Original Investigation

Radiological Quantification of Sarcopenic Obesity and its Role in Chronic Liver Disease Severity

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Rationale and Objectives: To define sarcopenic obesity (SaO) among chronic liver disease (CLD) patients via CT and MRI, and assess its impact on liver disease severity.

Materials and Methods: CLD patients referred from the Gastroenterology and Hepatology Department diagnosed as chronic hepatitis B (*N*:101), cirrhosis (*N*:110), and hepatocellular carcinoma (*N*:169) with available information on body height, weight, Child-Pugh and MELD scores within 2 weeks of CT or MRI scanning were included in the study. Cross-sectional examinations were retrospectively evaluated for skeletal muscle index (SMI) and visceral adipose tissue area (VATA). The disease severity was assessed by Child-Pugh and MELD scoring.

Results: The rate of sarcopenia and SaO in the cirrhotic patients was higher than that in the chronic hepatitis B patients ($p < 0.033$ and $p < 0.004$, respectively). The rate of sarcopenia and SaO in HCC patients was higher than that in the chronic hepatitis B patients ($p < 0.001$ and $p < 0.001$, respectively). Sarcopenic patients in Chronic hepatitis B, cirrhotic, and HCC groups had higher MELD scores than nonsarcopenic patients ($p < 0.035$, $p < 0.023$, and $p < 0.024$, respectively). Despite finding a similar increase in Child-Pugh scores in cirrhotic and HCC sarcopenic patients, results were statistically insignificant ($p < 0.597$ and $p < 0.688$). HCC patients with SaO had higher MELD scores than patients with other body composition catagories ($p < 0.006$). Cirrhotic patients with SaO had higher MELD scores than nonsarcopenic obese patients ($p < 0.049$). Chronic hepatitis B patients with obesity had low MELD scores ($p < 0.035$). Cirrhotic and HCC patients with obesity had higher MELD scores ($p < 0.01$ and $p < 0.024$, respectively). Cirrhotic and HCC patients with obesity had higher Child-Pugh scores than nonobese patients but only HCC patients showed statistically significance ($p < 0.480$ and $p < 0.001$).

Conclusion: Radiologic evaluation of SaO and harmonizing body composition with MELD scoring is critical in CLD management.

Key Words: Sarcopenic obesity; Sarcopenia; Skeletal muscle index; Visceral adipose tissue; Chronic liver disease.

Abbreviations: BMI body mass index, **HCC** hepatocellular carcinoma, **HU** Hounsfield units, **SMA** skeletal muscle area, **VATA** visceral adipose tissue area

INTRODUCTION

Sarcopenic obesity (SaO), characterized by low muscle mass and strength amidst obesity, has been rapidly gaining attention as a topic of clinical research (1). This has led to a growing accumulation of data, ultimately leading to the recognition of sarcopenia as a disease in ICD-10 (2). While primary sarcopenia results from aging-related decline in muscle mass and strength, secondary sarcopenia is caused by underlying diseases (2). The chronic, progressive nature of sarcopenia increases the risk of numerous comorbidities, including chronic liver disease, metabolic disorders, obesity, diabetes, and cancer (3). Obesity is a well-known risk factor for morbidity and mortality. The combination of these two culprits referred to as SaO has been pointed out as an emerging health problem (4).

The spectrum of chronic liver diseases (CLD) varies from simple fat accumulation to severe forms like non-alcoholic steatohepatitis, chronic viral hepatitis, cirrhosis, and hepatocellular carcinoma (HCC) (5). CLD patients commonly suffer from sarcopenia, with prevalence rates ranging from 30% to 70%, depending on factors such as diagnostic methods, liver damage severity, patient demographics, and ethnicity (6). Obesity is becoming increasingly prevalent in cirrhosis (7). The coexistence of sarcopenia and obesity exacerbates liver fibrosis and leads to adverse clinical outcomes in CLD patients (8–10).

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Obesity is a major risk factor for the development of hepatocellular carcinoma (11). However, the degree of impact it has on perioperative and post-transplant morbidity and mortality shows discordance resulting in "obesity paradox" (12). Because of the overlap in the pathophysiological pathways, both sarcopenia and obesity are risk factors in CLD. SaO, with its intertwined pathophysiological pathways, poses a greater threat to CLD outcomes than either obesity or sarcopenia alone (4,13). The muscle-liver-adipose tissue axis plays crucial role in development of distinct body composition-related clinical phenotypes and affects CLD clinical outcomes (5).

