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THE TREND OF ENTERAL FEEDING AMONG CRITICALLY- ILL PATIENTS IN ADULT ICUs IN MALAYSIA

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ABSTRACT: The adequacy of caloric intake is crucial for all critically-ill patients in Intensive Care Units because energy expenditure is higher in these patients compared to normal patients in general wards. Adequate calorie intake will promote positive outcome to the patients while inadequate calorie will lead to malnutrition which will increase the length of stay. The objective of this study was to determine the adequacy of caloric intake received by critically-ill patients in the general ICU in Malaysia. This was a cross sectional study which used a proforma adapted from ICU protocol. There were 132 participants involved in this study. The descriptive statistic and independent t-test were used for the statistical analysis. The results showed that 75.8% (n=100) received adequate or more than calorie prescribed while 24.2% (n=32) received calorie less than the given prescription. Patients that received early feeding were 72% (n=95) and late feeding were 28% (n=37). The continuous feeding method was most commonly used in early feeding patients from Day 1 to Day 3. There was an association between the adequacy of calorie intake and the length of stay ($p<0.05$). Findings obtained from this study will provide information for the nurses and other health care providers to improve the management of patients so that all patients will receive adequate caloric intake during their stay in ICUs.

Key words: Intensive Care Unit (ICU); Enteral feeding; Continuous feeding; Intermittent feeding; Calorie intake

1. INTRODUCTION

Nutritional support is considered as an essential component in the care of critically-ill patients, either to treat existing malnutrition or to prevent the development of nutritional deficiencies [1]. Despite treatment of patient's disease by using medications, adequate caloric intake has become an important element in patient's management [2]. Malnutrition is very common among ICU patients and frequently it was due to inadequate caloric intake [3, 4]. Evidence shows that malnutrition is associated with poor outcomes among ICU patients as reflected by increased morbidity, mortality, and length of stay [5, 6]. Intensive care patients with adequate caloric requirements are more likely to achieve reduced time on a ventilator support, fewer complications such as low risk of infection and shorter time of hospital stay [7].

Enteral feeding is the most common method used in ICU to provide nutrition support to the critically-ill patients. Enteral feeding is recommended for critically-ill patients who cannot consume oral diet within three days in order to supply the energy to the patients [8] Advantages of enteral feeding include the enhancement of intestinal mucosal integrity and nutrient absorption, improvement of metabolic and immune response, reduction of complications and costs [6].

Early enteral feeding in critically ill patients should commence within 24 hours of admission to the ICU [9]. In order to achieve adequate calories for all patients in ICU, early enteral feeding was recommended as soon as possible after being admitted to ICU. Current recommendations suggest a target calorie intake of 25 kcal/kg/day for patients in ICU [9]. Many studies have been conducted on the adequacy of caloric intake among ICU patients worldwide but there is limited data available in Malaysia especially regarding the adequacy of caloric intake among ICU patients. The objective of this study was to determine the adequacy of caloric intake received by critically-ill patients in the General ICU in Malaysia.

2. METHODS

Study Design and Participants

This was a cross-sectional study conducted in a General ICU hospital in regional Malaysia from October until December 2008. All participants were above 18 years old. They received intermittent bolus or continuous feeding for more than 24 hours. The

study did not include patients who received nutrition support either orally, parenteral, or a combination of enteral and oral methods during the period of the study. The sample size for this study was 126 patients.

2.1 Instrument

Data were collected using a standardized checklist (Proforma) which was developed from ICU management protocol [9]. The proforma was divided into two sections. The first section was focused on patients' demographic characteristics: age, weight, height, diagnosis on admission, ideal body weight (IBW), SOFA (Sequential Organ Failure Assessment) score and SAP II (Simplified Acute Physiology) score followed by admission date to ICU and start date of feeding. The second section included type and formula of enteral feeding. This section also focused on patients' conditions as well as problems encountered from day one until day five. Calculation of calorie intake started from 7 am until 7am (completed for 24 hours) and updated in proforma.

