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Correlation between protein intake and nitrogen balance of surgical patients in anesthesiology and intensive care installation, Sanglah General Hospital, Denpasar, Bali, Indonesia

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ABSTRACT

Background: A cell injury from surgical stress in a trauma or a non-trauma case will induce a hyper metabolic response in which the protein degradation increases, the somatic protein synthesis decreases and the amino acid catabolism increases. Thus, the pyper metabolic response contributes to nitrogen loss in urine. This response, without an adequate nutrition, will lead an iatrogenic malnutrition and deterioration. A balance nitrogen formula through urinary urea nitrogen is one of many nutrition evaluation methods. This method aids in evaluating the daily nutrition status and it can be the baseline data for daily intake.

Objective: To find a correlation between the protein intake and the nitrogen balance of the surgical patients in anesthesiology and intensive care installation, Sanglah General Hospital, Denpasar, Bali.

Methods: Fifty-one surgical patients with trauma and non-trauma cases were observed for their protein intake for 2-3 days continuously. Moreover, they were evaluated for their nitrogen balance based on the urinary urea nitrogen per 24 hours for 2-3 days. For statistical analysis, we utilized Shapiro-Francia, Shapiro-Wilk, Spearman Frank correlation, two-sample t test, and multivariate regression analysis in Strata SE 12.1.

Results: The correlation between the protein intake and the nitrogen balance on the first day was r^3=0.50 ($p<0.05$), on the second day r^3=0.70 ($p<0,05$), and on the third day r^3=0.740 ($p<0,05$).

Conclusions: There is a correlation between the protein intake and the nitrogen balance of surgical patients in Anesthesiology and Intensive Care Installation Sanglah General Hospital Denpasar.

Keywords: protein intake, nitrogen balance, Urinary Urea Nitrogen, correlation

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INTRODUCTION

The measurement of the nutritional support and the metabolism outcome in critically ill patients are still debatable.

In general, the experts have agreed to optimize the digestive tract as early as possible if there is no absolute contraindication for enteral nutrition. For measuring the metabolism result, a calorimetry is used as the gold standard to determine a patient's nutritional status periodically.[1-3]

Approximately 40% of patients with multiple trauma who are malnourished in a hospital most susceptible to infection, thus increasing the mortality rate in more than 60% of patients treated in a critical care unit for more than five days. This is caused by the systemic inflammation, followed by a paralysis of the immune system, commonly happens after trauma. An activation of Compensatory Anti-inflammatory Response Syndrome (CARS) will also lead to an immunosuppression, causing sepsis, organ dysfunctions and death.[4] Protein degradation will increase in response to injury, along with a decrease in then somatic protein synthesis and an increase in the catabolism of amino acids, which results in the loss of body nitrogen.[1-5]

The negative nitrogen balance occurs primarily due to an increase in the body protein breakdown to support the metabolic needs. During the acute metabolic stress phase, the protein reserves will undergo a catabolic process, causing a loss of nitrogen through urine.[3]

The prevalence of malnutrition in hospital admission, recorded in the United States, was about 35-55%. Nearly 50% of the patients were malnourished during the treatment. In Indonesia, a study claimed 37% of the digestive surgery patients in Cipto Mangunkusumo Hospital, Jakarta, was malnourished when admitted to the hospital. A hyper metabolic condition, when not supported by an adequate and an appropriate nutrition, would precipitates an underfeeding or overfeeding in patients, which could worsen their condition.[5-8]

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To identified an optimum patient nutritional support and metabolism outcome, we analyze the relationship between the protein intake and the nitrogen balance level of then surgical patients treated in the Installation of Anesthesia and Intensive Therapy (IAIT), Sanglah General Hospital, Denpasar.

METHODS

This study is a prospective observational study. The sample is all surgical patients admitted to IAIT, Sanglah General Hospital, from March to April 2016, who met the eligibility criteria. The inclusion criteria are: (1) be 18 to 65 years old when admitted, (2) either already or not yet underwent a surgical procedure, (3) the patient in a "flow" phase according to Cuthbertson, so they could be given the full caloric nutrients. Meanwhile, the exclusion criteria are: (1) the patient/patient relative refused to be included in the study, (2) a patient with septic, or burn, or renal failure, or coronary problems, or a cardiac surgery patient and patients with coronary problems, (3) a patient with Revised Trauma Score <4 or APACHE> 30, (4) a patient who was admitted to the IATI for the second time, (5) a pregnant or postpartum patient, (6) patients with shock or hemodynamically unstable condition, (7) patients with disorders or gastrointestinal abnormalities or not allowed for early enteral nutrition in the first 24 hours.

There are 51 patients who met the inclusion criteria and eligibility. The sampling was conducted consecutively by including every surgical patient admitted to the installation who met the criteria up to the number of samples met. Nitrogen balance was measured as a result of follow-up of the protein intake.

RESULTS

The age mean was 44.5 (SD 14.8). By gender, 58.8% (n=30) men and 41.2% (n=21) women. The body mass index mean was 23 (SD 2.8). There was 43.1% (n=22) trauma case and 56.9% (n=29) non-trauma. The trauma case had an average of Revised Trauma Score 10.4 (SD 1.3). In the non-traumatic group, the proportion of the APACHE 0 was 62% (n=18), APACHE 1 was 24% (n=7) , APACHE 2, 3, 4, 5 and 7,8 was each 3.5% (n=1). Based on the type of protein given, 55% (n=28) received 1.3g/kg of bodyweight per day, and 45% (n=23) received 1.5 g/kg of bodyweight per day.

