

Enteral Nutrition In 6 Malaysian Intensive Care Units: A Point Prevalence Study of Prescription Practices

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ABSTRACT

INTRODUCTION: Enteral nutrition (EN) is the first line of nutrition therapy for critically ill patients with an intact gastrointestinal tract. Even though intensive care units (ICUs) generally have established feeding protocols, prescribing practices to achieve nutrition goal is still widely variable among intensive care practitioners. The aim of this study was mainly to investigate commonly prescribed types and energy concentration in EN formulations including protein prescription. **MATERIALS AND METHODS:** This was an observational, point prevalence study, involving six level 3 ICUs in Malaysia. All patients aged type of EN formulation and protein prescription recorded. **RESULTS:** A total of 109 patients were included in the analysis out of which 78% of them were mechanically ventilated. At the point of the study, more than 16 years of age in the participating ICUs on the 11th of October 2016 were enrolled in this study and 71.5% (78/109) received EN. Among the EN group, 68% (53/78) received standard formulation feeds (1kcal/ml) while the rest received energy dense formulation (>1kcal/ml). Fluid restriction was the main indication for energy dense formulation prescription, occurring in almost all (24/25) of the patients. There was no report of feeding intolerance. Only 2/109 received parenteral nutrition (PN) giving the EN to PN ratio of 30:1. The mean protein prescription was 0.9g/kg (SD± 0.4). **CONCLUSION:** Prescription of EN was 30 times more frequent than PN in these ICUs. In those receiving EN, standard formulation feed was 3 times more commonly prescribed than energy dense feeds with fluid restriction being the main indication of the latter. Protein prescription was less than the guideline recommendation.

KEYWORDS: enteral nutrition, prescription practices, intensive care, standard formulation feeds, energy dense feeds

INTRODUCTION

Providing nutrition is essential in managing the critically ill patient. It prevents exacerbation of pre-existing malnutrition and wasting of lean body mass as these patients are typically in catabolic state evidence by systemic inflammatory response and multiorgan dysfunction. Initiation of nutrition has changed from an adjunctive therapy for maintenance of homeostasis thus modulating of immune response and preventing oxidative cellular injury.^{1,2,5}

Enteral nutrition (EN) is defined as nutrition provided through the gastrointestinal tract via a tube or stoma that delivers nutrient distal to the oral cavity. Among the reported advantages of EN include modulation of stress responses, maintenances of gut integrity, attenuation of disease severity and for stress ulcer prophylaxis. The European Society for Parenteral and Enteral Nutrition (ESPEN) in 2016 recommends starting EN in patients who are not expected to be on a full oral diet within 48 hours of admission as dangerous depletion of lean tissue may occur after 14 days of starvation.³ These critically ill patients also may be at risk of malnutrition after a 48 hours of hospital stay.³ A meta-analysis of 12 trials in 2009, showed significant reductions in infection morbidity when early enteral nutrition was started on average within 36 hours of ICU admission.⁴ An updated meta-analysis of 21 randomized control trials in 2016,

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comparing the provision of early EN versus delayed EN demonstrated that provision of early nutrition was associated with a significant reduction in mortality and infectious morbidity.⁵

The energy requirement for prescription of nutrition is ideally calculated via measured energy expenditure using indirect calorimetry. Weight based formula (20-25 kcal/g/day) and other formula based on resting energy expenditure e.g., Harris Benedict Equation that may be used as a guide. ESPEN 2018 recommends that in any critically ill mechanically ventilated patients, energy expenditure should be determined by using indirect calorimetry³. If indirect calorimetry is not available, the measurement of exhaled carbon dioxide (VCO₂) from the ventilator can be obtained to calculate the resting energy expenditure (REE) is recommended as it is more accurate than the weight base formula.³ Despite the accuracy, these devices is not widely available, thus simpler method of weight base formula is preferred among local clinicians with risk of inaccuracy in prescribing.^{6,7} An international survey on nutritional practices conducted in 167 ICUs across 37 countries, 69% received EN alone, and while mean daily energy prescribed was 24kcal/kg/day, only a mean of 14kcal/kg/day was delivered.⁸

To achieve EN goals early in a feeding intolerant patient, the use of promotility drugs, intravenous erythromycin with or without combination intravenous metoclopramide may be initiated.⁹ Small intestinal feeding or post pyloric feed is another method that can be introduced but require local expertise.¹⁰ Alternatively, energy delivery can be hastened to achieve early EN goals using an energy dense feed (>1kcal/ml).^{11,12}

A point prevalence study of EN prescription practices done in 38 ICUs in Australia and New Zealand in the year 2012 with a total of 522 patients showed 40% of those patients received EN with near equal distribution of patient receiving standard feeding (1kcal/ml) and energy dense feeding (>1kcal/ml).¹³ In Malaysia data on EN prescription practices is still limited, especially among critical care patients.

