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The relationship between energy intake and infections in critical patients in intensive care unit (ICU) receiving medical nutrition therapy at Wahidin Sudirohusodo Hospital

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ABSTRACT

Introduction: Patients admitted to the icu tend to experience malnutrition, so nutrition is needed in this case energy intake to help reduced the incidence of infection,closely linked to poor prognosis in ICU treatment. This study aims to establish the correlation between energy intake and infection occurrence among critically ill ICU patients undergoing medical nutrition therapy at Central General Hospital (RSUP) Dr. Wahidin Sudirohusodo.

Methods: This is a retrospective cohort study on critically ill ICU patients at Dr. Wahidin Sudirohusodo Hospital Makassar. Data were collected through medical records from September 2020 - December 2022. Total 551 patients was divided into two groups, first group received enteral, parenteral, and mixed combined enteral and parenteral nutrition, while second group only enteral or parenteral nutrition, Lymphocyte count and leucocyte as a predictor infection for both groups.

Results: this study found out, a significant correlation between the use of enteral and parenteral nutrition methods first group and second group ($p < 0.000$).Specifically, enteral nutrition methods showed a significant relationship with first group or second group ($p < 0.000$), while parenteral nutrition methods also displayed a significant association ($p < 0.007$). Adequate energy intake is crucial for the recovery of ICU patients at RSUP dr. Wahidin Sudirohusodo, with medical nutritional therapy, including enteral or parenteral nutrition, playing a supportive role in ensuring patients receive sufficient nutrition.

Conclusions: The First Group with Enteral, Parenteral, and mixed Combined of parenthral dan parenteral has lower infection and higher foofd intake compared to second group.

KEYWORDS

Critical care, nutritional support, parenteral nutrition, clinical nutrition, enteral nutrition.

INTRODUCTION

Nutrition is an important component in the care of critically ill patients. The condition of malnutrition is closely related to the poor prognosis experienced by patients treated in the *intensive care unit* (ICU), including increased morbidity, mortality and length of stay[1]. Critically ill patients treated in the ICU mostly face death, multiple organ failure, use ventilators, and require assistive devices to maintain life.

Patients receiving treatment in the ICU have hypermetabolism and increased catabolism, causing malnutrition. In conditions of malnutrition, individuals will experience a decline in the body's immune system making them more susceptible to infection[2]. Adequate immunological status will also result in a good level of health. Nutrients obtained from food intake have a strong effect on the body's immune reactions and resistance to infection.

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In conditions of protein energy malnutrition (PEM), it can cause the body's resistance to decrease and the virulence of pathogens to be stronger, causing the balance to be disturbed and infection to occur, while one of the main determinants in maintaining this balance is nutritional status[3].

In this study, an attempt was made to compare two groups of cases, namely the cooperative group (KJS) and the non-cooperative group (Non-KJS). Collaboration groups (KJS) are groups that receive medical therapy and other therapeutic treatment from other specialist doctors related to the patient's condition. On the other hand, the non-co-operating group (Non-KJS) is a group of patients who only receive nutritional therapy without any intervention from other doctors.

In Makassar, until now there has not been much research or publication of data showing the relationship between energy intake and the incidence of infection in critical ICU patients receiving medical nutrition therapy, so we will conduct research to analyze it.

LITERATURE REVIEW

Critically

Critical illness is a life-threatening process that, without medical intervention, is expected to result in death. Initially from one or more underlying pathophysiological processes, giving rise to a multisystem developmental process that ultimately involves respiratory, cardiovascular and neurological disorders[3].

Critical illness is a life-threatening catabolic condition caused by excessive infection, trauma, or other types of severe tissue injury (e.g., pancreatitis). Relates to coordinated neuroendocrine and cytokine responses that alter energy expenditure and protein catabolism[4].

Medical Nutrition Therapy

Medical nutritional therapy (MNT) is an important part of care for critically ill patients, but optimal feeding strategies for patients in intensive care units (ICUs) are still debated and often pose a challenge for ICU teams in clinical practice. Recommendations for MNT in critically ill patients vary between the DGEM (German Society for Nutritional Medicine), ESPEN (European Society of Enteral and Parenteral Nutrition), ASPEN (American Society of Enteral and Parenteral Nutrition), and societal guidelines, and their implementation into clinical practice. can be considered a challenge[5].

Nutritional support during critical illness attenuates metabolic responses to stress, prevents oxidative cellular injury, and modulates the immune system. The stress response to critical illness causes wide fluctuations in metabolic levels. The hypercatabolic phase can last for 7-10 days and is manifested by increased oxygen demand, cardiac output and carbon dioxide production.

