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Enteral Feeding in Surgical Critically Ill Patients

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Abstract

Objective: **To study current practice in prescribing enteral nutrition for surgical critically ill patients and to identify factors associated with the initiation, successful or tolerance to enteral nutrition and mortality related to feeding character.**

Patients and Methods: **Forty-four ventilator supported patients who were expected to stay in the ICU for more than 3 days with retained nasogastric tube in surgical intensive care unit, Siriraj Hospital and Faculty of Medicine, were enrolled in this prospective cohort study. Patients who tolerated feeding were followed for at least 7 days or until 11 days if feeding were not tolerated. Patients were ceased to follow-up if they were discharged from the ICU, changed to the other route of feeding, or expired. Time from ICU admission to initiation and tolerance of enteral feeding was recorded and factors associated with these events were examined. We defined tolerance or successful as being able to receive 80% of estimated daily energy requirement for more than 48 hours without gastrointestinal dysfunction (ie, high gastric residuals, vomiting, diarrhea, abdominal distention) and early feeding as the initiation of enteral feeding within 72 hrs after admission to ICU.**

Results: **All patients were started on enteral feeding with the median time of 4.5 days after admission. The main reasons for late enteral feeding included post-operative abdominal surgery (46.2%), post-operative neurosurgery (30.8%) and absent bowel sound (26.9%). The time required to reach nearly 80% of energy requirement was about 6-7 days after admission. Twenty out of 44 patients (45.4%) achieved tolerance of the regimen. Once started, the enteral feeding was decreased or discontinued if patients experienced gastrointestinal dysfunction or had feeding time longer than 3 days and we found that the most common reason is gastrointestinal dysfunction (37.5%) with the top three reasons being high gastric residuals, abdominal distention and absence of bowel sound. The median time of successful feeding in patients who were on feeding longer than 3 days was 4.5 days (average 4.5 ± 0.57 days). Major reasons for termination of follow-up in non-successful feeding were tolerance of feeding (21.05%), follow-up for more than 10 days (26.31%) and being discharged from ICU (42.11%). We found that in all patients, survival was not correlated with successful or tolerance of feeding and early or late enteral feeding ($p = 0.48$ and 0.29 respectively). On the other hand, the early feeding group was significantly correlated with successful of feeding ($p = 0.019$).**

Conclusions: **Enteral nutrition is not started early in all surgical ICU patients. Approximately half of all patients receiving enteral nutrition achieved tolerance or successful feeding. Post-operative abdominal surgery is the most common reason for delay feeding while gastrointestinal dysfunction causing intolerance to enteral nutrition is the most common reason for discontinuing feeding.**

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Introduction

The critically ill patients carry the risk of having malnutrition because of the stress from systemic inflammatory response and the nutritional status of patients. Malnutrition is significantly correlated with morbidity and mortality.[1,2] "When the gut works, use it" is the proverb of nutritionist for the promotion of enteral feeding. Enteral nutrition has many advantages. It is more physiologic, less expensive and convenient to take care of. Gut plays an important role in immunologic function. It also has the role in pathophysiology of unknown source of sepsis due to impaired gut barrier and induced bacterial translocation followed by respiratory failure and septicemia that may lead to multiorgan failure.[3,4] Enteral feeding promotes function of gut and gut integrity and prevents gut mucosal atrophy[5-9] which decreases septicemia in animal study.[10] Furthermore, it stimulates the immunoglobulin A from biliary system when compared to parenteral nutrition.[11] In burn patients, enteral feeding decreases the catabolic hormone.[12] When compared between early and late enteral feeding, evidence shows that early enteral feeding results in less septicemia,[13-16] improves the wound strength[17] and decreases the hypercatabolic state in flow phase after the assault.[18] In major traumatic patients, the early feeding within 12-18 hours after admission decreases the infection rate when compared to the late fed patients.[19,20] In critically ill patient without contraindication for enteral diet, the earliest reach for enteral route to achieve the target of energy is recommended. To the best of our knowledge there had been no data of enteral practice in Thailand. This study describes the current enteral nutritional prescription practice for critically ill patients in our institution and identifies factors that are associated with the initiation, successful or tolerance of enteral nutrition and relation of feeding character to mortality.