Despite the growing number of studies on sarcopenia, the radiological definition, selection of imaging modalities, and methods for quantification remain diverse and unstandardized (14). The obesity indices and morphometric measurements commonly used in clinical practice suffer from limitations, including variation in cut-off values based on race, ethnicity, age, and gender. There is a lack of consensus on the diagnostic criteria for sarcopenia, obesity, or SaO within the CLD spectrum. Given these limitations, cross-sectional imaging with CT and MRI are emerging as diagnostic tools to noninvasively evaluate body composition. This study aims to define SaO and body composition among CLD patients by using CT and MRI to calculate the skeletal muscle index (SMI) and visceral adipose tissue area (VATA). We also aim to investigate the impact of sarcopenia, obesity, and particularly SaO on the severity of different stages of the CLD spectrum.

MATERIALS AND METHODS

Patients

This retrospective study was approved by the Ethics Committee of our institution. Patients were referred from the Gastroenterology and Hepatology Department between 2016 and 2022. Three hundred and eighty chronic liver disease patients screened for disease progression and follow up were analyzed. Subjects with established diagnosis of chronic hepatitis B disease (*n*:101), cirrhosis (*n*:110), and hepatocellular carcinoma (*n*:169) with available information on body height, weight, Child-Pugh and Model for end-stage liver disease (MELD) scores within 2 weeks of CT or MRI scanning were included in the study. Distinguishing chronic hepatitis B patients from patients with cirrhosis or HCC was based on a combination of commonly used laboratory data and clinical presentation, as well as screening methods. Patients with HCC were further distinguished from those with cirrhosis through radiological screening. There was no overlap observed between patients in each group. MELD exception points have not been used in any of the participants. Subjects with chronic renal failure (*n*:7) were excluded from the study since the MELD score is driven in part by serum creatinine levels. Patients with extra hepatic malignancies such as thyroid carcinoma (*n*:2), and renal cell carcinoma (*n*:1) were excluded from the study. The median age was 59 years (range: 22−87 years). 133 (35%) patients were female, and 247 (65%) were male. Patient characteristics are summarized in Table 1.

Equipment (Computed Tomography and Magnetic Resonance Examination)

CT scans were performed with a 256-slice scanner (Brilliance ICT 256 Philips, Philips Healthcare, Eindhoven, the Netherlands). Abdominal CT examinations were evaluated for skeletal muscle area (SMA) and visceral adipose tissue area (VATA). Cross-sectional SMA was calculated at the level of the third lumbar vertebra. VATA was measured at the level of the umbilicus. Skeletal muscle area included the psoas, the erector spinae, the multifidus, the quadratus lumborum, and

TABLE 1. Patient Characteristics

	N	Minimum	Maximum	Mean
Age (years)	**380**	**22**	**87**	**58.56**
Chr.HBV	101	22	77	50.23
Cirrhosis	110	26	81	58.88
HCC	169	30	87	63.54
Height (cm)	**380**	**140**	**189**	**167.074**
Chr.HBV	101	140	185	166.31
Cirrhosis	110	145	185	166.18
HCC	169	145	189	167.87
Weight (kg)	**380**	**38**	**186**	**78.152**
Chr.HBV	101	38	112	78.39
Cirrhosis	110	52	182	103.11
HCC	169	43	186	76.76
BMI (kg/m2)	**380**	**16.8**	**60.7**	**27.997**
Chr.HBV	101	16.8	45.1	28.25
Cirrhosis	110	17.9	46.7	28.97
HCC	169	16.8	60.7	27,23
VATA (cm^2)	**380**	**15**	**416**	**121.94**
Chr.HBV	101	17	416	111.83
Cirrhosis	110	17	344	133.23
HCC	169	15	327	132.45
SMA (cm^2)	**380**	**60**	**244**	**141.078**
Chr.HBV	101	60	244	145.31
Cirrhosis	110	70	213	236.05
HCC	169	77	235	142.25
SMI (cm^2/m^2)	**380**	**23.5**	**83.5**	**50.649**
Chr.HBV	101	26.67	76.63	51.78
Cirrhosis	110	23.51	83.51	49.19
HCC	169	28.98	72.53	50.34
Child-Pugh Total	**380**	**5**	**13**	**5.69**
Chr.HBV	101	5	5	5
Cirrhosis	110	5	13	6.36
HCC	169	5	13	6.18
MELD	**380**	**5**	**38**	**10.637**
Chr.HBV	101	6	11	7.44
Cirrhosis	110	5	38	12.62
HCC	169	6	25	10.88

