Correlation between Nutric Score and Adequacy of Energy and Protein Intake with Duration of Mechanical Ventilation in the Intensive Care Unit Dr. Kariadi Hospital, Semarang-Indonesia

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Correlation between nutric score and adequacy of energy and protein intake with duration of mechanical ventilation in the intensive care unit Dr. Kariadi Hospital, Semarang-Indonesia

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ABSTRACT

Background: Malnutrition in the ICU patients increases morbidity, mortality, cost, and mechanical ventilation (MV) duration. Nutric score has been validated as a screening tool in critically ill patients to identify patients at risk of malnutrition. The pathophysiology of malnutrition in critically ill is caused by severity of disease and inflammation resulting in hypercatabolism. Delivering protein-energy intake will reduce hypercatabolism and maintain lean body mass that affects outcome. The study aims to analyze the correlation between nutric score and adequacy of energy and protein intake with MV duration.
Methods: This cross sectional study enrolled 65 subjects ≥18 years with mechanical ventilation in the ICU of Dr. Kariadi Hospital Semarang during May to July 2020. The nutric score was determined within 24 - 48 hours. Statistical analysis used correlation test.
Results: The mean nutric score was 2.3 ± 1.49, duration of MV was 3.9 ± 4.44. There was significant correlation between nutric score and duration of MV (r = 0.685; p < 0.001). The mean adequacy of energy intake was 1448.7 ± 235.87 and protein intake was 57.9 ± 11.94. There was significant negative correlation between adequacy of energy intake and MV duration (r=-0.246; p = 0.048). There was significant negative correlation between protein adequacy intake and MV duration (r=-0.34; p=0.006).
Conclusion: Nutric score was correlated with duration of MV in the ICU patients. Adequacy of energy and protein intake had significant correlation with duration of MV.

Keywords: critically ill, duration of MV, malnutrition, nutric score, nutritional screening.
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INTRODUCTION

The duration of mechanical ventilation (MV) is one of the outcome parameters used to evaluate care quality in the intensive care unit (ICU). Malnutrition in critically ill patients increases morbidity, nosocomial infections, cost, prolonged MV and mortality. The prevalence of malnutrition in intensive care ranged from 38% to 78%. It is very important to make the diagnosis of malnutrition in ICU patients by using validated screening tools.[1,2] Nutritional screening is crucial in ICU patients therefore nutritional screening should be done to determine patients at risk of malnutrition. It should describe severity of disease and inflammation which caused malnutrition.[2-4]

Critically ill patients associated with hypercatabolism caused by inflammation that will worsen nutritional status. The catabolic process will decrease muscle mass which causes several complications such as increased morbidity, infection, multi-organ dysfunction, failure of weaning, length of stay, and increased mortality. Nutritional therapy is needed to prevent catabolism due to metabolic stress and oxidative cell injury modulating the immune response.[4-5] Energy and protein achievement is crucial need for ICU patients. Energy delivery prevents catabolic state, gluconeogenesis, and glycaemic control. The benefits of protein to achieve the synthesis of acute-phase response proteins related to immune response and muscle protein synthesis.[6]

Nutric score was found by Heyland et al.[7] in England as a screening tool in the ICU by considering that previous screening tools such as NRS (Nutritional Risk Score) 2002 and SGA (Subjective Global Assessment) met the difficulties such as energy-protein intake history, functional status before treatment, gastro intestinal symptoms before ICU admission, and changes in body weight. This difficulty is due to the majority of patients using mechanical ventilation (MV) and sedation, difficult to collect recall of energy-protein intake. It is an objective and quantitative parameter and supports the role of nutrition in patients at risk of malnutrition in critically ill patients who benefit from nutritional therapy interventions.[4-7]

METHOD

This cross-sectional study was conducted on 65 subjects admitted to the ICU Dr. Kariadi Hospital Semarang during May to July 2020. The inclusion criteria were mechanically ventilated patients aged ≥ 18 years who were admitted to the ICU with the criteria for medical and surgical patients using MV. The Nutric score of subjects who met the inclusion criteria was assessed within 24 - 48 hours admitted in ICU. The variables of the nutric score are age, APACHE score (Acute Physiology Health Disease Classification System II), SOFA score (Sequential Organ Failure Assessment), level of acute inflammation (IL-6) with Human IL-6 ELISA Kit, comorbid, days of hospitalization prior to ICU. Patients died in ICU were excluded. Patients were classified for high-risk ICU patients with nutric score ≥6 and low nutritional scores (0-5).

Nutritional adequacy was recorded while the patient was in the ICU. Energy and protein target requirements are based on ASPEN guidelines (American Society Parenteral and Enteral Nutrition) with energy 25-30 kcal/kg/day and protein 1.2-2 g/kg/day. The Adequacy of energy and protein was calculated at the last hospitalization in the ICU.

Data analysis was performed using Spearman correlation test to analyze the correlation between the nutric score and adequacy energy and protein intake with duration of MV. All values considered significant if p<0.05.

