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Assessment of Nutritional Risk by Modified Nutric Score and It's Association With 28 Day Mortality In Critically Ill Patients On Mechanical Ventilation In Medical Icu

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ABSTRACT-
The prevalence of malnutrition in critically ill patients is very high and varies between 39-50% in the published clinical studies. These patients are at risk of higher morbidity and mortality as compared to well-nourished patients. Though there are multiple risk scores proposed and well validated for indoor patients, not much risk scores are there for ICU patients. Among the few tools validated for ICU patients are APACHE II score, SOFA score etc. In the current study we have tried to validate a relatively newer screening tool, modified NUTRIC score in identifying at risk patients and mortality among the at-risk patients.

Keywords- ICU, APACHE II, SOFA, modified NUTRIC score

I. INTRODUCTION-

Critically ill patients are those whose condition is life-threatening and requires comprehensive care and constant monitoring, usually in an intensive care unit (ICU).[1]The prevalence of malnutrition in critically ill patients is very high and varies between 39-50% in the published clinical studies.[2-4]Malnutrition in these patients can be due to inadequate intake, decreased absorption, increased requirement.[5]

There are two phases of critical illness that have been described- Ebb and Flow phase. The 'ebb' phase comprises an early hyperacute phase of hemodynamic instability, which is the reason for ICU admission, and the 'flow' phase includes a subsequent period of metabolic instability and catabolism followed by a later period of anabolism. In case of an early phase of critical illness, due to the effects of catabolic hormones like glucagon, cortisol, and catecholamines, endogenous energy substrates such as glucose, amino acids, and free fatty acids are produced following mobilization of muscle and adipose tissue. Simultaneously, some pro-inflammatory cytokines like IL-1, IL-6, and TNF-α are also secreted in response to stress, which further aggravates the catabolic process.[6]

Malnutrition in critically ill has been shown to be associated with prolonged hospitalization, increased risk of nosocomial infections, poor outcomes in terms of higher mortality.[7-9] Many scoring and screening systems were described in past decades for use in different clinical settings and different patient populations (indoor, elderly, community, etc.). Nutritional screening need to be performed within the first 24–48 hours after hospital admission and then should be followed at regular intervals thereafter (e.g., weekly) to quickly and accurately identify individuals who should be referred to the nutrition specialist for further detailed assessment. Different nutrition risk screening tools have been described to assess nutritional status in hospitalized patients like Nutritional Risk Screening2002(NRS), Mini nutritional assessment (for geriatric population), Malnutrition Universal Screening Tool score (MUST), Subjective Global Assessment tool (SGA), Body Mass Index, anthropometric measurements, etc.[10-12] Many of these tools rely on the history of loss of weight, reduced dietary intake, which has to be answered reliably by patients themselves, but in ICU setup, most patients are on mechanical ventilation, sedated, leading to inaccurate nutritional screening and assessment. Also, ICU patients may have generalized edema due to underlying illness leading to weight gain or loss of weight due to poor oral intake prior to hospitalization. Therefore, actual weight at the time of admission is not a good indicator of a patient's nutritional status, which is a component of some of the scores mentioned above. Moreover, these tools do not include variables related to metabolic state and disease severity.A simple yet very effective tool for nutritional risk screening of critically ill

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patients has been described by Heyland et al. called NUTRIC (Nutrition In Critically ill) score. This is the first nutritional risk assessment tool developed especially for ICU patients and has been validated. Again nutritional interventions should not be provided as a rule to all ICU patients in the same manner. The main concept behind the NUTRIC score is to identify the patients who are at risk and would be benefited from aggressive nutritional therapy, as opposed to most other risk scores and assessment tools, which consider all critically ill patients to be at high nutrition risk. The NUTRIC-score combines parameters like prehospital admission duration, acute inflammatory marker like Interleukin-6, chronic inflammatory parameters like the number of comorbidities, the severity of illness like APACHE-II(Acute Physiology and Chronic Health Evaluation -II) and SOFA(Sequential Organ Failure Assessment) scores on ICU admission and age of patient to assess nutritional risk and associated outcomes in terms of mortality and morbidities (ventilatorfree days, duration of ICU stay, etc.). NUTRIC score variables have been seen to correlate well with the pathophysiology of malnutrition in critical illness.[13]However, the non-availability of IL6 in most of ICUs limits its utility in critically ill patients. To overcome this issue, Heyland et al. suggested a modified version of it, called modified NUTRIC score(mNUTRIC), which excludes the parameter Interleukin-6. Modified NUTRIC score has been subsequently validated in many clinical studies.[14-26]