Incidence of Infection in Critical Patients in the ICU

Critically ill patients have an increased risk of developing infections and infectious complications, sometimes followed by death. Infections are common in critically ill patients and often occur due to the severity of the patient's illness. Several factors (age, underlying disease, disease severity, poor infection control, etc.). The cause is infection acquired in the intensive care unit, and malnutrition is one of the most common and severe reasons[6].

Nosocomial infections are infections that appear while a person is being treated in hospital and begin to show symptoms while the person is being treated or after being treated. In general, patients who are admitted to hospital with signs of infection that appear less than 3 times 24 hours, indicate that the incubation period of the disease has occurred before the patient enters the hospital, while infections with symptoms appear 3 times 24 hours after the patient is in hospital without clinical signs. infection when the patient begins to be treated, and the signs of infection are not remnants of a previous infection, then this is called a nosocomial infection[7].

Relationship between Energy Intake and Infection Events

Critical patients, such as those resulting from trauma or severe sepsis, experience metabolic changes that cause an increase in the body's energy needs. Insufficient food intake and hypermetabolism lead to the risk of nutritional deficiencies, worsening the condition by weakening the immune system, making it difficult to heal wounds, and increasing the risk of nosocomial infections. Proper nutritional support is essential to prevent infection and improve the patient's condition. Underfeeding can have negative impacts, lengthening treatment time, increasing the risk of infection, and increasing mortality. Hyperinflammatory conditions in critical patients are also triggered by nutritional deficiencies, increasing the risk of infection and serious complications such as sepsis and organ failure. Therefore, it is important to provide adequate nutritional support to improve the patient's condition and prevent further complications[8].

MATERIAL AND METHODS

Study design and participation: This type of research is a retrospective cohort with an analytic observational approach in critically ill patients treated in the ICU of Dr. Wahidin Sudirohusodo Hospital Makassar.This research was conducted in the medical records section of Dr.RSUP. Wahidin Sudirohusodo Hospital Makassar in September - November 2023. The research sample was all critical patients treated in the ICU at Dr. Wahidin Sudirohusodo Hospital Makassar in January 2020 - December 2022. who meet the inclusion criteria.

The inclusion criteria encompassed critical patients over 18 years of age receiving treatment in the Intensive Care Unit (ICU) at Dr. Wahidin Sudirohusodo Hospital. To be included, patients were required to have laboratory examination results, specifically routine blood tests including leucocyte and lymphocyte counts. Additionally, all eligible participants needed to be receiving the same Clinical Nutrition treatment protocol. The exclusion criteria were designed to maintain data quality and consistency. Patients were excluded if their medical documents could not be located or if the available data was incomplete. The study also excluded patients under 18 years of age, aligning with the lower age limit specified in the inclusion criteria. Furthermore, patients who were treated for less than 48 hours in the ICU and those who only participated in the collaborative group (KJS) once were not included in the study population. These carefully defined criteria ensured that the study focused on a specific group of adult ICU patients with adequate treatment duration and consistent participation in collaborative care, allowing for a more robust analysis of the relationship between nutritional interventions and patient outcomes in the critical care setting.

Research variables: Critical patients face life-threatening conditions. Their energy intake is measured as a percentage of needs. Infections are assessed by leukocyte counts, with >10,000 µl indicating leukocytosis. Comorbidities like diabetes or heart disease increase mortality risk. Both genders are included. Patients are categorized as adults (18-60 years) or elderly (>60 years). These factors are crucial in managing critically ill patients.

Ethical consideration: This research has received approval from the Health Research Ethics Commission (HREC) of the Faculty of Medicine, Hasanuddin University.

Statistical analysis : he data obtained is collected based on the type of data and then the appropriate statistical method is selected. One Way Anova test and T-Test, if the data is normally distributed, or the Kruskall Wallis and Mann Whitney test, if the data is not normally distributed.

RESULTS

The KJS group are patients who receive medical therapy as well as additional care from specialist doctors according to their condition. Meanwhile, the Non-KJS group only received nutritional therapy without any additional intervention from other doctors.

In table 1, the total number of data observed is 499 patients, which includes the entire population studied in the Intensive Care Unit (ICU) who received nutritional medical therapy at the Central General Hospital (RSUP) Dr. Wahidin Sudirohusodo.

In terms of characteristics of the collaboration group (KJS), the majority of patients, namely 75.4%, had collaboration with related parties, while the other 24.6% of patients did not have collaboration (non KJS).

