Modified NUTRIC score: a predictor for mortality in patients with septic shock-a single center retrospective study

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Abstract

Objective
to evaluate the modified NUTRIC score in identifying nutritional risk patients and predicting mortality in septic shock patients.

Methods

A retrospective study was performed with septic shock patients admitted to the intensive care unit (ICU) from January 2018 to December 2019. A receiver operating characteristic (ROC) curve was used to identify the performance of the instruments to predict mortality.

Results

Among the patients, 46 patients were non-survivors and 78 were survivors. The median mNUTRIC score was 5.41±1.69 vs 4.29±1.58 (P<0.0001). 28-day mortality increased with higher modified NUTRIC score. In the ROC curve of mNUTRIC score, the best cut-off point was at 4. It was identified for our sample, showing the best parameters of both sensitivity and specificity for the prediction of mortality 28 days after ICU admission. The area under the curves (AUCs) of the mNUTRIC score for predicting 28-day mortality was 0.664 (95% CI: 0.574, 0.746).

Conclusions

The modified NUTRIC score was a good nutritional risk assessment tool for septic shock patients. mNUTRIC score showed a good performance for the prediction of 28-day mortality. A new cutoff value was identified for septic shock patients.

Background

Sepsis is a syndrome characterized by a dysregulated inflammatory response leading to organ damage in response to a microbial infection. Septic shock is associated with an overall catabolic state leading to the breakdown of carbohydrates, lipid, and protein stores. Despite advances in medicine, from germ theory to the advent of modern critical care medicine, Septic shock continues to be a leading cause of inpatient expenditures and death. The nutritional statuses of patients admitted to ICUs deteriorate rapidly, even when they are in well-nourished state. [1]. Malnutrition in septic shock patients is associated with increased morbidity, nosocomial infections, longer hospital stays, and all-
cause mortality [2, 3]. It is therefore crucially important to identify patients in ICU who are at nutritional risk and will benefit from aggressive nutritional therapy, resulting in improved clinical outcomes, such as lower rates of nosocomial infection, morbidity, and mortality [4, 5]. NUTRIC is the first tool developed to assess nutritional risk in ICU patients [6]. It includes variables such as age, number of comorbidities, Acute Physiologic and Chronic Health Evaluation (APACHE II) and Sequential Organ Failure Assessment (SOFA), number of days at hospital prior to admission in the ICU and interleukin-6 (IL-6). But IL-6 is not frequently requested due to its high cost [7]. Thus, another version of NUTRIC was created later removing from the final score of the IL-6 measurements, called modified NUTRIC score [7].

Our study has two aims: 1) to explore if mNUTRIC score is associated with outcomes such as mortality in an Chinese population of septic shock patients: for this, we included all septic shock patients admitted to the ICU during the study period, and 2) to make a cutoff value of mNUTRIC score that can identify high-risk patients who are most likely to benefit from nutritional intervention.

Methods
Study Participants

We collected septic shock patients admitted to the ICU from January 2018 to December 2019. During this period, 124 patients who were at least 18 years old were admitted to the ICU with septic shock and had ICU stays of more than 24 h. The exclusion criteria were: patients admitted with exogenous intoxication, patients hospitalized for less than 24 h.

Data Collection

All clinical data, including variables for calculating the mNUTRIC score (age, number of comorbidities, APACHE II) and lab values, were collected from the medical records and APACHE II was calculated by e-calculator. The data for demographics, height, body mass, comorbidities, the SOFA, length of stay at hospital (LOS), ICU hospitalization time, hospitalization time before ICU, and death were collected from the ICU Monitor system. The mNUTRIC score was calculated in the first 24 h of ICU admission.

Statistical analysis

For the analysis, all statistical tests were evaluated with a 2-tailed p-value and p-values less than 0.05
were considered significant. Categorical variables were compared using the chi-square test and
continuous variables using Student’s t-test or the Wilcoxon–Mann–Whitney test. A receiver operating
characteristic (ROC) analysis was used to determine the mNUTRIC score with better sensitivity and
specificity for death. The ROC curve was compared using MedCalc software (version 1.76; MedCalc
Software, Ostend, Belgium). The Youden criterion [8] (sensitivity + specificity -1) identified the best
cut-off point (value of 1 indicates that the test is perfect) for mortality prediction 28-day after ICU
admission. All other statistical analyses were performed using Statistical Package for Social Sciences
( SPSS) for Mac, version 22.

Results
Among the patients, 78 were survivors and 46 patients were non-survivors. The patients' general
characteristics are described in Table 1. Among the patients, there were 84 males (67.7%) and 40
females (32.3%). The mean age of the two groups had no statistical difference. The median APACHE
II score was 18.33±6.26 vs 23.48±8.62, the median SOFA was 10.39±3.07 vs 12.43±4.4. The median
mNUTRIC score was 4.29±1.58 vs 5.41±1.69. There were no significant difference between the
groups on LOS and LOS in ICU.
Table 1 general characteristics

