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- **Nutrition Support Teams In Hospitals- Are They Really Effective?"**
- **Nutritional Support in Sepsis & Catabolism**

Nutrition Foundation of India Building, C-13 Qutab Institutional Area, New-Delhi-110016
Tel: 91-11-26857814,26962615 Fax: 91-11-26857814
E-mail: nfi@nutritionfoundationofindia.res.in; crnssindia@gmail.com Website: www.crnssindia.res.in

To Our Readers

Dear Readers,

We, at the CRNSS wish you all a very happy 2011!

The current issue (49) of the CRNSS Update Series “Nutrition in Disease Management” consists of two review articles authored by eminent experts in the field of Hospital Nutrition.

The lead article discusses a subject of profound importance and of relevance to every medical speciality in a hospital setting – the necessity of nutrition support teams(NST) in hospitals and examining the evidence of their effectiveness from the standpoint of contributing to an improved nutritional status – which, in turn, translates to a faster recovery from illness, shorter hospital stay and overall decrease in cost of hospitalization.

The second article is a technical review which discusses the potential utility of nutritional support in a clinical setting of sepsis and catabolism.

Dr. Sarath Gopalan
Executive Director, CRNSS
and Editor

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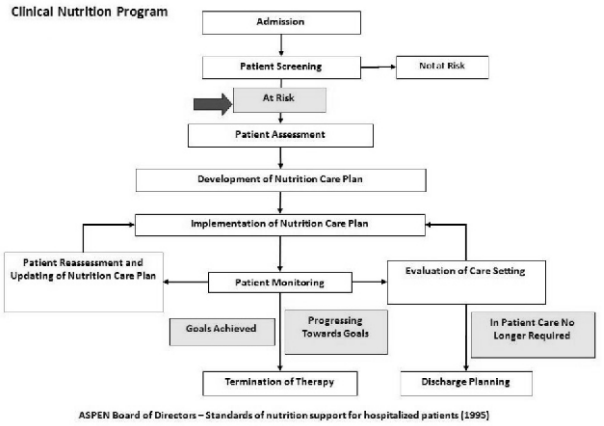
Nutrition Support Teams In Hospitals - Are They Really Effective?"

Dr. Luisito O. Llido, FPCS, DPBCN
Head, Clinical Nutrition Service
St. Luke's Medical Center, Quezon City
Metro-Manila, Philippines
E-mail: llido2001@yahoo.com

INTRODUCTION

Nutrition support teams (NST) were developed as a response to the need to address the multi-factorial aspects of nutritional care for hospitalized patients especially the critically ill or severely malnourished who developed malnutrition related complications. Utilizing the expertise of the different members of the nutrition team from the physician, dietitian, nurse, and pharmacist, a tailored approach to the nutrition care of the patient is expected or hoped to reduce complications especially in parenteral nutrition and to be a cost-effective measure in the long term treatment of this patient. [1] (Figure 1) In 1995 Dr. John Wesley enumerated the value one can get from Nutrition Support Team (NST) activities. [2] These are: a) recognition and treatment of malnutrition, b) reduction of mechanical and metabolic complications of enteral and parenteral nutrition, c) reduction of morbidity and mortality, d) reduction in the cost of providing nutrition support by facilitating the appropriate use of enteral and parenteral nutrition therapies, e) provision for more cost-effective selection of products, f) reduction in costly wastage of formula, g) selection of appropriate nutrition support equipment and devices, h) reduction in length of stay and costs to the hospital, i) reduction in liability exposure, and j) selection and monitoring of appropriate laboratory test. Were these goals achieved effectively?

