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NUTRITION SUPPORT FOR CHILDHOOD ONCOLOGY

Advances in the use of multimodal therapy, combination chemotherapy and better supportive care have vastly improved survival rates for childhood cancers over the decades.^{1,2} However, more intensive treatment regimens frequently result in nutritional depletion and evidence suggests that malnutrition is a common complication of childhood cancer and its treatment.

The consequences of malnutrition in this patient group are well documented³⁻¹¹ and adequate nutrition plays an important role in clinical outcomes such as treatment response, quality of life and cost of clinical care.¹² Nutritional management in childhood cancer with the provision of safe, appropriate and effective nutritional support is, therefore, well recognised as an important part of support care.

Over the past two decades, the type of nutritional support utilised in children with cancer has changed. Previously, parenteral nutrition was routinely used; however, enteral feeding is now recommended as the preferred route. The instigation of early enteral tube feeding in children identified to be at a higher nutritional risk due to their disease and/or planned therapy, can prevent nutritional decline during treatment. Studies have demonstrated that nasogastric feeding during intensive treatment improves

nutritional status with minimal complications and improves energy intake and well-being.¹³⁻¹⁶

One of the key considerations for successful enteral feeding in children undergoing treatment for cancer is enteral feed choice. Generally, an age-appropriate standard polymeric feed will be tolerated in children with a normal gastrointestinal (GI) function. However, a peptide-based semi-elemental feed may be more appropriate following some chemotherapy agents if there is malabsorption and should also be considered in children with lower gut mucositis or radiation enteritis; also those with graft versus host disease (GvHD) involving the GI tract and/or liver following allogeneic haematopoietic stem cell transplant.

The priming chemotherapy for both allogeneic and autologous haematopoietic stem cell transplant causes severe vomiting, mucositis, diarrhoea and protein losing



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Figure 1

Fig 1 Chemotherapy Drugs which cause structural and functional injuries to the GI tract resulting in mucositis:

Anthracyclines: Epirubicin,
Daunorubicin, Doxorubicin
Actinomycin D
High dose Methotrexate

High dose Melphalan
Mitrozantrone
m-Amsacrine

enteropathy. Nutritional support is provided to minimise the morbidity of the conditioning regimen and complications resulting from the procedure such as GvHD or veno-occlusive disease (VOD) of the liver.¹⁷⁻¹⁹

MUCOSITIS

Mucositis can cause villous atrophy, enterocyte damage, inflammation and crypt hyperplasia of the GI tract and hence is associated with significant pain, ulceration, abdominal distension, nausea, vomiting and diarrhoea.^{20, 21}

Many chemotherapy drugs, in particular anthracyclines, actinomycin, high dose methotrexate and high dose melphalan, result in the structural and functional injuries to the GI tract described above, resulting in mucositis (Figure 1).

GI mucositis is a common complication occurring five to 10 days after chemotherapy. It can occur in up to 100% of patients undergoing high dose chemotherapy and haematopoietic stem cell transplantation.²⁰ Children at risk of developing mucositis are, therefore, those whose treatment protocols include the above chemotherapy drugs. This currently includes the following diagnostic groups:

- Acute Myeloid Leukaemia
- Infant Acute Lymphoblastic
- Leukaemia
- B-cell Non Hodgkins Lymphoma
- Rhabdomyosarcoma

- Osteosarcoma
- Ewing's sarcoma
- High dose therapy and peripheral Blood stem cell rescue
- Haematopoietic stem cell transplant


Parenteral nutrition is still indicated in children with severe GI mucositis and enteritis. Other indications include typhlitis, neutropenic enterocolitis, ileus, chylous ascites post surgery or severe stage IV-III GvHD. Parenteral nutrition feeding, however, is associated with decreased enzyme activity and increased permeability in the gut, potentially leading to an increased risk of bacteraemia and endotoxaemia.^{22, 23}


In order to prevent gut atrophy, a small amount of continuous enteral nutrition is recommended whenever possible. Semi-elemental feeds tend to be the first line of choice for these patients, as peptides can have a trophic effect on the gut and are more complex than amino acids to evoke the epidermal growth factor.

