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The comparison of Body Mass Index (BMI) and Muscle Mass Index (MMI) as a mortality predictor in patients with malignant jaundice at Dr. Sardjito General Hospital, Yogyakarta, Indonesia

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ABSTRACT

Background: Jaundice is found to be a clinical manifestation of malignancy. Around 70% of all jaundice cases are caused by malignancy. Another complication of malignancy is decreasing the Muscle Mass Index (MMI), also called sarcopenia. MMI in malignant jaundice increases the mortality rate. Body Mass Index (BMI) is describing the nutritional status of a person. Due to malnutrition, morbidity and mortality increase. This study aims to compare the MMI and BMI in patients with malignant jaundice to predict the outcome of mortality.

Methods: This study is a retrospective cross sectional non-experimental epidemiologic analysis. Samples were taken from medical reports at Sardjito Hospital from April 2019 - March 2020. A CT scan calculated MMI at the third lumbar vertebrae. BMI was evaluated by body weight (kg) divided by height (m) square (kg/m^2). Data were analyzed using SPSS version 20 for Windows.

Results: Most of respondents were males (55.0%), following by age $\geq$ 50 (62.5%), stage 3 (62.5%), ASA 2 (92.5%), albumin < 3.5 g/dL (82.5%), CA19-9 $\geq$ 37 U/ml (57.5%), CEA < 5 ng/ml (62.5%), and total bilirubin $\geq$ 1.5 mg/dL (90.0%), normal BMI (62.5%), survive (77.5%), and low MMI (72.5%). There was no significant relationship between MMI (OR: 5.71; 95%CI: 0.60-134.12) and BMI (OR: 0.15; 95%CI: 0.02-1.34) to the mortality risk (p>0.05).

Conclusion: MMI had a higher incidence of mortality compared to BMI in malignant jaundice. However, there was no significant relationship between MMI and BMI to predict mortality.

Keywords: BMI, MMI, Malignant Jaundice, Mortality.
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INTRODUCTION

One complication of malignancy is decreased Muscle Mass Index (MMI), also known as sarcopenia.[1] Sarcopenia is experienced as a decrease in muscle function as well as muscle mass itself.[1] The signs of sarcopenia are fatigue, defined as decreased activity, mobility, slow walk, and immunity. As it is a topic that emerged recently, many doctors and researchers are not yet familiar with sarcopenia and its effects on the treatment of cancer patients.[1] The patient's nutritional status can be reflected by calculating the Body Mass Index (BMI). In malignancy, the BMI of a patient may experience a rapid decrease and requires good nutritional regulation. Malnutrition is defined by a BMI of <18.5 and >22.9.[2] Malignancy may cause jaundice and supports a worse prognosis, similar to pancreatic cancer, cholangiocarcinoma, gallbladder cancer, tumour of the ampulla vateri and more. On presentation, cancer commonly underwent distant metastasis.[2] Jaundice can be clinically detected when the total bilirubin level >2.5.[3,4] MMI is easily detected by an abdominal CT-Scan which is routinely carried out in patients preoperatively; therefore, the MMI is a significant predictor of the patient's outcome.[5] Few reports state that the factors enhancing jaundice are age, gender, sepsis, bilirubin level, Ca 19-9, albumin levels, drainage procedure, and other comorbidities.[6-13]

There is no known evidence comparing MMI and BMI in malignant jaundice to predict the mortality rate in Sardjito Hospital Yogyakarta. Based on those mentioned above, this study aims to evaluate the comparison of BMI and MMI as a mortality predictor in patients with malignant jaundice at Dr. Sardjito General Hospital, Yogyakarta, Indonesia.

METHODS

This research was designed as a retrospective cohort where samples were collected retrospectively from medical records in Dr. Sardjito General Hospital from April 2019 through March 2020. All patients diagnosed with biliary duct cancer and were admitted to the surgery

Table 1. Demographic of Clinical characteristics of samples with Jaundice Malignancies.