Figure 1: The clinical nutrition process



Outcomes of the NST:

Reports for the past 10 years on experiences from hospitals around the world showed the following outcomes of NST's:

a) Prevalence of malnutrition was determined to be at 30-35% in the U.S. [3], 27.4% in Germany [4], 53% in Brazil [5], 47-53% in the Philippines [6], 27.3-31.9% in China [7], and 42% in India [8].

b) Appropriate and improved utilization of parenteral nutrition: the 1991 survey on parenteral nutrition practice in the U.S. showed that 82% of prescriptions used a standardized order form [9]. In the 2008 U.S. survey 53% of prescriptions were in computerized order formats [3]. Lately 85% of parenteral nutrition preparations were outsourced and 78% of facilities had a process to track and attempt to avoid inappropriate parenteral nutrition use. Nowadays 53% of parenteral nutrition preparation facilities now utilize a performance improvement process. [3]There is now an increasing emphasis for patient safety in all areas of parenteral nutrition, from formulation, preparation, access, and delivery.

c) Cost-effectiveness of the clinical nutrition process: Reduction of infections in parenteral nutrition due to the use of strict protocols in access and formulation delivery was reported as early as 1970's to 80's [10]. Naylor reported in 2004 that patients managed by the NST had a reduced incidence of catheter-related complications, they were more likely to receive adequate energy requirements, and there was a reduction in costs of therapy. [11] Utilization of protocols that would shift from a parenteral nutrition based feeding to enteral nutrition were observed to reduce costs significantly. [12-13] Implementation of early enteral nutrition has also shown cost reduction by shortening the ICU stay and reduction of complications ranging from reduction of infectious complications and organ dysfunction and failure. [14-15] Even the removal of one important component of the nutrition support team (the NST nurse) had far reaching economic side-effects like increased costs due to inappropriate feeding. [16]

d) Enteral nutrition: Early feeding, percutaneous endoscopic gastrostomy (PEG) placement, shifting to oral or enteral nutrition following algorithms has now become standard practice. When these were coordinated and ordered by NST's, reduction in morbidity and mortality was noted. [3,17]

e) Monitoring of patients: currently 39% of NST's use clinical pathways for guidance in the clinical nutrition process. The Philippine Society of Parenteral and Enteral Nutrition (PHILSPEN) has helped organize a fellowship training program in clinical nutrition which has produced clinical nutrition physician specialists who are now leading the organization and performance of nutrition teams in key hospitals of the country. [18] Recognition of the problem of inadequate intake in geriatric critically ill patients by the NST has led to improved feeding practice in this group of patients. [19,20] In the last survey on NST's in the U.S. the following improvements were

reported by the practicing NST's: (1) adequacy of protein/energy intake was achieved by 84% of responders , (2) incidence of catheter sepsis was reduced as reported by 54%, (3) prevention of pressure ulcers was noted by 20%, (4) decreased incidence of nosocomial infections was reported by 9%, and (5) decreased hospital length of stay was noted by 15%. (3)

f) Home nutrition practice: The need for long term parenteral nutrition management for home care patients has found its natural partner in the nutrition support team. A skilled NST has been recognized as essential for optimal management of long term home PN patients. [21] This is particularly true for those patients initiating PN in the home. [22]

g) Change in practice: the utilization of evidence based guidelines has done a lot in changing the practice environment in clinical nutrition. The shift from parenteral nutrition to mainly enteral nutrition with the goal of achieving adequate intake and combining them when needed is the current trend. [23] The role of an NST closely monitoring patient intake has now come to the fore. Studies are now showing that achieving adequate intake has made a difference in mortality and morbidity rates especially in the critical care setting. [24-26] The utilization of special substrates has now been actively introduced in the clinical practice setting, thus glutamine and fish oil use together with supplementation of antioxidants are now being reported with excellent results. [27-29]

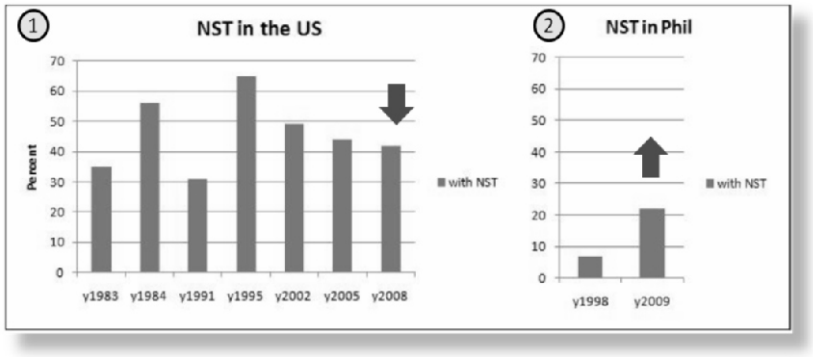
However, not all reports are positive for NST's. In France a report on the effect of NST in pediatric intensive care showed no impact on the nutrition management of patients. [30] In the U.S. twenty-two percent of institutions with an NST now had none. However these groups felt that patient outcomes had been adversely affected by this change. Institutions without an NST had multiple individual clinicians writing nutrition orders 43% of the time. The impact on cost is huge. [3]