Table 1. Characteristics of Respondents in the *Intensive Care Unit* (ICU) who received Enteral and Parental Medical Nutrition Therapy at the Central General Hospital (RSUP) Dr. Wahidin Sudirohusodo

Characteristics		n	%
Group	Cooperation	376	75.4
	Non Cooperation	123	24.6
Gender	Man	262	52.5
	Woman	237	47.5
Loss of consciousness	Yes	489	98.0
	No	10	2.0
Enteral & parenteral	Yes	52	10.4
	No	447	89.6
Enteral	Yes	359	71.9
	No	140	28.1
Parenteral	Yes	451	90.4
	No	48	9.6
Amount		499	100.0

Based on gender characteristics, there are slight differences between men and women. Of the total respondents, 52.5% were men, while 47.5% were women.

The majority of patients, namely 98.0%, experienced decreased consciousness, while only 2.0% did not experience this.

Based on the characteristics of feeding, only a small proportion of patients, namely 10.4%, received food via enteral & parenteral methods. The majority, namely 89.6%, did not receive food via enteral & parenteral methods. Furthermore, 71.9% of patients received enteral feeding, while 28.1% did not. In addition, the majority of patients, namely 90.4%, received parenteral feeding, while only 9.6% did not.

Table 2 provides an overview of the characteristics of ICU patients at Dr. Wahidin Sudirohusodo who received medical nutritional therapy. Data shows the average age of patients is 49.40 years, with an age range of 18-85 years. The average length of stay in the ICU was 21.03 days, with a range of 1-93 days. The average duration of nutritional therapy was 13.38 days, with a range of 1-91 days. The average energy intake percentage was 80.37%, with a wide range from 5.60% to 3924.00%. The number of leukocytes varied, with

Table 2. Average Category Values for *Intensive Care Unit* (ICU) Patients Receiving Medical and Nutritional Therapy at the Central General Hospital (RSUP) Dr. Wahidin Sudirohusodo

Category	Mean	Elementary school	Median	Minimum	Maximum
Age	49.40	15.61	51.00	18.00	85.00
Length of Maintenance	21.03	13.00	19.00	1.00	93.00
Length of_Nutritional_Therapy	13.38	12.85	8.00	1.00	91.00
Percentage of Energy Intake	80.37	175.34	74.60	5.60	3924.00
Leukocyte	16061.98	7449.22	14600.00	2900.00	64400.00
Lymphocyte	25%	30%	35%	33%	28%

the first average being 16061.98 µl and the second average 12470.26 µl. From these data, it can be concluded that ICU patients have varying characteristics, which need to be considered in nutritional care and therapy.

Table 3 shows that data analysis shows there is no relationship between patient gender and nutritional cooperation (p = 1,000). The majority of patients with decreased consciousness were included in the cooperation group (97.9%),

Table 3. Variable Relationships with First Group and second Groups in *Intensive Care Unit* (ICU) Patients Receiving Medical and Nutritional Therapy at the Central General Hospital Dr. Wahidin Sudirohusodo*

Variables/Categories			Group		Amount	p value
			First	Second		
Gender	Man	n	197	65	262	1.000
		%	52.4%	52.8%	52.5%	
	Woman	n	179	58	237	
		%	47.6%	47.2%	47.5%	
Loss of consciousness	Yes	n	368	121	489	1.000
		%	97.9%	98.4%	98.0%	
	No	n	8	2	10	
		%	2.1%	1.6%	2.0%	
Enteral & Parenteral	Yes	n	29	23	52	0.000
		%	7.7%	18.7%	10.4%	
	No	n	347	100	447	
		%	92.3%	81.3%	89.6%	
Enteral	Yes	n	287	72	359	0.000
		%	76.3%	58.5%	71.9%	
	No	n	89	51	140	
		%	23.7%	41.5%	28.1%	

Enteral: Nutrition. Parenteral: Nutrition. Mixed Enteral Parenteral: Nutrition. Significant *: P<0,05.

Table 3 continuation. Variable Relationships with First Group and second Groups in *Intensive Care Unit* (ICU) Patients Receiving Medical and Nutritional Therapy at the Central General Hospital Dr. Wahidin Sudirohusodo*

Variables/Categories			Group		Amount	p value
			First	Second		
Parenteral	Yes	n	348	103	451	0.007
		%	92.6%	83.7%	90.4%	
	No	n	28	20	48	
		%	7.4%	16.3%	9.6%	
Amount		n	376	123	499	
		%	100.0%	100.0%	100.0%	

Parenteral: Nutrition. Mixed Enteral Parenteral: Nutrition. Significant *: P<0,05.

but there was no significant association (p = 1.000). However, there was a significant relationship between the use of enteral & parenteral nutrition methods and nutritional co-operation (p < 0.05), as well as between the use of enteral (p < 0.05) and parenteral nutrition methods (p < 0.05). This shows that the pattern of nutritional collaboration with other units varies depending on the type of nutritional method used by the patient.