CURRENT PRACTICE


As mentioned earlier, current practice suggests the early introduction of a peptide-based semi-elemental feed for patients at risk of developing mucositis, or when weaning off parenteral nutrition. Short chain whey-based peptides improve protein absorption and can lead to increased gastric emptying rates.²⁴

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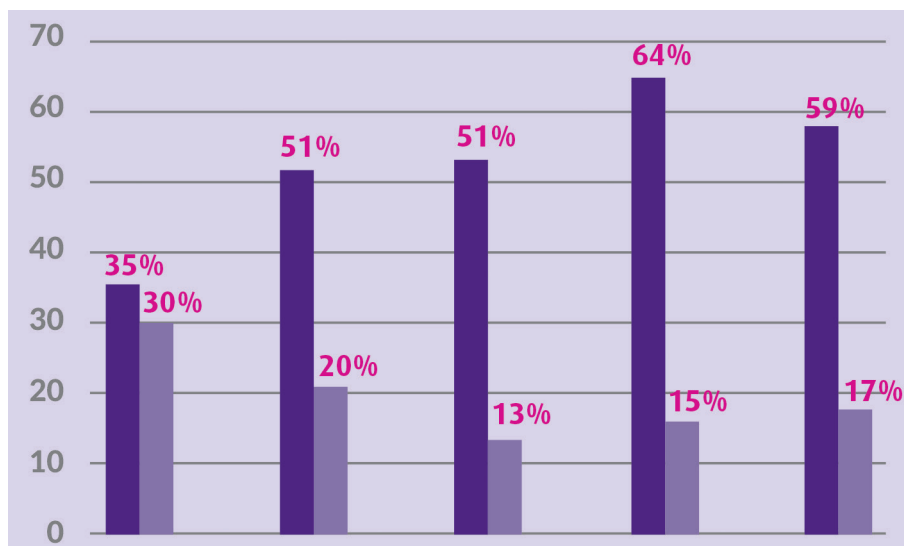
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Figure 2: Percentage of patients on enteral and parenteral nutrition at Yorkshire Regional Centre for Paediatric Oncology and Haematology



This has consequently been associated with improved feed tolerance in children at risk of vomiting.^{25, 26} The hydrolysed whey protein has a lower osmolality compared to feeds based on 100% free amino acids, which can improve tolerance. Children with impaired GI function due to mucositis may have suboptimal digestion, absorption, or transport of long chain triglycerides (LCT), leading to fat malabsorption and progressive malnutrition.

Peptide-based semi-elemental feeds generally have >45% of their total fat content as medium chain triglycerides (MCT), resulting in enhanced absorption and digestion of fat and improved nutritional status. The advent of paediatric ready-to-hang semi-elemental feeds eliminates the risk of any mixing errors. They are also microbiologically safe, which is particularly important for immunocompromised patients.

By considering early enteral tube placement in children undergoing treatment for cancer at risk of developing mucositis and considering use of a ready-to-hang peptide-based semi-elemental feed, the number of children supported with successful enteral feeding has greatly increased over the past decade. This has helped to reduce the incidence of parenteral nutrition as shown in Figure 2.

ENERGY DENSE PAEDIATRIC PEPTIDE-BASED FEED

Although successful enteral nutrition is possible using a peptide-based semi-elemental feed for children with impaired GI function following chemotherapy, there are other complications of treatment where a fluid restriction may be indicated (Table 1).

One specific complication of haematopoietic stem cell transplant is veno-occlusive disease (VOD) of the liver which occurs when the small blood vessels that lead into and are inside the liver become blocked. VOD can occur in up to 60% of patients who have undergone this procedure. Symptoms include increased liver enzymes and bilirubin, fluid retention/ascites and increased platelet consumption. A strict fluid restriction forms part of the management for this (usually 80% maintenance fluid or less).

