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IMPORTANCE OF NUTRITION ASSESSMENT IN CRITICALLY ILL PATIENTS

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Intensive Care Unit

Subjective Global Assessment

Acute Physiology and Chronic
Health Evaluation

Body Mass Index

ABSTRACT

A timely assessment of nutritional status in critically ill patients is crucial. This was an observational prospective hospital study carried out for 3 months from December 2019 to February 2020 in an ICU in a multispecialty hospital in Madurai, Tamilnadu, India. All adult patients with ≥ 72 hours of ICU-LOS were included and their nutritional assessment was completed by SGA (Subjective Global Assessment) forms within 24 hours of ICU admission. Data collected regarding variables such as Age, Nutritional status, APACHE IV, SOFA score, presence of Comorbidities. All patients were studied about their duration of stay in ICU and hospital, Predicted Mortality rate, & discharge outcome. 120 patients were involved in the study in the age 62.2 ± 14 years, among this 55.3% were males and rest 44.7% were females. Their complete nutritional assessment revealed that 50%, 43%, and 17% were well nourished, moderately malnourished, severely malnourished respectively. A strong correlation was observed between nutritional status, morbidity, and their prolonged stay in ICU. Mean ICU & hospital mortality percentage was 37%, 45% respectively. The average duration of stay in the ICU and hospital was 13, 20 days respectively. Participants anthropometric data decreased considerably (mean weight, MUAC, calf circumference) during ICU discharge day. BMI comparison of admission and discharge didn't show significant change. Timely nutrition intervention and medical nutrition therapy reduce the duration of patient stay in ICU and hospital and improved patient outcomes. The disease severity scoring system can be used as guidance for objective assessment of disease outcomes and estimation of the chance of recovery.

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1 Introduction

Malnutrition is a global health problem in hospitalized patients, especially within the critical care setting. Especially for critically ill patients, malnutrition is noted as a major consequence of hospitalisation. Hyper metabolism in patients increases nutrient requirements but the patient's energy and protein intake were considerably less leading to malnutrition. Many research with critically ill patients showed that malnutrition before admission to the ICU leads to the diminished status of macro and micronutrients in their bodies. Nutritional Assessment on admission is the first and foremost step in a nutritional intervention which will help in reducing the duration of ICU and hospital stay and appropriate nutrition therapy prevent complications and infections thereby mortality risk will be reduced.

In critically ill patients, SIRS (systemic inflammation response syndrome) impacts a catabolic state that increases metabolic demand and accelerates the development of malnutrition (Heyland et al., 2011; Blaser et al., 2017). This study was conducted to assess the nutritional status of critically ill patients on ICU admission and discharge day through various clinical indicators and to highlight the importance of nutritional assessment for critically ill patients. Further, this study also correlated the mortality prediction score APACHE IV, SOFA scores on admission with patient's duration of stay in ICU and hospital along with patient outcome (Hopkins et al., 2017). The SOFA score is considered as an important tool in defining both the clinical condition of the individual patient and the response to therapies in the context of clinical trials (Simon Lambden et al., 2019). ICU patients were assessed with various clinical indicators to categorise their nutritional status. The anthropometric indices include BMI (body mass index), MUAC (mid upper arm circumference), and calf circumference. The body composition markers and biochemical investigations comprise visceral protein, total protein, albumin, and lymphocyte. A clinical questionnaire called SGA (Subjective global assessment) was applied in the study to analyse the participant's level of nutritional status. The SGA form widely accepted tool for identifying hospitalised patient's nutritional status including critically ill patients (Hopkins et al., 2017). Subjective global assessment (SGA) is an inexpensive, and quick method that can be conducted at the bedside. It is a reliable tool for inferring outcomes in critically ill patients (Herridge et al., 2016; McClave et al., 2016; Mehta et al., 2018).

2 Materials and Methods

2.1 Study Design

This was a hospital based prospective study duration, which was conducted for 3 months from December 2019 to February 2020, in a multidisciplinary ICU with a bed capacity of 21 beds in India,

Tamilnadu, Madurai. All adult patients admitted in ICU with ≥ 72 hours of ICU-LOS were included and their nutritional assessment was completed by SGA (Subjective Global Assessment) forms. This process was completed soon after their ICU admission (within 24 hours). Reassessment was done once in seven days and during discharge and this was utilized for monitoring and evaluation of patient nutritional status.

