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Role of sarcopenia and malnutrition in complications and mortality among liver cirrhosis patients

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OBJECTIVE **To analyze the effect of sarcopenia and malnutrition on complications and mortality in patients with liver cirrhosis.** METHOD **This study employed a prospective cohort design involving 132 liver cirrhosis patients. Data collected included age, gender, etiology, duration of diagnosed liver cirrhosis, comorbidities, sarcopenia, nutritional status, complications, and mortality. Complications analyzed in this study included upper gastrointestinal bleeding, ascites, and hepatic encephalopathy over a 12-month follow-up period. Logistic regression analysis was employed to assess the risks associated with sarcopenia and malnutrition, calculating the relative risk (RR).** RESULTS **This study involved 132 liver cirrhosis patients, of whom 76 were diagnosed with sarcopenia and 56 without sarcopenia. Additionally, 68 patients were malnourished, while 64 were not. Our findings showed that patients with sarcopenia had a higher likelihood of experiencing upper gastrointestinal bleeding (RR: 2.48; 95% confidence interval [CI]: 1.69–3.84; p<0.0001), ascites (RR: 1.76; 95% CI: 1.05–3.45; p=0.0266), and encephalopathy (RR: 1.69; 95% CI: 1.17–2.08; p=0.0122) compared to patients without sarcopenia. Additionally, an increased risk of upper gastrointestinal bleeding (RR: 6.22; 95% CI: 3.26–12.67; p<0.0001), ascites (RR: 5.89; 95% CI: 1.93–21.3; p<0.0001), and encephalopathy (RR: 1.72; 95% CI: 1.11–2.24; p=0.0207) was also found in malnourished patients compared to those without malnutrition. Regarding mortality risk, neither sarcopenia nor malnutrition was associated with mortality in liver cirrhosis patients.** CONCLUSIONS **Sarcopenia and malnutrition significantly increase the risk of complications in patients with liver cirrhosis.**

Ο ρόλος της σαρκοπενίας και του υποσιτισμού στις επιπλοκές και στη θνησιμότητα σε ασθενείς με κίρρωση ήπατος

Περίληψη στο τέλος του άρθρου

Key words

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Mortality
Sarcopenia

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Liver cirrhosis is a chronic liver condition that needs serious attention because of its complications.[1] Generally, the incidence and prevalence are rising, and in the United States (US) only one in three patients actually realizes the presence of liver cirrhosis.[2] It continues to be a serious health threat due to the high mortality rates among cirrhotic patients seen worldwide. During this period, liver cirrhosis increased globally by 47.15% between 1990 and 2017.[3] According to the World Health Organization (WHO) data in 2016, mortality rates of liver cirrhosis were 51.1 out of 100,000 male populations and 27.1 out of 100,000 female populations in Indonesia.[1] Within a year in Indonesia in 2020, liver cirrhosis patients were recorded at as many as 1,500 patients by ten health centers. It is also claimed that liver cirrhosis has been positioned as the fourth leading cause of death in Indonesia.[2] The high prevalence and mortality among liver cirrhosis patients result from the necessity of comprehensive management and inherent difficulties due to the complex pathogenesis of cirrhosis with various influencing factors, among which nutrition is significant. Theoretically, the liver is involved very centrally in the metabolism of several nutritional elements such as carbohydrates, proteins, and fats, vitamins, or minerals. In chronic progressive liver disease, there is a growing impairment in the metabolism of these nutrients.[4] One of the most prevalent but often overlooked conditions in patients with liver cirrhosis is sarcopenia.[5] A recent study pointed out that sarcopenia represents one of the relatively strong predictors of prognosis and is associated with a high risk of complications linked to cirrhosis, such as hepatic encephalopathy and ascites. Optimal management of sarcopenia is an indispensable requirement for better improvement in quality of life and prognosis in patients with liver cirrhosis.[6]