These children tend to be on a number of drugs with drug volume and blood products taking precedence over volume for nutritional support. In order to maximise nutritional intake within a limited volume allowance, an energy dense peptide-based feed may be indicated in these children. Other indications for this type of feed include children with large abdominal masses unable to tolerate a polymeric feed,

Table 1: Indications for fluid restriction

| |
|---|
| • Acute Myeloid Leukaemia |
| • Infant Acute Lymphoblastic |
| • Leukaemia |
| • B-cell Non Hodgkins Lymphoma |
| • Rhabdomyosarcoma |
| • Osteosarcoma |
| • Ewing's sarcoma |
| • High dose therapy and peripheral Blood stem cell rescue |
| • Haematopoietic stem cell transplant |

e.g. Neuroblastoma, Wilm's tumour and Hepatoblastoma.

CONCLUSION

Malnutrition in children undergoing treatment for cancer should not be accepted as an inevitable process. It is well documented that effective cancer therapy contributes to nutritional morbidity in childhood cancer, particularly those at risk of mucositis.

Nutritional assessment and intervention should be integrated as an important aspect of

supportive care. Frequent monitoring is crucial to ensure effective nutritional support as feed (type, volume and delivery) and oral intake can vary throughout treatment due to the side effects of therapy.

Early aggressive enteral feeding using a peptide based semi elemental feed can adequately provide nutritional support and help to reduce the incidence and duration of parenteral nutrition in children who are undergoing treatment for cancer and at risk of developing lower GI mucositis.

