Original Article

The Role of CRP and mNUTRIC score in predicting outcome in critically ill elderly.

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Abstract:

Background: Malnutrition is highly prevalent in hospitalized patient and higher in critically ill patients admitted to an intensive care unit (ICU), it is associated with increased length of hospital stay, decreased quality of life, and increased mortality. Early recognition of patients who are at high nutritional risk may improve their clinical outcomes as these patients may benefit more from nutritional interventions than those at lower nutritional risk. So, proper assessment of risk of malnutrition should be done for ICU patients. The aim of this study is to determine the role of CRP on admission and mNUTRIC score in predicting ICU patient outcome.

Methods: A prospective cohort study involved 155 elderly patients aged 60 years and above recruited from geriatric intensive care unit in Ain Shams University Hospital. Data collection included history taking (personal history, past medical history), cause of ICU admission, comorbidities, APACHI II score, SOFA score, mNUTRIC score was calculated from the previous data taken on admission. A venous blood sample was collected from each participant to measure CRP on admission.

Results: The in-hospital mortality of the studied population was 61/155 (39.35%).The non survivors had higher mean CRP, mNUTRIC, SOFA, and APACHE II scores. The mNUTRIC > 4 has a 70.49% sensitivity and 87.33% specificity in predicting mortality with AUC= 0.844. While CRP level > 80 has a sensitivity 70.49% and specificity 71.28% in predicting mortality with AUC= 0.738.

Conclusion: CRP and m-NUTRIC score obtained at admission to the ICU had moderate accuracy for predicting ICU mortality.

Key words: mNUTRIC, CRP, intensive care unit, mortality.

Introduction:

Hospitalized patients, particularly those who are critically ill, frequently suffer from malnutrition, which is linked to higher rates of morbidity and mortality, prolonged hospitalization and increased hospital costs [1] According to a significant European study, 48%–57% of elderly patients in Western Europe are "at nutritional risk," a statistic that rises to 87%–100% for patients in intensive care [2]. To begin appropriate

treatment that could enhance patient outcomes, it is critical to identify individuals at high risk of malnutrition as soon as possible [3].

Current nutritional risk assessment tools for critically ill patients often incorporate number of factors, including dietary intake, illness severity, physical examination findings, anthropometric measurements, and functional assessments. However, obtaining these data points in this population can be challenging due to the frequent use of mechanical ventilation and sedation. [4].

A novel screening instrument known as the Nutrition Risk in Critically Ill (NUTRIC) score was presented by Heyland et al. in 2011 and validated for use in intensive care unit patients, it is used to assess adverse outcome risk as (mortality and mechanical ventilation) which can be modified by intensive nutritional intervention [5]. Since the IL-6 component of the score makes it challenging to use [6], Rahman et al. validated modified NUTRIC (mNUTRIC), which permits the IL-6 level to be excluded, to evaluate nutritional risk at admission [7].

Hepatocytes produce C-reactive protein (CRP), an acute-phase protein, through stimulation by the cytokines during an acute-phase response. It is an objective marker of inflammation [9]. Intensive care unit mortality and organ dysfunction are correlated with CRP levels[10]. . It offers the benefits of simplicity, rapidity, and repeatability and is regularly monitored in intensive care units. [11].

Emerging evidence recommends the combined use of the mNUTRIC score alongside additional parameters like laboratory biomarkers, sarcopenia index, and handgrip strength for a more comprehensive assessment of nutritional status [8]. Thus, the primary goal of this research is to identify how CRP concentration on admission and mNUTRIC score relate to the prognosis of elderly critically sick patients.

Materials and Methods:

Study design and setting:

A prospective cohort study was carried out in geriatric ICU in geriatric hospital, Ain shams university hospitals, Cairo, Egypt from September 2023 to December 2023 to assess the predictive value of CRP and mNUTRIC score for aged critically ill patients. Included in the study were all patients 60 years of age and older who had been admitted to the geriatric ICU for longer than 48 hours during study period.

Sample size :

The sample size was calculated using the PASS 15 program, reviewing results from earlier research [12]. A sample size of 130 patients was calculated.

Data collection:

All patients involved in the study were assessed within 48 hours of admission. Data collection included demographic characteristics in the form of age, gender, and special habits. Baseline clinical data included the medical comorbidities, cause of ICU admission, and the number of days from hospital to ICU admission. SOFA and APACHE II score were calculated on admission.

Nutritional assessment using the mNUTRIC score was done within 48 hours of admission. This score incorporates five factors: age, number of comorbidities, time elapsed since hospital admission, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, and Sequential Organ Failure Assessment (SOFA) score. The mNUTRIC score was calculated within a range from 0 to 9. A total score of four and below displays low nutritional risk while above 4 show high nutrition risk.