Sarcopenia is one of the indicators for determining

protein-energy malnutrition in chronic patients, such as those diagnosed with liver cirrhosis.[7] It had been reported to impact patients negatively regarding deteriorating clinical outcomes and reduction in quality of life, which increases healthcare costs with increased risk of death.[6,8] Indeed, some papers document that reduced handgrip strength is linked to a heightened mortality risk among liver cirrhosis patients.[9–11] However, the association of handgrip strength with complications in cirrhosis patients has not been explored further. Since this is a point of critical consequence due to sarcopenia, the evaluation for sarcopenia is also an important factor that must be considered in the evaluation of liver cirrhosis patients.[12] Apart from sarcopenia, the other aspect of poor nutrition in cirrhosis is attributed to the fact that the liver plays an important role in metabolizing nutrients. Malnutrition is seen in 80% of all cirrhotic patients, mostly in a decompensated stage.[6,7] Malnutrition can lead to ascites and infection, variceal bleeding deterioration, and increased mortality.[13–15] It is hence very relevant that nutritional status assessment is one of the important steps in the management of liver cirrhosis patients.[8] Subjective global assessment (SGA) is one of the quick and easy nutritional status assessments among cirrhotic subjects.[4] The SGA is a nutritional assessment tool consisting of both medical history and physical examination, which can assess the nutritional status of the patient.[16] Because of the great influence of sarcopenia and malnutrition on morbidity and mortality of liver cirrhosis patients, every cirrhosis patient should be screened for sarcopenia and malnutrition. This is important in nutritional therapy provision for the liver cirrhosis patients who need the intervention toward an improved quality of life and survival.[12] Up until now, research related to the studies of sarcopenia and malnutrition in regard to morbidity and poor mortality among liver cirrhosis patients remains scanty. The effects of sarcopenia and malnutrition on complications such as upper gastrointestinal bleeding, ascites, hepatic encephalopathy, and mortality in patients with liver cirrhosis were investigated here using the handgrip strength assessment to diagnose sarcopenia and SGA for determining the presence of malnutrition.

MATERIAL AND METHOD

Design

This was a prospective observational cohort study, and it was undertaken with the aim of determining how sarcopenia and malnutrition would affect morbidity in the form of upper gastrointestinal bleeding, ascites, hepatic encephalopathy, and mortality in patients with liver cirrhosis. Assessment of sarcopenia was based on handgrip strength, but assessment for malnutrition was based on SGA. The current study examined patients from January 2022 to January 2024 in the Dr Saiful Anwar General Hospital, Malang. A checklist of STROBE –a reporting tool for observational studies in epidemiology– was used to enhance the standards of the study protocol in our prospective cohort study.[17]

Ethical approval

Before conducting this study, we obtained approval from the Ethics Committee of Dr Saiful Anwar General Hospital, Malang, with approval numbers 400/093/K.3/102.7/2022 and 400/045/K.3/102.7/2022. Additionally, this study followed the principles outlined in the Declaration of Helsinki.[18] Patients participating in the present study were informed about the study's purpose, risks, and benefits. Before participating, patients were asked to sign a written consent form. Furthermore, we allowed patients the freedom to withdraw from the study at any time without consequences. No incentives were provided to patients in this study.

Participants and eligibility criteria

We determined the sample for this study using purposive sampling based on inclusion criteria. The study set a minimum sample size of 54 patients. This calculation of sample size was derived from the consideration that the prevalence of liver cirrhosis is 3.84% of the general population with a power of 95%.[19] The formula for calculating the sample size in this study referred to previous study.[20] We established the inclusion criteria to include patients with a diagnosis of compensated liver cirrhosis or with a history of previous complications, with or without comorbidities, and agreeing to take part in the study by signing a consent form. Meanwhile, the exclusion criteria included pregnant and breastfeeding women, patients with musculoskeletal disorders in the forearm muscles, patients diagnosed with carpal tunnel syndrome (CTS), patients in unstable hemodynamic conditions or currently hospitalized, patients with malignancies or hematological disorders, patients with a history of chemotherapy, and patients with severe infections such as sepsis, tuberculosis, and human immunodeficiency virus (HIV).

