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The Value of CT Imaging and Psoas Muscle Index in Grading the Severity of Sarcopenia in Liver Cirrhosis Patients and its Impact on Morbidity and Mortality

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Abstract

Background: Sarcopenia is a common feature of malnutrition in patient with liver cirrhosis and is widely recognized as independent predictor of poor outcome and mortality in this setting.

Aim of Study: This work was conducted to assess the severity of sarcopenia in liver cirrhosis patients, by quantifying muscle mass through CT at L3 level, measuring psoas muscle volume and cross sectional area, than correlating the results with hand grip strength as representative of functional status.

Patients and Methods: This study included 101 liver cirrhosis patients and 30 controls. All enrolled subjects had abdominal computed tomographic (CT) imaging at the level of L3 to calculate Psoas muscle cross sectional area, volume, and psoas muscle index (PMI) which is the sum of both RT and LT cross sectional area/height^2 (m^2), also hand grip strength was calculated for all patients using hand grip dynamometry. The severity of cirrhosis was classified according to the Child-Pugh and MELD scores.

Result: This was an observational prospective study including (101 liver cirrhosis & 30 controls), the mean age was 59.67 ys±8.01, cirrhotic patients were graded into three groups according to Child scoring system. Mean CT psoas volume, psoas surface area and psoas muscle index for Child (A+B) were 25.44±6.96, 7.97±2.23 & 4.58±1.21, while for Child C, were 15.85±6.02, 5.02±1.80 & 2.96±1.00. Using the FNIH (Foundation for the national Institutes of health) cuff off of hand grip (<26kg in male and <16kg in female Psoas muscle index cut off was 4.5cm^2/m^2.

Conclusion: Psoas muscle cross sectional area, volume and index measurements were well correlated with hand grip strength and proved to be independent prognostic factor for grading sarcopenia in cirrhotic patients.

Key Words: *Sarcopenia – CT – Psoas muscle – Handgrip strength.*

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Introduction

SARCOPENIA is defined as a regression in the muscle mass, muscle strength and physical activity [1]. It is associated with defective physical capability, poor quality of life, detrimental metabolic effects, disability, mortality, and high health care expenses [2].

Malnutrition and sarcopenia are highly common in patients with advanced and chronic liver disease, and they are frequently common in patients with liver cirrhosis [3]. Once sarcopenia develops, prognosis is markedly declined and patients are at high risk for liver related morbidity and mortality [4].

Conventional prognostic scores for patients with cirrhosis, such as the Child-Turcotte-Pugh (CTP) score or the model for end-stage liver diseases (MELD) score, have limitations, including the lack of a nutritional status evaluation [5]. This may be caused by the lack of a clear definition and the complexity of a nutritional assessment in patients with cirrhosis and fluid overload [6]. Some

List of Abbreviations:

BMI	: Body mass index
FNIH	: Foundation for National Institutes of Health
HGS	: Hand grip strength
HU	: Hounsfield units
MUAC	: Mid upper arm circumference
SD	: Standard deviation
CT	: Computed tomography
LT	: Left
RT	: Right
PMI	: Psoas muscle index
SMI	: Skeletal muscle index
MELD	: Model of end stage liver disease
CTP	: Child-Turcotte-Pugh
SMA	: Skeletal muscle area
SPSS	: SPSS statistical package for the Social Sciences
PACS	: Picture archiving and communication system

of these reports suggest that sarcopenia adds to the prognostic value of the model for end-stage liver disease (MELD) scoring system [7].

Different imaging modalities is being progressively used to diagnose and estimate the degree of sarcopenia in patients with cirrhosis, including DEXA, CT, MRI and ultrasonography [2]. Computed tomography (CT) represents the gold standard for diagnosing sarcopenia, [8] since it has the capacity to differentiate between different body tissues (skeletal muscle, adipose tissue, bone, water and air) based on tissue specific attenuation values, calculated in Hounsfield units (HU) [10].

CT scanning through specific software allows measuring of skeletal muscle area (SMA), which when adjusted for height, generates the skeletal muscle index (SMI), which is being the most widely used parameter. SMI is generated from the cross sectional area of abdominal skeletal muscles at the third lumbar vertebrae, normalized by body height [8,11].

SMI is known to be an independent prognostic factor of mortality in cirrhotic patients [2]. Abdominal muscles, including the psoas muscle, are appropriate to use for the estimation of skeletal muscle mass, because abdominal muscle mass, unlike appendicular muscle mass, is generally independent of activity level [2].

There is increasing evidence showing that Voluntary handgrip strength (HGS) is an indicator of nutrition status [12] and a promising undernutrition screening tool. It is an indicator of overall body muscle strength [13] and can delineate effects of nutrition deprivation, before alterations in body composition parameters are identifiable [14].

The Foundation for the National Institutes of Health Sarcopenia Project [15] recommends specific cutoff points to identify populations with functional limitations associated with sarcopenia. These evidence-based criteria recognize measures of low muscle strength (i.e., grip strength <26kg for men and <16kg for women) and low lean body mass (i.e., appendicular lean mass adjusted for body mass index (BMI; weight in kilograms divided by the square of height in meters) <0.789 for men and <0.512 for women) [16]. These criteria were validated as predictive of future mobility impairment with a 3-year clinical follow-up, 16 and this definition of muscle weakness appears to be a treatable symptom of sarcopenia [17].

In the present study, we primarily aimed to verify the concordance between muscle wasting, determined by CT scan with other techniques providing muscle functions such as the HG test. As a secondary aim, we evaluated the correlation between muscle wasting, degree of liver cirrhosis, impairment, and survival.

Patients and Methods

Patients:

The current study was an observational prospective study conducted during the period from January 2020 to January 2021, including 101 cirrhotic patients admitted to the Internal Medicine Hospital, Kaser Al-Eini, Cairo University, being referred either from the outpatient clinics or from the emergency department, also 30 control participants were included within the study, to validate the role of CT measures in assessing the severity of sarcopenia in liver cirrhosis.