Variable	N=40	%
Gender		
Male	22	55.0
Female	18	45.0
Age (Years)		
≥ 50	25	62.5
< 50	15	37.5
Stage		
4	15	37.5
3	25	62.5
2	0	0
1	0	0
ASA Criteria		
1	0	0
2	37	92.5
3	3	7.5
Albumin (g/dL)		
< 3.5	33	82.5
≥ 3.5	7	17.5
CA19-9 (U/ml)		
≥ 37	23	57.5
< 37	17	42.5
CEA (ng/ml)		
≥ 5	15	37.5
< 5	25	62.5
Total Bilirubin (mg/dL)		
≥ 1.5	36	90.0
< 1.5	4	10.0
Body Mass Index (BMI) (kg/m^2)		
Malnourished	15	37.5
Normal	25	62.5
Mortality		
Death	9	22.5
Survive	31	77.5
Muscle Mass Index (MMI) (cm^2/m^2)		
Low	29	72.5
Normal	11	27.5

ward were included in this research. The research was registered in the ethical committee of the Medical, Public Health and Nursing Faculty Universitas Gadjah Mada in 2020. The inclusion criteria were jaundice, weight loss, increased tumour markers with a suspect of biliary duct cancer. An abdominal CT-Scan with contrast was carried out. To calculate MMI in every patient, the total surface area of the muscles at the third lumbar vertebrae inferiorly were measured manually. The muscles included were psoas, erector spinae, quadratus lumborum, transversus abdominis, obliques externus et internus, and rectus abdominis. All muscles were identified by an HU of 29 to +150. The cross-section of the muscles (cm^2) in the lumbar region were measured manually on the CT printout. Muscle area was normalized for height (m^2) and was reported as L3 Muscle index (L3 MI) (cm^2/m^2). The cut off to diagnose low MMI was the same as stated in the previous study, such as 36.0 cm^2/m^2 for males and 29.0 cm^2/m^2 for female samples. All individuals with scores lower than the cut off were diagnosed with sarcopenia.[5]

BMI was calculated by dividing weight (kg) with height (m) in a square. The BMI definition of underweight was <18.5 kg/m^2 and >22.9 kg/m^2 was described as overweight. Both underweight and overweight was stated malnourished. The relevant variables were transcribed to SPSS version 20 for Windows. Univariate analysis was used to describe the patient population where the continuous variable was shortened into the average; the categorical variables were stated in a table in percentage form. Bivariate analysis was done using chi-square to analyze the categorical variables in categories. After the chi-square analysis, the predictive values for mortality could be shown by the odds ratio of the exposed group. Survival analysis was evaluated by Kaplan Meier to compare the survival and mortality rates of the sarcopenia group compared to the non-sarcopenia group. The multivariate analysis was used if there were more than one significant variable. The result was stated significant if it was at 5%.

RESULTS

Of 40 patients who participated in the research 55% were male and 45% female, the majority of patients were over 50 years old (60%). The concentration of Albumin serum <3,4 mg/dL was 80.0%, the majority of tumor marker Ca 19-9 > 37 U/mL was 65.0%, followed by tumor marker CEA < 5mg/ml (62.5%), total bilirubin > 1,5 mg/dl was 90%, the majority of normal BMI (18,5-22,9) was (62,5%), the majority of L3 MMI (L<36 dan P <29) was (77,5%), the majority of non-metastasis stage (stage 3) was (62,5%), a majority of patients with ASA 2 was (92,5%), every patient underwent surgery and the majority of patients survived (77,5%), percentage of patients who died was 22,5%. The percentage of sarcopenia patients was (72,5%) (Table 1).

To determine the thickness of muscle mass, an abdominal CT scan at an axial image of the vertebra lumbar 3, some muscles that were objected to in determining mass muscle thickness included the rectus abdominis muscle and psoas, oblique externus and internus muscle and erector spine muscle. In Figure 1, the difference between normal muscle mass and abnormal muscle mass is shown.

The result of statistical analysis between low MMI and mortality shows no significant difference (p=0.132). Still, in patients with low MMI, the mortality rate increased by 5.71 times higher than patients with normal MMI (Table 2). The analysis was based on BMI analysis in 8 patients with normal BMI who died and

1 patient with malnourished BMI. There was no significant correlation between BMI and mortality (p=0.117) (Table 2).