Laboratory assessment done on admission including CRP, hemoglobin level, albumin level, white blood cells, platelets, INR,

BUN, Create, Na, K, Ca, phosphorus, magnesium, AST, and ALT.

Outcome:
The primary outcome was ICU mortality while the secondary outcomes included length of stay in the intensive care unit, use of vasopressors, and mechanical ventilation. . Patients were followed from the date of admission to the ICU, during the ICU stay for the occurrence of mortality or discharge.

Ethical consideration

Every patient or the patient's next of kin gave their informed consent for participation in the research and blood sample collection, and The Ethical Committee of Scientific Research (Ain Shams University, Faculty of Medicine) gave its approval to the study.

Statistical analysis

Data was analyzed using statistical package for social science (SPSS) version 27.0, data was expressed as mean and standard deviation (SD), median (IQR) and frequency and percentage when indicated. The following tests were used: Independent samples t-test, Chi square test, Mann Whitney U test, ROC analysis, Pearson's correlation coefficient and logistic regression analysis, the confidence interval was set to 95%, P value < 0.05 what's considered significant.

Results

There were 155 critically ill older patients enrolled in the study.
The mean age of the patients was 72.31 ±(8.8) years, with 51% males and 49% females. Nearly 60% of the participants were non-smokers, 19% where smokers, 12.9% where ex smokers and only 8.4% were passive smokers. As for comorbidities hypertension (63.9%), ischemic heart disease (46.5%) and diabetes (48.4%) where the most frequent diseases. The mean ±(SD) of SOFA and APACHE II scores was 5.12 ±(3.4) and 17.50 ±(7.9) respectively. Both the patients' clinical and demographic details were shown in **Table 1**.
Regarding the relation between studied variables and patient's outcome, the outcome in relation to the CRP level, mNUTRIC score, SOFA score, and APACHE II score differed statistically significantly (P < 0.001) **Table 2**.

ROC analysis regarding CRP and mNUTRIC score as predictors of mortality showed the mNUTRIC score cut off value >4 has a 70.49% sensitivity and 87.33% specificity in predicting mortality and the area under the curve was 0.844. While CRP level > 80 has a sensitivity 70.49% and specificity 71.28% in predicting mortality with area under the curve 0.738 (**Table 3, Figure 1).**

As regarding the correlation between the studied variables and outcome there was strong correlation between mNUTRIC score, APACHE II score, SOFA score and patients' mortality.

Discussion

Our goal in this study was to evaluate the m-NUTRIC score's diagnostic accuracy for predicting ICU mortality by prospectively following up of 155 critically ill older patients during their ICU stay. Our results revealed that age, C-reactive protein (CRP), and m-NUTRIC score emerged as independent predictors of ICU mortality. The m-NUTRIC score at cut off> 4 had moderate accuracy for predicting ICU mortality (AUC=0.844, sensitivity= 70.49% , and specificity= 87.23%). This study

stands out as the first study to assess the prognostic ability of m-NUTRIC score in critically ill older patients (>60 years). Although, the original purpose of the NUTRIC score and its modified version was to evaluate nutritional risk among critically sick patients and to determine those who would possibly benefit from nutritional therapy [5, 13], and they were included in different nutrition guidelines. [14,15] Recent evidence accumulated regarding the potential usefulness of both tools in predicting ICU related mortality. [16-19] This association to mortality in critically ill patients may be attributed to the NUTRIC score's built-in risk assessment using SOFA and APACHE II scores, which are well-known for predicting severity and death in critical illness [20,21] However, this shouldn't underestimate the increased ICU mortality attributed to malnutrition.

It has been demonstrated that a number of nutritional risk assessment scores independently predict death in individuals with critical illnesses [22-24] Yet, many of the nutritional risk assessment tools can be difficult to apply in ICU in clinical practice. Thus, NUTRIC and m-NUTRIC scores emerged as useful clinical nutritional assessment tools that can predict mortality in ICU.

According to Mukhopadhyay and colleagues in their observational study [16], A mixed Asian ICU population's 28-day mortality was linked to the m-NUTRIC score (OR 1.48, CI 1.25-1.74, $p < 0.001$). Similar discriminative ability of the m-NUTRIC-score for 28-day mortality was demonstrated by another observational investigation is AUC= 0.768 (95% CI 0.722–0.814) using Cut off point (>4). [19]

The current study revealed that CRP level>80 mg/L had AUC=0.738, sensitivity=70.49%, and specificity =71.28% for predicting ICU mortality. Similar results were obtained by Qu et al., 2020 who identified the cut-off point of CRP level > 62.8 mg/L linked to an increased risk of ICU mortality (odds ratio, 2.145; 95% CI, 1.343–3.427; P = 0.001), with AUC= 0.684. [25] CRP is a commonly used biomarker to predict systematic inflammatory response (SIR), which is a major contributor to all-cause death in critically ill patients [26]. Elevated CRP on admission (>100 mg/L) independently predicted increased ICU and 30-day mortality and prolonged hospital stays, regardless of the disease severity as assessed by SAPS-3 [26].

