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Surveys

Enteral Nutrition in the Critically Ill: A Prospective Survey in an Australian Intensive Care Unit

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SUMMARY

Nutritional support is routine practice in critically ill patients and enteral feeding is preferred to the parenteral route. However this direct delivery of nutrients to the gut is potentially ineffective for a variety of reasons. We performed a prospective audit of 40 consecutive intensive care patients to determine whether enteral feeding met the nutritional requirements of our patients. The ideal requirements for each patient were calculated using the Harris-Benedict equation with an adjustment determined by the patient's diagnosis. We compared the amount of feed delivered with the daily requirements over a seven-day period. Successful feeding was defined as the achievement of 90% of the ideal calorie requirement for two consecutive days. The mean calculated (±SD) energy requirement was 9566kJ (±2586). Patients received only 51% (SD 38) of their energy requirements throughout the study period. Only 10 patients (25%) were successfully fed for at least any two-day period in the seven days. Feeding was limited mainly by gastrointestinal dysfunction or by the need to fast the patient for medical, surgical and airway procedures. Success of feeding was not related to the use of sedative or paralysing agents and had no correlation with plasma albumin concentration. There was no difference in the volume of feed delivered to patients who survived or died. Prokinetic agents were used in 25 patients and in these patients there was a trend towards improved delivery of feed.

Key Words: NUTRITION: enteral, energy, critical illness

The increase in morbidity and mortality associated with malnutrition in hospitalized patients has led to nutritional support becoming common practice in the intensive care unit[1,2]. Since oral intake is usually impossible in these patients, both the enteral and parenteral routes are routinely used. Studies comparing parenteral with enteral nutrition favour the enteral route since it is associated with lower infection rates[3,4], better wound healing[5], reduced mortality[6] and lower cost[7]. In addition, enteral nutrition preserves gut mucosal integrity[8] which may act as a barrier against the endogenous bacteria implicated in the pathogenesis of nosocomial pneumonia, sepsis and multiple organ failure[9,10]. However, enteral nutrition often fails to deliver the desired energy requirements for critically ill patients whilst parenteral nutrition reliably achieves nutritional goals[11,12]. Enteral feeding is also associated with its own complications. These include gastrointestinal dysfunction, metabolic sequelae, mechanical problems with delivery[13], and an increased risk of aspiration with subsequent development of pneumonia[14].

The aim of this audit was to evaluate the adequacy of our feeding protocol and define the factors which influence the delivery of nutrition in a group of critically ill patients in a mixed medical-surgical intensive care unit.

METHODS

The study was conducted in a level 3 general intensive care unit. Ethical approval for the audit was obtained from the Research Ethics Committee of the

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Royal Adelaide Hospital. Patients requiring enteral nutrition were prospectively enrolled. Data were collected for a seven-day period unless death or discharge from the intensive care unit occurred sooner. Prior to initiation of enteral feeding, the unit dietician determined the ideal daily energy requirements for each patient. The ideal energy requirement was taken as the product of the basal energy expenditure calculated using the Harris-Benedict equation and an injury factor determined by the patient's admission diagnosis[11,12]. This value was then set as the patient's goal for each day of the study period. All patients received an iso-osmotic feed (Osmolite, Ross Laboratories, Columbus, Ohio) via a naso-enteric tube. The volume of feed administered determined the number of calories delivered each day and this value was compared with the daily goal. Successful enteral feeding was defined as achieving 90% of the ideal calorie requirement for two consecutive days[15]. The age, gender, diagnosis, admission APACHE II score, time to commencement of feeding, reasons for reducing or ceasing feeding, the use of sedative, paralysing or prokinetic agents and daily plasma albumin levels were also recorded.

For each patient we compared the actual energy intake with their ideal estimated requirements for each day of the study. Statistical analysis was performed with Minitab 13 for Windows using Pearson's correlation coefficient, two-sample t-test and one-way ANOVA. A P value of 0.05 was considered significant in all analyses. Data are mean ±SD unless otherwise stated.