NST presence in the hospital

These data are evidence that NST's “work and deliver” their assigned or expected roles either in the hospital or home care setting. Currently the NST is the de-facto “gold standard” when it comes to delivering nutrition support in the hospital setting. [31] The question then is: has there been an increase in the presence of NST in the hospital? The answer is a mixed yes and no. In the U.S. surveys on the presence of NST's showed the following data: 35% in 1983, 29% in 1991 (484/2000 hospitals), and the highest in 1995 (65%). The last ASPEN survey in 2008 showed a declining presence of NST's at 42%. [3] Up to this time the presence of NST's has not been established in the whole Asia Pacific region. In India only 64% of hospitals have a dietetic service with 18% having no dietitian in the service. [32] In the Philippines there was an increasing trend of NST's (from 6/83 or 7% to 18/83 or 22%, 83 being the number of hospitals in the Philippines with more than 200 beds). [33] (Figure 2) In the PENSA 2005 in Korea these are the data: Korea (27/115 or 23.9% with more than 200 beds, year 2003), Taiwan (57/1200 or 4.7% which passed the NST

accreditation), and in Japan (404/756 or 53% of participant hospitals have an active NST). [34] In Europe these data give us a bird's eye-view on the status of NST's in this region: In the United Kingdom (37.3% in 1994)[35], Germany (47/2000 or 2.3% in 1999 increasing to 5.6% in 2002, in hospitals with more than 250 beds) [36,37], Germany, Austria, and Switzerland (98/3071 or 3.7% in 2005)[38].

Figure 2: Trends in Nutrition Support Team (NST) development in the U.S. and Asia



(1) ASPEN Practice Management Task Force. The state of nutrition support teams and update on current models for providing nutrition support therapy to patients. NCP 2010; 25 (1): 76-84.
(2) http://www.philspenonline.com. ph/ NST_PositionPaper.pdf / page 7.

CNT = Clinical Nutrition Team; NST = Nutrition Support Team

The Challenge

It is clear that setting up nutrition support teams is still a big challenge in spite of the wealth of data showing its value, thus a continuing work of promoting the NST benefits through awareness and education drives is still needed. These are the reported drawbacks against the establishment of NST's as reported by the ASPEN 2008 survey: a) decentralized nutrition support services (24%), b) lack of physician leadership interest (23%), c) finances (17%), d) lack of administrative support (12%), and lack of time (10%). These are the identified areas which need to be developed in order to have a successful clinical nutrition program: evidence-based guidelines (34%), financial support (22%), and interdisciplinary cooperation (22%). [3] Interestingly similar observations and suggestions have been made by the nutrition societies in Europe and Asia. [39-41]

Dr. Bruce Bistrian gave this comment on two factors which greatly influenced NST development in the U.S. [42] An aspect of the health care system that has slowed down the development of NST's is the system of payments, called diagnosis-related groups (DRG) which put extreme cost constraints on hospital finances which often limited financial support for NSS teams, particularly the physician and nurse specialist members. Furthermore, as the concern for the nutritional status of patients spread to other specialties, critical care physicians, trauma surgeons,

gastroenterologists, endocrinologists, and nephrologists often took responsibility for nutrition support in their area of expertise with a dwindling of the model of an internist or general surgeon with special skills in nutrition support playing the key MD role across the specialties. This system is being implemented globally thus a similar impact is expected to be felt in the efforts to develop nutrition support teams in the hospital setting.

