To Our Readers

We are encouraged by the enthusiasm of our readers and the interest displayed in the CRNSS Update Series on “Nutrition in Disease Management”. The Update Series now enters its fifth year of publication with the January 2003 (Update Series 17) issue.

The first article emphasises the importance of appropriate nutritional support in the transplant setting. The approach to nutritional supplementation in different organ transplant situations has been described.

The second article describes the practical issues to be considered in the nutritional management of patients with cystic fibrosis. The disorder, although predominantly encountered in the Caucasian population, is being diagnosed more frequently in Indians. The section on “Pick your brains” is aimed at stimulating the readers to develop an interest in enteral and parenteral nutrition and enriching their knowledge.

Edited by: Sarath Gopalan (Editor) and Shailee Saran (Assistant Editor) for CRNSS. Designed and produced by Media Workshop India Pvt Ltd.

Nutrition In Solid Organ Transplantation

Dr S. Shanmuga Bhaskar
MB, FRCS Ed, Transplant Surgeon and Surgical Gastroenterologist, Chennai Transplant Centre, Madras Medical Mission, Chennai

Malnutrition is common in patients with end stage organ failure and the severity of malnutrition is related to the severity of organ failure. Malnourished patients spend more days in the ICU, need longer mechanical ventilation, develop infectious complications frequently and experience higher mortality. Hence, it is important that organ transplant candidates undergo early and periodic nutritional assessment and aggressive nutritional support to facilitate a favourable outcome. The goals of nutritional support in organ transplantation are to:

- To maintain nutritional status and replete deficits;
- Minimise catabolic consequences of organ failure;
- Decrease risk of pre-and post-transplant infections; and
- Optimise transplant organ function and minimise rejection.

Nutritional assessment in transplant candidates can be difficult due to fluid shifts and standard objective measurements like weight and anthropometric measurements are unreliable. The assessment should begin with subjective global assessment with detailed history, physical examination and assessment of co-existing conditions, mental status, psychosocial and economic factors and medication history. Biochemical parameters such as serum proteins and creatinine excretion should be interpreted cautiously as they can be affected by organ failure and fluid shifts.
NUTRITION IN LIVER TRANSPLANTATION

Incidence of malnutrition in patients with end stage liver disease (ESLD) is common and ranges from 20 to 60 per cent\(^5\). Elderly patients and cirrhotic patients with frequent and prolonged history of ethanol ingestion are at a higher risk for malnutrition. The etiology of malnutrition in these patients is multifactorial. Nutritional depletion can be caused by poor diet (quantity and quality), anorexia, nausea, vomiting, metabolic derangements, malabsorption, dietary restrictions and psychological stress\(^5,6\). At the other end of the spectrum, nearly 40 per cent of patients are morbidly obese and present a technical challenge for transplant surgeons other problems include post-operative wound infections, pulmonary problems and anesthetic difficulties\(^7,8\).

**Metabolic derangements in patients with ESLD:** Liver is the key organ in nutrient metabolism and liver failure alters energy metabolism. Liver dysfunction leads to a catabolic state associated with increased serum insulin, glucagon, epinephrine, cortisol concentrations and also insulin resistance\(^9\). Liver disease causes alterations in protein, calorie, carbohydrate, fat, fluid, vitamins and mineral requirements. Liver glucose production is decreased and peripheral glucose utilisation decreases. The rate of gluconeogenesis is increased and the body prefers noncarbohydrate fuels such as lipids and amino acids for energy\(^10\). There is increased lipolysis and serum levels of free fatty acids (FFA), ketones and glycerol increase.

Glucose intolerance is present in two-thirds of cirrhotic patients, secondary to hyperglucagonemia and decreased binding to insulin receptors\(^11\). Protein catabolism and hyperammonemia are enhanced and there is decreased synthesis of albumin, clotting factors and secretory proteins\(^12\). Concentrations of plasma aromatic amino acids (AAA) increase whereas plasma branched chain amino acid (BCAA) levels decrease\(^13\). The resulting alteration in BCAA-AAA ratio is implicated in the pathogenesis of hepatic encephalopathy\(^5\).