Patients and Methods

We conducted the prospective cohort study of patients in surgical and medical intensive care unit who were expected to survive for longer than 3 days, needed the ventilator support and retained nasogastric tube at Siriraj Hospital and Faculty of Medicine, Mahidol University, Bangkok, between December 2002 and March 2003. The study was approved by the Research Ethics Committee, Faculty of Medicine, Siriraj Hospital, Mahidol University. Following patients were excluded; those who expired within 3 days, those who did not need the ventilator support and those who were on other routes of enteral access such as gastrostomy or jejunostomy tube. The study was discontinued when the following criteria were met; successful feeding, patient expired, the route of the enteral access was changed or the patient was transfered to ward.

Data were divided into 3 parts. Part I was the demographic data (age, sex, diagnosis, underlying disease and SOFA score), part ll was data from the first day of admission which included basic laboratory and pertinent physical examination findings, and part lll was continued recording form on nutritional data, route of nutritional administration (enteral or parenteral), gastrointestinal tolerance and drug administration.

Energy requirement was calculated by Harris-Benedic equation and compared with the energy that the patients received. We defined early enteral feeding as feeding of enteral diet within 3 days after admission. Patients with successful enteral nutrition received at least 80% of total requirement by enteral route within 3 days after initiation. The intestinal intolerance were conditions with residual gastric content more than 50% of the amount fed each time or more than 200 ml before the next feeding, vomiting, diarrhea more than 6 times per day, abdominal distention and aspiration. During follow-up, we divided patients into 2 groups: early and late feeding groups. We recorded the reasons for late feeding and followed both groups for 10 days. Data were analyzed by student t test, Chi square test and Odd ratio by SPSS program.

Results

Patient characteristic

Data were collected from December 2002 to March 2003 in 3 ICU settings with the total of 44 patients. The number of male patients were higher than female patients but with no statistical significance ($p = 0.26$). Mean age at the time of admission was 53.86 ± 19.32 years. Major reasons for ICU admission included post-operation and trauma. The severity of diseases assessed by SOFA score was 5.73 ± 4.67. The hospital mortality

Table 1 Demographic data admission

Demographic data	
Number	44
Age	53.86 ± 19.32
SOFA score	5.73 ± 4.67
Albumin	2.70 ± 0.56
BMI	23.68 ± 5.18
Height	160.80 ± 7.19
Weight	61.42 ± 14.82
P/F ratio	295.92 ± 124.30

Table 2 Reasons for ICU admission

Admission reason	**Patients (%)**
Sepsis	
Respiration	0
Gastrointestinal	2 (4.5)
Neurologic	1 (2.3)
Other	1 (2.3)
Neurologic or COMA	2 (4.5)
Cardiac disease	0
Post-Operation	
Gastrointestinal	9 (20.5)
Neurologic	8 (18.2)
Sepsis	3 (6.8)
Shock	2 (4.5)
Trauma	
Neurological	9 (20.5)
Abdominal	6 (13.6)
Hypovolemia	1 (2.3)
Total	**44 (100)**

in this study group was 25%. The BMI of admitted patients was normal but albumin upon admission was only 2.70 ± 0.56 mg/dL (Table 1, 2).

Nutritional administration characteristic

We calculated the basal energy expenditure (BEE) by Harris-Benedics equation, the mean BEE was 1337.47 ± 239.6. Total energy expenditure (TEE) was 1352.41 ± 298.4 kcal /day. The mean enteral starting date was 4.02 ± 2.36 days and the number of patients with early enteral feeding was only 18 (40.9%) (Table 3).

The first three reasons for late enteral feeding included post-operative abdominal surgery (46.2%), post-operative neurological surgery (30.8%) and

Table 3 Energy profile, the enteral feeding starting date and the number of patients with early and late enteral feeding

Energy character	
BEE (kcal)	1337.47 ± 239.6
TEE (kcal)	1352.41 ± 298.4
First day feeding (from admit)	4.02 ± 2.36
Day feed more than 3 (day)	4.50 ± 0.57
Initial feeding	
Early	18 (40.9)
Late	26 (59.1)

Table 4 Reason for delay or late enteral feeding

Reason for late enteral feeding*	**Patients (%)**
Hemodynamic unstable	5 (19.2)
More gastric content	4 (15.4)
Postoperative abdominal surgery	12 (46.2)**
Postoperative neurological surgery	8 (30.8)**
Observation of neurological sign	2 (7.7)
Absent bowel sound	7 (26.9)**
Preoperative preparation	2 (7.7)
Abdominal distention	3 (11.5)
Delirium	1 (3.8)

**One patient may had more than 1 reason*
***First three most common reasons*

decreased bowel sound and hemodynamic instability (26.9%) (Table 4).

