



SENSITIVITY TEST OF MID-ARM MUSCLE AREA AND UPPER ARM CIRCUMFERENCE TO ASSESS NUTRITIONAL STATUS IN PATIENT WITH ACUTE LYMPHOBLASTIC LEUKEMIA (ALL) INDUCTION PHASE

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ABSTRACT

BACKGROUND : Leukemia is the most common malignancy, with incidence of 3.7 – 4.9 case per 100.000 children and the majority are children 2 to 5 years old. There are various nutritional status and one of them depend on the measurement method. In a case presence with organomegali, mass, and ascites, the past way to measure the nutritional status is by measuring the mid-arm muscle area (MAMA) and upper arm circumference (UAC)

OBJECTIVE : to assess sensitivity of MAMA and UAC to determine the nutritional status in patient with ALL induction phase

METHODS : Cross sectional study on 35 patient with ALL that had induction phase chemotherapy. Sample were taken with consecutive sampling, and MAMA and UAC were measured. ROC analysis was performed to obtain the cut off point. Bivariate analysis was performed with chi-square

RESULT: From 35 sample that meet the inclusion and exclusion criteria, there were 20 patient with severe malnutrition by measuring the MAMA and the other 15 patient by measuring the UAC. We found the AUC values MAMA is 70%, the cut off point is 1033,07 mm² and AUC values UAC is 87,8% with cut-off point 152,5mm by using ROC analysis.

CONCLUSION : The sensitivity value of the measurement of the MAMA 47% and UAC 80% with specificity value MAMA 70% and UAC 85%. and the sensitivity value UAC 80% and specificity 85%. From result measuring MAMA not more sensitive to assess the nutritional status of ALL patients in the induction phase

KEYWORDS : Children, acute lymphoblastic leukemia. Mid-arm muscle area, upper arm circumference

INTRODUCTION

Leukemia is a malignancy of blood cells originating from the bone marrow, which is characterized by the proliferation of white blood cells.¹ Acute lymphoblastic leukemia (ALL) is the most commonly diagnosed malignancy in children.^{2,3} In the United States, annual ALL events are 3.7 up to 4.9 cases per 100 000 children aged 0 to 14 years.² In Cipto Mangunkusumo Hospital (RSCM) ALL was found around 30 to 40% at the age of under 15 years, with a peak incidence of ages 2 to 5 years.^{1,2,3} Research in 2012 at H.Adam Malik General Hospital in Medan found 50 children from October 2011 to February 2012.⁴ Malnutrition is a major problem in children suffering from cancer, especially ALL, due to the occurrence of Cachexia which is characterized by decreased appetite, weight loss, and muscle wasting.^{5,6} The prevalence of malnutrition in ALL patients when diagnosed has been reported in 2013 as 7% in the country advanced, around 21 to 23% in developing countries, and around 10% in industrialized countries.^{5,7,8} Several researchers have reported that malnutrition can have a negative impact on treatment tolerance, high recurrence rates, increased mortality, and worse prognostics in children with cancer, especially in ALL.^{9,10}

The prevalence of malnutrition varies significantly around 10% to 60% depending on the assessment tool used, type and stage of cancer, evaluation time, and socio-economic background.¹⁰ One nutritional assessment by determining nutritional status using the Body Mass Index (BMI) and anthropometry of the arm, such as UAC, triceps skin fold thickness (TSF) and MAMA.^{10,11} In ALL that has symptoms such as palpable mass, ascites, enlarged organs, and the occurrence of cachexia which causes weight loss and muscle wasting, arm anthropometry is more recommended use the MAMA because it shows better results for evaluating body composition and diagnosing malnutrition in oncology patients.^{6,10,12-14} Mid-arm muscle area evaluates overall calculated fat-free muscle use a formula where one of the calculations uses the UAC value, which makes the MAMA a

better indicator.⁶

Assessment of nutritional status in ALL patients aims to help evaluate nutrition as a strategy to prevent nutritional disorders and provide appropriate and effective nutritional interventions to improve children's quality of life, and reduce incidence relapse using anthropometry of the arm such as the MAMA and UAC.^{10,15} Therefore, it is important for us, especially the oncologist to assess nutritional status routinely to be needed as a basis for adequate nutrition and achieve remission.^{6,16,17}

The aim of this study was to assess the sensitivity of the MAMA and UAC to assess nutritional status in patients with ALL in the induction phase at H.Adam Malik General Hospital in Medan.

MATERIAL AND METHOD

Patient selection

This study was conducted at the pediatric ward of H.Adam Malik General Hospital in November 2018 to January 2019. Patients with ALL received chemotherapy induction phase of 1 - 17 years ago were included. Measurements of TSF and UAC were measured. The value obtained is entered according to the formula to get the value of the MAMA. Measurements were made by researchers.