A single day point prevalence study was held on the 11th of October 2016 in six different tertiary hospital ICUs. The main purpose of this study was to investigate the prescribing practices of providing EN in critically ill patients. Additional data on types of

EN, indication for energy dense feeds, semi-elemental feeds and parenteral nutrition were also collected. The primary aim was to determine the types of EN most commonly prescribed by the intensive care doctors in Malaysia. In addition, we would like to determine the proportions of patients on EN were prescribed on energy dense or semi-elemental formula with their indications. Patients on PN were also collected with their indications. We hypothesized that EN is more commonly prescribed than PN, with frequent use of standard formula compared to energy dense formula.

MATERIALS AND METHODS

Six tertiary level ICUs audit participated in this study. Approval was obtained from the relevant authority and research ethics committee of each hospital. It was an observational point prevalence audit on the chosen date of 11th October 2016. All adult patients (more than 16 years old) who were in the ICUs at that point of the day were recruited. This study was approved by Malaysia Research Ethical Committee (NMRR-16-1251-31432). Informed consent was waived as this study was observational in nature.

Surveillance information attained were patient's demographic (age, gender, weight, height). Source of admission, admission diagnosis, days of hospital admission, simplified acute physiology score (SAPS II) and sequential organ failure assessment score (SOFA) on admission and whether the patient was on invasive or non-invasive ventilation.

Specific information on EN includes the number of patients on EN, methods of EN delivery, days of EN, formula (brand) of EN. Also obtained were the divisions of patients receiving standard formula, dense energy formula and semi-elemental formula with each of their indications and prescribed protein.

Statistical Analysis:

The prevalence of patients on EN was described by descriptive analysis in each of the EN characteristic. Variables were reported as mean (SD) and median as appropriate. Formal sample size was not calculated as the objectives were descriptive in nature. However, to represent a usual clinical practice, sample sizes of at least 100 are believed to be

Table 1. Patient information

	Total Patients Recruited	Enteral Nutrition	Parenteral Nutrition
No. of patients	109	78	2
Mean Age, Years (SD)	50.7 (SD±17)	49 (SD±18)	70 (SD±17)
Male Sex (%)	65%	63%	50%
Mean Weight, Kg (SD)	68.6 (SD±17)	68.2 (SD±16)	58.5 (SD±17)
Source of Admission (%)			
Emergency Department	52.2%	53%	
Ward	46.7%	46%	100%
Hospital transfer	1%	1%	
Median Hospital Stay, Days	7	7	9
Mean SAPS II, no. (SD)	42.5 (SD±20)	44 (SD±19)	46 (SD±19)
Mean SOFA, no. (SD)	7.8 (SD±4)	8.3 (SD±4)	9.5 (SD±4)
Ventilation (%)			
Invasive	78%	88%	100%
Non-Invasive	0.05%	1%	
Mask	17%	11%	
Median Feeding Days, Days	5	5	4

SOFA = Sequential Organ Failure Assessment, SAPS II = Simplified Acute Physiology Score

enough. Information was collected in Excel Format and were analysed using IBM SPSS Statistics. Results were reported by descriptive statistic.

109 patients from six tertiary ICUs in peninsular Malaysia were enrolled. Patient characterizations were as per Table 1 with the youngest and oldest were sixteen and eighty-three, predominantly male. Mean weight was 68.2kg (SD±17.8), with the highest was 160kg whom was on non-invasive ventilation and was kept nil by mouth. On the day of the study 85 out of 109 patients (78%) of patient were mechanically ventilated, while 5 (0.05%) were put on non-invasive ventilation. There was a near equal distribution from source of admission with 57 (52%) of patients were admitted from the emergency department and 51 (46.7%) were from ward transfer.