The ethics commission of our institution approved this study and written informed consent for the current study from all patients before enrollment was obtained. Patients were fully informed about the risks and benefits of the radiological procedures; also they were informed about the research plan.

Inclusion criteria:

The criteria for enrollment were as follows:

- Adult patients previously diagnosed with liver cirrhosis either by biopsy or abdominal ultrasound (based on the morphologic characteristics of cirrhosis, including hepatic contour, texture, and existing portal collaterals).
- Patients admitted to our hospital by a complication of liver cirrhosis (hematemesis, spontaneous bacterial peritonitis, hepatic encephalopathy, hepatorenal syndrome).

Exclusion criteria for:

1- History of end organ failure which interfere with nutritional status e.g end stage renal failure on hemodialysis, heart failure, and respiratory failure).

2- Malignancies and hepatocellular carcinoma.

3- Acute liver cell failure.

All patients were submitted to the following:

1- History taking.

2- Full physical examination, (including BMI, nutritional risk score (NRS), anthropometric measurements), additionally to the clinical features and extent of the underlying pathology. The severity of cirrhosis was classified according to the Child-Pugh and MELD score.

3- Laboratory investigations including liver function tests and kidney functions.

Image analysis:

CT protocol:

- CT was performed using (Siemens Healthcare emotion 16 multidetector CT scan, Erlangen Germany).
- CT was done as a part of the overall investigations done for the cirrhotic patients.
- Single axial CT image at the level of L3 was utilized to outline both psoas muscles, using tube voltage of 130kV, tube current 50-200mA, exposure time: 100-300mAs, slice thickness 10mm, tissue-specific Hounsfield unit thresholds of –30 to +200 to separate muscle tissue from fat tissue or bone.
- Images were analyzed through picture archiving and communication system (PACS). Within the generated CT image, the borders of the right and left psoas muscles were manually drawn within the axial sections passing through the mid part of L3 vertebra.
- Volume of psoas muscle (cm^3) (Fig. 1) and cross-sectional area (cm^2) at L3 level (Fig. 2), were calculated automatically by adding tissue pixels and multiplying by the pixel surface area using Ultima program.
- The total psoas area was calculated by the sum of left and right psoas areas, then normalized by using the patient's height to produce psoas muscle index (PMI) in cm^2/m^2.
- Height correction is crucial to assess the relative muscle mass due to the linear relationship between skeletal muscle and height.
- Psoas muscle index (PMI) in cm^2 / m^2 at L3 = Total psoas muscle area at L3 level cm^2 / height (m^2)
- The attenuation of muscle was also measured to detect muscle quality. Low muscle attenuation, described as myosteatosis, which is defined by increased intramuscular fat content, which contributes to muscle weakness irrespective of the age-associated loss in muscle mass.

Assessment of muscle function:

Hand Grip strength (HGS):

It was measured using the hand grip dynamometry shown in (Fig. 3). The Patient's data in the form of age and sex were recorded then the patient was asked to use their maximum effort to grip both handles of the dynamometer together. The test was repeated for 3 times for every hand separately then the highest number value was used as a predictor of patient's performance. According to the Foundation for national institutes of health sarcopenia project, which identified a cut off for muscle strength as <26kg for men and <16kg for women.

Correlation of CT measurements and HGS:

Comparative analysis was done between the CT findings with the muscle function using the Hand Grip strength (HGS), then the results were correlated with the normal cut off values for age and sex, as outlined within the results.

Statistical methods:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables, frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired *t*-test, when comparing 2 groups and analysis of variance (ANOVA) with multiple comparisons post hoc test when comparing more than 2 groups. For comparing categorical data, Chi square test was performed. Exact test was used instead when the expected frequency is less than 5.

Correlations between quantitative variables were done using Pearson correlation coefficient. *p*-values less than 0.05 were considered as statistically significant.

Results

The present study was conducted on 101 liver cirrhosis patients, who were admitted in internal medicine hospital. In addition to 30 health participants as control group Tables (1,2).

According to Child score, patients were divided into 3 groups: Child A (6 patients), Child B (20 patients) and Child C (74 patients). The data of Child A and Child B patients were analyzed as one group in comparison to child c patients.

Control group constituted of 30 healthy participants with mean age 59.67ys±8.01.

Hand grip and anthropometric measures in Child groups:

The hand grip and anthropometric measures in Child groups namely dry weight, BMI, Mid upper arm circumference (MUAC) differed significantly between patients and control as well as between both groups of patients (*p*-value <0.001). Table (3).

Hand grip showed significant positive correlation with anthropometric measurements (BMI, MAUC), and significant negative correlation with disease severity score (Child score), mortality risk (MELD) and nutritional assessment. Table (4).

Table (1): Demographic data of the studied group.

	Child A,B N (26)	Child C N (75)	Control N (30)
Age:			
<60	8	46	14
>60	18	29	16
Sex:			
Male/Female	19/7	36/39	16/14
Cause of admission:			
Hematemesis	24	48	
Hepatic coma	2	21	
SBP	0	5	
Hepto-renal	0	1	
Etiology:			
Hemochromatosis:	0	1	
HCV	21	65	
HBV	0	5	
Bilharziasis	5	3	
Autoimmune	0	1	
Ascites:			
Tense	0	55	
Moderate	20	20	
Non	6	0	
ll edema:			
Present	20	74	
Non	6	1	

Table (2): Model for End-Stage Liver Disease (MELD), nutrition risk score (NRS) and length of hospital stay.

	Child A,B Mean ± SD	Child C Mean ± SD	*p*-value
MELD	11.58±3.19	22.41±6.71	<0.001
NRS	2.42±0.86	4.05±0.77	<0.001
Length of hospital stay (days)	3.38±0.80	7.08±2.53	<0.001

Table (3): Hand grip and anthropometric measures.