Data Analysis

Demographic data such as age, sex, weight, height, MAMA, UAC, organomegaly and chemotherapy protocol were collected. The MAMA was assessed by calculating TSF measured using a caliper and UAC using a measuring tape.

$$MAMA = \frac{(UAC - \pi \cdot TSF)^2}{4 \cdot \pi}$$

From the formula, $\pi = 3.1416$. The calculation of MAMA is plotted into the frisancho table, then categorized according to the nutritional status of the patient.

Table 1. Diagnosis of the percentile based on the Frisancho table

Percentile	Diagnosis
<5	Wasted
5 – 95	Average
>95	High Muscle

Statistical Method

Demographic data were analysed by univariate analysis. Receiver Operating Characteristics (ROC) curve used to the Area Under the Curve (AUC) value and the cut off point. Diagnostic test using the chi square test. Analysis was carried out with SPSS software. P values <0.05 were considered significant with 95% confidence intervals.

RESULT

Table 1. characteristics of study subjects

Characteristics	n=35
Mean oage of subjects, years (SD)	6.9 (4.76)
Sex, n(%)	
Male	19 (54.3)
Female	16 (45.7)
Organomegaly, n (%)	
Palpable	26 (74.3)
No Palpable	9 (25.7)
Protocol Chemotherapy, n(%)	
Standart Risk	22 (62.9)
High Risk	13 (37.1)
Mean of Body Weight, Kg (SD)	24.3 (15.69)
Mean of Body Height, m (SD)	1.15 (0.27)
Mean Mid-arm Muscle Area, mm2 (SD)	1565 (854.9)
Mean Upper Mid Circumference, mm (SD)	170 (38.26)
Nutritional Status With Mid-arm Muscle Area, n (%)	
< P5th	20 (57.1)
> P5th	15 (42.9)
Nutritional Status With Upper Mid Circumference, n (%)	
< P5th	15 (42,9)
> P5th	20 (57.1)

Table 4. Diagnostic Test MAMA with nutritional status in patients with ALL in the induction phase

Mid-arm muscle area	Nutritional status		Total	Sn %	Sp %	PPV %	NPV %	PLR	NLR
	Malnutrition	No malnutrition							
< Cut off	7 (53.8)	6 (46.2)	13	47	70	53	64	1.55	0.76
> Cut Off	8 (36.4)	14 (63.6)	22						

Table 5. Diagnostic Test UAC with nutritional status in patients with ALL in the induction phase

Upper arm circumference	Nutritional status		Total	Sn %	Sp %	PPV %	NPV %	PLR	NLR
	Malnutrition	No malnutrition							
< Cut off	12 (80)	3 (20)	15	80	85	80	85	5.33	0.23
> Cut Off	3 (15)	17 (85)	20						

DISCUSSION

Malnutrition is a major problem in children suffering from cancer, especially ALL.¹⁸ In ALL patients who experience malnutrition can have a negative impact on treatment and prognosis.^{9,10} Malnutrition was assessed in two methods of arm measurement, MAMA and UAC. Muscle mass is recognized as an important clinical indicator to determine energy deficiency which indicates malnutrition caused by the occurrence of cachexia. The occurrence of cachexia in cancer patients causes malnutrition such as weight loss, impaired carbohydrate, fat and protein metabolism which affects changes in body composition, especially muscle wasting.¹⁹ Measurement of the MAMA is considered better because it only assesses muscle mass, compared to the UAC assess muscle mass and fat in the arm.^{6,20,21,22}

In this study, malnutrition with measurements of the MAMA

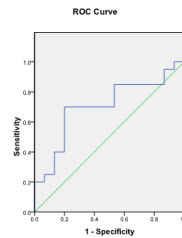


Figure 1. ROC curve of MAMA to nutritional status based on UAC

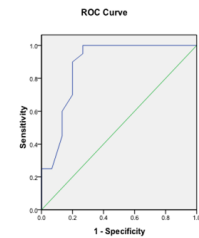


Figure 2. ROC curve of UAC to nutritional status based on UAC

Table 2. AUC MAMA and UAC from ROC curve

	Area Under Of Curve	Cut Off	CI 95%	
			Lower	Upper
Mid-arm muscle area	0.703	1033.07	0.526 (1457.23)	0.881 (866.07)
upper arm circumference	0.878	152.5	0.734 (165)	1 (119)

ROC analysis also obtained cut off values from MAMA and UAC to assess the nutritional status of ALL patients in the induction phase was 1033.07 mm² and 152.5mm. After getting the cut off value, the chi square between the MAMA and UAC a corresponds to each cut-off to find the relationship between the both with malnutrition. From the chi square test, the nutritional status based on the MAMA and UAC according to each cut-off, obtained significant results with a P value of 0.002 as in table 3

Table 3. Relation of Nutrition Status by MAMA with UAC based on Cut Off

Mid-arm muscle area	Upper arm circumference		Total	P value
	< Cut off	> Cut Off		
< Cut off	10 (76.9)	3 (23.1)	13	0.002
> Cut Off	5 (22.7)	17 (77.3)	17	

From the correlation test results, it was continued to analyze sensitivity (Sn), specificity (Sp), positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (PLR) and negative likelihood ratio (NLR).