BMI, body mass index; Chr. HBV, chronic hepatitis B; HCC, hepatocellular carcinoma; SMA, skeletal muscle area; SMI, skeletal muscle index; VATA, visceral adipose tissue area.

Bold values represent values of total study group for each characteristics.

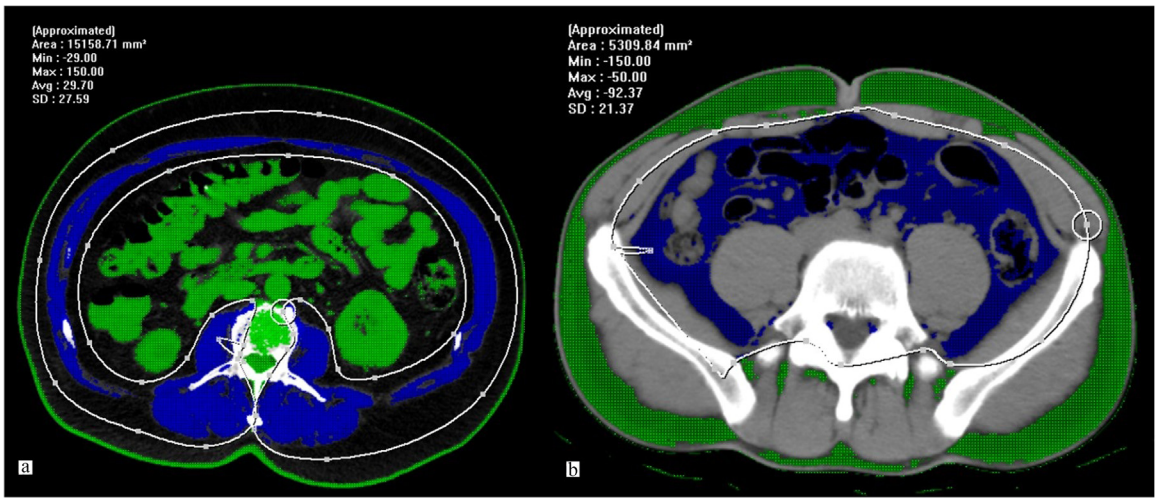

Figure 1. Abdominal CT images taken at the third lumbar vertebra applied to quantify (a) total skeletal muscle area. Skeletal muscle area included the psoas, the erector spinae, the multifidus, the quadratus lumborum, and abdominal wall muscles. The skeletal muscle was identified and areas were quantified using CT viewer tissue segmentation program. A threshold range of -29 to 150 HU was used to define skeletal muscle. Total muscle area is colored in blue (b) Abdominal CT images taken at the level of the umbilicus applied to quantify visceral adipose tissue area. A threshold range of -150 to -50 HU was used to define visceral adipose tissue which is colored in blue. (Color version of figure is available online.).

abdominal wall muscles namely the transversus abdominis, the external oblique, internal oblique, and the rectus abdominis muscles. The skeletal muscle and the visceral adipose tissue were identified and areas were quantified in Hounsfield units (HU) using CT viewer tissue segmentation program. A threshold range of -29 to 150 HU was used to define skeletal muscle, and a range of −150 to −50 HU was used to define visceral adipose tissue (Fig 1).

MR scans were performed with a 3T Philips Ingenia (Philips Healthcare, Eindhoven, the Netherlands). Cross-sectional SMA was calculated at the level of the third lumbar vertebra on T2-weighted axial images. VATA was measured at the level of the umbilicus on T2-weighted axial images. Free manual tracing method was used for calculating areas (Fig 2). Sum of the cross-sectional areas of mentioned muscle groups are used for calculating total SMA.