Previous reports suggested that CRP is useful for predicting infection, sepsis, and other inflammatory non-infectious conditions. [27-29]

Moreover, The Global Leadership Initiative on Malnutrition(GLIM) suggested the global diagnostic framework of malnutrition, which includes CRP as a biomarker for inflammation as an etiological criterion [30,31] .The proposed cut off for the inflammation criterion of the GLIM diagnosis in elderly experiencing acute illness was relatively low >3 mg/L. [30]

Conclusion

CRP and m-NUTRIC score obtained at admission to the ICU can be used for risk stratification of critically ill older adults. Both had moderate accuracy for predicting ICU mortality. Thus using MNUTRIC score to assess nutritional status in critically ill elderly patients and also using CRP level as an inflammatory marker can help in early identification of patients at high risk of death and the ability to intervene early to improve patient survival

Limitations of the study

The study employed a one-time assessment of mNUTRIC and CRP levels upon admission, with no subsequent monitoring

during the hospitalization course. Furthermore, due to the study's single-center design, it's possible that the results cannot be applied to other patient populations.

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Author Contributions

Marwa Abd Elazeem and Abeer Hassan assisted in the collection of data. Writing original draft Marwa Abdelazeem. revising and editing Abeer hassan. Statistical analysis by Khaled Abdou. All authors contributed significantly to the study's conception, design.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Table 1: Demographic and clinical characteristics of the studied group:

age	Mean ±(SD)	72.31 ±(8.8)
	Median (IQR)	71 (65-80)
Gender	Males (%)	79 (51%)
	Females (%)	76 (49%)
Smoking	Non smokers	92 (59.4%)
	Current smokers	30 (19.4%)
	Ex- smokers	20 (12.9%)
	Passive smokers	13 (8.4%)
Types of comorbidities	Diabetes mellitus (%)	75 (48.4%)
	Hypertension (%)	99 (63.9%)
	Renal diseases (%)	67 (43.2%)
	Chronic liver disease (%)	34 (21.9%)
	Ischemic heart diseas (%)	72 (46.5%)
	COPD (%)	54 (34.8%)
	GIT	32 (20.6%)
	Neurological diseases	63 (40.6%)
	Cognitive impairment	13 (8.4%)
	Thyroid disorder	7 (4.5%)
	Malignancy	10 (6.5%)
APACHI II	Mean ±(SD)	17.50 ±(7.9)
	Median (IQR)	16 (12-21.75)
SOFA	Mean ±(SD)	5.12 ±(3.4)
	Median (IQR)	4 (3-7)
Days from hospital to ICU admission	Mean ±(SD)	3.8 ±(6.7)
	Median (IQR)	0 (0-5)
CRP	Mean ±(SD)	79.23 ±(73)
	Median (IQR)	65 (24-96)
mNUTRIC	Mean ±(SD)	4.14±(1.8)
	Median (IQR)	4 (3-5)

Table 2: Relation between studied variables and patient's outcome.

		Outcome		P-value
		survival	mortality	
		No. = 94	No. = 61	
Age	Mean ± SD	72.00±8.4	72.79±9.3	0.587
Sex	Males (%)	46 (48.9%)	33 (54.1%)	0.530
	Females (%)	48 (51.1%)	28 (45.9%)	
Days from hospital to ICU admission	Median (IQR)	1 (0-6)	0 (0- 4.25)	0.345
	Range	0-36	0-30	
No. of co-morbid conditions	Median (IQR)	3 (2-5)	3 (2-5)	0.682
	Range	0-8	1-7	
CRP	Mean ± SD	58.48 ± 61.7	111.21± 78.0	< 0.001
mNURTIC score	Median (IQR)	3 (2-4)	6 (4-7)	< 0.001
	Range	1-8	2-8	
APACHI 2 score	Median (IQR)	13(10-17)	23 (18-30)	< 0.001
	Range	5-37	9-38	
SOFA score	Median (IQR)	3 (2-4)	8 (4.75-11)	< 0.001
	Range	0-10	0-14	

Table (3): ROC curve of CRP and mNURTIC score as a predictor of Outcome.

