of COPD (AECOPD). Secondary aim of this study was to evaluate the effect of MUST, NRS-2002, and other severity risk scoring system commonly used in ICU in these patients.

MATERIALS and METHODS

After ethical committee approval (04/19/2019-624) this study was conducted with the data analysis of critically ill AECOPD patients admitted to the respiratory ICU in 2018. We obtained informed consent from the patient or the legally responsible relatives. The data were collected from the medical records of the patients.

Inclusion criteria determined as; patients with a diagnosis of COPD, and admitted to ICU due to AECOPD. Patients who were hospitalized from another center or transferred to another center for any reason, which had multiple comorbidities like malignancy, who had multiple admission to ICU, and who received mechanical ventilation (MV) less than 24 hours were excluded from the study (**Figure 1**).

Demographic data of all patients, Charlson Comorbidity Index (CCI), time from patient ward to ICU admission, sepsis parameters including procalcitonin and C-reactive protein (CRP), body mass index (BMI), parameters used in mNUTRIC score, ICU length of stay (LOS ICU), vasopressor use, and 28-day mortality were recorded. We also determined the MUST, NRS-2002, and mNUTRIC scores.

Physicians calculated the mNUTRIC and MUST score for all patients and mNUTRIC score of above and below 5 were standardized. Malnutrition risk was considered high in patients with mNUTRIC score $\geq$ 5.

Statistical Analysis

Data analyses were performed by using SPSS for Windows, version 22.0 (SPSS Inc., Chicago, IL, United States). Whether the distribution of continuous variables was normal or not was determined by Kolmogorov Smirnov test. Levene test was used for the evaluation of homogeneity of variances. Unless specified otherwise, continuous data were described as mean ± standard deviation for normal distributions, and

median (minimum - maximum value) for skewed distributions. Categorical data were described as number of cases (%).

Statistical analysis differences in normally distributed variables between two independent groups were compared by Student's t test, and Mann Whitney U test were applied for comparisons of the not normally distributed data. Categorical variables were compared using Pearson's Chi-Square test or Fisher's exact test.

First of all it was used univariate logistic regression with risk factors that is thought to be related with mortality. Risk factors that has p-value < 0.25 one variable logistic regression was included to model on multivariable logistic regression. Whether every independent variables were significant on the model was analysed with Wald statistic. It was evaluated with Nagelkerke R2 how much independent variable explained dependent variable. Besides, it was evaluated model adaptation of estimates with Hosmer and Lemoshow model adaptation test. Receiver operating characteristic (ROC) curve analysis was used to determine the cut-off points. It was accepted p value < 0.05 as a significant level on all statistical analyses.

RESULTS

This study was conducted with the data analysis of 351 critical ill patients in respiratory ICU in 2018. The 235 of these had history of COPD. The 76 of these patients did not meet the inclusion criteria and were excluded from the study. The 100 (62.9%) males and 59 (37.1%) females were involved in the study, and the mean age was 70.92 ± 11.11 years.

Age, CCI, day from patient ward to ICU admission, SOFA score, APACHE II score, MUST score, NRS-2002 and 28-day mortality were found to be statistically significantly higher in those with mNUTRIC $\geq$ 5 (p<0.05) , (**Table 1**).

When patients evaluated in terms of 28-day mortality, the mNUTRIC score (p < 0.002), MUST (p < 0.001), SOFA score (p<0.001), APACHE II (p<0.001) score, CRP (p < 0.002), and procalcitonin (p< 0.020) was found statistically significantly higher (**Figure 2**), (**Table 2**). The MV day was not statistically significant in terms of 28-day mortality (p > 0.072), (**Table 2**).

The logistic regression (LR) analysis was utilized to evaluate the factors affecting 28-day mortality. Variables with p < 0.25 as a result of univariate analysis were applied to the multivariate analysis. Backward LR method was used in multivariate analysis. The values indicated in the Table 3 belong to the sixth step, which is the last step. Here the interpretation is made according to the results of multiple analyzes, p < 0.05 are considered significant. The Nagelkerke R2 is desired to be between 0.20 and 0.40, because it is in this range, it is understood that the model established is meaningful, and p > 0.05 in the Hosmer and Lemoshow test, and the model has a good fit with the data. SOFA score and CRP value appear to have an effect on mortality. Increasing the SOFA score by one unit increases the risk of mortality 2.469 times. One unit increase in CRP increases the risk of mortality by 1,058 times.