Image Interpretation

Of the 380 subjects %61 (*N*: 230) had CT scans and %39 (*N*: 150) MRI scans which were evaluated retrospectively. The patient distribution according to the modality applied and evaluated is summarized in Table 2. All patient data was examined on a PACS system (Novapacs, Novarad Corporation, USA) by three radiologists with 4, 10, and 25 years of expertise. All patients were reviewed separately by all radiologists and each documented their findings. Their data were

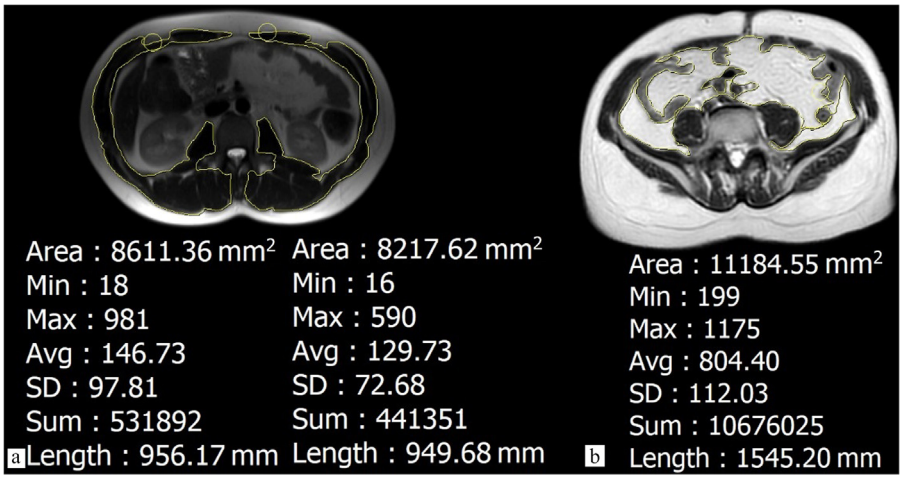

Figure 2. Axial T2 weighted MRI images. (a) Total skeletal muscle area calculated by free manual tracing method at the third lumbar vertebra . (b) Visceral adipose tissue area calculated by free manual tracing method at the level of umbilicus.

TABLE 2. Patient Distribution Based on Applied Modality

	N	CT	MRI
Chr. HBV	101	28 (28%)	73 (72%)
Cirrhosis	110	49 (45%)	61 (55%)
HCC	169	153 (90%)	16 (10%)
Total	380	230 (61%)	150 (39%)

CT, computerized tomography; Chr. HBV, chronic hepatitis B; HCC, hepatocellular carcinoma; MRI, magnetic resonance imaging.

then cross-matched and differing findings (n = 3) were re-evaluated together and a consensus was reached to resolve discrepancies.

The quantity of skeletal muscle was evaluated by skeletal muscle index (SMI), calculated by normalizing the cross-sectional areas of skeletal muscle (SMA) in centimeters squared by the height of the patient in meters squared. Sarcopenia was defined by cutoff values of SMI < 50 cm^2/m^2 for males and <39 cm^2/m^2 for females (15).

Obesity was considered present if the VATA was ≥100 cm^2 in both males and females (16).

According to the presence or absence of sarcopenia and obesity patients were classified into one of four body composition categories as nonsarcopenic nonobesity (NN), nonsarcopenic obesity (NO), sarcopenic nonobesity (SN), and sarcopenic obesity (SaO) (12) (Figs 3 and 4). The severity of the disease was assessed by Child-Pugh and MELD scoring systems. The impact of sarcopenia, obesity, and sarcopenic obesity determining severity in different stages of chronic liver disease is investigated.