**Nutritional recommendations for a liver transplant candidate:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>30-35 Kcal dry weight, 1.3 to 1.5 times BEE</td>
</tr>
<tr>
<td>Protein</td>
<td>0.8 - 1.2 g/kg (compensated)</td>
</tr>
<tr>
<td></td>
<td>0.6-1.0 g/kg (encephalopathy) BCAA enriched formula</td>
</tr>
<tr>
<td>Fat</td>
<td>25 to 40 per cent calories</td>
</tr>
<tr>
<td>Sodium</td>
<td>2-4 g/d</td>
</tr>
<tr>
<td>Fluid</td>
<td>1,000-1,500 ml/d</td>
</tr>
<tr>
<td>Vitamins</td>
<td>monitor levels, supplement to RDA</td>
</tr>
<tr>
<td>Minerals</td>
<td>800-1,200 calcium/d, supplement to RDA</td>
</tr>
</tbody>
</table>

**Post-transplant nutrition recommendations:** The nutritional goal is to provide adequate nutrition to promote recovery from major surgery and replenish nutritional stores. Protein catabolism is markedly
increased after OLTX and mean daily nitrogen loss of 20 to 25 g/day is common14,15. A daily protein intake of 1.5g-2.0g/ kg dry weight may be required. The BCAA-AAA ratio usually normalises but any worsening of the ratio is associated with graft failure16. The REE is not greatly elevated after liver transplant and calorie requirements of 20 per cent over BEE are usually adequate17. A mixed fuel system of carbohydrate and fat for providing energy is suggested in the post-operative period5. Carbohydrate usually should provide 70 per cent of NPC and fat about 30 to 50 per cent of NPC.

NUTRITION IN RENAL TRANSPLANTATION

The nutritional cost of renal insufficiency and failure is high. Malnutrition is common in renal patients and the incidence may be as high as 70 per cent18. Malnutrition is more common in children with renal failure compared to adults19. The etiology of such malnourished states in this disease process is multifactoral. Increased energy requirements have been suggested as one possible cause. Long-term hemodialysis is associated with a high energy and protein cost due to losses in the dialysate and also through blood loss20. Insufficient caloric intake is another major cause of malnutrition in patients with renal failure18,21. Many of these patients suffer from gut dysfunction like nausea, vomiting, diarrhoea and malabsorption that may be related to the uremia.

Post renal transplant patients: These patients rarely require nutritional support as recovery of normal renal function allows rapid return to oral diet. Nutritional supplementation is usually required in paediatric recipients who are malnourished in the pre-transplant period 22. Recently interest has been raised in using immune enhancing diets in the post-operative period to modulate the immune response. Immune modulating diets have been shown to reduce the acute rejection rates in renal transplant recipients compared to controls receiving standard diet23. At the other end of the spectrum, obesity has been shown to compromise renal transplant outcome7. Obese patients tend to have delayed graft function, reduced one year graft survival, more ICU admissions and reintubations, increased incidence of wound infections and higher mortality. New onset diabetes is also more common in obese patients following renal transplantation.

NUTRITION AND HEART TRANSPLANTATION

Malnutrition significantly affects the outcome of heart transplant patients. A survey of 4,515 heart transplants from 38 institutions has shown that the BMI and IBW are risk factors for mortality following heart transplant24. Patients with <80 per cent or > 140 per cent IBW had a higher mortality rate. Nutritional assessment and monitoring of nutritional status is difficult due to a shift in fluids and weight gain up to 25 kg is common following a heart transplant. Patients with severe cardiac failure exhibit significant malnutrition called cardiac cachexia with wasting of body muscle and fat25. The etiology of malnutrition is multifactoral and is due to a combination of mental depression, anorexia, unpalatable low salt food and poor cardiac output. Aggressive nutritional supplementation in these patients will increase the BMR and may worsen the cardiac failure26. Hence the goal of nutrition support in these patients is to maintain current state and not nutritional repletion. The post-surgery heart transplant patient rarely requires nutritional supplementation, as oral intake is usually possible soon after surgery. If oral intake is not adequate, naso-gastric or naso-enteric tube feedings are preferred to intravenous support.
CONCLUSION

Malnutrition is common in solid organ transplantation patients which is secondary to the associated organ failure. The surgical procedures are more complex and of greater magnitude than traditional surgery. Immunosuppressive medications can also affect nutrition status in these patients. Hence providing optimal nutritional support to post-transplant patients is important and can reduce complications, shorten hospital stay and improve overall outcome.

REFERENCES


---

PENSA & ISPEN 2003
Hotel Marriott Resorts, Goa, India
November 6-8, 2003

Conference Highlights

- Workshops – practice and problem oriented
- Oration, closing lecture
- Breakfast ‘Meet the expert’ sessions
- Debates, symposia, panel discussions
- Lunch symposia
- Free paper, poster presentations
- World renowned faculty

Selected Topics

- Debate – Is nutritional support evidence-based medicine?
- Symposium on enteral nutrition
- Symposium on educational issues in nutrition
- Symposium on immune enhancing nutrients
- Debate – Immunonutrition in the critically-ill: fact/fantasy/future
- Nutritional support teams – The international experience
- Branched chain amino acids
- Role of CRRT in optimising nutritional support
- Immunonutrition in ARDS
- Strict glycemic control improves outcome in critically-ill
- Adjustment of NS according to severity of illness – myth or reality

Congress Agency
Jetair Tours Pvt Limited – Conference Division
Phone : 91-22-283 7054, 281 0899
Fax : 91-22-202 6632
Email : conference@jetair.co.in
Website: www.jetairtours.com

Congress Secretary
Dr Shivakumar Iyer
NEURO- ICU
Jehangir Hospital and Medical Centre
32 Sassoon Road, Pune - 41100
E-mail: pensa2003@indiatimes.com; s_iyer@vsnl.com
Tel: + 91-20-6050550/6122551
PICK YOUR BRAINS!