	Group			*p*-value
	Child A,B Mean ± SD	Child C Mean ± SD	Control Mean ± SD	
Dry wt (kg)	61.69±7.54	51.73±5.22	84.52±12.45	<0.001
BMI	20.59±1.69	18.27±0.80	28.21±4.89	<0.001
MUAC	28.31±3.16	21.28±3.47	33.45±2.52	<0.001
Hand grip	22.78±6.36	14.88±5.13	29.15±7.50	<0.001

Table (4): Correlation between HGS, MAUC, BMI, MELD, Child score, NRS.

	Hand grip	MELD	Child	NRS	MUAC	BMI
Hand grip:						
Pearson Correlation	1	-0.463-	-0.542-	-0.645-	0.878	0.726
p-value		<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101

Muscle assessment by CT:

CT measurements of the psoas muscle at L3, including volume, surface area and psoas muscle index in Child groups were significantly decreased in patients when compared to control group Tables (5,6), Figs. (4,5).

Psoas CT at L3 CT measurements of the psoas muscle at L3, including Volume, surface area and Psoas muscle index (right, left), were significantly decreased with increasing disease severity, it was worst in Child C patients compared to Child A,B patients (p-value <0.001) Table (7), Figs. (6,7).

All CT parameters have significant positive correlation with HGS.

Also they have significant negative correlation with (Child, MELD, and NRS) scores and length of hospital stay with (p-value <0.001) Table (8).

Cut off values for male psoas index (Fig. 8):

It is illustrated in Table (8) with good sensitivity 84.1% and good specificity 100%. Table (7).

Cut off values for female psoas index (Fig. 9):

It is illustrated in Table (9) with good sensitivity 93% and good specificity 100%.

In general the CT L3 psoas volume, surface area, and psoas index on both sides with mean measure, showed significant positive correlation with anthropometric measurement, hand grip, and laboratory results (alb, Bil, INR, creat) (p-value <0.001). Table (10).

Table (5): Computerized tomography at L3 volume, surface area and psoas muscle index in Child groups.

	Group			*p*-value
	Child A,B Mean ± SD	Child C Mean ± SD	Control Mean ± SD	
RT CT Psoas volume	25.12±6.87	15.64±6.03	30.06±9.85	<0.001
LT CT Psoas volume	25.76±7.11	16.06±6.09	30.69±10.52	<0.001
Mean RT & LT CT Psoas volume	25.44±6.96	15.85±6.02	30.38±10.17	<0.001
RT CT Psoas surface area	7.84±2.15	4.99±1.78	10.25±2.32	<0.001
LT CT Psoas surface area	8.11±2.34	5.06±1.89	10.50±2.41	<0.001
Mean RT & LT CT Psoas surface area	7.97±2.23	5.02±1.80	10.37±2.34	<0.001
CT Psoas ms index	4.58±1.21	2.96±1.00	5.94±1.24	<0.001

Table (6): Post hoc pairwise comparison (*p*-value between each 2 groups).

	Child A,B vs Child C	Child A,B vs Control	Child C vs Control
RT CT Psoas Volume	<0.001	0.036	<0.001
LT CT Psoas volume	<0.001	0.046	<0.001
Mean RT&LT CT Psoas Volume	<0.001	0.040	<0.001
RT CT Psoas surface area	<0.001	<0.001	<0.001
LT CT Psoas surface area	<0.001	<0.001	<0.001
Mean RT&LT CT Psoas surface area	<0.001	<0.001	<0.001
CT Psoas ms index	<0.001	<0.001	<0.001

Table (7): Correlation between CT parameters, (Child, MELD, and NRS) scores, hand grip, and length of hospital stay.

	Child	MELD	NRS	MUAC	Hand grip	Length of hospital stay (days)
RT CT Psoas Volume:						
r	-0.570-	-0.488-	-0.674-	0.898	0.964	-0.498-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
LT CT Psoas volume:						
r	-0.582-	-0.495-	-0.678-	0.899	0.971	-0.520-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
Mean RT&LT CT Psoas Volume:						
r	-0.578-	-0.494-	-0.679-	0.902	0.971	-0.511-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
RT CT Psoas surface area:						
r	-0.555-	-0.478-	-0.638-	0.886	0.951	-0.481-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
LT CT Psoas surface area:						
r	-0.570-	-0.495-	-0.644-	0.883	0.960	-0.519-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
Mean RT&LT CT Psoas surface area:						
r	-0.568-	-0.492-	-0.648-	0.893	0.965	-0.506-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101
CT Psoas ms index:						
r	-0.580-	-0.516-	-0.656-	0.892	0.960	-0.521-
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
N	101	101	101	101	101	101

Table (8): Cut off values for male psoas index.

Area Under the Curve	*p*-value	95% Confidence Interval		Cut off (cm^2/m^2)	Sensitivity %	Specificity %
		Lower Bound	Upper Bound			
0.969	<0.001	0.928	1.000	4.66	84.1	100

Table (9): Cut off values for female psoas index.

Area Under the Curve	*p*-value	95% Confidence Interval		Cut off (cm^2/m^2)	Sensitivity %	Specificity %
		Lower Bound	Upper Bound			
0.977	0.006	0.927	1.000	3.19	93	100

Table (10): Correlation between CT L3 psoas volume, surface area, and psoas index with anthropometric measurement and laboratory results.