II. MATERIALS AND METHODS-

Place of study – Medical ICU of Atal Bihari Vajpayee Institute of Medical Sciences and Dr. Ram Manohar Lohia hospital, New Delhi
Type of study-Cross sectional observational study
Duration- 1st November 2019 to 31st March 2021
Sample size –100
The study of M.S. Kalaiselvan et al. observed that the AUC of mNUTRIC score in predicting mortality was 0.582. Taking this value as reference, δ as 0.10 and 5% level of significance, the calculated sample size is 81 patients. For reduction of margin of error, sample size taken is 81
Formula:-

$$n = \frac{1 - AUC}{2}\left(\frac{Z_{\alpha/2}}{\delta}\right)^2$$

Where Zα is value of Z at twosided alpha error of 5% and δ is 0.10
Calculations:- N=((1-.582)/2)(1.96/.1)2 = 80.29=81(approx.)

Definitions used -

Critically ill- these are those patients whose clinical condition is life-threatening and requires utmost care and constant monitoring, usually in an intensive care unit.[1]

Nutritional screening- As defined by ASPEN, is a process to identify the individuals who are malnourished or those at risk of malnutrition to determine if a detailed nutritional assessment is indicated.[9]

Inclusion criteria-
1. Age> 18yr
2. Critically ill patients admitted to medical ICU requiring mechanical ventilation for more than 72 hours.

Exclusion criteria-
Duration of stay less than 72 hours in ICU

III. METHODOLOGY-

The study was conducted in the 13 bedded Medical ICU of ABVIMS, Dr.RML Hospital. For every patient, routine hematological, biochemical investigations and arterial blood gas analysis were done. Data variables required to calculate modified NUTRIC score like age, APACHE II score, SOFA score variables, comorbidities, and days in hospital prior to ICU admission were noted at baseline within 24 hours of admission to ICU. Patients were followed up and outcomes were collected, including length of ICU stay and 28-day mortality. Complete blood count (hemoglobin levels, total leucocyte counts, differential counts and platelets) was estimated by Autoanalyzer Medonic CA620. Routine biochemical parameters including Liver function tests (total bilirubin, direct and indirect bilirubin, serum alkaline phosphatase, serum aspartate transaminase, serum alanine transaminase), kidney function tests (serum urea, serum creatinine, serum uric acid), serum total protein, serum albumin, globulin, fasting blood sugar and serum sodium, serum potassium, calcium, phosphate were assayed on Vitros-5600 based upon dry chemistry technology (Ortho Clinical Diagnostics, USA). Blood was also collected for arterial blood gas analysis and analyzed using an autoanalyzer.

IV. OBSERVATIONS AND RESULTS-

The cross-sectional observational study was conducted on 100 adult critically ill patients admitted to medical ICU requiring mechanical ventilation for more than 72hours. All patients underwent routine blood and radiological investigations. Data was collected on variables required to calculate modified NUTRIC score. Data

collection included age, number of comorbidities, days from hospitalization to ICU admission, SOFA score and APACHE II score variables.
Patient were classified as having high modified NUTRIC score if the score >= 5 and were concluded to be at high risk of malnutrition.
Outcomes were calculated on length of ICU stay and 28- day mortality.

In present study, 26.00% of patients belonged to age group 41-50 years followed by 18-30 years (21.00%), 31-40 years (18.00%), 51-60 years (16.00%) and 61-70 years (14.00%). Only 5 out of 100 patients (5%) were >70years of age. Mean value of age(years) of study subjects was 45.44 ± 15.6 with median (25th-75th percentile) of 45(34-57.25). 54.00% of patients were males and 46.00% of patients were females.

In the present study, 54% of patients had comorbidities and majority of them (61.11%) had one comorbidity. Two comorbidities were present in 28.93% of patients while 12.96% patients were found to have three comorbidities. No comorbidity was found in 46% of patients. Majority of patients who didn't have any comorbidity were admitted to ICU in view of sepsis (50%) followed by tubercular meningitis (21.7%).

In present study if we look at patients with different comorbidities, majority (33.00%) of patients were hypertensive, followed by type 2 diabetes mellitus (15.00%), coronary artery disease (7.00%), hypothyroidism (6.00%), type 1 diabetes mellitus (5.00%), seizure (4.00%), chronic liver disease (3.00%), chronic kidney disease (3.00%), chronic obstructive pulmonary disease (3.00%), old cerebro vascular accident (2.00%) and human immuno deficiency virus (2.00%). Post covid destroyed lung, dilated cardiomyopathy, interstitial lung disease, rheumatoid arthritis and atrial fibrillation was seen in only 1 out of 100 patients (1.00%) each.