The mean percentage of energy obtained from enteral nutrition approached nearly 80% of energy requirement at 6-7 days after admission. After that parenteral nutrition was slowly decreased. But after 7th day, only the non-successful patients were followed up to 11 days and we found that the mean energy from enteral nutrition was only about 40-50% but the total energy received was about 100 %. (Table 5 and Figure 1)

Successful feeding (obtaining the enteral feeding up to 80% of total requirement) was found in 20 patients (45.4%) and non-successful feeding in 24 patients (54.6%). The 3 major reasons for non-successful feeding included gastrointestinal reasons, feeding longer than 3 days and termination of follow-up, (37.5%, 16.6% and 79.1% respectively) (Table 6, 7).

For the gastrointestinal reasons, we found that over 50% of residual content from nasogastric tube,

Table 5 Mean percent of total energy received, enteral and parenteral, to expected energy requirement

	Number	Total (%mean)	EN (%mean)	PN (%mean)
Day 1	44	21.89 ± 36.25	11.94 ± 32.21	9.67 ± 10.66
Day 2	44	46.35 ± 45.67	25.83 ± 46.37	20.52 ± 26.22
Day 3	44	60.95 ± 51.46	31.37 ± 48.68	29.58 ± 40.76
Day 4	44	71.61 ± 50.35	42.62 ± 51.79	28.00 ± 41.01
Day 5	40	79.58 ± 40.76	56.80 ± 46.23	22.77 ± 32.37
Day 6	38	96.97 ± 37.23	72.04 ± 51.29	22.97 ± 36.35
Day 7	37	93.23 ± 45.15	72.90 ± 54.28	20.33 ± 36.24
Day 8	16	93.91 ± 46.10	52.54 ± 47.77	42.06 ± 51.23
Day 9	11	104.63 ± 44.33	52.75 ± 61.32	53.44 ± 57.25
Day 10	10	101.33 ± 81.05	44.81 ± 47.94	59.83 ± 71.04
Day 11	10	81.82 ± 41.59	40.72 ± 48.22	46.36 ± 47.22

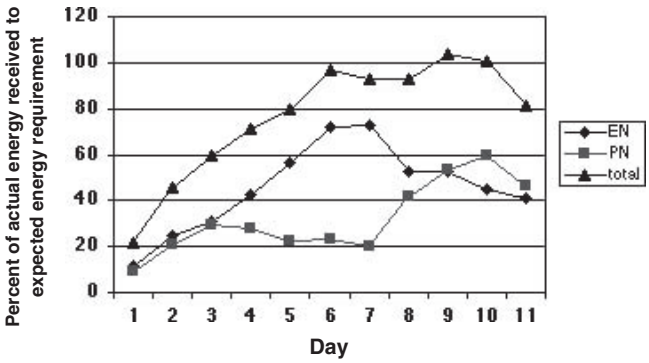

Figure 1

Table 6 Successful and non-successful feeding

Success of feeding	No. of patients
Successful	20 (45.4)
Non-successful	24 (54.6)

abdominal distention and decreased bowel sound were the top three causes of unsuccessful feeding. The mean, median and mode in patients who reached 80% of energy requirement from the enteral feeding longer than 3 days were 4.50 ± 0.71, 4.5 and 4 respectively. The first three reasons to terminate follow-up included follow-up for more than 10 days, receiving feeding more than 80% of requirement and discharge from ICU, respectively.