RESULTS

Forty consecutive patients were studied; 10 female and 30 male. The patients had a median (range) age of 52 (14 to 84) years, weight 79 (35 to 140) kg and APACHE II score 20 (8 to 43). Admission diagnoses to the Intensive Care Unit are shown in Table 1.

Feeding was commenced four days (0 to 15) following admission to ICU. Enteral nutrition was the sole source of nutrition for 38 patients. The remaining two patients received supplemental parenteral nutrition, one for one day and the other for four days during initiation of enteral feeding. Thirty-nine patients were fed via a nasogastric tube and one patient via a nasojejunal tube. Thirty patients (75%) were fed for the entire seven days. Thirty-two patients received morphine, sixteen received neuromuscular blocking agents. The mean ideal energy requirement was 9566±2586 kJ per day.

Values for day 1 were excluded due to the time delay between the decision to commence feeding and delivery of feed. Figure 1 shows the average daily energy intake. Patients received an average of 51±38% of the their ideal energy requirements during the entire study period. The effect of the admission diagnosis on the success of feeding is shown in Table 1. Using the criteria stated previously only 10 patients (25%) were successfully fed during the seven-day study period.

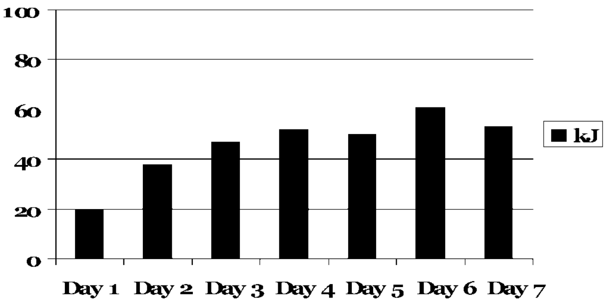

FIGURE 1: Mean percentage of nutritional goals received each day.

There were a variety of causes for the failure to deliver the prescribed feed (Table 2). The major reason was gastrointestinal intolerance which accounted for approximately 50% of failed feeding. There was no association between the volume of feed delivered and the use of neuromuscular blocking agents (P=0.73), the dose of morphine (r=–0.096, P=0.11), the dose of midazolam (r=–0.065, P=0.28),

TABLE 1

Number of patients in each diagnostic group and effect on percentage of nutritional goal achieved

Diagnosis	Number	Percentage nutritional goals achieved Mean (±SD)
Medical	19	49 (37)
Trauma (excludes head trauma)	7	37 (22)
Neurological (includes trauma)	6	43 (23)
Surgical	4	64 (23)
Burns	4	71 (25)

TABLE 2

Major causes for cessation of enteral nutrition in critically ill patients

Reason	Number of patient days
Gastrointestinal dysfunction: large aspirates, vomiting, distension, diarrhoea	57
Airway procedures: planned extubation, tracheostomy insertion, tube change	30
Procedures: visits to radiology, hyperbaric oxygen treatment, theatre, radiotherapy	19
Other: no supply, unstable, problems with jejunostomy, involvement in an investigational study	12

or either the plasma albumin concentration on day 7 (r=–0.091, P=0.68) or the change in plasma albumin concentration over the study period (r=–0.001, P=0.9).

There were 13 deaths in the study group. There was no difference in energy intake between patients who survived (51% of goal) or died (48% of goal) (P=0.124).

Prokinetic agents (erythromycin, cisapride or metoclopramide) were used in 25 patients at some time during the seven days. This group of patients had an average energy intake of only 31% of the estimated goals compared with 53% in those who did not receive a prokinetic agent. Overall there was no significant improvement in the success of feeding following the use of prokinetic drugs, although where it was possible to assess the effects of these agents, eight out of 14 patients had increased delivery of feed after the administration of the drugs.

DISCUSSION

In this study enteral feeding did not meet the nutritional goals of 40 unselected critically ill patients. Patients received only 51% of their ideal energy requirements and only 25% of patients met the criteria for successful feeding at any time in the seven-day audit period. A number of previous studies have also reported low success rates[15] and inadequate delivery of calories[16-18] with enteral nutrition. Thus while the provision of nutrients via the gut lumen has become the preferred means of feeding critically ill patients, this may result in only partial feeding[19].