Statistical Analyses

The study used IBM SPSS version 21 (IBM, Armonk, NY) to perform statistical analysis on different patient groups, including Hbv, HCC, cirrhosis, and all patients. Descriptive analysis was used to calculate ratios and demographic values, while the Sperman test was used to evaluate the correlation between Child-Pugh classification and MELD score. The Child-Pugh and MELD value were analyzed using both categorical and numerical values. The data were analyzed for each group according to the presence of sarcopenia, obesity, and sarcopenic obesity. The Chi-square test was used for

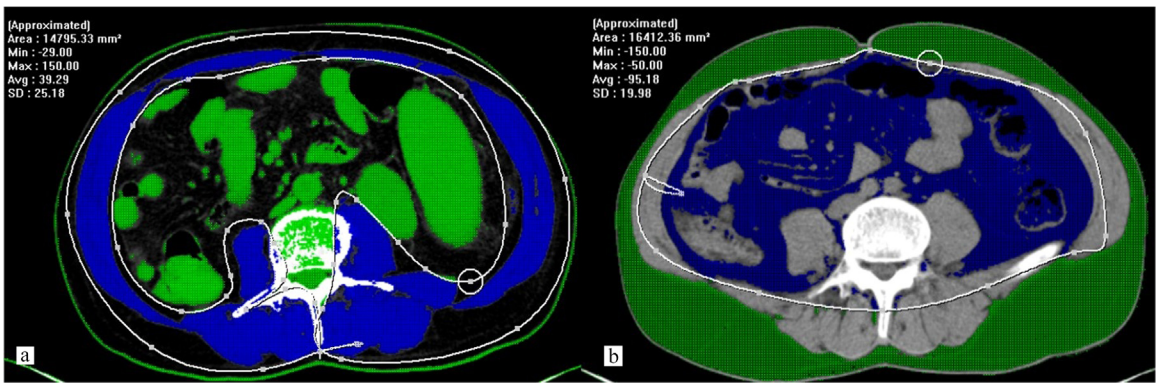

Figure 3. Abdominal CT images of a cirrhotic male patient with sarcopenic obesity. A threshold range of -29 to 150 HU was used to define skeletal muscle and -150 to -50 HU to define visceral adipose tissue. Skeletal muscle area 147 cm^2, height 1.82 m^2, skeletal muscle index 44.4 cm^2/m^2, visceral adipose tissue 164 cm^2.

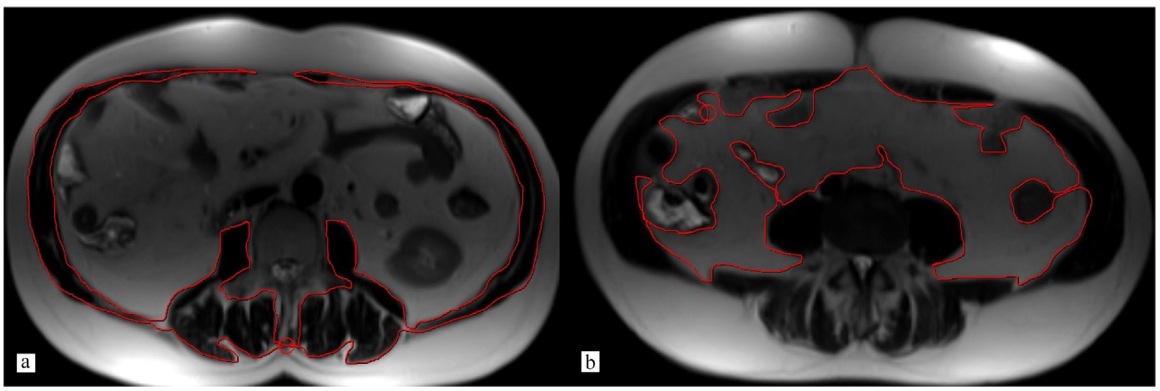

Figure 4. Abdominal MR images of a cirrhotic female patient with sarcopenic obesity. Total skeletal muscle area and visceral adipose tissue area calculated by free manual tracing method. Skeletal muscle area 87 cm^2, height 1.68 m^2, skeletal muscle index 30.8 cm^2/m^2, visceral adipose tissue 160 cm^2.

categorical data, Mann-Whitney *U* test for numerical data, and one-way ANOVA test for multivariate analysis of sarcopenic obesity with other groups. p value < 0.05 was considered statistically significant.

RESULTS

Baseline characteristics of the 380 patients enrolled in the study are shown in Table 1. The median age was 59 years (range: 22−87 years). 133 (35%) patients were female, and 247 (65%) were male. When compared by gender sarcopenia, obesity, and SaO was higher in males than females ($p < 0.001$, $p < 0.024$ and $p < 0.001$, respectively).