Twenty-nine patients had low MMI, 9 patients died, 15 patients had malnourished BMI, and 25 patients had normal BMI. In addition, statistical analysis between MMI and BMI did not show significant results (p=0.273) (Table 3).

In the Kaplan Meier analysis, a diagram shows all non-sarcopenia patients survived. In contrast, the survival rate of sarcopenia patients at 20 days of care was 50.0% with a p log-rank of 0.081 (p>0.05), so that there was no statistically significant difference (Figure 2).

DISCUSSION

Muscle mass loss in malignancy patients is a form of complication that may affect the patient's outcome. An abdominal CT scan detects muscle mass loss in Lumbal 3. Every malignancy patient undergoes CT scan examination to determine resectability and spread of cancer. Prospective research in 95 cases of biliary tract malignancies states that low MMI is an independent risk factor for complications after surgery.[14] In prospective control research of 75 cases of biliary tract malignancies, low MMI is a risk of bad quality of life in patients with biliary tract malignancies, such as inflammations, low immunity, from neutrophil to lymphocyte ratio (NLR), are also independent predictors for quality of life.[15] A previous study found that biliary tract malignancies with high NLR and low MMI has shown unfavourable results.[15]

Some mechanisms explain that jaundice has adverse effects, like damaging cellular immunity, which follows tumour growth and progressivity in malignancies if management is not done correctly. Obstructions in biliary tracts will decrease the viability of digestive tracts absorption of vitamins and fat, including vitamin K that may result in coagulopathy and increase the risk of bleeding throughout the surgery. Bacterial and germ translocation from mucus in the digestive tract can happen in jaundice patients and cause further serious complications such as sepsis.[16] Jaundice can be caused by direct infiltration from a tumour, lymph node involvement, and an intraluminal tumour.[17] In this research, 9 patients with low MMI died.

However, statistical analysis results of MMI compared to mortality did not prove significant with a score of p=0,132, but from OR 5.71 times more causing mortality. Low MMI has a risk of increased mortality according to a previous study.[18] A research in 75 cases of biliary tract malignancies mentioned that low MMI is a risk of bad quality of life in patients with biliary tract malignancies, such as inflammations and low immunity, from neutrophil to lymphocyte ratio (NLR), are also an independent predictor for quality of life. A previous study found that malignancy in the biliary tract with high NLR and low MMI has shown

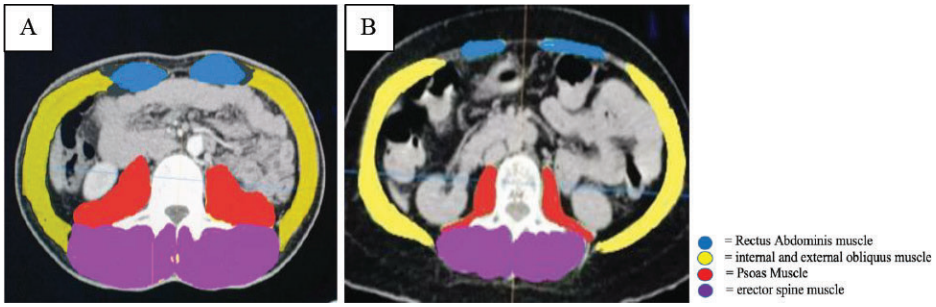

Figure 1. (A) Normal muscle mass index and (B) Sarcopenia.

Table 2. Analysis results predicting MMI and BMI compared to mortality

Variable	Mortality Groups (n=40)				OR	p
	Death (n=9)		Survival (n=31)			
	n	%	n	%		
MMI						
Low	9	100.00	20	64.50	5.71 (0.60-134.12)	0.132
Normal	0	0	11	35.50		
BMI						
Malnourished	1	11.10	14	45.20	0.15 (0.02-1.34)	0.117
Normal	8	88.90	17	54.80		

MMI: Muscle Mass Index; BMI: Body Mass Index; OR: Odds-Ratio; *Chi-Square: Statistically significant if p-value less than 0.05

Table 3. The relationship between MMI compared to BMI groups

Variable	BMI Groups (n=40)				OR	p
	Malnourished (n=15)		Normal (n=25)			
	n	%	n	%		
MMI						
Low	9	60.00	20	80.00	0.375 (0.09-1.56)	0.273
Normal	6	40.00	5	20.00		

MMI: Muscle Mass Index; BMI: Body Mass Index; OR: Odds-Ratio; *Chi-Square: Statistically significant if p-value less than 0.05.