1. Which of the following is most likely to predispose an infant receiving parenteral nutrition to develop cholestasis?
   - 1. Sepsis
   - 2. Poor thermoregulation
   - 3. Duration of therapy less than two weeks
   - 4. Inadequate administration of amino acids

2. Which of the following infusion devices is most appropriate for administering parenteral nutrition to an infant?
   - 1. Syringe pump
   - 2. Volumetric pump
   - 3. Peristaltic pump
   - 4. Intravenous controller

3. Which of the following metabolic problems is LEAST likely to occur in preterm infants maintained on parenteral nutrition?
   - 1. Rickets
   - 2. Hyperglycemia
   - 3. Hyperammonemia
   - 4. Hyperosmolar coma

4. When a child on parenteral nutrition therapy mentions food, the most appropriate intervention would be
   - 1. Change the topic immediately
   - 2. Introduce a diversional activity
   - 3. Allow the child to discuss food
   - 4. Remind the child that nutrition is received through the veins

5. In addition to the family, which of the following provides the most appropriate environment for assessing a child's adaptation to home parenteral nutrition?
   - 1. School
   - 2. Church
   - 3. Nutrition clinic
   - 4. Girl or boy scout club

6. To be eligible for medicare funding of home parenteral nutrition, patients under 65 years of age require
   - 1. A treatment plan for malignant disease
   - 2. Completion of a Treatment Authorisation requests
3. Proof of inability to thrive on enteral feeding
4. Designation as totally disabled for a 24-month period

7. Parenteral nutrition without any enteral intake would be most appropriate for the initial nutrition support of a paediatric patient with

- Gastroschisis
- Cystic fibrosis
- Chronic diarrhoea
- Inflammatory bowel disease

8. Which of the following best describes carbohydrate administration in newborns?

- Glucose levels less than 100 mg/dL are considered hypoglycemic
- Initial delivery of dextrose should begin at 2 to 3 mg/kg/min
- Maximum dextrose delivery should be 5 mg/kg/min
- Premature neonates (<28 weeks) are at risk for hyperglycemia and may need the addition of insulin therapy

9. In parenterally fed children, what ratio of carbohydrate to fat kilocalories should be used to promote optimal nitrogen retention.

- 1:2
- 2:1
- 1:10
- 10:1

10. Full-term infants with congenital malformations of the gastrointestinal tract are commonly started on parenteral nutrition to

- Reduce complications
- Enhance spontaneous growth
- Prevent necrotising enterocolitis
- Maintain appropriate growth and weight gain

11. In paediatric patients, which of the following procedures is an indication for the institution of prophylactic parenteral nutrition?

- Autologous bone marrow transplantation
- Liver transplantation for inborn errors of metabolism
- Allogeneic bone marrow transplantation for malignancy
- Allogeneic bone marrow transplantation for aplastic anemia

12. Which of the following reflects the caloric requirements of parenterally fed infants?

- Energy requirements begin to decrease after two years of age
- Infants generally require fewer calories when fed enterally than when fed parenterally
- Amino acid solutions designed specifically for the neonate have no effect on energy needs
4. Premature infants achieve positive nitrogen balance but not adequate weight gain with 50 Kcal/kg

13. Which of the following best conserves health care benefits of patients receiving home parenteral nutrition?

- 1. Quarterly visits by a home care nurse
- 2. Use of a premixed parenteral nutrition solution
- 3. Placement of a totally implantable access device
- 4. Training the patient to be as self-reliant as possible

14. In which of the following would the use of parenteral nutrition be indicated in a patient with moderate to severe Crohn’s disease?

- 1. Recent 5 per cent weight loss
- 2. Presence of an enterocutaneous fistula
- 3. Increased sedimentation rate
- 4. Less than 60 cm of functional intestine

15. In administering parenteral nutrition to a preterm infant within the first few days of life, the initial goal is provision of

- 1. Maintenance kilocalories, protein, and nutrients
- 2. Only enough dextrose to prevent hypoglycemia
- 3. Sufficient kilocalories, protein, and nutrients for growth
- 4. Maintenance kilocalories and nutrients, but no protein to prevent azotemia

If you have picked your brains, check your answers!