Looking into EN, 68 out of 85 (80%) mechanically ventilated patients were prescribed on EN. However, a total 19 (17%) of patients were kept nil

Table 2: Characteristics of patients on EN

	Standard formula (1kcal/ml)	Dense Energy Formula (>1kcal/ml)
No. of patients	53 (68%)	25 (32%)
Mean Age, Years (SD)	49 (SD±15)	52 (SD±17)
Male Sex (%)	60%	80%
Mean Weight, Kg (SD)	65 (SD±16)	70 (SD±13)
Source of Admission (%)		
Emergency Department	51%	52%
Ward	49%	44%
Hospital transfer	0%	4%
Median Hospital Stay, Days	6	7
Mean SAPS II, no. (SD)	41 (SD±18)	54 (SD±17)
Mean SOFA, no. (SD)	8(SD±4)	10 (SD±4)
Ventilation ((%)		
Invasive	87%	92%
Non-Invasive	2%	0%
Mask	11%	8%
Median Feeding Days, Days	4	6

by mouth on the day of the study, with multiple indications that were not recorded. When comparing types of feeds, 53 out 78 patients (68%) were given standard formula (1kcal/ml), while 25 patients (32%) were prescribed dense energy formula (>1kcal/ml). Table 2 described in the characteristics of the patients being prescribed on EN comparing standard formula which include semi-elemental and dense energy formula. Among the EN formula used in these intensive care units Novasource were the most prescribed (25 out of 78, 32%) and it was the only formula that being prescribed in the dense energy formula group. Variation of formula was seen in the standard formula group with Ensure being the most prescribed (23 out of 78, 29%).

Indications for starting dense energy formula was mainly for fluids restriction purposes (24 out of 25, 98%), while the remaining patient were prescribed on dense energy formula because of hypernatremia. On that day none of the patients on dense energy formula were due to achieving early EN goals with the background of intolerance to standard energy formula.

Table 3. Types of enteral nutrition prescribed

Standard formula (1kcal/ml) n=53 (68%)		Dense Energy Formula (> 1kcal/ml) n= 25 (32%)	
Formulation	No. (%)	Formulation	No. (%)
Ensure	23 (29%)	Novasource (2kcal/ml)	25 (32%)
Nutrien diabetic	13 (17%)		
Glucerna	10 (13%)		
Optimax	3 (3.8%)		
Jevity	2 (2.6%)		
Semi-elemental			
Peptamen	2 (2.6%)		

The EN: PN ratio was 30:1 with 2 out of 2 patients that were prescribed on parenteral nutrition were on bowel rest post intraabdominal surgery. None was reported due to intolerance to EN.

DISCUSSION

Our point prevalence study suggests that most of adult ICU patients (72%) received EN on the day of study. Out of these, standard formula was more frequently prescribed as compare to dense energy formula (68% vs 32%). For standard formula EN, the types of formulation were mainly based on each individual hospital protocol, but mainly given to tailored towards glycaemic control and feeding intolerance. Unfortunately, the method of calorie prescription was not captured on that day, but we assume that calorie prescription was mainly from the simplistic weight base equation due to ease of use with each patient being prescribed up to 25-30kcal/kg/day. Applicability of indirect calorimetry may be limited by institution availability and cost.

As with protein, the prescription in these sets of critically ill patients is lower than being recommended. From the data above, mean prescription was 0.9g/kg (SD±0.2). Despite the weak evidence, there is a strong consensus from ESPEN 2016 recommending protein prescription of up to 1.3g/kg/day progressively in the critically ill patients³. Protein is the most important macronutrient in wound healing, supporting immune function and maintaining lean body mass.¹⁴ During the first day of sepsis protein synthesis is severely diminished while protein breakdown is greatly increased.¹⁵ ICU related diseases such as sepsis,

trauma, and surgery added in with contributing comorbidities leads to a high degree of inflammatory process whereby it causes higher circulating cytokines, activating protein catabolism.¹⁶ The increased in proteolysis in critical illness causes muscle loss up to 1 kg/day, which can turn to the complications of ICU acquired weakness.¹⁷ A cohort study of 801 patients from 2004 - 2012 showed for each 1g/kg increase in daily protein delivery, the 90 days post-discharge mortality is reduced by 17%.¹⁸ However, a higher level of intake (1.9g/kg) did not improve the protein-sparing effect.¹⁹ In a retrospective study of 455 patients it was suggested that although overall low protein intake is associated with the highest mortality, high protein intake (1.2g/kg/day) during the first 3-5days of ICU stay is also associated with increased long term mortality.²⁰ Therefore, although care must be given in the intake of protein, the timing of intake might need to be considered during the prescription of protein for the critically ill.