The proforma was reviewed by two Anesthesiologists from a government hospital and one ward manager with critical care background from another government hospital. No alteration was made after the experts reviewed and agreed with the relevancy and adequacy of the proforma that measured the adequacy of calorie intake of critically-ill patients. The proforma was pretested on 10 adult patients with all the listed criteria from the same general ICU in September 2008.

Ethical approval was obtained from University Medical Research Ethics Committee and National Institute of Health Ethics Committee. Patients who fulfilled the inclusion criteria were chosen from the admission book and were selected for this study if they agreed to participate and signed informed consent. The purpose and confidentiality of this study was reported to the Head of Department and ward manager in charge of ICU before data collection. All information gathered during reviews of patients' report was remained confidential.

2.2 Data collection

Patients' daily calorie intake was collected in the health information system and the calorie received were calculated and updated in the proforma. Patients' calorie intake was monitored for five days after the initiation of enteral feeding. Data collection lasted for 5 days and each patient was followed up to determine the outcome of either being discharged from ICU or death.

2.3 Data Analysis

Data were analyzed by using the Statistical Package for Social Sciences ("SPSS") version 14.0. Descriptive analysis involving percentages, means and frequencies were used to report period of initiation, type of formula, mode of enteral feeding, calorie intake per day and problems encountered. An independent sample t-test was conducted to examine the association between early initiation of enteral feeding and adequacies of calorie intake received by patients with patient's length of stay in ICU.

3. RESULTS

There were 377 admissions in ICU during the three-month study period. Out of the 377 admissions, 142 admissions were not on enteral feeding, 22 participants did not meet the inclusion criteria and 81 participants had less than 24 hours enteral feeding. The final number of participants in this study was 132. Table 1 shows, participants were mostly of Malay (52%) ethnicity, the majority of them males (71.2%) and mean age was 53.35± SD15.96. The length of stay of the participants ranged from 2 to 61 with majority of the participants stayed in ICU for less than five days 40.2% (n=53).

Table 1 Demographics characteristic of ICU patients

Characteristics		n(%)	Mean± SD
Ethnicity			
	Malays	69 (52)	
	Chinese	26 (19.7)	
	Indians	24 (18.2)	
	Others	13(9.9)	
Sex			
	Male	94 (71.2)	
	Female	38 (28.8)	
Age			53.35± 15.96
ICU LOS (day)			9.12±8.236
	≤5	53(40.2)	
	6-10	48(36.4)	
	11-15	14(10.6)	
	≥16	17(12.9)	

LOS: Length of Stay

The mean SOFA score was 8.65±SD3.969 and mean SAPS II score was 43.11±SD17.75. Meanwhile, the most common disease involved was the respiratory system (35.6%). Severity of illness score of patients' condition are shown in Table 2.

Table 2 Severity of illness

Severity of illness	n(%)	Mean ± SD
SAPS II score		43.11±17.75
SOFA score		8.65±3.969
System		
Respiratory	47(35.6)	
Immune	24(18.2)	
Skeletal	14(10.6)	
Cardiovascular	11(8.3)	
Endocrine	10(7.6)	
Urinary	10(7.6)	
Central Nervous	8(6.1)	
Digestive	8(6.1)	

Table 3 shows the condition of patients in the ICUs. The number of participants with Invasive positive pressure Ventilator (IPPV) decreased from the first day to the fifth day (n=64; 48.5%) and (n=19; 14.4%) respectively. Some participants were discharged from ICU on day two onwards.