Data collection

This study was carried out at Dr Saiful Anwar General Hospital, Malang between January 2022 and January 2024. All study subjects were interviewed, and their medical records were reviewed and physical examinations conducted during their monthly visits to the outpatient clinic. Patient morbidity and mortality data were obtained through monitoring over one year. Sarcopenia was evaluated based on handgrip strength, while malnutrition assessment was based on the SGA. Additionally, we collected baseline characteristic data, including age, gender, etiology of liver cirrhosis, duration since liver cirrhosis diagnosis, and patient comorbidities. Data collection was conducted by AF and APS. If there were any

discrepancies or inconsistencies in the data, these were discussed and consulted with SS, BPW, and SM.

Covariates

We designated sarcopenia and malnutrition as predictor variables in this study. Sarcopenia evaluation was conducted based on handgrip strength, measured using a mechanical hand dynamometer (Smedley type), recommended for the Asian population. This device measures handgrip strength based on the tension generated on a steel spring and displays results in kilograms or pounds. Handgrip strength measurements were performed on respondents in the Gastroenterohepatology Outpatient Clinic at Dr Saiful Anwar General Hospital, Malang. The examination was conducted on the dominant hand or the one most frequently used for daily activities. It was performed in a seated position without arm support, with the elbow fully extended, and the forearm and wrist positioned at 0 to 15 degrees of ulnar deviation and 0 to 15 degrees of extension. This was done to produce the strongest grip. After three measurements, the results were interpreted based on the Asian Working Group for Sarcopenia (AWGS) criteria, with cutoffs of <26 kg for men and <18 kg for women.[21] Additionally, malnutrition assessment was based on the SGA.[22]

The outcome variables in this study included upper gastrointestinal bleeding, ascites, hepatic encephalopathy, and mortality, evaluated over a 12-month follow-up period. The incidence of complications and mortality was calculated based on the percentage of study subjects who experienced these conditions during the one-year observation period. Ascites examinations were conducted when respondents visited the Gastroenterohepatology Outpatient Clinic at Dr Saiful Anwar General Hospital, Malang. This examination began with a visual inspection of the abdomen, followed by palpation techniques to check for shifting dullness. If no signs of ascites were found in the physical examination of the abdomen, the patient underwent an abdominal ultrasound (USG) to detect ascitic fluid volumes of at least 500 mL, categorized as grade 1 ascites.[23] For hepatic encephalopathy, the criteria used in this study referred to recommendations from the European Association for the Study of the Liver (EASL),[7] and the American Association for the Study of Liver Diseases (AASLD).[24] Upper gastrointestinal bleeding in this study was observed based on patient or family reports of fresh blood vomiting or black-colored stool. Bleeding could also be identified through esophagogastroduodenoscopy results in patients with active bleeding varices, large varices, or findings of stigmata of bleeding.[25]

Statistical analysis

The data in this study were presented as n (%) for categorical variables. For numerical variables, we reported the data as mean±standard deviation (SD) for normally distributed values and as median (interquartile range, IQR) for those that were not normally distributed. For numerical variables, normality was tested using the Kolmogorov-Smirnov test, where data were considered normally distributed if p≥0.05. Baseline characteristics data, including age, gender, etiology of liver cirrhosis, duration of cirrhosis diagnosis, and patient comorbidities, were analyzed using the Chi-squared test for categorical variables and the t-test for numerical variables with a normal distribution, or the Mann-Whitney test for numerical variables that were not normally distributed. A p-value ≥0.05 indicated that the data were homogeneously distributed. To assess the primary findings of this study, differences in outcomes such as upper gastrointestinal bleeding, ascites, hepatic encephalopathy, and mortality between the groups with and without sarcopenia, or the groups with and without malnutrition, were determined using logistic regression tests. Point estimates were presented as relative risk (RR). For mortality data, survival analysis was also illustrated using Kaplan-Meier curves, accompanied by the Gehan-Breslow-Wilcoxon test. All statistical analyses in this study were conducted using GraphPad Prism (GraphPad Prism, GraphPad Software, LLC, Massachusetts, US), version 10.2.0.