	Age	Dry wt	HT	BMI	FBS	Alb	Bil	INR	Urea	Creat
RT Psoas CT Volume:										
r	-0.237-	0.817	0.591	0.742	-0.002-	0.503	-0.354-	-0.457-	-0.061-	-0.330-
p-value	0.017	<0.001	<0.001	<0.001	0.981	<0.001	<0.001	<0.001	0.542	0.001
N	101	101	101	101	101	101	101	101	101	101
LT Psoas CT volume:										
r	-0.213-	0.818	0.597	0.735	-0.035-	0.501	-0.368-	-0.475-	-0.012-	-0.327-
p-value	0.033	<0.001	<0.001	<0.001	0.726	<0.001	<0.001	<0.001	0.902	0.001
N	101	101	101	101	101	101	101	101	101	101
Mean RT&LT CT Psoas Volume:										
r	-0.225-	0.821	0.596	0.742	-0.019-	0.504	-0.363-	-0.468-	-0.037-	-0.330-
p-value	0.023	<0.001	<0.001	<0.001	0.850	<0.001	<0.001	<0.001	0.714	0.001
N	101	101	101	101	101	101	101	101	101	101
RT Psoas CT surface area:										
r	-0.232-	0.810	0.588	0.734	<0.001	0.502	-0.372-	-0.460-	-0.045-	-0.303-
p-value	0.019	<0.001	<0.001	<0.001	0.999	<0.001	<0.001	<0.001	0.656	0.002
N	101	101	101	101	101	101	101	101	101	101
LT Psoas CT surface area:										
r	-0.228-	0.794	0.567	0.726	-0.044-	0.490	-0.403-	-0.463-	-0.013-	-0.315-
p-value	0.022	<0.001	<0.001	<0.001	0.666	<0.001	<0.001	<0.001	0.894	0.001
N	101	101	101	101	101	101	101	101	101	101
Mean RT&LT CT Psoas surface area:										
r	-0.232-	0.810	0.583	0.737	-0.023-	0.501	-0.392-	-0.466-	-0.029-	-0.312-
p-value	0.019	<0.001	<0.001	<0.001	0.821	<0.001	<0.001	<0.001	0.774	0.001
N	101	101	101	101	101	101	101	101	101	101
CT Psoas ms index:										
r	-0.248-	0.773	0.512	0.751	-0.036-	0.514	-0.410-	-0.484-	-0.050-	-0.334-
p-value	0.012	<0.001	<0.001	<0.001	0.718	<0.001	<0.001	<0.001	0.621	0.001
N	101	101	101	101	101	101	101	101	101	101

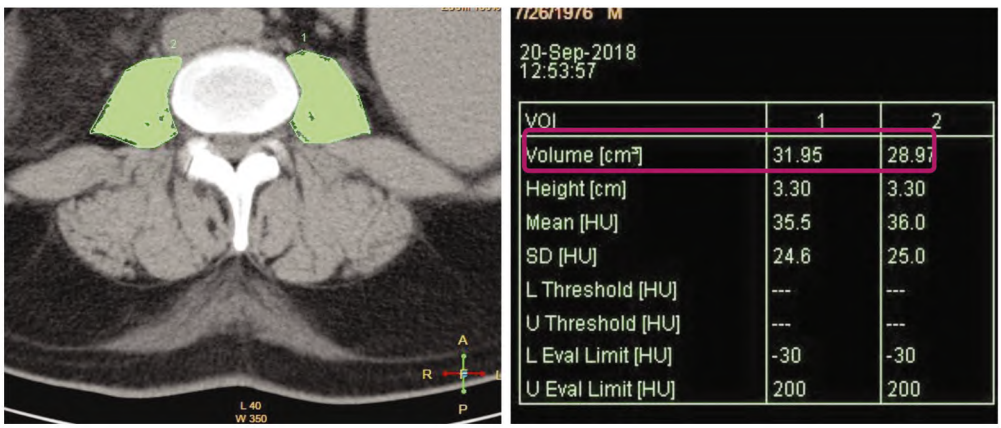


Fig. (1): CT psoas muscle volume which

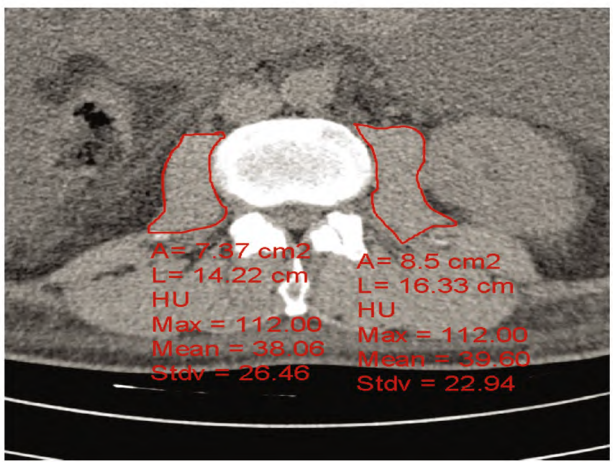


Fig. (2): CT psoas muscle cross sectional area.

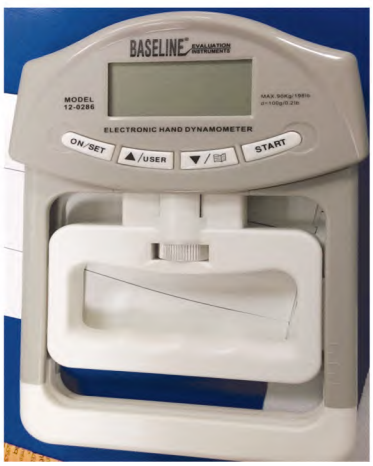
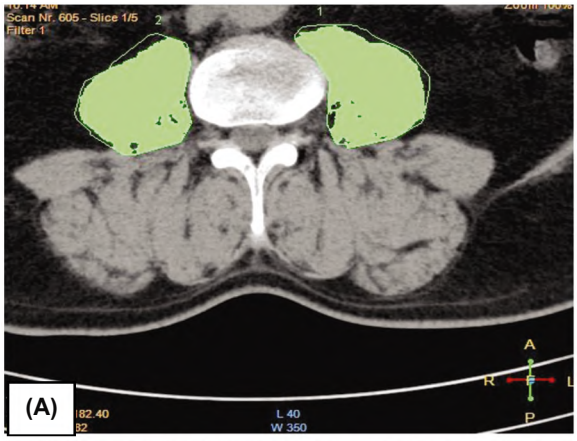


Fig. (3): Hand grip dynamometry.