Of the 380 chronic liver disease patients 27% (*N*: 101) had diagnosis of chronic hepatitis B disease, 29% (*N*: 110) cirrhosis, and 44% (*N*:169) hepatocellular carcinoma. Sarcopenia was defined at a cut off value of SMI <50 cm^2/m^2 in males and <39 cm^2/m^2 in females (15) and was present in 36.3% (*N*: 138) of patients. Obesity was defined present when the VATA values were higher than 100 cm^2 (16) which was seen in 54.4% (*N*: 207) of patients. SaO defined as the combination of these two criteria was seen in 18.4% (*N*:70) of patients enrolled in the study. Patient distribution based on the presence of sarcopenia, obesity, and SaO is outlined in Table 3. Patients were also categorized into four body compositions as NN, NO, SN, and SaO according to the presence or absence of sarcopenia and obesity (Table 4).

The rate of sarcopenia in the cirrhotic patients was higher than that in the chronic hepatitis B patients (p <0.033). The

TABLE 3. Patient Distribution Based on the Presence of Sarcopenia, Obesity, and SaO

	S	O	SaO
Chr. HBV	22 (21.7%)	45 (44.5%)	6 (5.9%)
Cirrhosis	42 (38.1%)	67 (60.9%)	25 (22.7%)
HCC	74 (43.7%)	95 (56.2)%	39 (23%)
Total	138 (36.3%)	207 (54.4.%)	70 (18.4%)

Chr. HBV, chronic hepatitis B; HCC, hepatocellular carcinoma; O, obesity; S, sarcopenia; SaO, sarcopenic obesity.

TABLE 4. Patient Distribution Based on Different Body Compositions

	NN	NO	SN	SaO	*N*
Chr. HBV	45 (44.5%)	38 (37.6%)	12 (11.8%)	6 (5.9%)	101
Cirrhosis	26 (23.6%)	40 (36.3%)	17 (15.4%)	27 (24.5%)	110
HCC	37 (21.8%)	53 (31.3%)	38 (22.4%)	41 (24.2%)	169
Total	108 (28.4%)	131 (34.5%)	67 (17.6%)	74 (19.4%)	380

Chr. HBV, chronic hepatitis B; HCC, hepatocellular carcinoma; Nonsarcopenic nonobesity (NN), nonsarcopenic obesity (NO), SaO, Sarcopenic obesity; SN, Sarcopenic nonobesity.

TABLE 5. Comparison of Sarcopenia and Sarcopenic Obesity Rates Within the Spectrum of CLD

Multiple Comparisons-Dependent Variable: *Sarcopenia*

(I) disease	(J) disease	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
HCC	Cirrhosis	0.5605	0.0581	0.6000	-0.0806	0.1927
	Chr.HBV	0.22005*	0.0596	**0.0010**	0.0797	0.3604
Cirrhosis	HCC	-0.0561	0.0581	0.6000	-0.1927	0.0806
	Chr.HBV	0.16400*	0.0654	**0.0330**	0.0102	0.3178
Chr.HBV	HCC	-0.22005*	0.0596	0.0010	-0.3604	-0.0797
	Cirrhosis	-0.16400*	0.0654	0.0330	-0.3178	-0.0102

Multiple Comparisons-Dependent Variable: *Sarcopenic Obesity*

(I) disease	(J) disease	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
HCC	Cirrhosis	0.010	0.140	0.997	-0.320	0.340
	Chr.HBV	0.514*	0.144	**0.001**	0.180	0.850
Cirrhosis	HCC	-0.010	0.140	0.997	-0.340	0.320
	Chr.HBV	0.504*	0.158	**0.004**	0.130	0.880
Chr.HBV	HCC	-0.514*	0.144	0.001	-0.850	-0.180
	Cirrhosis	-0.504*	0.158	0.004	-0.880	-0.130

Chr. HBV, chronic hepatitis B; HCC, hepatocellular carcinoma.
Bold values indicate the statistically significant results.
* The mean difference is significant at the 0.05 level.

rate of sarcopenia in HCC patients were higher than that in the chronic hepatitis B patients (p <0.001). The rate of SaO in the cirrhotic patients was higher than that in the chronic hepatitis B patients (p <0.004). The rate of SaO in HCC patients were higher than that in the chronic hepatitis B patients ($p < 0.001$) (Table 5). There was no statistically significant difference between these groups in terms of presence of obesity.