Table 3 Number of patients on NIPPV versus IPPV

	Day 1	Day 2	Day 3	Day 4	Day 5
	n(%)	n(%)	n(%)	n(%)	n(%)
Normal	21(15.9)	42(31.8)	67(50.7)	80(60.6)	96(72.7)
NIPPV	47(35.6)	48(36.4)	38(28.8)	28(21.2)	17(31.1)
IPPV	64(48.5)	42(31.8)	27(20.5)	24(18.2)	19(14.4)

Normal: Breathing normally; NIPPV: Non-invasive positive ventilation; IPPV: Invasive positive ventilation

Table 4 shows, the majority of these patients, 53.8% (n=71) were overweight with BMI more than 25kg⁄m². A majority of the participants 72% (n=92) had received early feeding within 48 hours of admission to the ICUs as compared to 30% of the participants who received feeding after 48 hours of admission.

Table 4 Anthropometric characteristic of patients in the ICUs

Anthropometrics(n=132)	n(%)	Mean±(SD)
Height(cm)		159.58±(12.391)
Weight		66.65±(16.626)
BMI(kg⁄m²)		25.9780±(5.39085)
Below 18.5		
18.5-25	4(3.0)	
Over 25	57(43.2)	
Ideal Body Weight	71(53.8)	57.83 (± 6.320)
<50kg	11(8.3)	
50-60kg	70(53)	
>61kg	51(38.7)	
Period of initiation of enteral feeding		
≤ 48 Hours	95 (72.0)	
> 48 Hours	37(28.0)	

Most of the patients used continuous feeding on day one and day two, 68.2% and 60.6% respectively. However, as Table 5 shows, choice of intermittent bolus feeding was increased on third (55.5%) and fourth day (66.7%).

Table 5 Methods of enteral feeding

Methods	Day 1 n=132 n(%)	Day 2 n=127 n(%)	Day 3 n=93 n(%)	Day 4 n=78 n(%)	Day 5 n=58 n(%)
Intermittent	42 (31.8)	50 (39.4)	51 (55.4)	52 (66.7)	38 (65.5)
Continuous	90 (68.2)	77 (60.6)	42 (45.1)	26 (33.3)	20 (34.5)

Table 6 shows the most common feeding formula used on the first day was enercal 43.2 % (n=57) followed by Glucerna 32.5 % (n=43). Only one participant used Isocal on the first day.

Table 6 Types of feeding formula

Formula	Day1 n=(132) %	Day2 n=127 %	Day3 n=93 %	Day4 n=78 %	Day5 n=58 %
Ensure	Nil	0.8	Nil	Nil	Nil
Nephro	13.6	14.2	14.0	12.8	12.1
Enercal	43.2	41.7	28.0	20.5	20.7
Isocal	0.7	Nil	Nil	Nil	Nil
Glucerna	32.5	29.9	39.7	46.1	46.6
Pulmocare	4.5	5.5	7.5	8.9	5.1
Others	5.3	7.9	10.8	11.5	15.5

Patients who received less calorie requirement were decreased from day two onward. Approximately half of the patients received less than their requirement on day one which is 57.6 % (n=76) however, the percentage decreased from day two 45.7% (n=58) onward. The number of patients receiving adequate calories or more than requirement increased from 42.4% (n=56) from day one to 72.4 % (n=42) on day 5 (Table 7).

Table 7 Distribution of caloric intake per day received by patients

Calories intake n(%)	Day 1 n=132 n(%)	Day 2 n=127 n(%)	Day 3 n=93 n(%)	Day 4 n=78 n(%)	Day 5 n=58 n(%)
<25kcal/kg/day 32(24.2)	76 (57.6)	58 (45.7)	39 (41.9)	29 (37.2)	16 (27.6)
≥25kcal/kg/day 100(75.8)	56 (42.4)	69 (54.3)	54 (58.1)	49 (62.8)	42 (72.4)

Table 8 shows the problems encountered during enteral feeding. The majority of the participants had hyperglycemia during five days of enteral feeding. However it decreased at day four and five. There was no problem encountered with vomiting after the third day of feeding. As for gastric fluid, it decreased from day one to day five.