VolumeResult2
9/6/2018
06 Sep 2018
10:14 AM
Scan Nr. 605 - Slice 4/5

VOI	1	2
Volume [cm³]	38.72	36.87
Height [cm]	3.00	3.00
Mean [HU]	39.4	39.9
SD [HU]	22.5	20.9
L Threshold [HU]	---	---
U Threshold [HU]	---	---
L Eval Limit [HU]	-30	-30
U Eval Limit [HU]	200	200

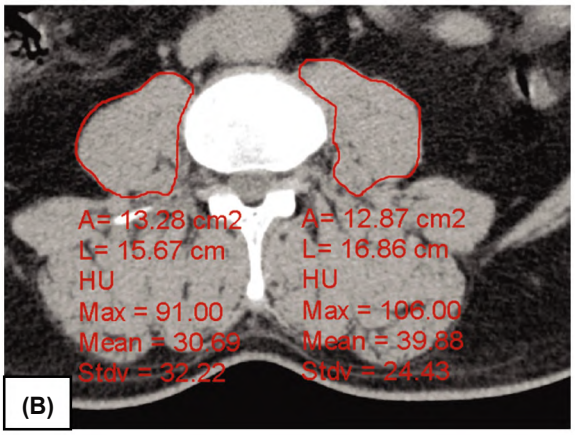
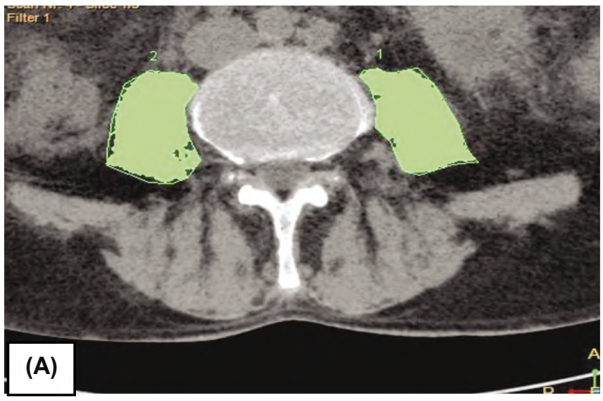


Fig. (4): (A) Psoas muscle volume and (B) Cross sectional area in healthy control subject.

BMI 23.6 & HGS: 35.
Positive correlation with HGS.



VolumeResult1
10/9/2018
09 Oct 2018
6:40:02 PM
Scan Nr. 4 - Slice 4/5

VOI	1	2
Volume [cm³]	30.80	28.77
Height [cm]	3.30	3.30
Mean [HU]	34.9	33.3
SD [HU]	21.1	22.1
L Threshold [HU]	---	---
U Threshold [HU]	---	---
L Eval Limit [HU]	-30	-30
U Eval Limit [HU]	200	200

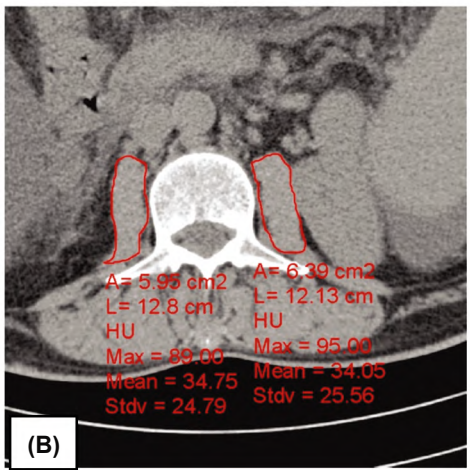


Fig. (5): (A) Psoas muscle volume and (B) Cross sectional area in child B sore.
BMI 19 & HGS: 26.5.
Positive correlation with HGS.