Current efforts in the development of clinical nutrition:

The drive to increase awareness of the malnutrition problem and impact of its treatment: A special day was organized by ESPEN called Malnutrition Day [43] which aimed to raise the awareness that malnutrition exists in every hospital in Europe. This concern was also raised by the critical care nutrition group from Canada which focused on the problem of malnutrition in the critical care units [44]. These two initiatives which focused on hospital malnutrition were well received all around the world through the different national societies of nutrition and to this day there is a hospital or nutrition society which is documenting this problem. For several years the PENSA or Parenteral and Enteral Nutrition Society for Asia has always included topics of malnutrition, nutrition surveillance, nutrition management, nutrition teams, and updates on clinical nutrition practice in the member countries. [34] The common issue which was always discussed was the presence of nutrition support teams in the hospital and what outcomes showed the value of having such a system. In the last PENSA (Kuala Lumpur 2009) the development of training programs to fast track the development of NST's was described.

In the Philippines a Fellowship Training Program in Clinical Nutrition for physicians was developed [18] followed by the setting up of a Master of Science in Clinical Nutrition for the different members of the nutrition support team [45]. Both programs are designed to teach the clinical nutrition process through a multidisciplinary approach in order to ensure every graduate knows how to organize NST, utilize the current clinical practice guidelines, and document all the necessary data for outcomes reporting. A board in clinical nutrition was organized In order to give the proper credentials to the graduates of these systems and to review quality management in all areas of clinical nutrition. [46] It is planned that together with the Philippine Society of Parenteral and Enteral Nutrition, the graduates and officers of both training programs can negotiate with the Department of Health of the Philippines and the Philippine Health Insurance Corporation to have the clinical nutrition program and an NST be required to be present in every hospital with 200 beds or more. These services are to be reimbursable by the national insurance services and the national formulary. Thus with clinical nutrition covered by the country's national budget it is hoped that NST's will stay and help in delivering quality nutrition care services to all hospitalized patients. Currently the NST's which are functioning fully are run by graduates of these training programs.

For Asia it is hoped that the different countries be able to tailor the needs and

requirements for NST development and come up with a system of cooperative efforts that will set up effective NSTs in the hospital or an institution like a home nutrition service that fully represents each country's specific cultural and economic needs. In this way total patient care will reach what every patient or caregiver wishes to achieve.

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Nutritional Support in Sepsis & Catabolism

Dr B Ravinder Reddy
MBBS, MS, FRCS (Edinburgh), FRCS (Glasgow)
Consultant Surgeon - Division of Surgical Gastroenterology & General Surgery
Chief - Division of Clinical Nutrition
Care Hospitals – The Institute of Medical Sciences, Hyderabad
Email: drbravinderreddy@yahoo.com

This is an overview of the nutritional interventions in acutely ill patients.

Introduction:

Human being is constantly bombarded by an enormous group of microorganisms, such as bacteria, viruses, fungi, protozoa, etc. A significant number of these microorganisms are pathogenic and many of the others have the potential to induce disease and cause tissue damage leading to catabolism and sepsis. In fact bacterial infection is the commonest cause of disease, sepsis and death.

Malnutrition and the immune system:

The fundamental need to preserve health is adequate nutrition. This preserves adequate health by maintaining normal homeostasis and immune function. Immune responses, both innate and adaptive are responsible for prevention of infection and ultimate recovery. Nutritional status has an important role in maintenance of immune system and prevention of infection. Essential nutrients include macronutrients (carbohydrates, proteins, fats) and micronutrients (vitamins, minerals and trace elements). These are necessary to maintain immune competence. Malnutrition predisposes to a cascade of unfavorable metabolic events. This impairs their ability to adapt, recover and survive.

Primary Malnutrition:

Malnutrition is said to be primary when it is present before the onset on critical illness. It could be due to reduced nutrient intake or inadequate intake or absorption of macro and micronutrients. Primary malnutrition is akin to stress-free starvation. The body initially adapts to this condition by reducing the metabolic rate. Fat becomes the main source of energy, as glycogen stores do not last for more than 24 hours. Protein is conserved until late in the process. If poor intake persists, fats and proteins too are depleted, and the individual is at the risk of developing immune deficiency, and is prone to develop opportunistic infections. In the absence of nutritional intervention, infection may lead to sepsis and death.