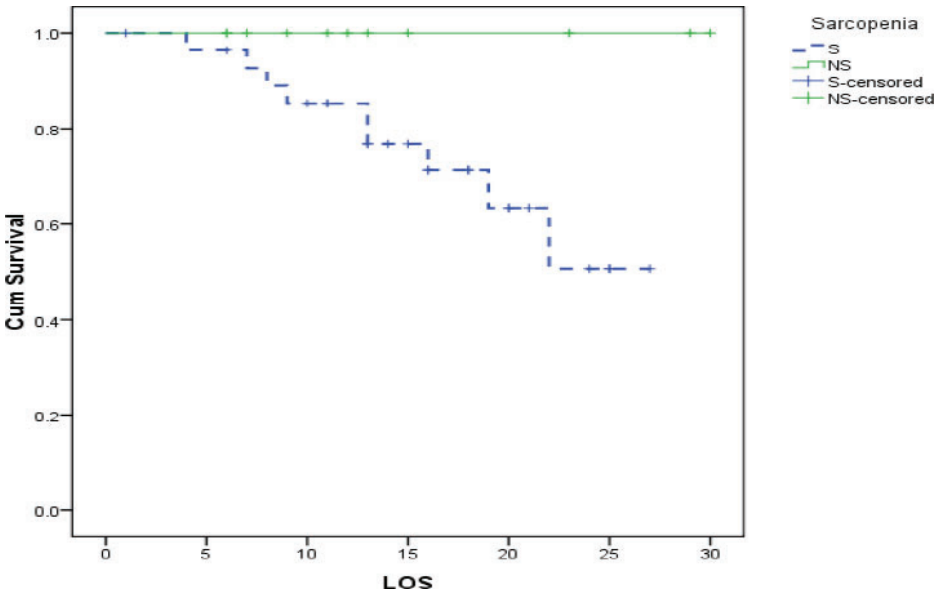

Figure 2. Kaplan Meier graphic of sarcopenia versus death.

unfavourable results.[15] According to the Global Burden of Disease, only 10% of patients with biliary tract malignancies can undergo curative resection that will increase the mortality rate in patients with low MMI.[19] Body Mass Index reflects nutrition and catabolism. In this research, 9 malnourished patients were involved, one patient (11.1%) was malnourished, and 8 (88.9%) with normal BMI died. The number of patients who died with normal BMI was higher than those with malnourished BMI. Mortality increased in malnourished patients.

Patients with malignancy have a higher risk of malnourished cases.[20] This research showed different results in which more patients with normal BMI died. This is caused by faster tumour growth and spread, resulting in worse complications. Nonetheless, in this research, no significant relationship was found between BMI and mortality (p=0.117). A non-significant relationship was also found between MMI and BMI (p=0.273). Malignancies with low BMI reflected nutrition and catabolism status. Low BMI related to low MMI.[14] The biggest mortality was found in patients with low MMI. In patients with malignant jaundice, evaluating the prognosis by MMI is more accurate besides novel biomarkers.[21]

CONCLUSION

MMI in the statistical analysis does not provide meaningful results, but the incidence rate is relatively high. BMI statistical analysis did not provide significant results. There was no significant relationship between MMI and BMI on mortality in patients with Jaundice malignancy. Patients with low MMI have a high risk of mortality. MMI can be used as an indicator predicting mortality.

ETHICS CONSIDERATION

Ethics approval has been obtained from the Ethics Committee of Clinical Research, Faculty of Medicine, Universitas Gadjah Mada, Dr.Sardjito General Hospital, Yogyakarta, Indonesia, based on COPE protocol prior to the study conducted.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the manuscript.

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AUTHOR CONTRIBUTION

All authors contributed to data analysis, drafting and revising the article, giving final approval of the version to be published, and agreeing to be accountable for all study aspects.

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