2.2 Study Population

The sample size for the study was derived as 120 critically ill patients. The formula used for the study was $n = Z^2 (SD^2/d^2)$, taking a value of $Z = 1.96$ with 95% confidence intervals, and $d = 0.7$ as the margin of error in estimating the mean or effect size. A total of 325 patients admitted to the multidisciplinary ICU were screened but only 120 patients were in the eligibility criteria. The inclusion criteria considered as 18 years of age, adult patients with ≥ 72 hours of ICU-LOS were included and other patients received from other hospitals ICU'S were excluded from the study. Approval obtained from Clinical Research and Institutional Ethics Committee of multispecialty hospital IEC application number - ASH/ACAD-004/12-19, as per the requirement of the ethics committee informed consent was obtained from the patient's caretaker who admitted the patient.

2.3 Data Collection

Participant's unique ID number noted and demographic and clinical details collected along with, admission diagnosis, age, sex, category of admission - medical/surgical were noted within 24 hours of ICU admission. In this study mortality risk assessment score namely APACHE IV Score (Acute Physiology and Chronic Health Evaluation) (Chakravarty et al., 2013; Lew et al., 2017) was employed, SOFA (Sequential Organ Failure Assessment) score was used to assess the disease severity of the patient. GCS (Glasgow Coma Scale) marked to analyze the conscious level of the patient, all these assessments were computed for every patient in the hospital during ICU admission and discharge days. On the day of ICU admission and discharge anthropometric indices were collected, for every patient in which height measuring ulna length and weight calculated from the patient's height. BMI was computed by using the formula weight in kg divided by height in meter square. MUAC (Mid-upper-arm Circumference) and calf circumference were measured as shown in Figure: 1. Public Health sponsored study acknowledged that MUAC has been used for evaluation of adult nutritional status as well, especially in resource-limited settings, including India. MUAC can be an efficient indicator of adult undernutrition—comparable or even better than BMI (Das et al., 2020).

SGA questionnaire was used for every patient on the date of ICU admission and discharge. SGA is a widely accepted nutritional

Figure 1 MUAC TAPE Colour Indicator tape

Table 1 BMI and MUAC Comparison

Corresponding BMI category				
	$< 17 \text{ kg m}^{-2}$ (moderately underweight)	$< 18.5 \text{ kg m}^{-2}$ (underweight)	$\geq 25 \text{ kg m}^{-2}$ (overweight)	$\geq 30 \text{ kg m}^{-2}$ (obese)
MUAC (cm)				
Men	22.9	< 23.9	≥ 28.1	≥ 31.4
Women	22.9	< 23.9	≥ 28.4	≥ 31.8

Source: researchgate.net

assessment tool. It includes details such as weight-loss history, diet intake pattern, GI (gastrointestinal) symptoms, functional capacity, and comorbidity details. This questionnaire also indicates details related to muscle wasting and wastage of subcutaneous fat. All mentioned data were entered to finalize the score as A, B, or C an indicator of the degree of malnutrition. Score A indicates well nourished, B denotes mild to moderate malnutrition, and C indicates severe malnutrition. On ICU admission and discharge date biochemical indices such as total protein, albumin, phosphorous, magnesium, calcium, and TLC -total lymphocyte count were collected (Auto analyzer was used).

Important details like ventilator-free days and duration of ICU / hospital stay (in days) was recorded and compared with APACHE IV SCORE (predictors for mortality rate and length of ICU stay).

2.4 Statistical Analysis

Statistical package for social sciences was used (SPSS version 19) for statistical analysis. The data were represented as mean and standard deviation. The comparison of data between admission and discharge were done by a paired t-test. The SGA distribution was compared by using the sign test. The duration of ICU/hospital,

Ventilator free days, and malnutrition status analysis related to ICU admission and discharge day was compared by using Pearson's Coefficient correlation $P \leq 0.05$.

3 Results

Complete data collection was carried out for the 325 ICU admitted patients for 3 months, among this finally 120 eligible patients' results were presented in this observational study (Table 2).

In table 2, the Patient's age, sex, and admission category were given, it revealed that the average patient's age was 62.2 ± 14 years, among these 55.3% were males, and the rest 44.7% were females. Further, among the selected respondents, 52.8% were admitted for medical management and 47.2 % for surgical intervention.

Results given in table 3 provides patient admission diagnosis among the study population. Among the diagnosis, the highest number of patients was reported for Trauma cases (%), this was followed by Neurological disorders. While the lowest patients number was reported for Sepsis (5%), Renal (5%), and Orthopaedic. Mortality and disease severity score was provided in table 4. The patient's clinical outcomes were shown in this table 5.