The two most frequent causes for the failure to meet target feeding goals were slow gastric emptying as indicated by large volume gastric aspirates, and fasting in preparation for airway procedures or prior to surgical or radiological procedures. The high incidence of gastrointestinal intolerance is in agreement with data from a number of other studies[13,15,17,20]. Slow gastric emptying in the critically ill may result from a number of factors. In this study, Intensive Care Unit admission diagnosis had limited influence on feeding success (Table 1). However patients with intracranial pathology or neurotrauma appeared to be less successfully fed than other groups. Patients with head injuries have been reported to have a high incidence of gastric dysmotility and delayed gastric emptying and our data are consistent with this.

A variety of approaches have been suggested to overcome slow gastric emptying. These include the use of prokinetics[21,22] or naso-duodenal/jejunal feeding[23]. Our data show that patients selected to receive prokinetic agents had a lower initial success rate for feeding. The improvement with prokinetic drugs was modest, although more than 50% of the patients who received these had an increase in delivery of feed. The choice and timing of prokinetic drug administration were however left to the discretion of individual clinicians and it is therefore not possible to determine the relative effect of individual agents. A more standardized approach to the use of such agents could improve the delivery of enteral feed in view of the reports of enhanced gastric emptying during routine use of cisapride[24]. We have also previously reported that the short-term use of erythromycin is associated with an increase in the success of feeding[25].

Post pyloric placement of feeding tubes has been reported to improve delivery of enteral nutrition. The one patient in our study who had a post pyloric tube achieved an average of 94% of the nutritional goals over the seven-day study period. However, positioning of these tubes can be difficult and may require endoscopy or other placement techniques[26]. In addition, although jejunal feeding may reduce the complications associated with enteral feeding, it does not eliminate these entirely[27].

Fasting prior to procedures or investigations was another major reason for interrupting delivery of enteral nutrition. Although little can be done to prevent these situations, fasting times can be minimized to prevent prolonged delays in nutrient delivery. In addition, the formula can be restarted at the rate reached immediately prior to fasting to avoid further delays in establishment of the feed volume.

Assessing the nutritional requirements for critically ill patients is difficult. In the current study the basal energy expenditure was calculated using the Harris-Benedict equations and the value increased between 20% for single organ dysfunction such as pneumonia to 100% for severe burns. It is thus possible that feeding goals in the current study were initially set too high. Indirect calorimetry has suggested that energy requirements of the critically ill are similar or even reduced compared to healthy subjects with the hypermetabolic nature of many disease states offset by inactivity[12]. In addition, clinical interventions such as early debridement of a focus of infection or the maintenance of body temperature for patients with severe burns may result in a reduction in energy expenditure. However, other studies have suggested that energy requirements may increase during prolonged admissions to Intensive Care Units[28]. It is therefore possible that the nutritional goals in some patients may have been excessive. However, delivery of feeds reached a plateau at about 50% of the calculated requirements and it is unlikely that the entire discrepancy between the desired and achieved feeding can be attributed to this.

The effect of feeding on outcome in critically ill patients is unclear. Early successful feeding with immunonutrition has been reported to improve outcome compared with unsuccessful feeding using the same enteral formulation[29]. This suggests that successful feeding itself may be of benefit. This does not concur with the view that any delivery of nutrient is sufficient to prevent breakdown of the gastrointestinal mucosal barrier. Currently feeding goals calculated using the Harris-Benedict equation are widely used in practice, and it would seem logical that prolonged restriction in energy or protein administration is likely to be deleterious. In some patients, this may require supplemental parenteral nutrition to fully meet patient energy and nutrient requirements[19].

In summary, we have demonstrated that the delivery of nutrition by the enteral route in critically ill patients is frequently inadequate. The implementation of a more aggressive feeding policy, systematic use of effective prokinetic agents and the use of post pyloric feeding may improve the delivery of nutrients. Further studies are also required to delineate the actual energy requirements of critically ill patients.

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