RESULTS

Patient characteristics

This study involved 132 patients with liver cirrhosis. Of these, 76 patients were diagnosed with sarcopenia, while 56 patients did not have sarcopenia. Additionally, 68 patients experienced malnutrition, and 64 patients did not have malnutrition. In the context of sarcopenia, data from baseline characteristics showed that the data on gender, etiology, and comorbidities between the sarcopenia group and the non-sarcopenia group did not differ (p≥0.05). However, there were differences in age and the duration of liver cirrhosis diagnosis, where sarcopenia patients were older compared to those without sarcopenia (p=0.0257), and the proportion of patients without sarcopenia was higher in the duration of liver cirrhosis diagnosed for 5–10 years (p=0.0394). Furthermore, in the context of malnutrition, the percentage of malnourished patients was greater among those diagnosed with liver cirrhosis for less than one year (p=0.0379), while the proportion of patients without malnutrition was greater in those diagnosed with liver cirrhosis for 5–10 years (p=0.0060). Meanwhile, age, gender, etiology of liver cirrhosis, and comorbidities between patients with malnutrition and those without malnutrition did not differ (p≥0.05). A summary of the distribution of baseline characteristics data between patients with sarcopenia and those without sarcopenia, as well as between patients with malnutrition and those without malnutrition, is presented in table 1.

Impact of sarcopenia on complications and mortality in patients with liver cirrhosis

The study showed that patients with liver cirrhosis who had sarcopenia had a RR of 2.48 for experiencing upper

Table 1. Baseline characteristics of patients included in our study.

Characteristics	Sarcopenia		p	Malnutrition		p
	Yes (n=76)	No (n=56)		Yes (n=68)	No (n=64)	
Gender						
Male, n (%)	54 (71.1)	42 (75.0)	0.6148	49 (72.1)	47 (73.4)	0.8589
Female, n (%)	22 (28.9)	14 (25.0)	0.6148	19 (27.9)	17 (26.6)	0.8589
Age, median (IQR) or mean±SD	55.0 (11.0)	53.0 (10.25)	0.0257	54.3±9.4	52.3±9.8	0.2284
Etiologies						
HBV, n (%)	59 (77.6)	43 (76.8)	0.9088	56 (82.4)	46 (71.9)	0.1511
HCV, n (%)	13 (23.2)	10 (17.9)	0.9104	9 (13.2)	14 (21.9)	0.1909
HBV-HCV, n (%)	1 (1.3)	1 (1.8)	0.8271	1 (1.5)	1 (1.6)	0.9655
Autoimmune, n (%)	2 (2.6)	0 (0.0)	0.2212	1 (1.5)	1 (1.6)	0.9655
Non-HBV non-HCV, n (%)	1 (1.3)	2 (3.6)	0.3901	1 (1.5)	2 (3.1)	0.5239
Duration of liver cirrhosis diagnosis						
<1 year, n (%)	32 (42.1)	17 (30.4)	0.1674	31 (45.6)	18 (28.1)	0.0379
1–5 years, n (%)	37 (48.7)	30 (53.6)	0.5788	34 (50.0)	33 (51.6)	0.8576
5–10 years, n (%)	4 (5.3)	9 (16.1)	0.0394	2 (2.9)	11 (17.2)	0.0060
>10 years, n (%)	3 (3.9)	0 (0.0)	0.1326	1 (1.5)	2 (3.1)	0.5239
Comorbidities						
Hypertension, n (%)	9 (11.8)	2 (3.6)	0.0893	5 (7.4)	6 (9.4)	0.6744
Diabetes mellitus, n (%)	11 (14.5)	6 (10.7)	0.5239	10 (14.7)	7 (10.9)	0.5183
Obesity, n (%)	5 (6.6)	5 (8.9)	0.6141	5 (7.4)	5 (7.8)	0.9206
Smoking, n (%)	29 (38.2)	20 (35.7)	0.7740	25 (36.8)	24 (37.5)	0.9304
Chronic renal failure, n (%)	1 (1.3)	0 (0.0)	0.3889	0 (0.0)	1 (1.6)	0.3008
Autoimmune, n (%)	2 (2.6)	0 (0.0)	0.2212	2 (2.9)	0 (0.0)	0.1668