Chronic hepatitis B, cirrhotic, and HCC patients with sarcopenia had higher MELD scores than nonsarcopenic patients which was statistically significant ($p < 0.035$, $p < 0.023$, and $p < 0.024$, respectively). Despite finding a similar increase in Child-Pugh scores in cirrhotic and HCC sarcopenic patients, results was statistically insignificant ($p < 0.597$ and $p < 0.688$, respectively).

Chronic hepatitis B patients with obesity had low MELD scores which was statistically significant ($p < 0.035$). Cirrhotic and HCC patients with obesity had higher MELD scores than nonobese patients which was statistically significant ($p < 0.01$ and $p < 0.024$, respectively). Cirrhotic and HCC patients with obesity had higher Child-Pugh scores than nonobese patients but only HCC patients showed statistically significance ($p < 0.480$ and $p < 0.001$, respectively).

HCC patients with SaO had higher MELD scores than patients with other body composition categories (NN, NO, SN) which was statistically significant ($p < 0.006$**).** Cirrhotic patients with SaO had higher MELD scores than patients with nonsarcopenic obese category (NO) which was statistically significant ($p < 0.049$).

Spearman correlation showed significant positive association between MELD and Child-Pugh scoring measurements ($p < 0.001$).

DISCUSSION

Sarcopenic obesity remains ill-defined, with inconsistent diagnostic criteria and methods for evaluation in the context of multifaceted liver diseases. In our study group, 36.3% of CLD patients had sarcopenia and 18.4% had SaO. Among patients with chronic viral hepatitis, 21.7% had sarcopenia and 5.9% had SaO, with lower rates compared to cirrhotic and hepatocellular carcinoma patients. Studies by Bering et al (17) and Chen et al (18) on adults with HCV and HBV infections reported similar rates of SaO at 3.8% to 7.4%. Chronic HBV patients with SaO were reported to have a 7.5 times greater odds of being in the poor and declining physical health trajectory group (18). Therefore, the evaluation of SaO is pivotal in patients with CLD.

In our study, we found a higher incidence of sarcopenia and SaO in patients with cirrhosis and HCC compared to those with chronic hepatitis B. Despite a scarcity of research on SaO in cirrhosis, our results align with previous studies, which report a prevalence of 20% to 35% (19). In chronic viral hepatitis the onset of SaO appears to be indicative of a dysregulated metabolic condition. With the development of cirrhosis and decompensation, the presence of SaO has an additional damaging effect on morbidity and mortality. In HCC, SaO is associated with worse survival and adverse outcomes, but conflicting findings have been reported in transplant patients (8,16,19,20).

The impact of sarcopenia and SaO on liver disease severity was assessed using the Child-Pugh and MELD scoring systems in our study. Our findings revealed that chronic hepatitis B, cirrhotic, and HCC patients who had sarcopenia exhibited higher MELD scores compared to nonsarcopenic patients. Additionally, HCC patients with SaO had even higher MELD scores than those with other body composition categories, while cirrhotic patients with SaO had higher MELD scores than nonsarcopenic obese patients. Our study highlights the importance of evaluating body composition in managing patients with cirrhosis and HCC who have already been screened via CT or MRI for follow up. MELD scoring is the most frequently used method to prioritize patients with end-stage liver disease for liver transplantation and it is calculated using serum levels of bilirubin, creatinine, and the international normalised ratio (INR) (21). Despite finding a similar increase in Child-Pugh scores in cirrhotic and HCC sarcopenic patients, results were statistically insignificant. This might be due to the fact that calculation of Child-Pugh scores involves not only laboratory evaluation of serum bilirubin, albumin, INR but also clinical evaluation of encephalopathy and presence of ascites. While some studies have reported a correlation between sarcopenia and both Child-Pugh and MELD scores, others have not (19).

