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Nutrition in the critically ill patient

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Critical illness presents with the classic response to stress, including hypermetabolism and increased catabolism, resulting in a negative energy and nitrogen balance. These harmful events initiate the immunological response, starting with the systemic inflammatory response syndrome, which, if not resolved, may lead to multiple organ dysfunction syndrome (MODS). Furthermore, patients who do not develop early MODS manifest a compensation anti-inflammatory response syndrome, which suppresses immunity and predisposes the patient to sepsis, thereby increasing the risk of late MODS and ultimately death. The use of specialized nutrition support, including enteral nutrition (EN) and parenteral nutrition (PN), has been initiated in an attempt to preserve muscle wasting and decrease catabolic response. Other implementations, including hypocaloric feeding and immune-enhancing agents, have also been investigated for their help in improving outcomes in the critically ill patient.

Energy expenditure

Alteration in energy expenditure is well established in the critically ill patient. Substantial increases in resting energy expenditure during critical illness, especially trauma, thermal injury and sepsis, have been reported. The use of predictive formulations (ie, the Harris-Benedict equation) plus additional factors to account for severity of injury and activity to determine energy expenditure in the critically ill patient are fraught with errors, leading to overfeeding of the patient. Recommendations from published studies and guidelines, including the American College of Chest Physicians (ACCP) and the American Society for Parenteral and Enteral Nutrition Clinical Guidelines Task Force, suggest initially providing 25–30kcal/kg/day and 1–1.5g protein/kg/day to critically ill patients.[1,2]

Research investigating decreasing caloric delivery (approximately 33–65% of ACCP recommendations) during the acute phase of illness or injury have reported less days of ventilation, fewer infections and decreased intensive care and hospital length of stay.[3-5] McCowen et al performed a prospective, randomized trial in 40 patients, comparing PN delivery of 25kcal/kg/day and 1.5g of protein/kg/day to hypocaloric PN delivery of a total of 1,000kcal and 70g of protein per day. Decreased rates of infections (29% vs 54%, p=0.11) and mortality (9% vs 16%) were reported in the group receiving hypocaloric nutrition.[4] While more prospective, randomized trials are necessary, the early results from these studies are intriguing.

Delivery of specialized nutrition support

The use of EN is the preferred method of nutrient delivery if the small intestine is functional and capable of absorption. EN over PN has been shown to decrease infections, particularly pneumonia, line infections and, in the trauma patient, abdominal abscesses. And while differences in mortality have not been shown between EN and PN, studies have reported reduced

MODS and decreases in length of intensive care and hospital stay, leading to decreased hospital costs.[2,6,7]

No clear evidence has been established to answer the question why the use of EN appears beneficial versus PN, but theories have been postulated. A long-held theory, "bacterial translocation", is that atrophy of the gastrointestinal (GI) tract resulting from disuse contributes to facilitating or permitting the translocation of enteric bacteria or their metabolic products into the circulation. Circulating bacteria may predispose the patient to infections and sepsis.[8]

A second theory has been postulated, proposing immunological communication between the GI tract and mucosal surfaces throughout the body via a common mucosal immunity. Failure to feed the GI tract results in alterations in the gut-associated lymphoid tissue which, in turn, lead to changes in GI vascularity and decreased production of IgA. Ultimately, these changes result in an increase in the inflammatory response to secondary insults in the lungs, liver and GI tract.[9,10]

Concerning the use of PN, a number of studies and recommended guidelines support only using PN in the malnourished critically ill patient in whom EN is not possible.[2,11] In those patients for whom there is no evidence of protein-calorie malnutrition, the use of PN should be reserved and initiated only after the first 7–10 days.[2]

Early EN is also considered advantageous in the critical ill patient. Patients resuscitated and haemodynamically stable should have EN initiated within 24–48 hours.[11,12] A meta-analysis by Marik and Zaloga reviewed 15 prospective randomized clinical trials of early versus delayed EN in critically ill patients and found that early enteral feeding was associated with decreased infections (relative risk reduction 0.45; 95% CI 0.30–0.66; p=0.00006) and reduced length of stay (relative risk reduction 2.2 days; 95% CI 0.81–3.63 days; p=0.004).[13,14]

Gastric or postpyloric routes of delivery may be used for EN. In a systematic review of prospective, randomized clinical trials, the incidence of pneumonia, intensive care unit (ICU) length of stay and mortality were similar between both gastric and postpyloric routes of feeding. Gastric feeding was initiated significantly sooner due to the delay in achieving postpyloric intubations.[15] Small bowel feedings should be considered in the critically ill patient at risk for regurgitation and aspiration and in those patients at high risk for intolerance to EN.[11]

Tools to help decrease the critically ill patients risk for regurgitation and aspiration include - raising the head of the bed to 45˚ when possible. A significant reduction in clinically suspected - nosocomial pneumonia was reported by Drakulovic and colleagues when patients were placed in a semirecumbent position compared with patients in the supine position (8% vs 34%; 95% CI for difference 10.0–42.0, p=0.003). Furthermore, the highest frequency of nosocomial pneumonia was observed in patients receiving EN in the supine position.[16]

Immune-enhancing agents

Immune-enhancing diets (IED) are the combination of some or all of the nutrients, including glutamine, arginine, omega-3 fatty acids and nucleotides to nutritionally complete enteral formulas. A number of studies investigating the use of immune-enhancing EN in the critically ill patients (ie, trauma, thermally-injured and surgery) have reported fewer infections and decreased ventilatory days, as well as decreased ICU and hospital length of stay.[11,17,18] The United States Summit on Immune-Enhancing Enteral Therapy recommended that patients who should receive early enteral IED include moderately to severely malnourished patients undergoing upper GI tract surgery or severely malnourished patients undergoing lower GI surgery, and trauma patients with an injury severity score ≥18 or an Abdominal Trauma Index ≥20. The consensus panel believed other populations, including head injury (Glasgow Coma Scale <8), thermal injury (≥30%; third degree), ventilator-dependent (nonseptic medical and surgical patients) and selective elective surgery patients may benefit from an IED.(17) A follow-up article reviewing IED studies in the critically ill patient, published after the Summit further substantiated the original recommendations.[18]

However, controversy does exist regarding the use of IED. The Canadian Guidelines recommended that diets supplemented with arginine not be used for critically ill patients.[11] Additionally, others have stated that it is "inappropriate to recommend glutamine for therapeutic use in any condition" due to limited available data.[19] Unarguably, while many smaller studies are available, large, prospective randomized trials with IED would be helpful.

Conclusion

Delivery of specialized nutrition support in the critically ill patient helps decrease nitrogen expenditure. Early initiation of EN significantly improves outcome in the critically ill patient. PN should be reserved for those patients considered protein-malnourished and unable to tolerate EN. IED may be considered but the patient's clinical condition must first be assessed.

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