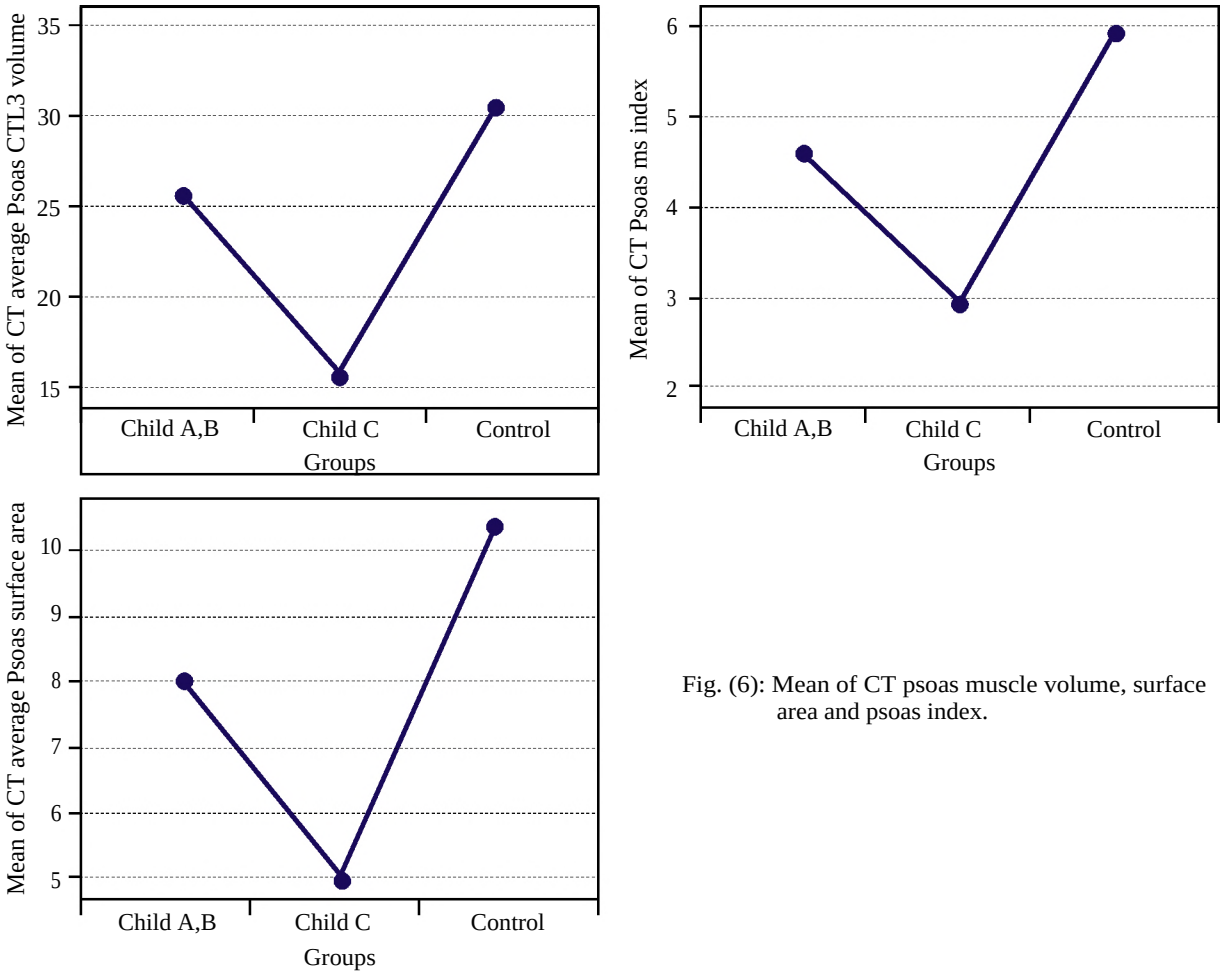


Fig. (6): Mean of CT psoas muscle volume, surface area and psoas index.

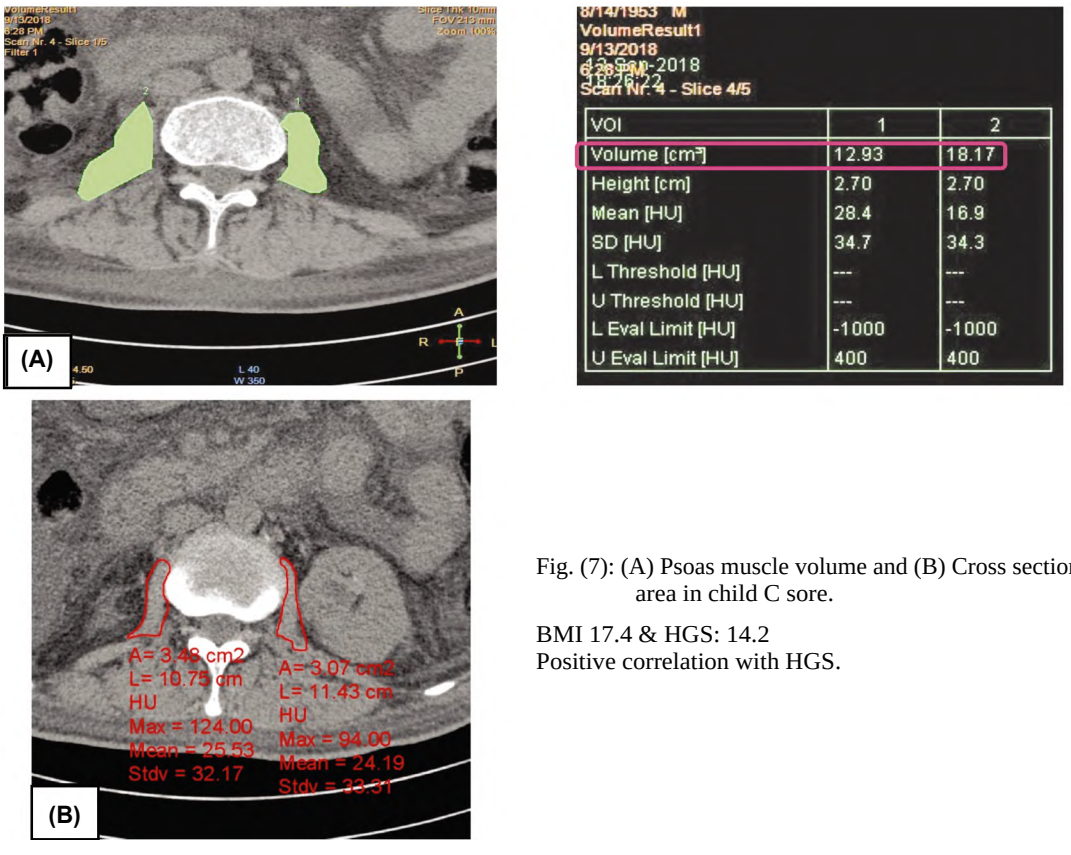


Fig. (7): (A) Psoas muscle volume and (B) Cross sectional area in child C sore.

BMI 17.4 & HGS: 14.2
Positive correlation with HGS.

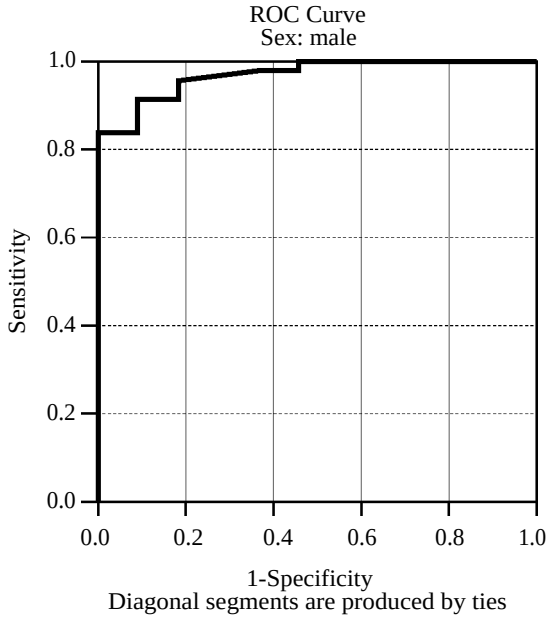


Fig. (8): Cut off value of male Psoas muscle index.