Note: Data were presented in n (%) or median (IQR) or mean±SD

HBV: Hepatitis B virus, HCV: Hepatitis C virus, IQR: Interquartile range, SD: Standard deviation

gastrointestinal bleeding compared to patients without sarcopenia (RR: 2.48; 95% confidence interval [CI]: 1.69–3.84; p<0.0001). Additionally, patients with sarcopenia had a RR of 1.76 for developing ascites in comparison to those without sarcopenia (RR: 1.76; 95% CI: 1.05–3.45; p=0.0266). We also found that the likelihood of hepatic encephalopathy was greater in patients with sarcopenia than in those without sarcopenia (RR: 1.69; 95% CI: 1.17–2.08; p=0.0122). Meanwhile, regarding mortality risk, we did not find a difference between patients with sarcopenia and those without sarcopenia (RR: 1.17; 95% CI: 0.61–1.65; p=0.5676). The Kaplan-Meier analysis also showed no difference between patients with sarcopenia and those without sarcopenia (hazard ratio [HR]: 1.44; 95% CI: 0.38–5.42; p=0.6164) (fig. 1A). A summary of the relationship between sarcopenia and the occurrence of complications and mortality in patients with liver cirrhosis in this study is presented in table 2.

Impact of malnutrition on complications and mortality in patients with liver cirrhosis

From the sample of 68 patients with malnutrition and 64 patients without malnutrition, we discovered that the risk of upper gastrointestinal bleeding was elevated in patients with malnutrition compared to those without malnutrition (RR: 6.22; 95% CI: 3.26–12.67; p<0.0001). On the other hand, we also showed that patients with malnutrition had an increased risk of developing ascites compared to those without malnutrition (RR: 5.89; 95% CI: 1.93–21.3; p<0.0001). We also observed that the elevated risk of hepatic encephalopathy was greater in patients with malnutrition than in those without malnutrition (RR: 1.72; 95% CI: 1.11–2.24; p=0.0207). Meanwhile, patients with malnutrition and those without malnutrition had the same mortality risk (RR: 1.57; 95% CI: 0.89–2.10; p=0.1024). In the Kaplan-Meier analysis, we also did not find any difference

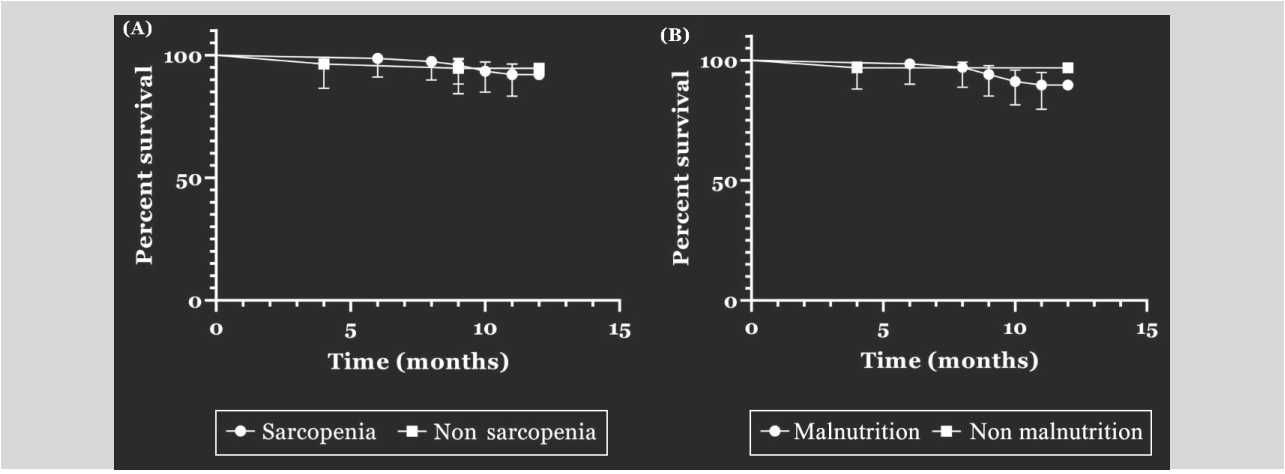

Figure 1. Survival analysis of liver cirrhosis patients in the study cohort. (A) Kaplan-Meier survival curves comparing liver cirrhosis patients with and without sarcopenia (hazard ratio [HR]: 1.44; 95% confidence interval [CI]: 0.38–5.42; p=0.6164). (B) Kaplan-Meier survival curves stratified by nutritional status, comparing liver cirrhosis patients with malnutrition to those without (HR: 2.90; 95% CI: 0.78–10.75; p=0.1205).