Table 2 Age, Sex & Admission category of the patients

Variable	N, 120Mean±SD or n (%)
Average Age (y)	62.2±14.1
Male	55.3%
Female	44.7%
Admission Category:	
Medical	66 (52.8%)
Surgical	59 (47.2%)

Table 3 Diagnosis of the selected Patient during ICU admission

Diagnosis	Patients (%)	Diagnosis	Patients (%)	Diagnosis	Patients (%)
Cardiovascular	12(6.6%)	Gastrointestinal	11(9.2%)	Renal	6(5%)
Neurological	22(26.6%)	Orthopaedic	2(1.6%)	Respiratory	14 (11.7%)
Trauma	40(33%)	Sepsis	6(5%)	Cancer	7 (5.8%)

Table 4 Mortality and Disease severity score

Variable	N, 120Mean±SD or n (%)
APACHE [†] IV score	70 ±21
Admission SOFA score	8.4 ±2.8
Admission GCS	7±3.2

Here, APACHE (Acute physiology and chronic health evaluation); SOFA (Sequential organ failure assessment); GCS (Glasgow coma scale)

Table 5 Clinical and Mortality related patient outcome details

	Mean±SD, Median (IQR)
Duration of ICU stay (d)	13 (7-22)
Duration of hospital stay (d)	20 (12-39.5)
Mortality in ICU (n, %)	37 (29.6%)
Mortality in hospital (n, %)	45 (36%)
Duration of ventilator-free days (d)	4 (0.5-10)

IQR: Interquartile range; SD: Standard deviation; ICU: Intensive care unit

Table 6 Anthropometric Measurements

Measurements	Admission day	Discharge day	P value
Weight (kg)	63.4±12.7	56.6±11.6	<0.001 [‡]
BMI (kg/m ²)	25.7 (23.3-28.8)	22.8 (21.3-26.5)	0.088
MUAC (cm)	30.1±4.5	27.6±4	<0.001 [‡]
Calf circumference (cm)	32.2±3.8	29.1±3.7	<0.001 [‡]

BMI: Body mass index; MUAC: Mid-upper-arm circumference

Table 7 Subjective Global Assessment Percentage (SGA %)

SGA (n, %) [†]	Admission day	Discharge day
A (Well nourished)	60 (50%)	45 (37.5%)
B (Moderately malnourished)	43 (35.8%)	52 (43.3%)
C (Severely malnourished)	17 (14.2 %%)	23 (19.2%)

SGA: Subjective Global Assessment,

Table 8 Biochemical parameters on Admission and Discharge Day

	Admission day	Discharge day	P value
Total protein (g/dl)	6±1.05	6.2±1	0.968
Albumin (g/dl)	3.4±0.6	3.3±0.6	0.16
TLC	1242.5 (787.6-2099)	1279.2 (1042-1699)	0.146
Mg (mg/dl)	2.2±1.2	2±0.4	0.013 [‡]
P (mg/dl)	3.5±1.2	3.3±0.7	0.72
Ca (mg/dl)	8.4±0.67	8.5±0.6	0.43

TLC: Total lymphocyte count; Mg: Magnesium; P: Phosphorous; Ca: Calcium

Table 9 SGA status correlation on ICU discharge day, admission day, and outcomes

Measurements on admission day	Correlation coefficient (Rho Spearman)	P value
Weight (kg)	-0.412	<0.001 [†]
BMI (kg/m ²)	-0.426	<0.001 [†]
MUAC (cm)	-0.459	<0.001 [†]
Calf circumference (cm)	-0.481	<0.001 [†]
Total protein (g/dl)	0.106	0.334
Albumin (g/dl)	0.132	0.221
TLC	-0.127	0.244
Mg (mg/dl)	-0.059	0.622
P (mg/dl)	-0.021	0.852
Ca (mg/dl)	-0.179	0.062
Length of ICU stay (d)	0.328	0.002 [†]
Length of ventilator-free days	0.288	0.11

[†]P≤0.05 was considered statistically significant

The mean duration of stay in ICU and hospital was 13 and 20 days respectively. On an average the patient's stay in ICU were 7.9 days and 27.4 days in the hospital. Ventilator free days were noted as 4 days (mean value taken). In addition to this ICU & hospital mortality percentage was indicated as Mean 29.6% and 36% respectively. Anthropometric details collected during admission and discharge days were provided in table 6. SGA on Admission and discharge were shown in table 7. A significant decrease was noted in the Nutritional status of the ICU patients. Nutrition status was inversely proportional with the duration of ICU stay. On ICU discharge day malnutrition scores increased significantly in comparison with admission-day scores. Biochemical parameters recorded on the admission day and discharge day were tabulated in table 8. Except for magnesium, the rest of the data did not change significantly during ICU stay but magnesium level decreased during ICU discharge day. Discharge day malnutrition score and duration of ICU stay showed a positive significant correlation

(Table 9). No significant correlation was noted in the discharge day malnutrition details and ICU ventilator independent days.

