Nutritional implications of cancer and cancer treatment in children

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INTRODUCTION

In common parlance the term "malnutrition" connotes inadequate nourishment, though in clinical and epidemiological practice it often encompasses both overweight and obesity. Under-nutrition has been defined as "a state of nutrition in which a deficiency of energy, protein and other nutrients causes measurable adverse effects on tissue/body form and function and clinical outcome" and is categorised by the World Health Organization (WHO) as acute (wasting) or chronic (stunting). The former is based on measures of weight for height and the latter on height for age. Both wasting and stunting are prevalent in children in low and middle income countries (LMICs), especially the former as defined by the World Bank on the basis of Gross National Income (GRI) per capita. The corollary prevails in high income countries (HICs) in which overweight and obesity, defined commonly by the measure of body mass index (BMI – wt. in kg/ht. in m^2), and has become a major public health concern, notably in children and adolescents. Both ends of the spectrum of perturbations of nutritional status, under-and over-nutrition, portend adverse consequences for young people with cancer, commanding international attention and resulting in the formation of expert groups focused on the challenges, exemplified by the Committee on Nutrition and Health in the International Society for Paediatric Oncology (SIOP). This review will be in 6 parts – measurement of nutritional status and body composition; assessment of nutritional status along the cancer journey; nutritional morbidity in survivors; interventions to reduce malnutrition in survivors of leukemia in childhood and adolescence; the special case of haematopoietic stem cell transplantation; conclusions.

Measurement of nutritional status and body composition

As the great majority (more than 85%) of children and adolescents with cancer live in LMICs, simple measures are most applicable. Those based on body weight can under-estimate under-

nutrition when more than 10% of body mass is composed of tumour. Furthermore, body mass index does not distinguish muscle from adipose tissue. However, arm anthropometry offers a solution. Mid-upper arm circumference (MUAC) is a surrogate for lean body mass and triceps skin fold thickness (TSKT) affords a measure of fat mass. These measures that are not influenced by the weight of tumour have been validated in children with cancer by dual energy X-ray absorptiometry.[1]

Assessment of nutritional status along the cancer journey

Studies in the USA demonstrated that, in children with AML, both under-and overweight status at diagnosis were associated with poorer survival due to greater treatment-related mortality; while obesity at diagnosis in children with ALL is also associated with poorer survival, in this case due to an increased rate of relapse. In children with cancer in LMICs, as exemplified in Central America, under-nutrition is present in almost 50% at diagnosis, determined by MUAC and TSFT, and is associated with a high rate of abandonment of treatment and compromised event-free survival.[2]

Longitudinal studies of nutritional status in children with cancer have been reported less frequently and with mixed results, in part as a result of the choice of measures. However, a study in the Netherlands, using bio-electrical impedance, demonstrated that fat mass increased steadily across the treatment experience while the lean body mass remained low[3]; the seemingly paradoxical phenomenon of sarcopenic obesity. Finally, one must not lose sight of the adverse effects of treatment on bone mineral, leading to osteopenia and osteoporosis, and of micronutrient deficiencies.

Nutritional morbidity in survivors

As survivorship begins at diagnosis it is not surprising that the burden of perturbed nutritional status continues beyond the completion of therapy. In HICs obesity is a common feature of survivors, risking adverse health outcomes such as the metabolic syndrome. However, this consequence can be minimised with a heart-healthy lifestyle that includes adequate physical activity and a Mediterranean diet. In LMICs, while obesity is an emerging problem, under-nutrition may persist because of socio-economic disadvantage.

Interventions to redress malnutrition in survivors of leukemia in childhood and adolescence

When nutritional supplementation is required, as it is often in children with brain and extra-cranial sold tumours, using the gut is strongly preferred (by mouth or with tube feeding) over the parenteral route. Not only does the former maintain gut integrity but the adverse effects of prolonged parenteral nutrition are avoided. Moreover, the costs of central venous lines and products for parenteral nutrition make this option unaffordable in many LMICs. Furthermore, innovative approaches with locally sourced ready-to-use therapeutic foods (RUTFs) are inexpensive and effective means of enteral supplementation. A striking example is the use of chiponde (a peanut based supplement) in Malawi. It is important to note that redressing under-nutrition can restore good survival prospects, as described first in children with ALL in Guatemala.[4]

The special case of hematopoietic stem cell transplantation (HSCT)

In children undergoing HSCT resting energy expenditure falls progressively in the first 4 weeks. This reflects loss of lean body mass, which contributes to prevalent sarcopenic obesity. In addition, loss of bone mineral is common and correlates with reduction in serum 1, 25 dihydroxy vitamin D. Aberrations of nutritional status after HSCT are associated with poorer survival rates due to higher treatment-related mortality, including greater graft-versus-host disease. Clinical experience points to the value of nutritional supplementation, when required, delivered by the enteral route. In children who experience severe mucositis, necessitating parenteral nutrition, there is no evidence to support the incorporation of supplemental glutamine.

CONCLUSIONS

Perturbations of nutritional status, both over-and under-nutrition, are common before, during and after treatment for cancer in children and adolescents. These alterations are associated with increased morbidity and compromised prospects for survival. Prompt intervention can prevent or ameliorate these adverse clinical outcomes. In LMICs the challenges are considerable but are subject to improvement with innovative, locally appropriate strategies.[5] The need for further more rigorous study has been well reviewed.[6]

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