Nutrition in children posttransplantation

Goddard EA
Department of Paediatrics, Paediatric Gastroenterology, Red Cross Children's Hospital, Rondebosch, Cape Town
Correspondence to: Dr EA Goddard, e-mail: liz.goddard@uct.ac.za

Abstract

Nutrition support is a vitally important issue in the pretransplantation period. Once a child has been assessed and placed on a list for transplantation the child must see a dietitian to optimise the child's nutritional status as this is vital to improve the outcome at surgery. Children with chronic liver disease who are candidates for transplantation have a better posttransplant outcome and growth potential if their nutrition is optimised pretransplantation. Well monitored nutritional support posttransplantation improves the long-term quality of life by minimising the complications associated with transplantation. An interdisciplinary approach to nutritional care of a transplant recipient involving the expertise of paediatricians, surgeons, dietitians and nursing staff is essential to optimise the outcome of these patients.

S Afr J Clin Nutr 2010;23(1) Supplement:S19-S21

Introduction

Transplantation in children differs in some aspects of perioperative and posttransplant care from adult transplantation because of differences in the aetiology of the primary underlying disease, patient size, immunologic responsiveness, medication pharmokinetics as well as growth and development issues.

There is little data looking at nutrition posttransplantation in children. Improvement in growth should occur postoperatively. Factors associated with continued poor growth include age at transplantation, malnutrition, surgical complications of the transplant, allograft dysfunction and excessive corticosteroid use.

The nutritional goal in the immediate postoperative period is to provide adequate nutrition to "catch up" the pretransplant nutritional deficit associated with a chronic liver disease and to allow for recovery from major surgery.

Early oral or enteral feeding should be strived for after successful uncomplicated heart, liver and kidney transplantation. Aggressive early posttransplant nutritional therapy facilitates wound healing, decreases infectious complications and shortens ventilation time. Parenteral nutrition is needed if there is prolonged postoperative ileus or if gastrointestinal complications of surgery limit enteral feeding.

All transplant patients require nutritional follow up to assess nutritional status and to detect, prevent and treat late-onset complications such as obesity, hyperglycaemic hyperlipidaemia or osteoporosis. Dietetic support is an essential component of the transplant team. Although this manuscript focuses on the nutritional care of the paediatric patient post liver transplantation, most aspects of the management is relevant to a patient undergoing any solid organ transplant. Aspects of care specific to renal or intestinal transplantation will also be addressed.

LIVER

Children with chronic liver disease (CLD) are at high risk for malnutrition, especially when the disease is cholestatic in nature and its onset is in infancy. The most common CLD in our setting requiring transplantation in childhood is biliary atresia (70% of cases). Malnutrition is a manifestation of decompensated liver disease. Liver transplantation is a complex procedure that is performed in children who often have multiple co-morbidities.

Growth retardation and malnutrition are common complications of CLD because of decreased intake, malabsorption and relative growth hormone resistance. Nutritional support is complicated by increased energy expenditure, malabsorption secondary to gut oedema, cholestasis and poor intake. Cholestasis leads to malabsorption of fat soluble vitamins. Managing malnutrition in children in with end stage liver disease is a challenge.

Pretransplant nutritional therapy

In children with end-stage liver disease (ESLD) the nutritional goal is to maintain maximum growth potential, prevent further liver injury, promote liver regeneration, minimise risk of infection and avoid vitamin and mineral deficiencies.[1] They require 130–150% of the recommended dietary allowances (RDA) of energy for their ideal body weight. About 60–70% of the energy should be given as high complex and simple carbohydrates. The later should be limited when glucose intolerance is present. The other 30–40% of energy are provided by fat with some as medium chain triglycerides, if fat malabsorption is present. Long chain triglycerides should not be decreased to less than 10% of the total energy intake to prevent deficiencies in essential fatty acids. The RDA of protein for children with CLD is 2.5–3.0 g/Kg of ideal body weight because of their catabolic state and the need to improve growth rate.[2] Branched chain amino acids (BCAA) (leucine, isoleucine and valine) improve

hepatic protein synthesis. Most formulas contain between 16–53% BCAA. If the patient is encephalopathic the protein may need to be decreased (1.0–1.5g/Kg) and the more expensive formulas with a high content of BCAA may be considered.

Nasogastric tube feeds may be required in children with advanced liver disease who are unable to take sufficient feeds orally. If continuous nasogastric feeds become necessary it is important to continue small amounts of oral feeds so that the infants do not lose feeding skills after transplantation.

Patients awaiting orthotopic liver transplantations should take a daily multivitamin, as well as fat soluble vitamin supplementation including additional vitamin D as needed together with folic acid, zinc and magnesium.

Posttransplant nutritional therapy

Early postoperative period

The nutritional goal in the immediate postoperative period (two months) is to provide adequate nutrition to correct the pretransplant nutritional deficit associated with chronic liver disease and to allow for the additional stress of major abdominal surgery.

Preoperative malnutrition, stress of the surgical procedure, immunosuppressive therapy, liver or kidney dysfunction or sepsis are all factors that contribute to a persistent catabolic state in the early posttransplant period.