Secondary Malnutrition:

Malnutrition is said to be secondary when the nutritional status is disrupted due to the acute disease process, Unlike primary malnutrition, protein stores (or lean body mass) are lost immediately and up to two to three times more than seen in simple-starvation. In addition to muscle loss, there is hyperglycemia, hypermetabolism and increased energy expenditure. Hyperglycemia occurs, mainly due to increase in stress hormones and also due to the development of insulin-resistance. Increase insulin levels inhibit fat breakdown, and more muscle-protein is broken down to provide substrates for neoglucogenesis. In the absence of nutritional intervention, the patient rapidly deteriorates and progresses to developing sepsis syndrome with multiple organ failure and ultimately death.

Surgical Malnutrition:

This can be regarded as secondary malnutrition and occurs after complicated surgery or after prolonged hospitalization. Nutritional intervention plays a crucial role in recovery.

Singular therapy in sepsis with intravenous fluids and antibiotics is ineffective. Appropriate metabolic support (Table 1) along with immune modulating agents and source control (by surgery in appropriate cases) is associated with successful outcomes.

Table 1

Basic Nutritional Support	Assessment, Adequate calories, Adequate macro and micronutrients, Routes of nutritional support
Pharmaconutrients	Glutamine, Arginine, Omega-3 fatty acids, Antioxidants, Vitamins, Trace elements
Endocrine Support	Glucose control, Cortisol, Vasopressin Noradrenaline, Dobutamine
Cellular Requirements	Anabolic hormones and Beta-blockers

Nutritional Support:

The present concepts of artificial nutrition support have evolved in the past few decades. All acutely ill patients are different and *one-for-all* formula is inappropriate. Nutrition intervention in critical illness should be based on sound metabolic principles, and commenced after evaluation of the acute illness and co-existing chronic diseases. Appropriate macro and micronutrients are administered based on sound principles of macronutrient metabolism in sepsis (Table 2). It can be

Table 2

Macronutrient	Metabolic consequence in sepsis	Causes of alterations
Carbohydrate	Normal or increased Increased hepatic glyconeogenesis and glycogenolysis Increased peripheral uptake & oxidation	Increased glucagon & glucose production Increased glucocorticoids, catecholamines Increased insulin resistance
Fat	Starved septic pts. use fat as main fuel Increased lipolysis Decreased FFA due to increased use	Increased lipase by catecholamines Use of FFAsby skeletal & cardiac muscle to preserve glucose for obligate users
Protein	Catabolism > synthesis Amino acids used to produce acute phase proteins Septic pts. lose 15 g nitrogen per day	Cytokines and cortisol stimulate protein catabolism

administered through the enteral, parenteral or combined enteral-parenteral route, after physical assessment and reviewing laboratory parameters.

Nutrition intervention will not reverse the catabolism, but will decrease its extent. The goals on nutritional therapy are to preserve adequate glucose levels and provide amino acids to increase total body protein content. Insulin is an essential component in this practice, as it increases glucose transport into the cells, increases glycogen production and protein synthesis, while decreasing protein breakdown. Although there is insulin resistance in sepsis, it retains its ability to reduce lipolysis and protein breakdown.

Gastrointestinal Tract, Nil-By-Mouth and Nutritional Support:

The gastrointestinal tract tends to be overlooked and under appreciated immune organ. It is the largest immune organ, containing 70% to 80% of total immune tissues, and plays a significant role in critical illness. It has a sophisticated physiological and structural barrier which prevents the spread of microorganisms, endotoxins, and macromolecules from the intestinal lumen to the blood stream.

Keeping patients nil-by-mouth is a common practice in the ICUs. This leads to gut “luminal starvation” characterised by intestinal mucosal atrophy, villi flattening, decreased absorption and disruption of barrier functions. This will lead to translocation of the gut contents including toxins to gain access to mesenteric lymph nodes and to the portal and systemic circulation.

Bacterial translocation is a common event in all critically ill patients who are not fed. This is associated with increased incidence of infections, prolonged hospitalisation, morbidity and mortality. Hence early enteral nutrition is associated with increased immunologic protection and outcome.

After achieving the initial primary goals (maintain hemodynamic stability, limitation of secondary complications and operative repair of anatomic injury), nutritional intervention is commenced. In those who cannot have oral diet or

tolerate oral feeds, minimal enteral feeds (which are also called as trophic, gut stimulatory, non-nutritive or hypocaloric feeding) should be commenced at low volumes of 15 to 20 mls per hour.