Table 8 Distribution of problem encountered during enteral feeding

Problem Encountered	Day 1 n=132 n(%)	Day 2 n=127 n(%)	Day 3 n=93 n(%)	Day 4 n=78 n(%)	Day 5 n=58 n(%)
Asp >200ml	13 (9.8)	10 (7.8)	6 (6.4)	3 (3.8)	2 (3.4)
Vomit	4 (3.0)	1 (0.7)	nil	nil	nil
Diarrhea	2 (1.5)	5 (3.9)	5 (5.3)	4 (5.1)	nil
Hyperglycemia	46 (34.8)	49 (38.5)	45 (483)	27 (34.6)	26 (44.8)
Omission	11 (8.3)	13 (10.2)	6 (6.4)	1 (1.2)	2 (3.4)

Asp: Aspiration

The results in Table 9 indicates, there was no significant association between patients that received

early feeding more than 48 hours (M=10.16, SD=6.77) and the patients who received early feeding less than 48 hours (M=9.01, SD=8.74, t (130) =0.72, p=0.47 eta score, 0.004). The t-test was also conducted to compare the mean length of stay in ICU for the group receiving adequate calorie requirement and group receiving inadequate calorie requirement. The results of the analysis indicated a significant difference between the group received adequate calorie requirement (M=9.97, SD=8.09) and the group receiving inadequate calorie requirement (M=6.47, SD=4.90; t (97.15) =-2.82 p=0.006, eta squared= 0.06)

Table 9 Association between early initiation of enteral feeding and adequacies of calorie intake received by patients and length of stay (LOS)

	LOS			
	n	mean	SD	P*
Period of initiation				
Less than 48 hours	95	9.01	8.743	0.371
More than 48 hours	37	10.16	6.768	
Calorie received				
Less than requirement	32	6.47	4.90	0.006
Adequate or more than requirement	100	9.97	8.90	

4. DISCUSSION

Most of the patients (75.8%) received adequate caloric consumption. This is consistent in a study conducted in a ICU at a private tertiary care hospital in Philippines [10]. The authors found that calorie intake was achieved at day three after starting enteral feeding. The majority of the participants in this study were above 50 years of old with the mean age of 53.4 which support the findings of Chittawatanarat et al. [11]. This finding highlights the importance of extra nutritional support for older people when being admitted to hospital due to malnutrition [12].

This study also yielded some information on the ethnicity of the patients which reflects the composition of the population in terms of ethnicity. The majority of patients who received enteral feeding were Malays (52%) followed by Chinese (19.7%), Indians (18.2%) and others races (9.9%) including one aborigine and 12 foreigners. According to Yip et al., [8] Malays, mostly, choose traditional treatment in the early stage and they visit the hospital in critical poor nutrition condition. As a result, more intervention is needed compared to the other ethnic groups. They also reported that 40% of Malay patients went to hospitals only when the diseases such cancer was at the critical stage.

The majority of the patients (72%) had received early feeding within 48 hours of admission to ICU which corresponds with Malaysian Society of Anaesthesiologist [9] guidelines in the initiation of enteral feeding. Clinical stability and poor nutritional status are the factors which interrupt early initiation of enteral feeding [9, 13]. Findings of previous studies also unanimously agree that initiation of enteral feeding within 48 hours after injury or acute illness should be provided for patients requiring intensive care [14].

Provision of early feeding also affects patients' calorie intake as most of the patients achieved their caloric requirements three days after the commencement of their enteral feeding [15]. The findings of previous studies have also provided evidence on the effect of early nutrition support on the duration of patients' intensive care [16]. However, the findings of studies on the effect of early nutritional support on the duration of stay have been far from conclusive because patients who received early feeding had the longer length of stay [17, 18]. It appears that the existence of such variation may be due to different factors that include, but they are not limited to different study populations, types and severity of diseases, and age of patients.