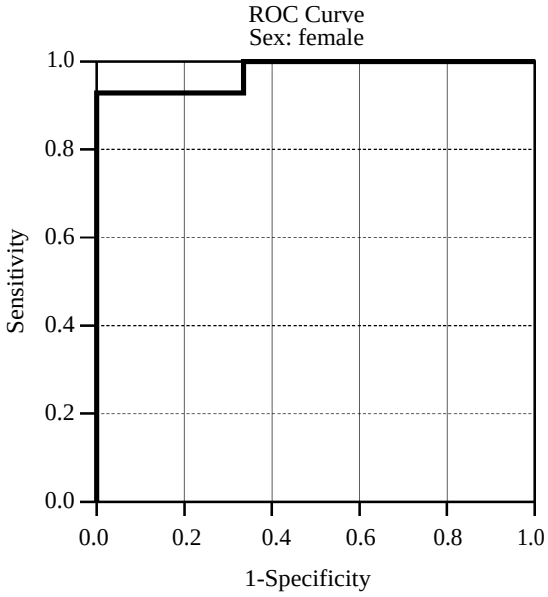


Fig. (9): Cut off value of female Psoas muscle index.

Discussion

Sarcopenia is characterized by progressive decline of muscle mass and strength, as well as functional capacity, having progressive relationship with malnutrition, chronic disease and malignancy **[17]**. In general muscle mass in sarcopnia is defined as being below two standard deviation of the normal healthy adult **[18]**.

Severe muscle wasting or sarcopenia is one of the most common and frequently hidden complications in patients with cirrhosis, which negatively impact survival, quality of life, and response to stressor, such as infections and surgeries **[19]**. Patients with malnutrition and/or sarcopenia have longer hospital stay, and increased in-hospital mortality **[20]**.

Nowadays, calculating muscle mass with CT images acquired at level of L3, is an objective and reproducible method for assessing the degree of malnutrition and sarcopenia **[18]**.

In our study, both CT parameters of the psoas muscle (Psoas Volume, surface area, and psoas muscle index) showed significant decrease in patients in comparison to control even in Child A patients.

Psoas muscle volume, surface area and psoas index were negatively correlated with (Child& MELD) scores, and duration of hospital stay, the lower psoas muscle volume, surface area, psoas index the higher Child score, MELD score, duration of hospital stay with (p<0.001).

Kang SH, et al., **[21]** conducted Cohort study which enrolled 452 patients with cirrhosis (Child A (n: 215) Child B (n: 200) Child C (n: 37). L3 SMI was measured on CT imaging. Among the patients, 42% (190/452) had sarcopenia [Child A (n: 93) B (n: 87) C (n: 10)], these results agree with our study, since sarcopenia started early even in Child A. Nearly 50% (48.9%) of patients who were either compensated or with early decompensated cirrhosis as in Child B patients were sarcopenic.

Gajula U and Murugan N, **[22]** performed a study which included 95 patients with liver cirrhosis. Similar to our study, they utilized CT examination at the level of L3, to estimate PMI (psoas muscle index). At their study Sarcopenia diagnosed by CT scan was correlated with (Child, MELD) scores and HGS. Gender specific Psoas muscle index cut-off values to define sarcopenia were derived from a pilot study of sixty healthy adults between 20-30 yrs whose values were <5.7cm^2/m^2 in males and <3.5cm^2/m^2 in females. Prevalence of sarcopenia assessed by PMI in their study was was found to be positively proportionate with the severity of chronic liver disease assessed by Child score (p-value <0.05) and with MELD score (p-value <0.005). Also sarcopenia was increased with decreased HGS (p-value <0.005) and this agree with the results we reached in our study.

Ebadi M, et al., **[23]** established cut-off for PMI to predict mortality for (males <5.1 cm^2/m^2; females <4.3cm^2/m^2), in our study we established Cut off value of PMI (<4.66cm^2/m^2 for males and <3.19

cm^2/m^2 for female) using ROC curve of hand grip with high specificity (100%) and sensitivity (84% & 93%), with (area under the receiver operating characteristic curve AUC 0.9) is similar to cut off values previously estimated by Ebadi et al., in 2018 in males but lower value for females.

HGS is a noninvasive, simple and quick method that can be applied in clinical and epidemiological studies **[24]**.

Álvares-da-Silva MR and Silveira TR, **[25]** suggested that in early stages of cirrhosis, muscle strength measured by HGS should be used to evaluate for malnutrition and sarcopenia. In their study, among patients with cirrhosis, 88% were Child-Pugh A and only 12% were Child-Pugh B, these patients were tested by handgrip strength (HGS) in the outpatient clinic (n=50) and followed for one year to verify the incidence of major complications, the need for transplantation, and death. Among these patients, the prevalence of malnutrition was 63% by HGS (p<0.05) and this agrees with our study, as we found that Hand grip showed significant positive correlation with anthropometric measurements (BMI, MAUC), and significant negative correlation with disease severity score (Child score) and with mortality risk (MELD) with (p-value >0.001).

Contrary to our results, a study conducted by Fernandes SA, et al., **[26]** showed no correlation between HGS and Child classification. They included patients who were mostly with compensated liver cirrhosis (91 of 129 patients were Child A, 27 were Child B, and only 9 were Child C). They tested the non-dominant hand and showed that HGS did not significantly decreased with increased severity of liver cirrhosis with (p=0510).

The discrepancy between the results of our study and 26 may have originated from the fact that HGS was tested in the dominant hand in our study, while Fernandes et al., examined the non-dominant hand.