1. Infants developing parenteral nutrition-related cholestasis have many associated predisposing factors including prematurity, decreased birth weight, and sepsis. The truly compromised patient is at greatest risk to develop hepatic dysfunction due to parenteral nutrition. The multifactorial etiology created by a premature infant’s reduced energy stores, along with substrate depletion due to systemic infection increase the need for long-term nutritional management. Parenteral nutrition-related cholestasis has been associated with excessive amino acid delivery, but not with alteration in thermoregulation.

2. If a paediatric patient on parenteral nutrition is receiving small volumes of fluid, severe complications may occur as a result of inappropriate rate of administration. An infusion device will deliver intravenous fluids at a pre-selected flow rate by exerting positive pressure on the tubing (peristaltic pumps) or by pushing the fluid through a cylinder (syringe pump). The pumps deliver the rate either in drops per minute or in ml per hour (volumetric). The volumetric pump is preferred because ml are more precise than drops. A controller works by gravitational force, requiring that the intravenous container be at least 30 inches above the infusion site, a position difficult to maintain with a paediatric patient.
3 Hyperglycemia, Rickets, and hyperammonemia have been documented to occur with increased frequency in preterm infants.

4 Children on parenteral nutrition therapy often become preoccupied with food. They should be allowed to express their interest. Talking and seeing food is a means of dealing with its deprivation. Although avoiding food-oriented situations would seem kind and wise, when a child expresses a need to talk about food, it should be recognised as necessary and therapeutic and should not be discouraged.

5 School is one of the most influential social systems outside the family. It provides the setting within which the child is measured and in which the child measures himself academically, socially, emotionally, and physically. Follow-up contact with the child’s school is a means of understanding the child’s adaptation to home parenteral nutrition.

6 Federal funding for persons under the age of 65 requires that the patient be designated totally disabled for 24 month period to become eligible for Social Security benefits and medical assistance.

7 An infant with gastroschisis will not regain bowel function for approximately three weeks after surgical correction and will require total parenteral nutrition during that period. Initial nutrition support in children with inflammatory bowel disease, chronic diarrhoea, or cystic fibrosis usually involves both enteral and parenteral support.

8 Ideally, dextrose infusion should begin at 6 to 7 mg/kg/min and be advanced up to a maximum of 10-12 mg/kg/min (15g/kg/min) over three days. While most neonates tolerate 15 to 20 per cent dextrose, premature neonates may become hyperglycemic and may only tolerate 5 to 10 per cent dextrose concentrations. It is not uncommon for severely premature neonates (less than 28 weeks gestational age) to require a supplemental infusion of insulin to help control glucose levels while simultaneously delivering adequate calories. Many newborns are at high risk for development of hypoglycemia and need to be monitored closely. Glucose levels typically decline in the first day of life and do not require treatment if greater than 60 mg/dL.
Highest nitrogen retention is associated with infusion of a balanced formula in which carbohydrate provides twice the energy as fat. This ratio also was associated with a lower basal metabolic rate and respiratory quotient. Very high carbohydrate formulas lead to higher basal metabolic rates and respiratory quotients while high fat formula lead to fat overload syndrome.

It is important to start infants who are unable to eat on parenteral nutrition so they do not fall behind developmentally. Intravenous therapy does not reduce complications or prevent necrotising enterocolitis. Sustainable growth results from appropriate calories, protein, and micronutrients.

Parenteral nutrition has been shown to reduce the incidence of malignant relapse following allogeneic bone marrow transplantation for malignancy by producing an increased graft versus tumor effect.

Premature infants have been shown to have positive nitrogen balance with only 50 kcal/kg and 2.5 to 3.0 gram protein/kg, but they only maintain their weight rather than gain. Paediatric amino acid solutions have been shown to provide adequate weight gain in neonates with lower energy intake compared to neonates on standard amino acid solutions. Enteral energy needs are higher than parenteral because approximately 12 per cent of energy is lost in the stool as fat. Energy requirements, in terms of Kcal/kg, begin to decrease during the first year of life.

Loss of private health care benefits usually means patients receiving home parenteral nutrition must apply for Medicare coverage, which necessitates the patient claim total disability and, therefore, loss of work. Limiting ancillary medical services by training patients to be self-reliant decreases therapy cost, which may prolong the period of time during which the patient can continue to receive private health care benefits and continue to work.

Patients with less than 60 cm of intestine as a result of Crohn’s disease typically suffer from severe malabsorption and are unable to maintain fluid and nutrient requirements with enteral nutrition alone. Presence of an enterocutaneous fistula is not necessarily a contraindication to enteral nutrition support.

Failure to begin nutrition support once an infant is medically stable will result in significant losses of nitrogen, kilocalories, and minerals. Most preterm infants are stable enough to begin parenteral nutrition within the first few days of life. The initial goal is to replace nitrogen loss and provide maintenance nutrients. Provision of sufficient nutrition for growth is an important, but secondary, goal.