Macronutrient Requirements:

The respective amounts of macronutrients are important for recovery from sepsis.
Carbohydrates: Glucose is the preferred macronutrient for CNS, RBCs, immune cells, and injured tissues. Therefore it forms an important component is sepsis and SIRS. Carbohydrate can be given up to a maximum of 3 g to 5 g /kg/day, amounting to about 50% to 60% of the total calories. Amounts above this will lead to hyperglycemia, hyperosmolarity, osmotic diuresis, dehydration and respiratory complications due to increased CO_2 production. This will prolong mechanical ventilation.

Fats:

Lipids provide high caloric content (9 kcal/g) and are ideal to provide increased calories that septic patient needs. In addition, they have many nonenergy uses: they serve as an oxidant, are precursor to eicosanoids, provide insulation against heat energy, transport fat-soluble vitamins, prevent EFA deficiency and form an important part of cell membrane. They also decrease CO_2 production and may decrease respiratory quotient.

Nutritionally stressed patients can receive up to 1 g to 1.5 g/kg/day, amounting to 30% to 50% of total calories. Out of this, 4% or more should be from soybean or safflower lipid emulsions in order to prevent EFA deficiency. Amounts above this will lead to hypertriglyceridemia and causes the blood to become lipemic. This may interfere with normal functions.

Proteins:

Amino acids are essential for immune and hormonal balance, muscle health and wound healing. 15% of lean body mass is composed of protein, 3% (300 gms) of this is turned over daily during normal protein metabolism. In critical illness, this amount is increased. Septic patients need 1.5 g to 2.0 g/kg/day of amino acids, amounting to 15% to 20% of the total calories. This will maintain a neutral nitrogen balance.

Amounts exceeding this will lead to azotaemia and its associated problems.

Micronutrient Requirements:

Micronutrients do not contribute to the caloric content; instead they support various defense mechanisms. They act as cofactors and coenzymes in various metabolic functions and act as antioxidants.

All septic patients need two to three times the standard recommended doses of

vitamins, trace elements and minerals. The doses are further increased in patients on renal replacement therapy.

Immunonutrition:

Immunonutrition is defined as the effect of certain nutrients on the immune function. Metabolic support of septic patients and augmentation with certain dietary components is done to affect the immune response and reduce the excessive inflammatory response. The standard immune modulating nutrients are glutamine, arginine, omega-3 fatty acids and nucleotides (RNA).

Glutamine:

Is one o the most abundant amino acids in the body and is utilised by intestinal tract, liver, kidneys and lymphatic tissues. The beneficial effects of glutamine can be summarized as follows:

I. Anti-oxidant

ii. Is fuel for enterocytes, aids in gut barrier and gut function

iii. Is fuel for immune cells and aids in immune response (especially lymphocytes and neutrophil function)

iv. Helps in synthesis of nucleotides

v. Is anti-catabolic

vi. Helps in production of heat shock proteins (HSP 70)

Glutamine can be administered via enteral and parenteral route, at doses from 10 g to 40 g per day. Doses above this can lead to azotaemia.

Arginine:

Is an essential amino acid. It increases nitric oxide, by acting as a substrate for its production. It minimises negative nitrogen balance, stimulates immune system and improves wound healing, by stimulating growth hormone, insulin, glucagon and prolactin. However, in established sepsis with ongoing inflammatory response its use is controversial , as increased nitric oxide production will have detrimental effects on blood pressure and may affect the outcome.

Omega-3 fatty acids:

These are sources of linolenic acid. They have an anti-inflammatory effect by causing a shift away from prostaglandin and thromboxane A_2 production and by influencing leukotrien production.

These can be administered via enteral or parenteral route.

When administered early in the course of sepsis, they reduce the incidence of acute lung injury and reduce the other hyper inflammatory events.

Nucleotides:

These are nitrogen containing components of RNA and DNA. They support intestinal cell structure and function that support immune function.

Use of immunonutrition in critically ill patients is controversial. But the effectiveness of immunonutrition in the metabolic support of septic patients is increasing. In addition to glutamine, arginine, omega-3 fatty acids, the results of recent studies show that use of taurine, phospholipid, soluble fiber, and pectin is promising.