was obtained by 20 people (57.1%) and UAC which were 15 people (42.9%) with a sample of 35 people. The results of this study are in accordance with the results of a study conducted in Casablanca in 2008 that received malnutrition by measuring 22 people in the MAMA (37.9%) and 19 people (32.7%) with UAC. Research in Casablanca also used other measurements to assess malnutrition, such as TSF found 27 people (46.5%).¹⁸ Research in India from 2008 to 2013 received malnutrition with measurements of the MAMA of 70.2% and UAC 78.7% with a total sample of 658 people. The difference between this study and research in India is that there are more samples in research in India and longer periods of time, besides research in India states malnutrition from the results obtained and entered into the Frisancho table <P10th, while from this study malnutrition is enforced in the Frisancho table <P5.¹⁰ Malnutrition obtained from the Baghdad study was based on the UAC of 15 people (42%), but the Baghdad study

did not assess malnutrition based on the MAMA.²³

The occurrence of infiltration of cancer cells to various organs causes enlargement of organs / organomegaly especially in the liver and spleen is an ALL clinical phase of induction. In this study, there were 26 people (74.3%) with organomegaly, the results obtained in this study were different from those in Baghdad with 19 people (43%) and in Surabaya 50 people (60%).^{23,27} Research in Baghdad assessing organomegaly only with enlargement of the liver, but research in Surabaya assessed organomegaly as 50 enlargement of the liver (60%) and spleen 43 people (52.4%), while in this study organomegaly was assessed from enlargement of the liver and spleen.^{23,24}

Tan's research in Malaysia showed the same results as the results of this study in terms of mean body weight and mean height of 24 kg and 1.15 m, but different from mean of MAMA and UAC. In the study, Tan obtained the mean of MAMA which was 1819mm² while the study was 1565 mm². The results of Tan's study obtained a mean UAC of 193mm while the study was 170mm, this difference was possible because of the greater number of sample differences in Tan's study of 53 people. From the results of this study, the mean MAMA was not much different from the study in Baghdad, which was 1513mm², but different from the results of the mean UAC of 131mm.²³

From this study ROC curves from the MAMA were compared with nutritional status obtained from the UAC measurement as standard, and AUC was obtained by 70% (0.7). From the AUC values obtained, this study found the cut off value of the MAMA was 1033.07mm². There are no studies that discuss the value of the cut-off MAMA to assess nutritional status in pediatric ALL patients. Previous research from the Center for Human Growth and Development and the Department of Anthropology, University of Michigan in 1971 to 1974 which followed 19 097 samples aged 1 to 74 years that discussed the value of measuring the MAMA to determine nutritional status associated with gender and age and made in the Frisancho table. Until now the Frisancho table was used to determine the nutritional status of patients with arm anthropometric measurements.²⁰

The sensitivity of the MAMA is thought to be an indicator of muscle in the body that has been evaluated by several researchers.²¹ In a previous study from 2007 to 2009 in Japan, discussed the accuracy of anthropometric measurements of the MAMA compared to the MAMA in Computerized Tomography (CT) in 45 samples with 67 years of age. Samples taken in research in Japan did not match the sample of this study, because in this study took children as samples.²² Research in Japan showed that measurement of the MAMA was relatively unreliable in geriatric patients or atrophy patients muscle. The MAMA is a relative comparison of the MAMA between the anthropometric method and CT made with the values of the MAMA divided by the mid arm area.²²

Malnutrition is one of the serious problems because it has a negative impact on treatment tolerance, high recurrence rates, increased mortality and worse prognostics.^{9,10,25} From this study it was found that the sensitivity of the MAMA in assessing the nutritional status of LLA patients was 47% and the specificity 70% and the value of UAC sensitivity was above 80% and specificity was 85%. This happens because malnutrition caused by cachexia more than 80% occurs at an advanced stage, while the assessment of the sample in this study was assessed at the initial stage. Unfortunately, the value of sensitivity and specificity of the MAMA to determine nutritional status in ALL patients using a child sample has not been found. So that until now the MAMA is rarely used to determine nutritional status compared to the UAC. In addition

to the measurement of the MAMA which is more difficult than the UAC, the measurement of the MAMA causes pain when the calipers are used to clamp the patient's muscles, causing the patient to become restless so that sometimes the results are inaccurate.¹⁹

CONCLUSION

The sensitivity value of the measurement of the MAMA 47% and UAC 80% with specificity value MAMA 70% and UAC 85%. and the sensitivity value UAC 80% and specificity 85%. From result measuring MAMA not more sensitive to assess the nutritional status of ALL patients in the induction phase

LIMITATION

In this study the number of samples was small. In the next study, measurements of the MAMA and UAC can be carried out by a team of experts, so that measurements can be more accurate to assess the nutritional status of patients with ALL in the induction phase.

Suggestion

Measuring the MAMA can be examined in patients with solid tumors and advanced cancer. Triceps skin fold thickness can be investigated to assess muscle thinning that can assess nutritional status in cancer patients, especially ALL.

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