| Variable                  | All (n=124) | Survivors (n=78) | Non-survivors (n=46) | P value |
|---------------------------|-------------|------------------|----------------------|---------|
| Gender                    |             |                  |                      |         |
| male, n(%)                | 84 (67.7%)  |                  |                      |         |
| female, n(%)              | 40 (32.3%)  |                  |                      |         |
| Diagnosis                 |             |                  |                      |         |
| Gastrointestinal Tract    | 61 (49.2%)  |                  |                      |         |
| Liver and Biliary System  | 21 (16.9%)  |                  |                      |         |
| lung                      | 14 (11.3%)  |                  |                      |         |
| craniocerebral            | 10 (8.1%)   |                  |                      |         |
| orthopedic                | 8 (6.5%)    |                  |                      |         |
| thoracic                  | 7 (5.6%)    |                  |                      |         |
| urinary system            | 2 (1.6%)    |                  |                      |         |
| others                    | 1 (0.8%)    |                  |                      |         |
| Age, years                | 63.31±15.42 | 67.37±16.88      | 0.174                |         |
| APACHE-II score           | 18.33±6.26  | 23.48±8.62       | 0.001                |         |
| SOFA score                | 10.39±3.07  | 12.44±4.41       | 0.007                |         |
| mNUTRIC score             | 4.29±1.58   | 5.41±1.69        | <0.0001              |         |
| LOS, days                 | 21.52±15.84 | 20.3±17.59       | 0.694                |         |
| LOS in ICU, days          | 13.48±11.33 | 15.54±16.47      | 0.413                |         |

Our analysis showed that 28-day mortality increased with higher modified NUTRIC score (Fig.1): 28-day mortality for the maximum modified NUTRIC score was 100%. Modified NUTRIC score was significantly associated with 28-day mortality.

In the ROC curve of mNUTRIC score, the best cut-off point was at 4 (sensitivity 91.3% and specificity 28.21%). It was identified for our sample, showing the best parameters of both sensitivity and specificity for the prediction of mortality 28 days after ICU admission. The area under the curves (AUCs) of the mNUTRIC score for predicting 28-day mortality was 0.664 (95% CI: 0.574, 0.746) (fig.2).

Discussion

Indeed, early nutrition intervention has a beneficial effect in patients with high nutrition risk.[9–11] A
study in critically ill, postoperative patients with nutrition risk (score ≥ 5 evaluated by the mNUTRIC) showed an association between mortality and inadequate nutrition. The mNUTRIC score represents the first nutritional risk assessment tool developed and validated specifically for ICU patients, in order to specifically identify patients at higher risk, who may benefit from specialized nutritional care in terms of calorie and protein intake in order to positively impact the length of their hospital stay and mortality.

In this study, we found that the modified NUTRIC score was a good prognostic substitute for the mNUTRIC score in patients with sepsis. mNUTRIC showed a good performance for the prediction of 28-day mortality, presenting an area under the curve of 0.664. We found that the best cutoff of the ROC curve for modified NUTRIC score was at 4 (sensitivity 91.3% and specificity 28.2%) and the Youden index was 0.2007. This cut-off is slightly lower than presented in the first validation study [6], and slightly lower than the suggested a cut-off point of 5 points for high-risk, when IL-6 is not used. [7]

When observing the risk of death in relation to the mNUTRIC classification, we were able to see different results depending on the cut-off point. When using the cut-off points previously published, there is a 1.7 times higher mortality risk in patients classified as at risk with mNUTRIC ≥ 5. Using the new cut-off point suggested for our sample (NUTRIC ≥ 4), the patients classified at nutritional risk had on average a mortality risk almost 2.8 times higher after 28 days than individuals classified with no nutritional risk. Meanwhile, we found that the mNUTRIC score had no impact on the LOS or LOS in ICU within the septic shock patients.

It was observed in the study of mNUTRIC validation that each point increase in the mNUTRIC score resulted in a significant increase in the rate of mortality. [12] In another study conducted with 482 patients with sepsis, the AUC of the mNUTRIC score for predicting 28-day mortality was 0.762. [13]

The NUTRIC score is an important nutritional risk assessment tool to guide nutrition intervention in critically ill patients. Several studies have shown that the beneficial effects of nutritional support are more evident in high-risk patients. [6, 7, 14] The international societies guidelines recommend the use of the NUTRIC score to identify critically ill patients with nutritional risk and recommend that nutritional goals should be achieved early in patients with a high NUTRIC score. [15, 16]
Our study validated the mNUTRIC score as an ICU-specific nutritional risk tool for septic shock population. Several limitations of our study should be recognized. First, our study is a single centered retrospective study where residual confounding by factors that were not measured may have affected the observed associations. Multicenter prospective studies are needed to confirm our findings. Second, this sample comprised patients of a wide range of age and with different diseases. Further investigation is needed to find the best cutoff score for the high-risk group in the modified NUTRIC Score in order to compare our data with the original score used in the Caucasian cohort [17].

Conclusions
Based on our results, we suggest that mNUTRIC should be used within the first 24 h of ICU admission to detect septic shock patients at greater risk of mortality, and a score 4 seemed to be more adequate to our population. Its use is recommended, enabling the identification of those who would benefit from greater benefit from nutrition therapy to prevent mortality.

Abbreviations
ICU
intensive care unit
ROC curve
receiver operating characteristic curve
APACHE II
Acute Physiologic and Chronic Health Evaluation
SOFA
Sequential Organ Failure Assessment
mNUTRIC
modified NUTRIC
LOS
length of stay at hospital
AUC
area under the curves

Declarations

Ethics approval and consent to participate

The protocol for this study was approved by the Research Ethics Committee of China-Japan friendship hospital.
Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Funding

Not applicable.

Authors' contributions

Jiatong Hou collected and analyzed the patient data, and was a major contributor in writing the manuscript. Wentao Liu, Yina Wu and Xiaoqing Wu were responsible for statistical methods. All authors read and approved the final manuscript.

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Not applicable.

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Figures

![Figure 1](image.png)

28-day mortality according to modified NUTRIC score
Figure 2

ROC curve of the mNUTRIC score for predicting 28-day mortality