In the context of this study, Enercal (n=57, 43.2 %,) and Glucerna (n=43, 32.5%) which are the polymeric types of formula were commonly used to provide nutritional support to patients with enteral feeding in ICU. Patients' tolerance to formula feeding has an influence on whether they can achieve the caloric requirement in the targeted duration of time. Therefore, enteral feeding should be given based on the guideline while deciding on the appropriate feeding formula for patients to avoid any harm [9]. As a result, establishing guidelines and provision of knowledge on appropriate nutrition are important [19]. However, different studies might yield different results as to appropriate formula for patients in ICUs [20]. In this study patients, who received enteral nutritional support following Nephro formula, were scarce (7.6%) because Nephro formula is suitable for patients with renal diseases since the caloric content is higher than the contents of fluid which is 2kcal/ml [21]. At the same time, it is more concentrated and patients need only half the volume to achieve adequate calories. Still this formula can lead to higher incidences of diarrhea and hyperglycemia.

A majority of the patients used continuous feeding on the first and second days, (68.2%) and (60.6%) respectively, while the choice of intermittent bolus feeding was increased on the third (55.5%) and fourth day (66.7%). Previous studies in the literature have provided support on the use of intermittent feeding on the grounds that patients reach adequacy of calorie intake earlier that continuous feeding [22, 23]. In contrast, continuous feeding is mostly used in acute phases; therefore there may be a delay in receiving adequate calories.

The statement is supported by Chen et al. [22] whereby most of the patients had used continuous feeding during the acute stage to increase intragastric pH that promotes bacteria growth and helps with diarrhea or prevention of dumping in some patients. However, in longer term, continuous feeding will have adverse effect such as aspiration pneumonia especially at night

The majority of patients in this study 75.8 % (n=100) received adequate caloric intake within five days of enteral feeding which support other studies which found that patients with enteral nutrition received caloric requirement after three days of enteral feeding [11, 24, 25]. However, many interruptions including but not limited to high gastric residual, vomiting, and extubation compounded with the severity of the diseases and patients' conditions may interfere with achieving of calorie requirement [26, 27].

Findings of this study also indicated that problems encountered during enteral feeding cause intolerance to enteral nutritional support and as a result affect the adequacy of calorie intake for the patient. High aspiration volume 200ml or more on day one for 9.8% of the patients was the major problem encountered during enteral feeding for this study. However, the aspiration was decreasing to 3.8% volume on day five. Gastrointestinal dysfunction causing intolerance to enteral nutrition is a common reason for not starting, or discontinuing feedings leading to inadequacy of caloric intake [5]. Hyperglycemia was found as another major problem encountered during enteral feeding with 48.3% (n=49) of patients having hyperglycemia during enteral feeding. This finding is in accordance with that hyperglycemia and insulin resistance were common in critically-ill patients with enteral feeding, even if they have no existing diabetes.

The current study found that there was an association between the adequacies of calorie intake received by patients and the patients' length of stay. According to Roberts et al. [16] the adequacy of calorie intake is important to ICU patients because it will reduce the length of stay and infections. In contrast, Higgins et al. [2] found that the adequacy of calorie intake was not associated with the length of stays among critically-ill ICU patients. They had discovered that other factors such as severity of illnesses had an influence on the outcome of the patients. Other studies discovered that the adequacy of calorie intake is important to improve the patients' outcome shortenings the need on IPPV support, to reduce infections, lengths of stay, and health care cost [28].

5. CONCLUSION

The majority of the critically-ill patients in this general ICU have received adequate calorie intake via enteral feeding but the number of patients received adequate calorie intake was still insufficient. The most common problems occurred during enteral feeding were hyperglycemia and omission of the feeding. Patients who received early enteral feeding and intermittent bolus within 48 hours of admission achieved adequate caloric intake compared to patients who started late and received continuous feeding. The length of stay was not influenced by early initiation of enteral feeding. However, there was an association between patients' length of stay and adequacy of caloric intake. The findings of this study provided invaluable insights to health care providers regarding early time and adequacy of caloric intake among patients in general ICUs. These findings heighten the awareness of health care providers to the importance of maintaining adequate caloric intake for their patients.

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