In our study, HGS was positively correlated with CT L3 psoas volume, surface area and psoas muscle index with significant (p-value >0.001).

Michela G, et al. **[27]** conducted a study on fifty-nine patients listed for LT aimed to verify the association between muscle wasting, determined by CT scan and HGS. HG dynamometer failed to correlate with CT (SMI) muscle evaluation in men (p-value 0.73) and women (p-value 0.69). The decrease in SMI was not significantly associated with a worse liver function (MELD vs. SMI, p=0.33; Child-Pugh vs. SMI, p=0.76) and this disagree with our study.

Limitations:

1- The most patients admitted in our hospital who have complications like hematemesis, hepatic coma, and others due to hepatic decompensation are of Child C group so patients of Child A and B patients are less in number. And most of Child C group patients have critical case so we stabilized the patients first.

2- Overflow of patients in all specialties in our hospital makes using CT scan for limited number of hepatic patients not all unlike other institutes which are specialized in hepatology.

3- There are no normal values for muscle thickness among Egyptians (normal general population) whether by ultrasound or CT measured.

4- We didn't follow-up patients after discharge for quality of life, readmissions and post hospital mortality.

Strengths:

1- We used CT (volume, surface area) to assess muscle thickness also we used HGS to asses muscle function.

2- To our best knowledge this is the first study using HGS to set cutoff value for the psoas index by CT.

Conclusion:

Testing for sarcopenia is very important in patients with chronic liver disease and cirrhosis, as sarcopenia is one of the important prognostic factors for the disease severity and poor outcome. CT is considered a gold standard cross sectional modality to test for sarcopenia, through measuring Psoas muscle volume, cross sectional area and PMI through single axial cut at the level of L3.

Also HGS is a simple bedside technique used for assessment of muscle function and sarccopenia, correlates positively with the measured CT parameters, as well as with the different scoring and grading systems for the severity of liver disease.

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تقييم العلاقة بين شدة الساركوبينيا والنتائج التنبؤية فى مرضى التليف الكبدى

عرَّف الفريق العامل الأوروبى معنى الساركوبينيا لدى كبار السن بأنه وجود كل من كتلة العضلات المنخفضة ووظائف العضلات المنخفضة (القوة أو الأداء).

تعتبر الساركوبينيا سمة شائعة لسوء التغذية لدى المرضى الذين يعانون من تليف الكبد ومن المعترف به نطاق واسع أنه مؤشر مستقل لضعف النتائج والوفيات وإقامة المرضى مدة أطول فى المستشفى على تم اقتراح أن ضمور العضلات المركزى الذى تم تقييمه عن طريق التصوير المقطعى مؤخراً كإجراء موضوعى يمكن تطبيقه أيضاً على مرضى التليف الكبدى مع صورة واحدة على مستوى الفقرة القطنية الثالثة، وهو ممثل صالح لكتلة عضلات الجسم بأكملها.

والهدف من هذه الدراسة: تقييم شدة الساركوبينيا فى مرضى تليف الكبد وعلاقته بالنتائج التشخيصية التقليدية لتليف الكبد، مثل تقييم تشيلد وميلد وكذلك إكتشاف تأثيره على الوفيات ومدة الإقامة فى المستشفى.

وقد أجريت هذه الدراسة على ١٠١ من مرضى تليف الكبد المتواجدين بمستشفى أمراض الباطنة القصر العينى و٣٠ مشاركاً صحياً من الذين تتراوح أعمارهم بين ٤٠ سنة أو أكثر ≥ ٧٥ سنة. تم فحص جميع المرضى لقياس القياسات البشرية (مؤشر كتلة الجسم ومحيط منتصف الذراع العلوى) وأجريت اختبارات وظائف الكبد لجميع المرضى. تم حساب النتائج (درجة التغذية (NRS) وتقييم تشيلد وميلد). تم تقييم كتلة العضلات من خلال كتلة ومساحة السطح لعضلة psoas خلال التصوير المقطعى، ومؤشر عضلة psoas على مستوى الفقرة القطنية الثالثة. أيضاً قوة العضلات من خلال قوة قبضة اليد. وتم حساب طول الإقامة فى المستشفى.

تم تقييم كتلة العضلات خلال التصوير المقطعى لحجم عضلة psoas 15.85±6.02 فى تقييم تشيلد (C) و 25.44±6.9 فى تقييم تشيلد (A,B) ومساحة السطح 5.02±1.8 فى تقييم تشيلد (C) و 7.97±2.23 فى تقييم تشيلد (A,B).

١٠٠٪ من مرضانا كانوا يعانون من الساركوبينيا باستخدام أرقام قطع سابقة لمؤشر psoas وكان ٨٧٪ من المرضى كانوا يعانون من الساركوبينيا باستخدام أرقام قطع FINH لقوة قبضة اليد.

وتم عمل أرقام قطع لقيمة مؤشر عضلة psoas باستخدام FINH لقوة قبضة اليد و كانت (٤.٦ سم/م ٢) للذكور و ٣.١٩ للإناث).

وقد وجد علاقة سلبية بين كتلة ومساحة السطح عضلة psoas مع تقييم تشيلد وميلد ودرجة التغذية (NRS) ومع مدة الإقامة فى المستشفى وعلاقة إيجابية مع قوة قبضة اليد مؤشر كتلة الجسم ومحيط منتصف الذراع العلوى.

إذن الساركوبينيا فى مرضى تليف الكبد الذين تم تقييمهم بواسطة كتلة ومساحة السطح عضلة خلال التصوير المقطعى العضلات على مستوى الفقرة القطنية الثالثة، و قوة قبضة اليد هى مؤشرات مستقلة عن شدة أمراض الكبد والنتائج السيئة التى يتم تقييمها من قبل تقييم تشيلد وميلد. أيضاً قوة قبضة اليد هى تقنية بسيطة بجانب السرير تستخدم لتقييم الساركوبينيا مثل التصوير المقطعى.