Early use (within the first 24–36 hours) of enteral feeding is recommended post an uncomplicated liver transplant, once the postoperative ileus has resolved.[3] This is usually done using continuous nasogastric feeding of a polymeric feed. If this is not tolerated then use of a semi-elemental feed would be considered. When the patient begins to eat solid food, enteral feeding can be used as overnight feeds to enhance the appetite during the day. The oral intake can be changed to a regular diet as tolerated, and once there is adequate oral intake the enteral feeds can be stopped. In this period the patients have a high protein, high energy diet to counteract the weight loss associated with pretransplant cachexia. Patients are often not advised when to wean off this diet. Parental nutrition is needed if there is a prolonged postoperative ileus or gastrointestinal complications. Chylous ascites may be related to lymphatic disruption and responds to fat restricted diet.

Although liver transplantation allows resolution of metabolic dysfunction PEM and nutritional deficiencies, the need for nutrition monitoring and therapy continues. Patients who are not malnourished and who can eat within a few days of the transplant may not need post-op nutrition support.

Metabolic/electrolytes

Routine posttransplant care includes monitoring fluid balance carefully with strict intake and output measurements and daily body weight measurements. Many laboratory tests are monitored which include full blood count, differential and clotting, blood glucose, electrolytes, calcium, phosphorus, magnesium, albumin and liver enzymes. Electrolyte abnormalities are common in the early posttransplant period. Sodium can be lost in the urine, nasogastric tube losses, and abdominal drains. Serum potassium, phosphate and magnesium levels can deplete early post liver transplant due to the use of diuretics and the refeeding syndrome. Cyclosporin, tacrolimus and kidney insufficiency can cause hyperkalaemia. Cyclosporin can accelerate magnesium losses.

All children routinely receive multivitamin supplements. In the long term the transplant recipient should only receive dietary supplements, if indicated.

Long-term posttransplant nutritional therapy

The diet of the liver transplant recipient should be monitored for energy and protein intakes for the first 2–3 years posttransplantation to maximise growth and to prevent obesity and its complications.

Obesity

A major problem in the transplant recipient is long-term excess energy and fat intake with excessive weight gain leading to overweight and obesity. The side effects most often seen with over-nutrition would include hypertension, diabetes mellitus and altered blood lipids. Once the pretransplant loss of weight and muscle has been regained there must be careful nutritional monitoring to prevent excessive weight gain. Weight gain is most dramatic between two and 16 months after transplantation. In a study of adult liver recipients, 43% were obese 18 months after transplant and a further 24% were overweight.[4] The causes of weight gain are multifactorial, the appetite is definitely stimulated by corticosteroids and often the patients are quite sedentary.

Patients and their families need to be educated about posttransplant obesity and its risks. It is important to monitor weight gain and to make aggressive efforts to decrease high fat foods for children who are gaining weight excessively. Most of the weight gained after transplantation is fat. Muscle mass is not always regained. A diet low in saturated fat and high in fibre and vegetables together with regular aerobic and weight bearing exercise has been shown to have a major role in preventing weight gain and lowering lipid levels posttransplant. Dietary support by the dietitian is crucial.

Growth retardation

Many children, particularly those with cholestatic disease, have growth retardation before liver transplantation, because of decreased intake, malabsorption and relative growth hormone resistance. Generally transplanted children do not have complete catch up growth and achieve a final height below their genetic potential.[5,6] A recent study found that after liver transplantation in childhood, 50% of patients reached a final height lower than -1.3SD of their genetic potential.[5] Ng et al found that 73% of recipients were below average height five years post liver transplantation.[6] The growth delay in children after transplantation is often attributed to corticosteroid use but this is not the only factor. However, excessive corticosteroid use must be avoided.

Diabetes mellitus

The occurrence of diabetes mellitus (DM) in transplant recipients is significantly increased when compared with the general population. The real incidence in posttransplant DM in children is unknown. In small retrospective studies it is reported to be between two and 24%.[7] In an audit at Red Cross Children's Hospital the incidence in liver and kidney transplants was 6%. The high risk factors in our group were black patients (50%), tacrolimus, high dose steroids and overweight. Many children can be weaned off insulin during follow up.

Table I: Side effects of immunosuppressive agents

Corticosteroids:
Growth retardation
Increased susceptibility to infection
Impaired wound healing
Cataracts
Glucose intolerance
Hypertension
Cushingoid facies and acne
Mycophenolate mofetil:
Gastrointestinal disturbances
Nausea and vomiting
Diarrhoea
Calcineurin Inhibitors (Ccyclosporine and tacrolimus)
Cyclosporine
Nephrotoxicity
Hypertension
Gum hyperplasia/hypertrichosis
Hyperkalaemia
Hypomagnesaemia
Hyperlipidaemia
Tacrolimus
Hyperkalaemia
Hypomagnesaemia
Diabetes mellitus
Diarrhoea and abdominal pain
TOR inhibitors (sirolimus)
Hyperlipidaemia
Delayed wound healing