RESULTS

Most of the subjects were 39 females (60%). The subjects' mean age was 44.7±13.73 years old with 27 subjects were ≥50 years old (41.5%). The subjects' mean BMI was 22.14 kg/m^2 with 25% were underweight and 24.6% were obese (Table 1).

There were 63 (96.9%) subjects with low nutritional score (nutric score 0-5) and 2 subjects were at high risk of malnutrition (nutric score ≥ 6) were 2 subjects (3.1%). Most of the subjects, 45 subjects with a percentage of 75.8%, had an APACHE II score ≤15. There were 9 subjects or 9 % subjects who got APACHE score 15 - <20. The mean APACHE II score was 10.65. The mean SOFA score was <6. The mean duration of MV was 3.9±4.44 days. There were 50 subjects (76.9%) with duration

Table 1. Demography Characteristics and Body Mass Index (BMI)

Variable	n	%	Mean± SD	Median (min-max)
Sex				
Male	26	40		
Female	39	60		
Age (years)			44.7 ± 13.73	46 (18 – 72)
<50	38	58.5		
50-<75	27	41.5		
BMI (kg/m^2)			22.1 ± 4.78	21,5 (13.84 – 41.4)
< 18,5	16	24.6		
18.5 – 22.9	26	40.0		
23.0 – 24.9	7	10.8		
≥ 25	16	24.6		

Table 2. Characteristic data of nutric score and duration MV

Variable	n	%	Mean± SD	Median (min-max)
Age (years)			44.7 ± 13.73	46 (18– 72)
< 50	38	58.5		
50 – < 75	27	41.5		
APACHE II			10.6 ± 6.07	9 (4 -25)
<15	48	73.8		
15-<20	9	13.8		
20-28	8	12.3		
SOFA			4.7±2.64	
<6	48	73.8		
6- <10	13	20.0		
≥ 10	4	6.2		
Comorbid			0.8± 0.87	1 (0-2)
0-1	46	70.8		
≥2	19	29.2		
Days of hospitalization before admission ICU (day)			6.1±4.99	4(0-17)
0-<1	4	6.2		
≥1	61	93.8		
IL-6 (pg/ml)	65	100	3.01±4.14	1,37 (0.39 -16.54)
0-<400	0	0		
≥400				
Nutric			2.35±1.49	2 (1-6)
low (0-5)	63	96.9		
high (≥ 6)	2	3.1		
Duration of MV (day)			3.9±4.44	2 (1-17)
1-<7	50	76.9		
≥7	15	23.1		

Abbreviation; sequential organ failure assessment (SOFA); acute physiology and chronic health evaluation II (APACHE II).

Table 3. Characteristic data-target energi- protein dan Adequacy of energy-protein intake

Variable	Mean± SD	Median (min-max)
Energy target requirement (kcal)	1537.4 ± 89.98	1530 (1140 – 1980)
Protein target requirement (gram)	63.6 ± 10.43	65 (42 – 86)
Adequacy of energy intake (kcal)	1448.7 ± 235.87	1500 (980 – 1980)
Adequacy of protein intake (gram)	57.9± 11.94	57 (34-86)

Abbreviation; kilo calories (kcal)

Table 4. Correlation between nutric score and adequacy energy protein intake and mechanical ventilation

Variable	VM	
	p-value	r
Nutric score	<0.001	0.685
Adequacy of energy intake (kcal)	0.048	-0.246
Adequacy of protein intake (gram)	0.006	-0.340

Abbreviation; coefficient correlation (r)

of MV <7 and 15 subjects (15%) with duration of MV ≥ 7 (Table 2).

Table 3 showed the mean energy target requirement of this study was 1537 ± 89.89 kcal. The mean protein prescription was 63.6± 10.43 grams. The mean adequate protein intake was 57.9 ±11.94 grams. Table 3 described that most of the samples had received nutrition intervention close related >80% was based on guideline ASPEN 2016 in critically ill patients (Table 3).

This study used the Spearman non-parametric correlation test. Table 4 showed that was significant positive correlation. There was significant correlation between nutric score and duration of MV (r=0.685; p<0.001). There was significant negative correlation between adequacy of energy intake and MV duration (r = -0.246; p = 0.048). There was significant negative correlation between protein adequacy intake and MV duration (r=-0.34; p=0.006) (Table 4).

DISCUSSION

All patients who were treated for 48 hours in the ICU will be high risk of malnutrition. Nutric score is a screening tool to assess the risk of malnutrition that has been validated explicitly for ICU patients based on age, disease severity in the form of APACHE score, SOFA score, number of comorbid, length of stay until admission to ICU and IL-6. [8-9] APACHE II and SOFA were used to predict the mortality rate of patients who were admitted to the ICU. Several studies suggested that the APACHE II score to be a predictor of weaning outcome.[10-11]

This study's results were different from previous studies conducted by Rahman et al.[4] and Mendess et al.[3] The difference in previous studies was to describe the correlation between modified nutric score (mnutric) and mortality rate. Rahman et al. described the correlation between adequacy energy and protein intake and 28-day mortality rate. Kalaisevan et al.[8] described the correlation between nutric score and the duration of MV while in this study we analyzed the correlation between the nutric score and the adequacy protein-energy intake and the duration of MV.[3,8]