4 Discussion

Malnutrition in critically ill patients during ICU stay had a strong association with increased risk of mortality and morbidity rate. As per the study, nutrition assessment revealed that the malnutrition percentage of ICU patients on admission day (50%) had increased significantly on discharge day (62.5%). As per the SGA study, ICU patient's malnutrition prevalence on admission day was 50.0% (35.8% & 14.2% were mildly-moderately and severely malnourished respectively) which significantly increased on discharge day and it reached 62.5% (43.3% & 19.2%). In the current research, the variation in the nutritional status of the participants is related to age, the previous health status of the patients, and presence of comorbidities, 41.2% were with a history

of hypertension and 48.5% were diabetic and 60.3% of participants were in the geriatric age group. All these factors like age, comorbidities, and health status hurt their nutritional status. In the present study, malnutrition is strongly associated with a longer duration of ICU/ hospital stay, and it is evident when data were compared between malnourished and well-nourished patients. Medical Nutrition therapy always plays an important role in patient outcomes and recovery. In critical care units the anthropometric measures, MUAC measurements were utilised for assessing adult malnutrition.

This study showed a significantly lower level of values such as mean MUAC, Calf circumference among mild/moderate and severe malnourished patients versus well nourished patients. Accordingly, Haung et al. (2000) a reduction in anthropometric indices during a patient's ICU stay (Mehta et al., 2018).

The patient's detailed assessment depicted that mean weight, calf circumference, and MUAC, had significantly reduced. Similarly, Nematy et al. (2012) findings showed a significant decrease in weight and MUAC readings among critically ill patients. This indicated a higher incidence of malnutrition among ICU patients (Mendes et al., 2017; Vallejo et al., 2017; Wischmeyer, 2017). Besides this study also highlighted a decrease in nutritional status on discharge day (table 7).

Further, the present study also revealed that the serum albumin levels were significantly lower in malnourished patients (mild or severe) when compared with well-nourished groups and this low albumin levels were associated with an extended period of hospital stay. In the present study, the overall mortality rate was 41.2% whereas mortality rate of 55.9% and 26.5% was observed among malnourished and well nourished group respectively which was significantly lower in well nourished participants. So malnutrition is strongly associated with negative outcomes of critically ill patients in the term of increased morbidity and mortality (Nicolo et al., 2016).

Binary logistic regression was performed with lower nutritional status detected by SGA data and it was an independent predictor noted with a negative correlation with mortality. It also clearly indicates the mortality risk was two times higher for a malnourished patient compared to well-nourished participant. The predicted mortality risk scoring - APACHE IV and SOFA scores correlated positively with the observed mortality rate and length of stay in ICU. Bendavid et al. (2017) study result well correlated with the present study that malnourished patient's mortality rate was higher compared with the well-nourished patients (Schiesser et al., 2009; Vallejo et al., 2017). During ICU stay the Biochemical data evaluation revealed a significant decrease in serum magnesium concentration. Hypomagnesaemia was considered as a

single indicator of disease severity, morbidity, and mortality in ICU patients (Singer et al., 2019). The low magnesium level was prevalent due to poor nutritional status and low magnesium intake during hospitalisation.

In this study, critically ill patient's anthropometric indices (table 6) were considered as good predictors of nutritional outcomes (malnutrition severity scoring system) compared to patient's biochemical data (Table 8 & 9). Moreover, albumin level and SGA showed a significant correlation (Table 8). Thus, SGA analysis along with anthropometric parameters was a valuable and effective method in the evaluation of malnutrition status of hospitalised patients, especially for critically ill patients. The study limitation was that heterogeneous ICU patients with different medical or surgical problems were included in the study. However, these different types of ICU patients were intentionally involved in the study because the main aim of the study was to identify the malnutrition prevalence among critically ill hospitalised patients on admission and discharge days without considering the causes of their diseases.

Conclusion

To conclude, Subjective Global Assessment revealed that malnutrition on ICU discharge day increased to 57.32%. It was highlighted that nutritional assessment with detailed anthropometric details should be collected and SGA to be done for every patient entering into ICU. This initial approach paved the way to implement the timely nutritional intervention, and it reduced nutrition-related complications and resulted in an appropriate Nutrition care process.

The study clearly stated that prioritizing nutritional assessment early at ICU admission paved the way to the appropriate nutritional plans which minimize the impact of malnutrition on the patient's outcome and it helped to reduce the duration of ICU and hospital stay. SGA, timely nutrition intervention and medical nutrition therapy prevent hospital-acquired infection and thereby mortality rate reduced. The nutrition support team and Nutrition protocol implementation in all ICU is crucial and it is very important to achieve a positive outcome for a critically ill patient.

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Conflict of Interest: None declared.

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