References

- Landier W, Bhatia S Cancer survivorship: a pediatric perspective. *Oncologist*, 2008, 13(1) 1181-92
- O'Leary M, Kralio M, Anderson J et al. Progress in childhood cancer; 50 years of research collaboration, a report from the Children's Oncology Group. *Seminars in Oncology* 2008, 35(5) 484-93
- Donaldson SS, Wesley MN, DeWys WD et al. A study of nutritional status in pediatric cancer patients. *Am J Dis Child*, 1981, 135(12) 1107-12
- Lange BJ, Gerbing RD, Feusner J et al. Mortality in overweight and underweight children with acute myeloid leukaemia. *J Am Med Assoc* 2005, 293(2) 303-11
- Andressy RJ, Chwals WJ Nutritional support of the paediatric oncology patient. *Nutrition* 1998, 14 124-29
- Ladas ED, Sacks N, Meacham L A. Multidisciplinary review of nutritional considerations in the paediatric oncology population: a perspective from the Children's Oncology Group. *Nutr Clin Prac* 2005, 20(4) 377-93
- Charland SL, Bartlett D, Torosian MH. Effect of protein-calorie malnutrition on methotrexate pharmacokinetics. *J Parenter Enteral Nutr* 1994 18(1) 45-49
- Gomez-Almaguer D, Montemayor J, Gonzalez-Llano O et al. Leukaemia and nutrition. IV. Improvement in the nutritional status of children with standard risk acute lymphoblastic leukaemia is associated with better tolerance to continuation chemotherapy. *Int J Pediatr Hematol Oncol*, 1995, 2 53
- Sala A, Pencharz P, Barr RD. Children, cancer and nutrition - a dynamic triangle in review. *Cancer* 2004, 109(4) 677-87
- Tabori U, Sung L, Hukin J et al. Medulloblastoma in the second decade of life: a specific group with respect to toxicity and management. *Cancer* 2005, 103(9) 1874-80
- Taj MM, Pearson AD, Mumford DB et al. Effect of nutritional status on incidence of infection in childhood cancer. *Pediatr Hematol/ Oncol*, 1993, 10(3) 283-87
- Bauer J, Jurgens H, Fruhwald M. Important aspects of nutrition in children with cancer. *Adv Nutr* 2011 2 67-77
- den Broeder E, Lippins RJ, van't Hof MA et al. Effects of nasogastric tube feeding on the nutritional status of children with cancer. *Eur J Clin Nutr*, 1998, 52(7) 494-500
- Pietsch JB, Ford C, Whitlock JP. Nasogastric tube feeding in children with cancer: a pilot study. *J Pediatr Hematol/Oncol*, 1999, 21(2) 111-14
- Deswarte-Wallace J, Firouzbaksh S, Finklestein JZ. Using research to change practice: enteral feeding for pediatric oncology patients. *J Pediatr Oncol Nursing*, 2001, 18(5) 81-85
- Ward E, Hopkins M, Arbuckle L et al. Nutritional problems in children treated for medulloblastoma: implications for enteral feeding support. *Pediatr Blood Cancer*, 2009, 53(4) 570-75
- Hastings Y, White M, Young J Enteral nutrition and bone marrow transplant. *J Pediatr Oncol Nursing*, 2006, 23(2) 103-10
- Scott N, Ward E. The Nutritional management of graft versus host disease - The Leeds experience. *BSBMT News*, 2008, issue No 3.
- Thompson J, Duffy J. Nutritional Support Challenges in Hematopoietic Stem Cell Transplant Patients. *Nutrition in Clinical Practice* 2008 23 (5) 533-546
- Gibson R, Keefe D, Lalla R et al. Systematic review of agents for the management of gastrointestinal mucositis in cancer patients. *Support Care Cancer* 2013 21 313-326
- Duncan M, Grant G. Review article: oral and intestinal mucositis - causes and possible treatments. *Aliment Pharmacol Ther* 2003 18 853-874
- Buchman A, Moukarsel A, Bhuta S et al. Parenteral nutrition is associated with intestinal morphological and functional changes in humans. *JPEN* 1995 19 453-460
- Guedon C, Schmitz J, Lerebours E et al. Decreased brush border hydrolyse activities without gross morphologic changes in human intestinal mucosa after prolonged total parenteral nutrition in adults. *Gastroenterology* 1986 90 373-378
- Billeaud C, Guillet J, Sander B. Gastric emptying in infants with or without gastro-oesophageal reflux according to type of milk. *Eur J Clin Nutr* 1990 44 (8) 577-583
- Fried M, Khoshoo V, Secker D et al. Decrease in gastric emptying time and episodes of regurgitation in children with spastic quadriplegia fed a whey-based formula. *J of Pediatr* 1992 120 (4) 569-572
- Coppell J, Richardson P, Soffer R et al. Hepatic veno-occlusive disease following stem cell transplantation: incidence, clinical course and outcome. *Biol Blood Marrow Transplant* 2010 16 157-168

Questions relating to: *Nutrition support for childhood oncology.*

Type your answers below, download and save or print for your records, or print and complete by hand.

| | |
|------------|---|
| Q.1 | What are the key considerations for successful enteral tube feeding in children with cancer? |
| A | |
| Q.2 | What are the clinical indications for considering the use of a peptide-based semi-elemental feed in children undergoing treatment for cancer? |
| A | |
| Q.3 | When is the use of parenteral nutrition considered in children treated for cancer and what are some of the potential disadvantages of parenteral nutrition? |
| A | |
| Q.4 | What is mucositis and what are the causes and symptoms of mucositis in children undergoing treatment for cancer? |
| A | |
| Q.5 | What are the advantages of using a peptide-based semi elemental feed in children at risk of mucositis in terms of protein and fat content? |
| A | |
| Q.6 | Why is the use of a ready-to-hang feed important in children undergoing treatment for cancer? |
| A | |
| Q.7 | What are the signs and symptoms of veno-occlusive (VOD) disease of the liver? Which group of children are at risk of developing VOD? |
| A | |
| Q.8 | Why would an energy dense peptide-based semi elemental feed be considered in children with VOD? What are some of the other indications for considering the use of an energy dense feed in children treated for cancer? |
| A | |

Please type additional notes here . . .