In the present study, in majority (85.00%) of patients, APACHE II score was <=28. APACHE II score was >28 in only 15 out of 100 patients (15.00%). Mean value of APACHE II score of study subjects was 20.54 ± 7.21 with median (25th-75th percentile) of 20(16-26).

In present study, in majority (85.00%) of patients, SOFA score was <=10. SOFA score was >10 in only 15 out of 100 patients (15.00%). Mean value of SOFA score of study subjects was 7.31 ± 2.88 with median (25th-75th percentile) of 6.5(5.75-9).

In present study, in majority (63.00%) of patients, modified NUTRIC score was low. Modified NUTRIC score was high in only 37 out of 100 patients (37.00%). Mean value of modified NUTRIC score of study subjects was 3.93 ± 2 with median (25th-75th percentile) of 4(2-5).

Proportion of patients who expired was significantly higher in patients with high modified NUTRIC score (67.57%) as compared to low modified NUTRIC score (34.92%). (p value=0.002) Median (25th-75th percentile) of modified NUTRIC score in patients who expired was 5(4-6) which was significantly higher as compared to alive (3(2-4)). (p value <.0001)

V. DISCUSSION-

Malnutrition is highly prevalent condition in critically ill medical patients. Malnutrition can be present at the time of admission to ICU or patient can become malnourished during stay in the ICU due to increased demand, inadequate feeding or decreased absorption. Critical illness is associated with catabolic stress state in which patients undergo a systemic inflammatory response coupled with complications of multiorgan dysfunction, nosocomial infections, prolonged mechanical ventilation, prolonged hospital stay and mortality. Nutritional assessment is one of the most important aspect of any treatment protocol especially in the setting of ICU patients, which is often the most neglected part of the care. Nutritional has to be adequate and individualized for a given patient which can be attained by identifying those who are at high nutritional risk and poor outcome and might be benefitted from aggressive nutritional therapy.

This study was conducted on 100 critically ill patients who were on mechanical ventilation. The mean age(years) of study subjects was 45.44 ± 15.6 and 54.00% of the patients were males and 46.00% were females. In our study,54% of the patients were found to have comorbidities. Among those with comorbidities, majority of the patients (61.11%) had only one comorbidity. Two comorbidities were present in 28.93% of patients while 12.96% patients were found to have three comorbidities. No comorbidity was found in 46% of the patients. Hypertension was the commonest comorbidity (33%), followed by type 2 Diabetes mellitus (15%).

In majority (85.00%) of the patients, APACHE II score was <=28 and APACHE II score was >28 in only 15 out of 100 patients (15.00%). In present study, in majority (85.00%) of the patients, SOFA score was <=10. SOFA score was >10 in only 15 out of 100 patients (15.00%). Modified NUTRIC score was high (>=5) in 37 out of 100 patients (37.00%),suggesting high nutritional risk in these patients. In majority (63.00%) of patients, modified NUTRIC score was found to be low

(<5).Mean value of modified NUTRIC score of study subjects was 3.93 ± 2 with median (25th-75th percentile) of 4(2-5).

Patients with high modified NUTRIC score had higher mortality (67.57%), compared to those with low modified NUTRIC score (34.92%) (p value=0.002). Median (25th-75th percentile) of modified NUTRIC score in patients who did not survive was 5(4-6) which was significantly higher as compared to alive 3(2-4) (p value <.0001).

Discriminatory power-

Discriminatory power of SOFA score (AUC 0.619; 95% CI: 0.517 to 0.715), modified NUTRIC score (AUC 0.653; 95% CI: 0.551 to 0.745), APACHE II score (AUC 0.599; 95% CI:0.497 to 0.696) to predict mortality was acceptable. Among all the parameters, Modified NUTRIC score was the best predictor of mortality at cut off point of >=5 with 65.30% chances of correctly predicting mortality.

Sensitivity and specificity-

In our study Modified NUTRIC score had sensitivity of 53.19%, followed by SOFA score (27.66%), APACHE II score (25.53%). In prediction of mortality, APACHE II score had lowest sensitivity of 25.53%. On the other hand, SOFA score had specificity of 96.23% followed by APACHE II score (94.34%), modified NUTRIC score (77.36%).

Positive and Negative Predictive values-

In our study highest positive predictive value (PPV) was found in SOFA score (86.70%) and highest negative predictive value (NPV) was found in modified NUTRIC score (65.10%). There is always a trade-off between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity) so we choose that variable as best in which combination of sensitivity and specificity gives the maximum predictive value that is maximum diagnostic accuracy, so overall modified NUTRIC score was best predictor of mortality.