Table 2. The impact of sarcopenia and malnutrition on outcomes in patients with liver cirrhosis.

Outcomes	Sarcopenia		RR	95% CI	p	Malnutrition		RR	95% CI	p
	Yes (n=76)	No (n=56)				Yes (n=68)	No (n=64)			
Upper GI bleeding	59 (77.6)	18 (32.1)	2.48	1.69–3.84	<0.0001	61 (89.7)	16 (25.0)	6.22	3.26–12.67	<0.0001
Ascites	69 (90.8)	43 (76.8)	1.76	1.05–3.45	0.0266	66 (97.1)	46 (71.9)	5.89	1.93–21.3	<0.0001
Encephalopathy	11 (14.5)	1 (1.8)	1.69	1.17–2.08	0.0122	10 (14.7)	2 (3.1)	1.72	1.11–2.24	0.0207
Mortality	6 (7.9)	3 (5.4)	1.17	0.61–1.65	0.5676	7 (10.3)	2 (3.1)	1.57	0.89–2.10	0.1024

Note: Data were presented in n (%); GI: Gastrointestinal, RR: Relative risk, 95% CI: 95% confidence interval

between patients with malnutrition and those without malnutrition (HR: 2.90; 95% CI: 0.78–10.75; p: 0.1205) (fig. 1B). A summary of the relationship between malnutrition and the risk of complications and mortality in patients with liver cirrhosis in this study is presented in table 2.

DISCUSSION

This study demonstrated that sarcopenia and malnutrition have a significant relationship with upper gastrointestinal bleeding, ascites, and encephalopathy. The explanation for these results may be understood through several theories. Liver cirrhosis causes a metabolic imbalance, where the breakdown of muscle protein exceeds its synthesis. This triggers the onset of sarcopenia. This process is likely caused by decreased food intake due to reduced appetite, rapid satiety, and slowed gastrointestinal motility.[26] Furthermore, approximately 80% of patients with liver cirrhosis experience malnutrition due to various factors. As the liver's capacity to store glycogen also diminishes, the body relies on fat and muscle protein as energy sources during fasting. As a result, this condition may accelerate the loss of muscle mass.[27] Consequently, this leads to the emergence of sarcopenia and malnutrition, triggering various complications.[28] This explanation can serve as a basis for understanding our study's results, which found that patients with sarcopenia and malnutrition have a high risk of experiencing complications such as upper gastrointestinal bleeding, ascites, and encephalopathy.

In the present study, we found that sarcopenia increases the risk of upper gastrointestinal bleeding by 2.48 times compared to patients without sarcopenia, while malnutrition increases the risk of upper gastrointestinal bleeding by 6.22 times compared to the group without malnutrition. Our findings are consistent with previous study showing that in patients with sarcopenia and malnutrition, varices may appear and increase by approximately 7–8% each year, developing from small varices to large varices with an increase of about 10–12% each year. The study also indicated that groups with mild to moderate malnutrition have a higher

incidence of upper gastrointestinal bleeding compared to those with normal nutritional status according to SGA.[29] On the other hand, malnutrition is known to increase the risk of bleeding, as micronutrients such as vitamin K, vitamin C, copper, and zinc play important roles in the coagulation process. Furthermore, they demonstrated that early oral feeding may reduce the risk of recurrent upper gastrointestinal bleeding and expedite the healing process.[30] Additionally, studies using the Geriatric Nutritional Risk Index (GNRI) also found that patients experiencing malnutrition have a higher risk of upper gastrointestinal bleeding compared to those with better nutritional status.[26,31]