* Nutritional side effects are in bold

Table II: Medications that alter calcineurin (CNI) levels

Medications that decrease CNI levels:
Anticonvulsants
- Barbiturates
- Phenytoin
- Carbamazepine
Rifampin
St John's wort
Medications that increase CNI levels:
Calcium-channel blockers
- Verapamil
- Diltiazem
- Nicardipine
- Amlodipine
Azole antifungals
- Fluconazole
- Ketoconazole
Macrolide antibiotics
- Erythromcycin
- NOT azithromycin
Corticosteroids
Somatostatin
Amiodarone
Grapefruit juice
Medications that increase renal toxicity:
Vancomycin
Aminoglycosides
Bactrim
Aciclovir
Ganciclovir
Amphotericin

New onset diabetes mellitus is a known side effect of both glucocorticosteroids and the calcineurin inhibitors because these drugs affect insulin secretion and tissue sensitivity or resistance to the effects of insulin. Age, family history, African ethnicity and use of tacrolimus are all risk factors for a higher incidence of diabetes in transplant patients.

Metabolic bone disease

The adverse effects on bone that occur posttransplantation include osteoporosis/bone loss, fractures and avascular necrosis. Most liver transplant recipients lose bone mass for 3–6 months after transplantation. In patients with a normally functioning graft this bone loss stops after six months.[1] Adequate treatment with calcium and vitamin D in the pre- and posttransplantation periods along with physical activity is important to decrease the complications of metabolic bone disease.

Immunosuppression

Most paediatric liver transplant recipients are initially treated with a triple immmunosuppression regimen. The side effects of the more common immunosuppressive agents (Table I) together with the more common drugs and foods that affect the levels of the calcineurin inhibitors (cyclosporine and tacrolimus) (Table II) should always be brought in mind.

RENAL

Meticulous fluid and electrolyte management is important in the paediatric renal transplant patient because such patients often need additional intravascular volume repletion in the perioperative period to establish diuresis and avoid delayed graft function. This is critical if a small child has received an adult graft.

There is little data on dietary recommendations for children following renal transplantation. Energy and protein needs are increased immediately after transplant. Protein needs are 150–200% of the recommended daily allowance (RDA) for age and weight. It is important to meet these needs to achieve wound healing to help prevent muscle wasting associated with high dose steroids. Supplemental enteral or parenteral nutrition is indicated in patients who cannot meet their energy and nutrient requirements via oral intake in the first few days posttransplant.

INTESTINAL

The outcome after intestinal transplantation has improved over the past decade. The postoperative management after liver transplantation is the most challenging of all the solid organ transplants. Total parenteral nutrition (TPN) is required for the first 3–6 weeks after transplantation. Continuous small volume (2 to 5 ml/hr) of enteral feeding is usually started within 10 days of the transplant. Elemental enteral formulae are used. The choice of enteral diet depends on age, previous diets and previous sensitisations. Posttransplant fat malabsorption can occur secondary to the severance of lymphatic channels of the intestinal graft.[8]

Once enteral feeding is established, the TPN is decreased. TPN is usually maintained until 70% of nutritional requirements are tolerated enterally. When the child is stable and tolerating enteral feeds, solid food is introduced according to the child's age and preference. Chronically ill infants and children who are at risk for oral aversion enteral tube feeding is necessary for many months. The transition to full oral intake may take years and in some cases is never achieved. Development of food allergies is common so initial avoidance of milk and eggs from the diet is recommended.

References

1. Ramaccioni V, Soriano H E, Arumugam R, et al. Nutritional Aspects of Chronic Liver Disease and Liver Tranplantation in Children. J Pediatr Gastroenterol Nutr. 2000;30:361–367
2. Campos ACL, Matias JEF and Coelho JCU. Nutritional Aspects of Liver Transplantation. Curr Opinion in Clin Nutr and Metabolic Care. 2002;5:297–307
3. Weiman A, Ebener Ch, Holland-Cunz S, et al. Surgery and Transplantation – Guidelines on Parenteral Nutrition. Chp 18. German medical Science 2009;7:1–15.
4. Munoz S, Deems R, Moritz M, et al. Hyperlipidaemia and Obesity after Orthotopic Liver Transplantation. Transplantation Proc. 1991;23(1):1480–1483
5. Scheenstra R, Jan Gever W, Odink RJ, et al. Growth and Final Height after Liver Transplantation. J Pediatr Gastroenterol Nutr. 2008;47:165–171
6. Ng VL, Fecteau A, Shepherd R, et al. Outcomes of 5-Year Survivors of Pediatrric Liver Transplantation: Report on 461 Children from a North American Multicenter Registry. Pediatrics 2008;122;e1128-e1135
7. Gokce S, Durmaz O, Coskun C, et al. Investigation of impaired carbohydrate metabolism in pediatric liver transplant recipients. Pediatr Transplant 2009;13:873–880
8. Encinas JL, Luis A, Avila LF, et al. Nutritional Status After Intestinal Transplantation in Children. Eur J Pediatr Surg 2006;16:403–406.