VI. LIMITATIONS-

- Ours was a single centre observational study conducted in medical ICU patients on mechanical ventilation, which limits its general applicability to other ICU patients like surgical, trauma, burns etc.
- We performed nutritional assessment only at admission to ICU. Since critically ill patients can become high nutritional risk during ICU stay, subsequent nutritional assessments were not done in patients, who were found to have low modified NUTRIC score at baseline.
- Serial nutritional assessment was also not done to see the adequacy of feeding practices, since it was not the aim of the study.

VII. SUMMARY-

Background and aim: Critically ill mechanically ventilated patients are at high nutritional risk. Malnutrition often leads to poor outcomes in terms of prolonged length of ICU stay and mortality. Nutritional assessment on admission to ICU is of utmost importance to provide individualized nutritional support. Many nutritional risk assessment tools are available for hospitalized patients and are being used in ICU'S. Modified NUTRIC score is one such tool, which has been validated for use in critically ill patients. This observational study was carried out with the aim of identifying nutritional risk in mechanically ventilated patients using modified NUTRIC score. We also aimed to find the association of modified NUTRIC score with the length of ICU stay and in predicting mortality in these patients.

Methodology: Ours was an observational cross-sectional study done between 1st November 2019 and 31st March 2021, in 13 bedded medical ICU, which included 100 adult critically ill patients on mechanical ventilation. Data related to the patient's demographic profile, clinical examination, baseline routine hematological, biochemical, and radiological investigations was collected. Data was collected to calculate modified NUTRIC score variables which included SOFA Score, APACHE 2 Score, age, number of comorbidities, day from hospital to ICU admission. A modified NUTRIC score was calculated at admission and a score of >=5 was considered high, suggesting high nutritional risk and a score of<4 was considered low. Patients were followed up to calculate data on length of ICU stay and 28-day mortality. All these findings were later statistically analyzed.

VIII. RESULTS:

In our study, out of 100 patients, 54% were males and rest were females. The mean age of participants (in years) in our study was 45.44 ± 15.6. Among the study subjects, 46% of patients had no comorbidities and among those with comorbidities, majority (61.11%) had one comorbidity, most prevalent being hypertension (33%) followed by diabetes mellitus(20%). We categorized the patients according to modified NUTRIC score and found that 63% patients had a low modified NUTRIC score (=5). APACHE II score of <=28 was found in 85% of patients and

rest 15% patients had a score of >28.SOFA score of <=10 was found in 85% of patients and score was >10 in rest 15% of the patients.

The patients with high modified NUTRIC score (37%), had a higher mortality as compared to low modified NUTRIC score (67.57% vs. 34.92%) (p value=0.002). Mortality was also significantly higher among patients with high SOFA score and high APACHE II score patients as compared to those with low SOFA (<=10) and low APACHE II (<=28) score. For SOFA score, mortality was 86.67% vs 40% (p value<.0001).

In our study, all parameters had significant power to predict mortality. Discriminatory power of SOFA score (AUC 0.619; 95% CI: 0.517 to 0.715), modified NUTRIC score (AUC 0.653; 95% CI: 0.551 to 0.745), APACHE II score (AUC 0.599; 95% CI:0.497 to 0.696) was acceptable. Among all the parameters, modified NUTRIC score was the best predictor of mortality at cut off point of >=5, with 65.30% chances of correctly predicting mortality. In our study, we also found that modified NUTRIC score was more sensitive (53.19%) than APACHE II (25.53%) and SOFA score (27.66%) in predicting mortality but had low specificity. Highest positive predictive value was found for SOFA score (86.70%) while highest negative predictive value was found for modified NUTRIC score (65.10%) in predicting mortality.

We also compared the length of ICU stay(in days) among the patients who survived. Median of length of ICU stay (days) in alive patients with high modified NUTRIC score was 33.5(20-43) which was significantly higher as compared to low modified NUTRIC score (13(10-22) (p value=0.001), suggesting that high mNUTRIC score was associated with longer ICU stay.

IX. CONCLUSION-

The prevalence of malnutrition is very high in critically ill patients. Malnutrition is associated with poor outcomes. Among the 100 patients admitted to medical ICU, 37% patients in our study were found to be at high nutritional risk and high mNUTRIC score was associated with increased length of ICU stay and higher mortality. Modified NUTRIC score is a practical tool based on variables that are easy to obtain in the critical care settings. It is a good screening tool that may be used for identifying critically ill patients at high nutritional risk for predicting adverse clinical outcomes, in terms of mortality and increase length of ICU stay. Individualized nutritional intervention in high nutritional risk patients may lead to better patient survival. Further studies with larger sample size are required to demonstrate the validity of modified NUTRIC score and its association with adverse patient outcomes in critically ill patients. Prospective studies to show the effect of targeted nutritional interventions to improve outcome in patients with high nutritional risk are also warranted.

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