

Original Article

Nutritional status changes in children with malignant solid tumor before and after chemotherapy

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ABSTRACT

Background Although aggressive multimodal treatment programs in childhood cancer have significantly increased survival rates, the morbidity caused by protein energy malnutrition related to therapy is still high.

Objective To describe nutritional status changes in children with malignant solid tumors after 21 days of chemotherapy.

Methods A descriptive prospective study with pre- and post-test design in children with malignant solid tumors was conducted in the Department of Child Health, Medical School University of Indonesia/Cipto Mangunkusumo Hospital, Jakarta between January and July 2004. Anthropometrics (body weight, BW and mid-upper-arm circumference, MUAC) and serum albumin measurements were performed before and after 21 days of chemotherapy.

Results Twenty-two children were enrolled in this study. After 21 days of chemotherapy, 8 children had decreased BW and 6 children had decreased MUAC, but 3 children gained weight and had increased MUAC. Based on MUAC-for-age, 7 children had decreased nutritional status. Fifteen children had reduced serum albumin levels based on a 10% cut-off point. The number of children who had reduced serum albumin was larger than those who had reduced BW and MUAC. In the evaluation of average oral food consumption during 21 days, 7 out of 16 children could accept more than 2/3 portion of served food. All of the children who received enteral feeding could accept more than 2/3 portion of served food.

Conclusion There was a decrease of nutritional status, BW, MUAC, and serum albumin in most of the subjects after chemotherapy. Serum albumin level measurement was the more sensitive parameter in determining nutritional status changes. Enteral feeding seems more appropriate to fulfill nutritional needs than oral feeding [Paediatr Indones 2005;45:166-170].

Keywords: nutritional status, anthropometrics, serum albumin, enteral feeding, malignant solid tumor, chemotherapy

Poor nutritional status is frequently observed in children with cancer. It can be caused by the cancer itself, the treatment administered, or both.¹⁻⁵ In the past 20 years, significant advances have been made in childhood cancer treatment. Although aggressive multimodal treatment programs have significantly increased survival, the morbidity caused by protein energy malnutrition related to therapy still increases.³ Poor nutritional status has a significant negative impact on the ability to tolerate treatment as well as on the quality and duration of life. Twenty percent of deaths from malignancies are due to malnutrition and tissue wasting.⁶

The aim of this study is to describe nutritional status changes in children with malignant solid tumors after chemotherapy.

Methods

A descriptive prospective study with pre- and post-test design in children with malignant solid tumor was

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TABLE 1. NUTRITIONAL STATUS (MUAC-FOR-AGE) BEFORE AND AFTER 21 DAYS OF CHEMOTHERAPY

MUAC-for-age	After			
	Before	Well-nourished	Undernourished	Malnourished
Well-nourished	11	6	5	-
Undernourished	9	-	7	2
Malnourished	2	-	-	2
Total	22	6	12	4

TABLE 2. SERUM ALBUMIN BEFORE AND AFTER 21 DAYS OF CHEMOTHERAPY

Serum albumin	After		
	Before	Normal	Hypoalbuminemia
Normal	14	5	9
Hypoalbuminemia	8	2	6
Total	22	7	15

conducted in the Department of Child Health, University of Indonesia/Cipto Mangunkusumo Hospital between January and July 2004. Subjects were recruited by consecutive sampling. Children were included if they were between 1-18 years of age, hospitalized for chemotherapy in the Pediatric Oncology Ward, Cipto Mangunkusumo Hospital, and had informed consent from their parents. We excluded children who had congenital anomalies, chronic diarrhea, or malabsorption at the time chemotherapy was started. Non-cooperative children and children who underwent surgery or radiotherapy were also excluded.

Anthropometrics and serum albumin level measurements were performed before and after 21 days of chemotherapy. Twenty-one days was used as the interval between the first and second measurements, since the half life of albumin in blood is about 14–20 days.^{2,7,8} In patients with dehydration, all examinations were performed after the subjects were rehydrated. The anthropometrics measurements performed were mid-upper-arm circumference (MUAC) and body weight (BW). Serum albumin concentrations were examined according to the Brom Crisol Green method.

The anthropometrics standard used for interpretation in this study was the 1983 NCHS standard. Normal serum albumin level was defined as ≥ 3.5 g/dl and values less than 3.5 g/dl were considered as hypoalbuminemia.^{9,10} Body weight and MUAC changes of more

than 5% were considered clinically important.^{7,11} Changes in serum albumin level were considered clinically important if the difference was more than 10%.¹²

Food consumption was defined as an evaluation of feeding or dietary response, i.e., the average amount of the served food during 21 days which is consumed by the patient. Food consumption of more than 2/3 of the served food was considered as sufficient and consumption of less than 2/3 as insufficient.⁹ Enteral nutrition was given via nasogastric tube.

The study protocol was approved by the Medical Research Ethics Committee of the Medical School, University of Indonesia.

Results

Out of 26 patients (15 boys and 11 girls) who fulfilled the inclusion criteria, only 22 children could be observed for 21 days. Two children died before the end of the study period and 2 did not come for follow-up after 21 days. The subjects' age ranged between 1 to 11 years and most subjects (19/22) were less than five years old.

The types of cancers in our subjects were retinoblastoma (10 subjects), rhabdomyosarcoma (7 subjects), neuroblastoma (5 subjects), Wilms' tumor (2 subjects), Ewing's sarcoma (1 subject), and ovarian teratoma (1 subject).