The mean intake of protein was (SD 35.4) on day one, 36.7 (SD 34.7), on the second day, and 44.7 (SD 31.6) on the third day. The balance nitrogen result for day one was -6.6 (SD 8.1), the second day was -7.4 (SD 7.2), and the third day was -6.2 (SD 7.4).

From the Frank Spearman correlation test, we found an intermediate strength of correlation between the protein intake and the nitrogen balance on the first day (r^a=0.50, p<0.05). There was a strong correlation between the protein intake and the nitrogen balance on the second day (r^a=0.70, p<0.05) and on the third day (r^a=0.70, p<0.05).

A two-sample t-test was used to determine whether there were differences between the nitrogen balance measurement results in patients given 1.3 grams of protein/kg of bodyweight or 1.5 grams/ kg of bodyweight. Table 5 showed no statistical difference in nitrogen balance results between the 2 groups on day one, nor the second or the third day (p>0.05).

Table 1 The Sample Characteristics

	(n=51)	
Characteristics	**f (%)**	**mean (SD)**
Age		44.5 (14.8)
Gender		
Male	30 (58,8%)	
Female	21 (41,2%)	
BMI (kg/m^2)		23 (± 2.8)
Diagnosis		
Trauma case	22 (43,1%)	
Revised Trauma Score		10.4 (1.3)
Non-trauma case	29 (56,9%)	
APACHE		
0	18 (62%)	
1	7 (24%)	
2	1 (3,5%)	
3	1 (3,5%)	
5	1 (3,5%)	
7,8	1 (3,5%)	
Type of protein		
1.3g/kgBW/day	28 (55%)	
1.5g/kgBW/day	23 (45%)	

Table 2 Protein Intake Amount per Day of Observation

Protein Intake on Day	**Mean (SD) (n=51)**
1	24.3 (35.4)
2	36.7 (34.7)
3	44.7 (31.6)

Table 3 Nitrogen Balance per Day of Observation

Nitrogen Balance per Day	Mean (SD) (n=51)
1	-6.6 (8.1)
2	-7.4 (7.2)
3	-6.2 (7.4)

Table 4 Spearman Frank Correlation Test Result Between Protein Intake and Nitrogen Balance

Day of Observation	r[a]	p-value
1st (n=51)	0.500	0.0002
2nd (n=51)	0.700	< 0.001
3rd (n=38)	0.740	< 0.001

Table 5 The T-Test Result of the Nitrogen Balance Result Between the Two Protein Types

Nitrogen Balance per Day, Based on the Day of the Observation	Protein Type		Mean Difference	95% CI	p-value
	1.3 g/kgBW/day	1.5 g/kgBW/day			
1, mean ± SD	-5.9 ± 1.6	-7.4 ± 1.6-	1.1	-8.9-(-4.3)	0.525
2, mean ± SD	-7.0 ± 1.5	-7.9 ± 1.3	1.0	-9.5-(-5.4)	0.682
3, mean ± SD	-5.8 ± 1.8	6.6 ± 1.6	1.2	-8.6-(-3.7)	0.750

DISCUSSION

The provision of the type of protein given to the patients was based on the daily instructions written in the medical record by the attending physicians.

By comparing the amount of the patient protein intake per day of hospitalization with the amount of the protein intake that should be administered according to the daily instruction, we found that the average of the patient protein intake from the first to the third day was less than what had been instructed.[1-3,8,10-11]

There were numerous problems that could be the causal agents. Such as the difficulty to properly mix and measure food in the kitchen, a surgeon request to temporarily postpone the feeding, the fear of aspiration in patients with loss of consciousness, a temporary bloating, vomiting, a greenish nasogastric tube or other reasons, such as a detached nasogastric or orogastric tube.[1-3,8-11]

The average nitrogen balance on the first day up to the third day showed a state of a light catabolism. It was still acceptable, in accordance to the theory that the loss of body protein may occur with an increased metabolism characterized by the "flow" phase of the recovery from injury. During this phase, the energy breakdown and nitrogen loss are interrelated, and they are roughly related to the degree of injury or infection. Indeed, the degree of injury of injury or infection is very close to the amount of nitrogen excreted. An abnormal protein balance may occur due to a decrease in protein synthesis, an increase protein degradation, or a combination of both.[8]

The result of the Frank Spearman correlation test presents a correlation between the protein intake with the nitrogen balance on the first, second, and the third day. This is consistent with the theory that if the amount of nitrogen excreted is equal to the amount obtained from enteral or parenteral, then the person is said to be in nitrogen balanced. The difference between the amount of nitrogen that enters the body in the form of protein and the amount that comes out, determine the nitrogen status of a person.[8] By improving the delivery of protein intake from day to day, the nitrogen balance results will be closer to normal values.[1-3,8-11]

There is no significant difference in nitrogen balance results between the type of protein given per kg of bodyweight per day. The average showed a light catabolism. However, there the standard deviations were quite large. Some subjects reached the target of nitrogen balance, but some did not achieve the desired results. The type of protein given were determined by the Clinical Nutrition Department. The calculation was based on an estimation using a stress factor coefficient in a critically ill patient between 1.3-1.5g/kg of bodyweight, and then adjusted with the daily clinical assessment and the initial evaluation using the Subjective Global Assessment (SGA). Based on the results, in order to achieve positive nitrogen balance, protein is recommended to be given from first day of treatment.[1-3,8-11]

CONCLUSION

There is a correlation between the protein intake with the calculated nitrogen balance in the surgical patients treated in the Installation of Anesthesia and Intensive Therapy, Sanglah General Hospital, Denpasar, Bali, Indonesia. There is no significant difference in the nitrogen balance measurement in the surgical patients based on the type of protein given per kilogram of bodyweight per day.

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