Regarding the correlation of hospital discharge status and the feeding character (early or late, successful or non-successful), it was found that survival was not correlated with feeding character. However, successful

Table 7 Reasons for non-successful feeding

1. Gastrointestinal reasons	9 (37.5)
Over 50% of residual content	6*
Abdominal distention	4*
Absent bowel sound	3*
Vomiting	2
Aspiration	1
Self removal of NG tube	1
Diarrhea over 6 times/day	0
Upper GI hemorrhage	0
Esophageal perforation	0
2. Feeding longer than 3 days	4 (16.6)
Mean ± SD	4.5 ± 0.57
Median	4.50
Mode	4
3. Follow-up termination	19 (79.1)
Discharge from ICU	8*
Follow-up for over 10 days	5*
Tolerance of feeding	4*
Change of route	3
Expired	0

** First three most common reasons, one patient may have more than 1 reason)*

Table 8 The correlation of character of feeding to the discharge status

Parameter	p
Successful feeding vs Survival	0.484
Early enteral feeding vs Survival	0.288
Early enteral feeding vs Successful feeding	0.019*

feeding was significantly correlated with patients with early enteral feeding (Table 8).

Discussion

Nutritional therapy is an important part in the management of critically ill patients. Galanos showed that BMI correlated with survival of patients. When patient's BMI increases, survival increases.[21] Critically ill patients have the risk of intolerance to enteral nutrition from many mechanisms such as gastro-esophageal reflux or aspiration, gastroparesis, duodenogastric reflux, gastric alkalinization, decreased mucosal perfusion, impaired intestinal transit, increased colonization, increased permeability and decreased mucosal immunity.[22] Timing for the start of feeding is controversial in one meta-analysis, at least 18 studies showed the benefit of early enteral feeding compared with late or delayed enteral feeding but most of these studies included surgical, trauma and burn patients.[23] Early enteral feeding may have adverse effect. Ibrahim et al. found that there were higher infection rates in medical critically ill patients who had early enteral feeding in addition to prolongation of ICU admission.[24]

In most of the critically ill patients, the quantity of energy given was inadequate. De Jonghe et al. had surveyed the critically ill patients and found that the mean energy that patients received were only 10 kcal/kg[25]. The main source of energy for this group of patients was from enteral route. Unfortunately, it was inadequate due to various reasons. Therefore, parenteral nutrition plays an important role to fill up for the remaining required energy. Marcia et al. showed that nasogastric tube feeding alone was inadequate and inconsistent when compared to partial parenteral nutritional support[26].

To the best of our knowledge there were no data about the nutritional support in critically ill patient in Thailand especially regarding the enteral nutrition. We concentrated on the question of timing, quantity and route of feeding. We found that only 45.5% of patients in surgical intensive care units were successfully fed compared to 42.9% as reported by Heyland et al.[27] Average initiation time of feeding in surgical patient was 4.5 days after admission. Only 40.9% of patients were fed within 72 hours. The reasons for delay feeding included post-operative abdominal surgery and post-operative neurological surgery (77%). The enteral feeding reached 80% of required energy in 6-7 days. Schroeder et al. found that patients who were fed early after post-operative abdominal surgery had shorter wound healing time ($p < .05$) but the complications and hospital stay were not statistically significant.[28] Carr et al. similarly found that patients with early enteral feeding after post-operative intestinal surgery had significantly less complications than those with delay feeding ($p < .005$).[29]

Gastrointestinal intolerance was the main problem in non-successful feeding and was found in 37.5% of our study and the first three main reasons included residual content in excess of 50%, abdominal distention and decreased bowel sound. The causes of decreased bowel motility included anesthetic drug,[30] morphine, proton pump inhibitor, vasoactive drug and antibiotics.[31] The previous study showed that the main cause of non-successful feeding was residual gastric content which affected 51% of patients.[27]

Four patients (16.6%) who were fed longer than 3 days had successful feeding with an average of 4.5 ± 0.57 days. This data suggested that the delay to nutritional target may be due to the usual clinical practice. Mc Clave et al. found that half of patients did not meet the nutritional requirement due to clinician's order.[32] Therefore nutritional practice guideline should be implemented in intensive care unit.

Regarding the correlation between discharge status and character of feeding, we found that the character of feeding was not significantly correlated with survival although the early feeding was correlated with successful feeding ($p = 0.024$). This result contrasts with prior studies, but this is the secondary outcome. However, due to the small number of patients, the conclusion cannot be drawn at this point and further investigation is required.

Summary

Enteral nutrition is not started early in all surgical ICU patients. Approximately half of all patients receiving enteral nutrition achieved tolerance or successful feeding. Post-operative abdominal surgery is a common reason to initiate feeding while gastrointestinal dysfunction causing intolerance to enteral nutrition is a common reason for discontinuing feeding.

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