	AUC	P value	Cut off value	sensitivity	specificity
CRP	0.738	<0.001	>80	70..49%	71.28%
Nutric score	0.844	<0.001	>4	70.49%	87.23%

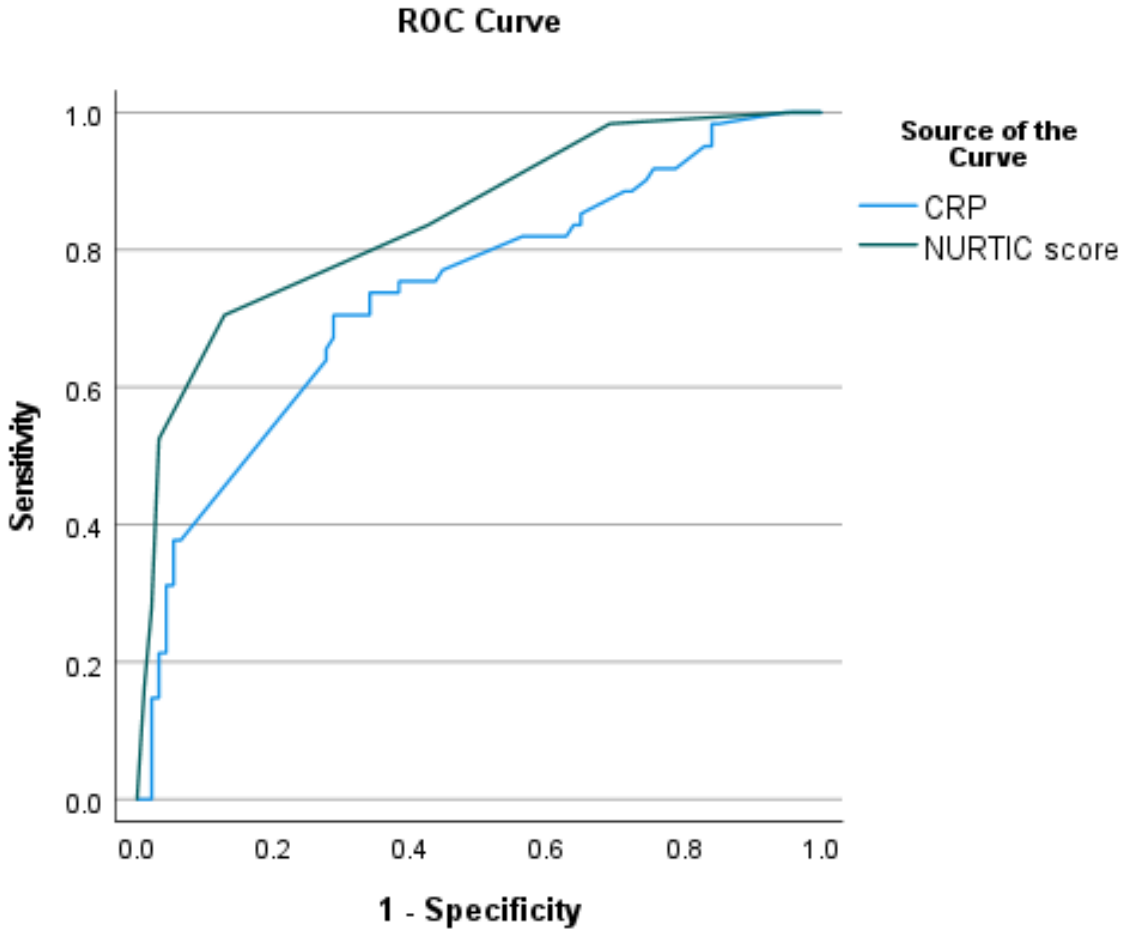

Figure 1: ROC curve for CRP and mNUTRIC score in predicting outcome.

Table 4: Coefficients and standard errors.

Variable	Coefficient	Std. Error	Wald	P	Odds ratio	95% CI
age	-0.069009	0.032950	4.3865	0.0362	0.9333	0.8749 to 0.9956
CRP	0.0093060	0.0031944	8.4870	0.0036	1.0093	1.0030 to 1.0157
acuterenalfailure	0.66403	0.50209	1.7491	0.1860	1.9426	0.7261 to 5.1972
NURTICscore	0.76902	0.33791	5.1794	0.0229	2.1577	1.1126 to 4.1842
APACHI2	0.024024	0.066947	0.1288	0.7197	1.0243	0.8984 to 1.1679
SOFA	0.20008	0.11070	3.2666	0.0707	1.2215	0.9832 to 1.5175
Constant	-1.87990	2.13678	0.7740	0.3790		

Table 5: Pearson correlation coefficient of the studied variables.

1.0 -1.0

NURTIC score		0.848	0.745	0.404	0.249	0.138	-0.081
APACHI 2	0.848		0.775	0.179	0.221	-0.015	-0.097
SOFA	0.745	0.775		0.065	0.165	-0.136	-0.146
age	0.404	0.179	0.065		0.063	0.012	0.001
CRP	0.249	0.221	0.165	0.063		-0.070	0.070
days from hospital to I CU admission	0.138	-0.015	-0.136	0.012	-0.070		0.032
ICU stay	-0.081	-0.097	-0.146	0.001	0.070	0.032	
	NURTIC score	APACHI 2	SOFA	age	CRP	days from hospital to I CU admission	ICU stay

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