88.9% of patients on EN in this study were being given through bolus methods (A feed for every 3 hours) and 10% were on continuous infusion. ESPEN 2016 recommends switching bolus feeding to continuous feeds in high risk patients or those who shows intolerance³. Few small RCT comparing bolus and continuous infusion have shown fewer interruption in the delivery of enteral nutrition with continuous feeds, but no significant difference in outcome^{21,22} except these patients on bolus feeding reached the prescription goal faster by day 7.²³ In terms of glycaemic control a randomised control trial involving 50 patients did not demonstrate clinically relevant differences between insulin use and glycaemic variability between bolus vs continuous EN.²⁴

A total of 32% of patients being prescribed on dense energy feeding. Most were being given for the indication of volume restriction while maintaining full energy goals. The patient was usually prescribed on dense energy feeding based on their pre-morbid or due to single or multiple organ damage. There were no reported data on using dense energy feeding to hasten the achievement of calorie target in patient with intolerance to standard formula feeds. Feeding intolerance can be determined by physical examination, including abdominal examination, passage of flatus and stool and

radiological evaluation (abdominal film). Suggestion of intolerance are vomiting, abdominal distension with discomfort, high nasogastric output, high gastric residual volume (ESPEN recommendation > 500mls), diarrhoea, constipation and presence of dilated bowel in abdominal film. As intolerance leads to cessation feeds, exacerbation of ileus can be complicated with frequent and long periods of cessation.²⁵ Besides prescription of promotility drugs (metoclopramide and erythromycin) and post gastric feeding, prescription of energy dense feeding (>1kcal/ml) can be recommended especially for the volume intolerance patient. In a paediatric study it was shown that the prescriptions of dense energy feeding to increase energy delivery in a small group of non- critically ill children were successful. However, it remained to be certain whether early enhancement of energy delivery will contribute to a general reduction in morbidity and mortality.²⁶

The prescription of parenteral nutrition (PN) in this study was mainly due to post intraabdominal surgery, in which patient was put in bowel rest. No data reported for initiation of PN due to enteral feeding intolerance. Our study shows an EN to PN ratio of 1:30. Guidelines from ESPEN 2016 suggested that supplementary PN can be prescribed within three days of inability to meet more than 60% of energy and protein goals by enteral nutrition alone and must be weighed on a case by case basis.³ All measures must be attempted to maximize EN tolerance before the decision to start on PN.

This study has pointed out that up to 71.5% of patients admitted to the ICU were being fed via EN. The main outcome measure from this point prevalence study is to understand better prescription practices among ICU caregivers in Malaysia. With this preferential technique of prescribing nutrition to critically ill patients, more emphasized should be placed on optimization of EN. This will ensure target energy and protein requirements were met and caloric balance is maintained in all critically ill patients.

Prescribing EN is more practical and safer as compared to PN. The most consistent outcome in comparing EN over PN is the reduction in infectious morbidity with two meta-analyses show a greater reduction in infectious morbidity when comparing EN over PN.²⁷⁻²⁸

Study Limitations

The study poses several limitations; among were, the patient sole nutrition prescription of that day was captured despite the patient may be on several other EN/ PN prescription during the entire ICU stay depending on the stages of his/her illness. The study also did not examine patients with feeding intolerance, which can contribute to the number of patients being put on nil by mouth during study day or were prescribed on PN. EN prescription was also may be limited by the risk of refeeding syndrome and nutrition risk as assessed by NUTRIC or NRS 2002 scores which were not reported in this study. Another limitation was the estimation of protein intake which was mainly based on the calculations of the protein content of the EN prescribed at the time of observation. Data on the supplemental protein was not recorded.

The result from this study may not be appropriate to other ICUs especially in non-tertiary hospital as their hospital may not have enough equipment such as feeding bags thus making their feeding protocol limited to bolus delivery. This point prevalence study is a random snapshot of prescription practices which does not represent the general practices in our hospital critical care settings. Nevertheless, the result of this study has identified the variation of enteral feeding prescribed in 6 Intensive care units in Malaysia. This information is important, as these findings will support future research in evaluating optimal nutrition delivery and its outcome.

CONCLUSION

This point prevalence study proposes that enteral nutrition was overwhelmingly more common than parenteral nutrition among critically ill patient with the EN: PN ratio of 30:1. Standard formulations EN were more frequently administered as compared to dense energy feeding. However, despite the prescription of dense energy EN may have a role in meeting early energy goals especially in feeding intolerance; we were unable to provide any data on this practice in this study.

Competing interests:

None declared.

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