The European Society for Clinical Nutrition and Metabolism has proclaimed a consensus definition of obesity as an excessive accumulation of fat (22). However, there are no established diagnostic criteria for obesity, particularly in the context of metabolic, cardiovascular, and liver diseases. The use of body mass index (BMI) to diagnose obesity is problematic because it fails to distinguish between lean body mass and fat and is also limited by its inability to account for fluid imbalances in patients with end-stage CLD. (23). Our study preferred to use VATA to overcome these limitations and more accurately define obesity. Our results revealed that nearly half of the patients enrolled in the study had obesity, with higher MELD scores in cirrhotic and HCC patients with obesity compared to chronic hepatitis B patients. Previous studies have reported conflicting results such as either accelerating the progression of cirrhosis status or significantly lowering mortality for obese cirrhotic subjects than for nonobese ones, often relying on BMI as the index of obesity (2,12,24). In a study by van Vugt et al. (25) a "MELD-Sarcopenia score" was found to have greater predictive accuracy for waiting list mortality than the MELD score alone. However, incorporating sarcopenia into the MELD score showed limited added value and De et al. (26) have raised a valid concern about this situation stating that the use of BMI-specific cutoff values for SMI in van Vugt et al.'s study may have resulted in the misclassification of sarcopenia in cirrhotic patients with ascites, of whom 59.9% presented with this condition (26). Therefore, we suggest that incorporating VATA instead of BMI with the currently accepted SMI cutoff values

in future studies will provide a more useful "MELD-Sarcopenic Obesity score" evaluation.

In CLD patients, cross-sectional imaging via CT or MRI is a crucial examination for regular monitoring, screening for disease advancement, and early detection of malignant changes. CT or MRI-based cross-sectional imaging provides a more accurate and trustworthy definition of sarcopenia compared to alternative techniques such as anthropometric metrics, bioelectrical impedance analysis, dual-energy X-ray absorptiometry (DEXA), and ultrasonography. The radiological interpretation of sarcopenia has undergone significant evolution, leading to the proposal of various cutoff values for different measurements. In several studies, the transverse psoas muscle thickness, psoas muscle area, psoas muscle index, and skeletal muscle index at the level of the third lumbar vertebra have been evaluated (8,14,15,24,27,28). Given the marked variability in body habitus, quality of life, and eating behavior between Western and Eastern populations, the estimation of SMI values as a continuous variable may be superior to a universal threshold. Our study adopted the SMI thresholds of <50 cm^2/m^2 for males and <39 cm^2/m^2 for females, as suggested by the North American Working Group on Sarcopenia in Liver Transplantation (15). One of the limitations of our study is that 61% of patients underwent CT scans and 39% underwent MRI scans. Although CT is considered the gold standard for sarcopenia evaluation, MRI has demonstrated comparable performance in the evaluation of sarcopenia (29,30). Another advantage of CT and MRI is the ability to apply fat quantification techniques for evaluating the muscle fat content in CLD patients (31). Myosteatosis is characterized by the pathological accumulation of fat in skeletal muscle, either within the muscular fibers or within the fascia of the skeletal muscle and is an emerging prognostic factor in cirrhosis (19). It is reported in more than 50% of patients with cirrhosis evaluated for liver transplantation and is associated with a higher risk of hepatic encephalopathy independent of liver function. As this was a retrospective study we were unable to evaluate muscle fat content due to the lack of fat quantifying sequences, which was another limitation of our study. One final limitation of the present study was that interobserver agreement was not determined.

In conclusion, our study showed a higher incidence of sarcopenia and SaO in patients with cirrhosis and HCC compared to those with chronic hepatitis B. The evaluation of SaO is critical in CLD patients, as the interplay between muscle, liver, and fat tissue explains the evolution and importance of different body compositions that significantly impacts patient health and progression of disease. Our study also revealed that CLD patients with sarcopenia and SaO exhibited higher MELD scores than nonsarcopenic patients. Therefore, we suggest incorporating body composition data into liver screening reports empowers radiologists to provide crucial insights since CT and MRI are significant in assessing the quality and quantity of both muscle and visceral adipose tissue. Future studies harmonizing SaO with MELD scoring are needed for better managing CLD patients.

DECLARATION OF COMPETING INTEREST

None.

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