General Principles, Recommendations and Practice Points:

- ? Metabolism is altered by acute disease state and is characterised by systemic inflammatory response syndrome
- ? Main features are activation of protein catabolism, peripheral insulin resistance, stimulation of hepatic gluconeogenesis, activation of lipolysis and increase in lipid oxidation, increase in energy expenditure and micronutrient requirements.
- ? In many patients the optimal nutrient supply may actually be lower than estimated requirements. Infusion of nutrients must never exceed the capacity for utilisation and oxidation. Hence daily monitor glucose, urea, lactate, electrolytes
- ? Energy expenditure can be calculated by various formulae: Harris-Benedict, Ireton-Jones etc. But for practical purposes, the rule-of-thumb of 20 kcal/kg/day, multiplied by stress and activity factor is sufficient.
- ? Reference weight for calculation should be based on (approximate, if it is not possible to measure the weight) current weight. Obese patients with BMI of > 30 should be given the requirements based on ideal body weight.
- ? Fluid and electrolyte requirements must be calculated separately. They can vary greatly and cannot be standardized. In many cases,, extra supplementations may be required.
- ? Micronutrient and antioxidant requirements should be increased during continuous renal replacement therapy
- ? Recommended energy intake is 20 – 30 kcal/kg/day (from both enteral and parenteral nutrition). Artificial nutrition products are available commercially in sterile containers, as incomplete formulas (Two-in-One), and complete formulas (All-in-One) and are premixed with micronutrients.

- ? The infusion rates of parenteral carbohydrates-amino acid-electrolyte solutions and lipid containing solutions should be administered within 6 to 12 hours for a liter bag. The 'All-in-One' complete nutrient solutions should be administered within 16 to 24 hours per bag.
- ? The infusion rate for minimal enteral nutrition should commence at 15 to 20 mls per hour and increased by 15 mls every 12 hours till 60 mls are reached. The maximum infusion of enteral nutrition should not exceed 100mls an hour and residual volumes should be checked every 4 hours once the feed amount is over 50 mls per hour. The hang time of each bag should not exceed 6 hours. Kitchen based enteral nutrition is not advisable in critically ill patients.
- ? In severely ill patients, adequate nutrition may be not possible to administer even when large doses of insulin are given. This is due to severe glucose disturbance, hypertriglyceridemia and impaired intestinal motility. In such situations, administer only minimal enteral feds or reduce the rate of parenteral nutrition. The risk of feeding induced complications is higher than underfeeding.
- ? Continuous mode of infusion of nutrition, commencing at a low rate and with gradual increases will facilitate monitoring and avoids metabolic deviations
- ? Monitor the rate, quantity and biochemical parameters. Maintain glucose between 80 to 110 mg%, taking care that it should not exceed 150 mg%. If urea is increasing by more than 10 mg, reduce amino acid supply. Maintain triglyceride to less than 350 mg%
- ? The selection of laboratory parameters and frequency of evaluation depend on the severity of illness and the metabolic stability of the patient.

Patient with multiple organ dysfunction syndrome (MODS):

Nutrition support should mainly be directed to the acute disease state, like renal failure, etc. The nutrition should be:

- ? Rich in amino acids (1.5 g/kg/day)
- ? Calories should NEVER exceed 30 kcal/kg/day
- ? Lipid utilisation is usually not impaired, hence lipid infusions can be administered up to 50% of the total calories.
- ? Consider glutamine (>20 g/day)

? Consider carnitine (500 mg/day)

? Consider selenium (120 to 300 micrograms/day)

? In high APACHE II scores (of >25), enteral immunonutrition has no proven benefits

? The use of probiotics is not proven, may even ve detrimental

Summary:

Nutrition interventions in septic and catabolic patients have evolved dramatically in the last 20 years, but continue to be a challenge. They are no longer just a part of supportive therapy. It has an established therapeutic role. Nutrition intervention will benefit patients when adequately indicated and prescribed. However, it may cause significant side-effects and harm if used inappropriately! Hence the clinician become familiar with the art and science of providing safe nutritional therapy, based on sound physiologic and nutritional principles.

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