After 21 days of chemotherapy there were 7 children with decreased MUAC-for-age. No subject had increased nutritional status based on MUAC-for-age (Table 1). Before the initiation of chemotherapy, there were 8 children with hypoalbuminemia. After 21 days of chemotherapy there were 15 children with hypoalbuminemia, and 2 previously hypoalbuminemic children regained normal albumin levels (Table 2).

There were 15 children with decreased albumin levels but only 5 children with decreased body weight and 6 children with decreased MUAC (Table 3).

Table 4 shows the average food consumption at 21 days of chemotherapy. In the first week of chemotherapy, 18 patients received oral feeding and 4 received enteral nutrition. In the second and third week, 16 children received oral feeding and 6 received enteral nutrition. Two of the children who received oral feeding in the first week had to be reassigned to enteral nutrition due to severe stomatitis. Most of the children could only consume less than 2/3 portion of their meals in the first week of chemotherapy. In the second and third week, more than half of the children could accept more than 2/3 portion. All children with enteral nutrition could tolerate more than 2/3 portion in the second and third week.

Discussion

The ratio of boys and girls with malignant solid tumor in this study was 1.4:1, similar to that in a study by Fernbach and Vietti.¹³ Most of our patients were between 1 to 5 years old (19/22 children). This was in accordance with data obtained by Stiller and Draper in Great Britain.¹⁴ In our study, the types of cancers in order of decreasing frequency were retinoblastoma, rhabdomyosarcoma, neuroblastoma, Wilms' tumor, Ewing's sarcoma, and ovarian teratoma. These findings differ from Kupfer's,¹⁵ in whose study this order was neuroblastoma, Wilms' tumor, retinoblastoma, and Ewing's sarcoma. The small sample size in our study may have caused this difference.

MUAC gives information about the condition of muscular tissue and subcutaneous fat. Nowadays, MUAC-for-age is a nutritional status indicator of choice.⁹ MUAC shows that inadequate calorie intake will cause mobilization of body reserves.^{7,9} In our study, after 21 days of chemotherapy 7 children had decreased MUAC-for-age and none had increased MUAC-for-age. These findings may reflect the severity of the disease, increased nutritional needs due to the disease, and chemotherapy side effects if not sup-

TABLE 3. NUTRITIONAL CHARACTERISTICS OF STUDY SUBJECTS AFTER 21 DAYS OF CHEMOTHERAPY

Characteristics	n	Albumin level changes		
		Increased >10% (n=2)	Constant (n=5)	Decreased >10% (n=15)
BW changes				
• Increased $\geq 5\%$	3	2	-	1
• Stable	11	-	2	9
• Decreased $\geq 5\%$	8	-	3	5
MUAC changes				
• Increased $\geq 5\%$	3	1	1	1
• Stable	13	1	4	8
• Decreased $\geq 5\%$	6	-	-	6

TABLE 4. WEEKLY FOOD CONSUMPTION DURING CHEMOTHERAPY BASED ON AVERAGE MEAL PORTION AND MODE OF NUTRITION

Mode of nutrition	Food consumption								
	n	Week 1		n	Week 2		n	Week 3	
		2/3 portion	< 2/3 portion		2/3 portion	< 2/3 portion		2/3 portion	< 2/3 portion
Oral	18	3	15	16	7	9	16	8	8
Enteral	4	2	2	6	6	-	6	6	-
Total	22	5	17	22	13	9	22	14	8

ported with adequate nutritional management. Accordingly,

Rickard *et al*⁴ stated that malnutrition is most commonly found at the time of diagnosis and worsens during chemotherapy.

Albumin is a protein with a half-life of 14–20 days in normal conditions.¹⁶ Rickard *et al* found that a decrease in albumin level of more than 10% showed subclinical protein energy malnutrition.¹² Before chemotherapy, we found 14 children with normal albumin levels and 8 children with hypoalbuminemia (**Table 2**). After 21 days of chemotherapy there were more children with hypoalbuminemia (15/22 children), but there were also 2 children with previous hypoalbuminemia who regained normal albumin levels. This may be caused by adequate food consumption as an advantage of the enteral mode of delivery. The decrease in albumin level was more pronounced than that in body weight and MUAC. This condition reflects the previously mentioned subclinical protein energy malnutrition due to inadequate intake.¹² In one child, body weight and MUAC increased by 35%, but albumin level decreased >10% (**Table 3**). Further investigation of this patient revealed increased liver transaminases to more than 5 times the normal value, which led us to assume that the decreased albumin level was due to impaired liver synthesis function.¹⁶

In the first week most of the children could only consume less than 2/3 portion of the served food. This might be due to side effects of chemotherapy, which usually occur in the first week and impair dietary intake. In the second and third weeks these side effects had subsided, so that more than half of the patients could tolerate more than 2/3 portion of the served food. All children who were given enteral nutrition via nasogastric tube could tolerate more than 2/3 portion of served food in the second and third weeks.

In conclusion, nutritional status based on BW, MUAC, and serum albumin deteriorated in most patients with malignant solid tumor following chemotherapy. In this study, serum albumin was the more sensitive parameter in determining nutritional status changes. Enteral feeding seems to be a more appropriate method to fulfill nutritional needs than oral feeding. Further evaluation of chemotherapy-related nutritional changes in patients with malignant solid tumor is needed, preferably with larger sample size and longer duration of observation.

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