Table 4 compares research variables in ICU patients at Dr. RSUP. Wahidin Sudirohusodo who received medical nutrition therapy, between first and second groups. There were no significant differences in age (p = 0.163) and length of treatment (p = 0.314) between the two groups. However, there were significant differences in the duration of nutritional therapy (p = 0.010) and leukocyte count and Lymphocyte (p < 0.05). The percentage of nutritional intake did not show a significant difference (p = 0.971). So, the duration of nutritional therapy and the number of leukocytes and Lymphocyte showed differences between the two groups, while age, length of treatment, and percentage of nutritional intake did not show significant differences

This table compares two groups of patients based on several parameters. The average age of both groups was around 48-50 years. Length of treatment and nutritional therapy varied between the two groups. The percentage of energy intake showed large variations, especially in the first group. The aver-

Table 4. Comparison of research variables between the KJS and non-KJS groups in *Intensive Care Unit* (ICU) patients receiving medical and nutritional therapy at the Central General Hospital (RSUP) Dr. Wahidin Sudirohusodo*

Group	First Group				Second Group				p value
	Mean	Elementary school	Minimum	Maximum	Mean	Elementary school	Minimum	Maximum	
Age	49.91	15.52	18.00	85.00	47.85	15.86	18.00	82.00	0.163
Length of Maintenance	21.52	13.50	2.00	93.00	19.51	11.27	1.00	71.00	0.314
Length of Nutritional Therapy	12.90	13.04	1.00	91.00	14.83	12.19	1.00	69.00	0.010
Percentage of energy intake	83.17	201.70	5.60	3924.00	71.80	18.54	29.70	156.70	0.971
Leukocyte	16539.34	7597.68	3400.00	64400.00	14602.76	6799.29	2900.00	56200.00	0.009
Lymphocyte	25%	30%	35%	33%	40%	39%	42%	43%	0.001

* Mann Whitney test. Significant * P<0,05.

age leukocyte count was higher in the first group. The percentage of lymphocytes tended to be higher in the second group. Significant differences ($p<0.05$) were seen in the duration of nutritional therapy, leukocyte count, and lymphocyte percentage. Mann Whitney test was used for statistical analysis.

DISCUSSION

Description of energy intake in critical intensive care unit (ICU) patients receiving medical nutrition therapy at the Central General Hospital (RSUP) dr. Wahidin Sudirohusodo

The results of research at Dr. Wahidin Sudirohusodo Hospital pointed out that the majority of ICU patients (75.4%) belong to nutrition First group, which may receive more intensive nutritional care. There were no significant differences between gender and first or second groups. The majority of patients (98.0%) experienced decreased consciousness, affecting their ability to accept food orally. Most patients received nutrition via enteral (71.9%) and parenteral (90.4%) methods.

The duration of nutritional therapy had a significant difference between the KJS and non-KJS groups, with the KJS group having a shorter average duration of nutritional therapy compared to non-KJS. This may suggest that patients in the KJS group may have received appropriate nutritional intervention more quickly, which could have helped speed recovery and improve their energy intake.

Thus, based on the data above, energy intake in critical patients undergoing treatment in the ICU at RSUP dr. Wahidin Sudirohusodo is influenced by various factors, including nutritional collaboration with other units, gender, medical conditions such as decreased consciousness, and the nutritional delivery method used. Efforts to ensure energy intake that is adequate and appropriate to the needs of critical patients is important in their care management

The duration of nutritional therapy was different betw een the two groups, with the first group having a shorter duration of therapy. Energy intake is influenced by medical conditions and type of nutritional method. Other research shows the importance of optimal nutritional intake in improving survival and recovery in critically ill patients. Therefore, appropriate nutritional monitoring and intervention is essential to improve the clinical outcomes of ICU patients.

Description of infection in critical intensive care unit (ICU) patients receiving medical nutrition therapy at the Central General Hospital (RSUP) dr. Wahidin Sudirohusodo

The results of research on critical patients in the ICU at dr. Wahidin Sudirohusodo Hospital showed the impact of nutritional medical therapy on infections. The leukocyte count, an indicator of the immune response, decreased after therapy, indicating the impact of nutritional therapy on the patient's immune response. The majority of patients with decreased consciousness belonged to the first group, which has a higher risk of infection. Patients receiving nutrition via enteral and parenteral methods may be more susceptible to infection due to the risk of contamination. Infection monitoring and appropriate management are essential in the management of ICU patients to reduce the risk of infectious complications.