This study also showed that sarcopenia and malnutrition increased the risk of ascites by 1.76 and 5.89 times, respectively, compared to the control group. Theoretically, sarcopenia and malnutrition may increase the risk of ascites in patients with liver cirrhosis by raising protein requirements due to decreased muscle mass. This condition is further exacerbated by reduced albumin synthesis by the liver. The decrease in protein synthesis leads to a reduction in oncotic pressure, which is crucial for maintaining fluid balance in the body, thus facilitating fluid accumulation in the peritoneal cavity as ascites.[32] Our findings align with a study on cirrhotic patients in China, which demonstrated that patients with liver cirrhosis who had sarcopenia and malnutrition had a higher risk of developing ascites.[33] On the other hand, our study also indicated that malnutrition assessed using SGA was associated with ascites. Malnutrition causes a decrease in serum protein levels, which subsequently triggers a drop in oncotic pressure. This reduction in oncotic pressure results in plasma exudation into the interstitial space.[32,33] Moreover, along with damage to the liver structure, resistance to portal blood flow also increases. This condition can further lead to elevated pressure in the portal venous system, and the high pressure forces plasma fluid out of the veins and into the abdominal cavity.[34–36]

Our findings also revealed that sarcopenia and malnutrition increased the risk of hepatic encephalopathy by 1.69 and 1.72 times, respectively, compared to the control group. Theoretically, sarcopenia and malnutrition involve the loss of muscle mass, which leads to increased ammonia levels due to reduced physical activity and enhanced protein breakdown.[34] This condition further exacerbates the process of ammonia detoxification, which is typically supported by muscle but is impaired in cirrhotic liver due to disrupted urea synthesis. As a result, patients with advanced liver cirrhosis who experience muscle loss face more episodes of hepatic encephalopathy.[37] Furthermore, our study also showed that malnutrition assessed using SGA was associated with complications of hepatic encephalopathy in cirrhotic patients. Malnutrition affects protein and amino acid balance. Although protein restriction has historically been used to manage hepatic encephalopathy under the assumption that it could reduce ammonia production, recent guidelines suggest that adequate protein intake is essential as it can help improve nitrogen balance, immune function, and muscle mass.[7] This, in turn, may reduce the severity of hepatic encephalopathy. Additionally, a systematic review and meta-analysis conducted by Wijarnpreecha et al also revealed that cirrhotic patients with sarcopenia faced a significantly higher risk of developing both mild and severe hepatic encephalopathy compared to those without sarcopenia.[38] This explanation may clearly elucidate the effects of sarcopenia and malnutrition on hepatic encephalopathy in our study.

This study showed that sarcopenia and malnutrition did not affect the mortality of cirrhosis patients. Our findings are supported by a previous study indicating that sarcopenia only impacts complications and does not influence the mortality of cirrhotic patients.[37] However, there are other studies that report results differing from ours. They found that sarcopenia has a strong association with a higher mortality risk in patients with cirrhosis.[39] Furthermore, a systematic review study involving approximately 6,965 cirrhosis patients over a study period of one to three years found that sarcopenia was associated with a significantly increased risk of mortality. Cirrhotic patients with sarcopenia faced a 2.6-fold increased risk of death compared to those without sarcopenia.[4] The differences in results between our study and previous studies may be attributed to variations in observation duration. The average observation time in previous studies was three years,[4,39] while our study had a follow-up duration of only one year.

This study had several limitations. First, the geographic and demographic location of our population may have been a limitation of the present study. As it is known, the patients in this study had different geographic conditions due to the circumstances in our country. This was likely also one of the factors that needed to be considered when drawing conclusions from our study results. Second, our study had several confounding factors such as age and duration of diagnosed liver cirrhosis. Additionally, potential confounding factors such as genetic variation, dietary patterns, adherence to treatment, and access to services were not evaluated in this study. This needed to be taken seriously when interpreting our study results. Third, the duration of the follow-up time in this study was likely another limitation of our study. Our study had a limited observation period of 12 months. This might have been a factor concerning the differences in mortality between our study and previous studies.[4,39] Fourth, the method used to measure sarcopenia, such as bioelectrical

impedance analysis (BIA), might have varying levels of accuracy compared to imaging techniques like magnetic resonance imaging (MRI) or dual-energy X-ray absorptiometry (DEXA).[40] The accuracy of these measurement tools and their consistency across different research centers could affect the obtained results. Furthermore, these measurements might also have been limited by the fact that they were taken at a single point in time, which could not capture changes in nutritional status over time. These limitations needed to be considered to understand the context and interpretation of the findings produced by our study.