The ROC analysis for mortality, the area under the process characteristic curve (AUC) in terms of mNUTRIC score was calculated as 0.741, and the mNUTRIC score was statistically significant in determining mortality in cases. In order to answer the question of which value should be taken as the cut-off value for this test, each sensitivity and specificity values given as a result of the analysis were examined and the optimum point was chosen. The cut-off value was calculated as 5.5 with a sensitivity of 75.5% and a specificity of 65.1%. It shows that the risk of mortality was higher in patients with mNUTRIC score above 5.5 (sensitivity %75.5 and specificity %65.1) (**Figure 3**).
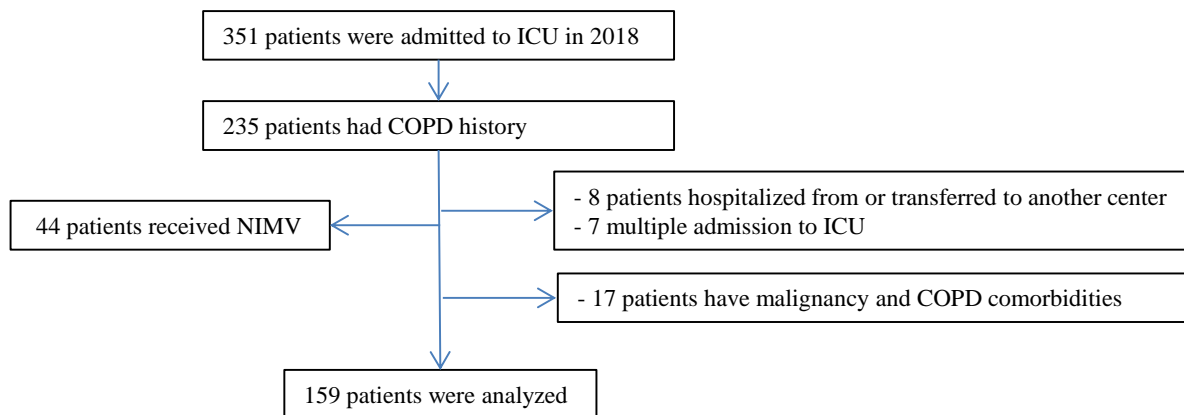

Figure 1: Flow chart of the patients

Table 1: Demographic and clinical characteristic of patients

		mNUTRIC Score		P
		<5 (n:46)	≥5 (n:113)	
Age (years)		63.43 ± 7.76	73.97 ± 10.85	**< 0.001**
BMI(kg/m^2)		24.5(13.3 - 40.6)	26.0(13.8- 49.9)	0.149
Gender	Male n(%)	30 (65.2%)	70 (61.9%)	0.699
	Female n(%)	16 (34.8%)	43 (38.1%)	
CCI		4 (2 - 7)	6 (3 - 13)	**< 0.001**
ICU LOS(day)		4 (2 - 20)	5 (2 - 50)	0.246
Days from ward to ICU		2.72 ± 4.01	4.60 ± 6.90	0.034
Vasopressor use		7 (15.2%)	33 (29.2%)	0.065
MV(day)		4 (1 - 21)	5 (1 - 50)	0.298
CRP (mg/L)		3.10(0.08-33.6)	3.74 (0.01-34)	0.770
Procalcitonin(ng/ml)		0.16 (0.01-14.5)	0.26 (0.01-97)	0.266
SOFA Score		5 (4 - 7)	6 (4 - 12)	**< 0.001**
APACHE II Score		17 (10 - 27)	23 (12 - 43)	**< 0.001**
MUST Score		10 (21.7%)	83 (73.5%)	**< 0.001**
NRS -2002		4 (2 - 6)	5 (3 - 6)	**0.004**
28-day mortality		7 (15.2%)	46 (40.7%)	**0.002**