Table 2 shows that 96.9% subjects of the nutric score were≤ 6 which meant that it had a low risk of malnutrition. The prolonged MV will have a high risk of malnutrition. Mostly APACHE results are ≤ 15 and SOFA results are < 6. This result presumes that IL-6 concentration was low. No one subjects concentrations were ≥ 400 pg/dl and influences the result of nutric score.[7,10]

Table 3 showed a significant negative correlation, which meant that each energy and protein supply would reduce MV duration. In this study that achievement of energy intake during in ICU had achieved >80%. This study revealed that the patient received nutritional interventions according to the target energy needs. The energy optimization strategy in the early phase would reduce hyperglycemia and insulin resistance. In some cases, excessive energy intake (overfeeding) was avoided to reduce morbidity of infection, duration of MV use, and length of stay.[11,12] In our study, we did not find an overfeeding subject.

Based on a previous study by Heyland et al.[7], patients with a nutritional score ≥6 received greater nutritional interventions that affected outcome. Patients who are at high risk of malnutrition will most benefit from early nutritional therapy. Not all ICU patients are the same risk for malnutrition and will benefit equally from nutritional therapy.[7,9,12]

In this study, the mean protein target requirement was found 63 grams. The adequacy protein intake is 57 grams with > 80% of the protein target requirement. Achievement of protein intake of ≥ 80% of the protein target was associated with decreased mortality. Delivering of energy and protein intake in this study was in accordance with the guidelines for providing nutritional therapy in critical patients based on the 2016 ASPEN that most patients had received nutritional interventions according to protein target requirement.[10] This research was different from the study of Rahman et al.9), which suggested the correlation between nutritional therapy's adequacy with the 28-day mortality rate and the mnutric score with the mortality rate.

The critical illness causes loss of muscle mass in the first few weeks. Loss of muscle mass decreases respiratory function and thereby prolonged MV. Loss of muscle mass is associated with increased mortality after discharge from hospital. Based on this theory, protein intake must be optimal in critical patients.[12-13]

Recent studies in critical illness have shown protein administration is more closely associated with positive outcomes than energy prescription. A prospective observational study in patients with MV demonstrated protein attainment of 1.3 g/kg bodyweight protein attainment and was associated with a 50% reduction in 28-day mortality. Adequacy protein intake is required to prevent disease-related catabolism or injury in critically ill patients, support protein synthesis and resolve anabolic resistance. There is much controversy regarding optimal energy and protein intake during the initial phase of ICU admission. A recent study by Koekkoek and Looijaard et al. found that giving protein intake of ≥80% of the described value for survival for 60 days and reducing MV duration. Delivering of high protein was controversial in recent studies.[12,14,15]

Adequacy nutritional therapy in the initial phase is only beneficial for patients at high risk of malnutrition, whereas patients at low risk have a good outcome even though they do not receive adequate nutritional therapy for several days.[6] In our study, all subjects had duration of MV ≤ 7 days. This positive correlation might occur because most of the study sample had a low risk of malnutrition (63%) and 3.1% had a high risk of malnutrition.

Delivering optimal energy protein intake in critically ill patients was still controversial. Several randomized studies suggest that giving underfeeding during the first week in the ICU provides a better outcome effect. Another study based on large-scale observational data showed that an intake greater than 2/3 of the target requirement was associated with reduced mortality. In a multicentre study conducted by Wei et al.[16] with a cohort study, patients with VM who were given adequate caloric intake in the first week were associated with a better 6-month survival rate and accelerated the recovery phase within 3 months.

The achievement of energy and protein intake depends on hemodynamic instability, vasopressor drugs, hematemesis, and gastrointestinal intolerance disorders, which evaluated gastric residue volume (GRV). Nutric score assessment was carried out 24-48 hours of admission to the ICU so that it only described the physiological condition at the first time of admission but the following day during treatment in the ICU when the patient experienced a decrease in hemodynamics, it was not reidentified so that this condition would affect the adequacy of energy and protein intake to reach the nutrition target via the enteral route was a challenge because early EN was often hindered by delayed gastric emptying or gastrointestinal dysfunction.[17,18]

The limitation of this study was subjected only a few person has nutric score ≥6. Therefore, it needs more subjects whom nutric score ≥ 6 to see the adequacy of protein energy intake intake between patients at high risk and low-risk malnutrition.

CONCLUSION

Nutric score was correlated with duration of MV in the ICU patients. Adequacy of energy and protein intake had significant correlation with duration of MV.

ETHICAL APPROVAL

This study was approved by Ethical Study Committee of Kariadi Hospital with ethical clearance reference number 453/EC/KEPK-RSDK/2020.

CONFLICTS OF INTEREST

There were no other conflicts of interest in this study.

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AUTHOR CONTRIBUTION

Ika Sutrisnawati and Etisa Adi Murbani responsible for project administration, writing the original draft, and data gathering. Darmono, Etisa Adi Murbawani, Niken Puruhita, Enny Probosari for supervision and guiding the main idea.

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