In conclusion, we have demonstrated that sarcopenia and malnutrition are associated with morbidity in patients with liver cirrhosis. We showed that sarcopenia and malnutrition have a significant association with an increased incidence of complications, such as hepatic encephalopathy, upper gastrointestinal bleeding, and ascites. However, neither sarcopenia nor malnutrition demonstrated a significant link to increased mortality in patients with liver cirrhosis. This study highlights the significance of addressing sarcopenia and malnutrition to lower the risk of complications in patients with liver cirrhosis.

ΠΕΡΙΛΗΨΗ

Ο ρόλος της σαρκοπενίας και του υποσιτισμού στις επιπλοκές και στη θνησιμότητα σε ασθενείς με κίρρωση ήπατος

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ΣΚΟΠΟΣ Να αναλυθεί η επίδραση της σαρκοπενίας και του υποσιτισμού στις επιπλοκές και στη θνησιμότητα σε ασθενείς με κίρρωση του ήπατος. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Χρησιμοποιήθηκε ένας προοπτικός σχεδιασμός κοόρτης που περιλάμβανε 132 ασθενείς με κίρρωση ήπατος. Τα δεδομένα που συλλέχθηκαν περιλάμβαναν ηλικία, φύλο, αιτιολογία, διάρκεια διαγνωσμένης ηπατικής κίρρωσης, συννοσηρότητες, σαρκοπενία, διατροφική κατάσταση, επιπλοκές και θνησιμότητα. Οι επιπλοκές που αναλύθηκαν στην παρούσα μελέτη περιλάμβαναν αιμορραγία από το ανώτερο γαστρεντερικό, ασκίτη και ηπατική εγκεφαλοπάθεια σε μια περίοδο παρακολούθησης 12 μηνών. Εφαρμόστηκε ανάλυση λογιστικής παλινδρόμησης για την αξιολόγηση των κινδύνων που σχετίζονται με τη σαρκοπενία και τον υποσιτισμό, υπολογίζοντας τον σχετικό κίνδυνο (RR). **ΑΠΟΤΕΛΕΣΜΑΤΑ** Η μελέτη περιλάμβανε 132 ασθενείς με κίρρωση του ήπατος, από τους οποίους 76 διαγνώστηκαν με σαρκοπενία και 56 χωρίς σαρκοπενία. Επί πλέον, 68 ασθενείς ήταν υποσιτισμένοι, ενώ 64 όχι. Τα ευρήματά μας έδειξαν ότι οι ασθενείς με σαρκοπενία είχαν μεγαλύτερη πιθανότητα να εμφανίσουν αιμορραγία από το ανώτερο γαστρεντερικό (RR: 2,48, 95% διάστημα εμπιστοσύνης [CI]: 1,69–3,84, p<0,0001), ασκίτη (RR: 1,76, 95% CI: 1,05–3,45, p=0,0266) και εγκεφαλοπάθεια (RR: 1,69, 95% CI: 1,17–2,08, p=0,0122) σε σύγκριση με ασθενείς χωρίς σαρκοπενία. Ακόμη, αυξημένος κίνδυνος αιμορραγίας από το ανώτερο γαστρεντερικό (RR: 6,22, 95% CI: 3,26–12,67, p<0,0001), ασκίτη (RR: 5,89, 95% CI: 1,93–21,3, p<0,0001) και εγκεφαλοπάθεια (RR: 1.72, 95% CI: 1.11–2.24, p=0.0207) βρέθηκε επίσης σε υποσιτισμένους ασθενείς σε σύγκριση με εκείνους χωρίς υποσιτισμό. Όσον αφορά στον κίνδυνο θνησιμότητας σε ασθενείς με κίρρωση του ήπατος, ούτε η σαρκοπενία ούτε ο υποσιτισμός συσχετίστηκαν με τη θνησιμότητα. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Η σαρκοπενία και ο υποσιτισμός αυξάνουν σημαντικά τον κίνδυνο επιπλοκών σε ασθενείς με κίρρωση του ήπατος.

Λέξεις ευρετηρίου: Επιπλοκές, Θνησιμότητα, Κίρρωση του ήπατος, Σαρκοπενία

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