mNUTRIC: Modified Nutritional Risk in Critical Patients. **BMI:** Body mass index**, CCI:** Charlson Comorbidite Index, **ICU:** Intensive care unit, **LOS:** lenght of stay, **MV:**mechanical ventilation, **CRP:** C-reactive protein, **SOFA:** Sequential Organ Failure Assessment, **APACHE II:** Acute Physiology and Chronic Health Assessment II**, MUST:** Malnutrition universal screening tool, **NRS- 2002:** Nutrition risk screening
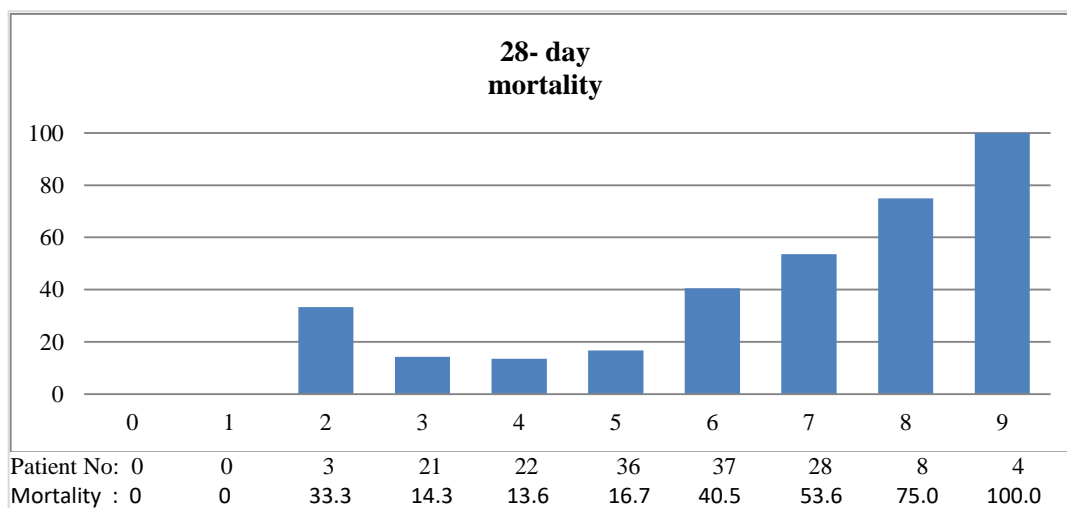

Figure 2: Correlation between mNUTRIC score and 28-day mortality

Table 2: Correlation between 28-day mortality and scoring systems, MV day, CRP, and procalcitonin

	28 Day Mortality		
	No Mortality	**Mortality**	**P**
mNUTRIC Score	67 (63.2%)	46 (86.8%)	**0.002**
MUST Score	52 (49.1%)	41 (77.4%)	**0.001**
SOFA Score	5 (4 - 9)	7 (4 - 12)	**<0.001**
APACHE II Score	20.05 ± 4.79	25.40 ± 6.90	**<0.001**
MV(day)	4 (1 - 50)	5 (2 - 34)	0.072
CRP(mg/L)	2.38(0.01-33.60)	5.05 (0.05-34)	**0.002**
Procalcitonin(ng/ml)	0.20 (0.01-14.50)	0.30 (0.01-97)	**0.020**

mNUTRIC: Modified Nutritional Risk in Critical Patients, **MUST**: Malnutrition universal screening tool, **SOFA**: Sequential Organ Failure Assessment, **APACHE II**: Acute Physiology and Chronic Health Assessment II, **MV**: mechanical ventilation, **CRP**: C-reactive protein
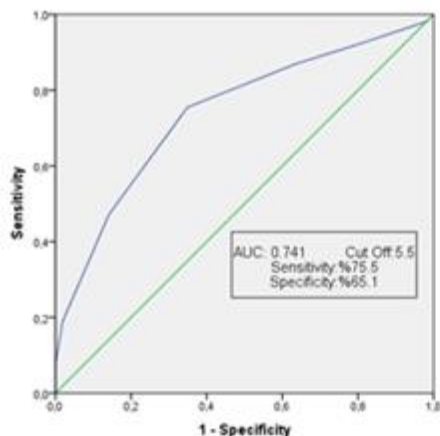
Area	Std. Error	p	Confidence Interval %95	Cut off	Sensitivity	Specificity
0.741	0.043	<0.001	0.656 − 0.826	5.5	%75.5	%65.1

Figure 3: The ROC analysis for mortality, the area under the process characteristic curve (AUC) in terms of mNUTRIC score

DISCUSSION

In this study, we defined that the mNUTRIC score could be a risk assessment tool for critically ill AECOPD patients to predict mortality. We also found that MUST, SOFA, APACHE II scores, CRP, and procalcitonin affect the 28-day mortality like mNUTRIC score.