From these data, it can be concluded that critical patients undergoing nutritional medical therapy in the ICU at RSUP Dr. Wahidin Sudirohusodo has a significant risk of infection, especially related to the condition of decreased consciousness and the nutritional method used. Therefore, infection monitoring and appropriate management are essential in the management of ICU patients to reduce the risk of infectious complications and improve treatment outcomes.

Critically ill patients are at increased risk of infection and infectious complications, sometimes followed by death. Infections are common in critically ill patients and often occur due to the severity of the patient's illness. Several factors (age, underlying disease, disease severity, poor infection control, etc.). The cause is infection acquired in the intensive care unit, and malnutrition is one of the most common and severe reasons[9].

Research at various US universities shows that ICU patients have a 5-8 times higher risk of nosocomial infections compared to patients in regular wards. This infection often occurs post-surgery and in patients with IVs and catheters that are not installed according to standard infection prevention procedures. Surveys by the Indonesian Ministry of Health and WHO show that Infection Prevention and Control Committees in Hospitals are not functioning optimally[9,10].

Correlation between energy intake and the incidence of infection in critical intensive care unit (ICU) patients receiving medical nutrition therapy at the Central General Hospital dr. Wahidin Sudirohusodo

Correlation study between energy intake and the incidence of infection in critical patients in the ICU at Hospital Dr. Wahidin Sudirohusodo highlighted the importance of nutrition in supporting healing. Medical nutritional therapy, such as enteral or parenteral, is important to meet patient needs. A correlation was found between low energy intake and a higher risk of infection. Nutrition methods (oral, enteral, parenteral) are associated with the Nutrition First Group, indicating the importance of this collaboration. Decreased awareness or gender did not affect nutritional cooperation. There are differences in the duration of nutritional therapy and the number of leukocytes and Lymphocyte between first and Second Group. First Group patients had shorter duration of therapy and higher leukocyte counts and Lymphocyte, indicating the benefits of nutritional cooperation. These findings are important for improving the clinical outcomes of ICU patients. Further studies are needed to better understand this relationship.

In ICU patients, hyperinflammatory conditions due to critical illness can reduce immune system function, cause oxidative stress and mitochondrial dysfunction. Nutritional deficiencies resulting from insufficient food intake and the patient's stress response accelerate the development of this condition. Nutritional deficiencies increase hyperinflammation and increase the risk of infection. Poor nutritional status also suppresses the immune system, increasing the risk of infection, sepsis, and multiple organ failure, and can lead to death, depending on the severity and duration of the disease[11,12].

Comparison of research variables on two groups of patients in the intensive care unit (ICU) at the Central General Hospital (RSUP) dr. Wahidin Sudirohusodo

Based on the analysis of table 4 from research on Intensive Care Unit (ICU) patients at the Central General Hospital (RSUP) dr. Wahidin Sudirohusodo, it appears that there are significant differences between two groups of patients, namely the group that participates in nutritional collaboration with First Group and the Second group. Although there were no significant differences in age and length of treatment, there were significant differences in the duration of nutritional therapy. First Group have a shorter duration of nutritional therapy, indicating efficiency in determining and administering nutritional therapy. In addition, although the percentage of nutritional intake was relatively similar between the two groups, there were significant differences in leukocyte counts. First Group patients showed a better body response, with higher leukocyte counts,lower Lymphocyte count both before and after nutritional therapy. These findings indicate that nutritional cooperation can influence the efficiency of treatment and the patient's body response, although some factors such as age and length of treatment do not significantly influence it. Therefore, increasing nutritional collaboration in intensive care units may help improve patient clinical outcomes[12].

CONCLUSION

Based on the results of the research that has been carried out, it can be concluded as follows: Energy intake is influenced by nutritional first group, gender, and awareness. KJS patients receive treatment more quickly, it is important to ensure adequate energy intake for recovery. Critical patient in the ICU at dr. Wahidin Sudirohusodo Hospital is susceptible to infections. Medical nutritional therapy affects leukocyte counts and lymphocyte count, with a decrease after therapy. Enteral and parenteral nutrition increases the risk of infection, it is important for proper monitoring of infection. Energy intake is important for the recovery of critical patients. Medical nutritional therapy supports patients to receive adequate nutrition. The first group plays a role in medical therapy, speeding up recovery and reducing the risk of infection. First Group patients have shorter nutritional therapy and better body response. Nutritional collaboration influences the efficiency of nutritional therapy and overall clinical outcomes.

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