Undernourished status is quite common in COPD patients, and this situation affects approximately one-third of patients which are associated with poor outcomes (7). Therefore, many critically ill AECOPD patients are undernourished in ICU or on the ward. In such cases, that is important to be able to identify who would benefit from adequate nutritional support. Clinicians should decide early whether the patient needs nutritional support. Even if different nutritional estimation tools have been used in clinical practice, the mNUTRIC score is an important scoring system that can use to evaluate the risk of malnutrition recently. Furthermore, it is a useful prewarning marker (2, 4, 6). Ozbilgin et al. determined that the mNUTRIC score was a good predictor of both mortality and morbidity in the postoperative acute care unit (8).

Although studies on mNUTRIC were conducted in heterogeneous patient groups, we also observed that the mNUTRIC score was an effective parameter in predicting mortality in our study involving AECOPD patients.

Since the severity of the disease in the ICU also negatively affected nutrition, those with a mNUTRIC score of 5 and above had higher ICU severity scores including APACHE II and SOFA. The mNUTRIC score can be a useful tool for optimizing clinical nutrition practices in the ICU setting and evaluating patients' response to nutritional support.

The LOS ICU and duration of MV had been studied by the researchers (9-11). Mendes et al. (9) found that, patients with high mNUTRIC scores had a long LOS ICU and high mortality. Moretti et al. (10) also found similar results in a study they conducted. Rahman et al (11) suggested; patients with high mNUTRIC scores had longer LOS ICU and the mortality rate was 31% in this group. In our study, in addition to these parameters, we also evaluated the duration of ward to ICU. Mortality rate and duration of the ward to ICU were higher in patients mNUTRIC score ⩾ 5, but LOS ICU was

similar in both groups. Ward to ICU time was also evaluated in our patients in order to assess the ongoing poor nutritional status of COPD patients. Loss of muscle and fat mass in COPD patients is a natural consequence of chronic long-term illness. In addition to poor nutritional status, particularly in COPD patients, adequate nutritional support might be underestimated during hospitalization. As seen in our results, we observed that patients with high mNUTRIC scores also had longer hospital ward stay. This suggests that, especially in COPD patients who admitted to ICU, it would be appropriate to consider the LOS hospital when nutritional support is determined.

This study showed that MUST, mNUTRIC, APACHE II, SOFA scores, CRP, and procalcitonin value influenced the mortality. Already, the mNUTRIC scoring system includes the SOFA score, which is used to determine the risk of organ dysfunction and death in ICU patients (12). The study by Coltman suggested that ICU severity scores (APACHE II and SOFA) were important factors like mNUTRIC score contributing to LOS ICU (4). Therefore, the correct identification of malnourished patients using the mNUTRIC score provides a more appropriate application of nutritional support and can thus reduce LOS.

Ping Zhang et al. (13) accomplished a study on Coronavirus Disease 2019 (COVID-19) patients, and they found that 28-day mortality was higher in patients with a high nutritional risk score in ICU admission. Kalaiselvan and colleagues (14) studied on ICU patients who need MV and they found that nearly half of MV patients are at nutritional risk, and high mNUTRIC scores increases LOS ICU and mortality. Our study indicated that, there is a high nutritional risk in COPD patients admitted to the ICU and higher mNUTRIC scores increase 28-day mortality.

We have several limitations in this study. First this study was retrospective study and the representation of the groups with high and low mNUTRIC scores had a limited number. In addition, mNUTRIC score calculation was based solely on the clinically specified by the physicians, and a large group of COPD patients receiving non-invasive MV was excluded.

CONCLUSION

The intensive care severity scores and 28-day mortality rates increase in critically COPD patients with high mNUTRIC score. Malnutrition due to sepsis affects critically ill patients even more negatively. As a result, the mNUTRIC score may be an appropriate tool for nutritional risk assessment and prognosis prediction in critically ill AECOPD patients.

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