Original Article

Sarcopenia in cirrhosis of liver - comparison of different tools in diagnosis

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Abstract

Background and aims: Sarcopenia in liver cirrhosis is a common condition associated with increased mortality and adverse clinical outcome. Early recognition and treatment is essential but challenging. Clinical detection of sarcopenia with various assessment tools gives indirect knowledge of muscle mass and strength. The aim of this study is to find the most easy and applicable assessment tool in daily clinical practice to diagnose sarcopenia.

Methods: A retrospective observational study was conducted and data was taken from electronic medical records of patients admitted with cirrhosis and sarcopenia in department of gastroenterology of Tribhuvan university Teaching hospital. A total of 51 cirrhotic patients were included during one and half year study duration. Sarcopenia was assessed using assessment tool like hand grip strength, chair stand test, 400 metre walk test and CT measurement of either skeletal muscle area (SMA) or skeletal muscle index (SMI).

Results: Among 51 patients assessed with performance based assessment tool to diagnose sarcopenia,taking CT as gold standard test, SARC-F score and chair stand test were found to have highest sensitivity and specificity of 93%, 87.5 % and 93%, 100% respectively.

Conclusion: Diagnosis of sarcopenia with simple clinic based assessment tool SARC-F score and chair stand test is very useful and comparable with more costly and resource-intensive CT scan.

Introduction

Liver cirrhosis is a chronic and progressive disease characterized by the replacement of healthy liver tissue with scar tissue, which leads to the loss of liver function. It results from prolonged liver damage due to various causes, including chronic viral hepatitis, excessive alcohol consumption, and non-alcoholic fatty liver disease (NAFLD). Liver cirrhosis significantly increases the risk of developing sarcopenia and malnutrition.[1] Sarcopenia is characterized by a progressive and generalized loss of muscle mass and function, leading to increased morbidity and mortality.[2] It is a common complication in patients with liver cirrhosis, contributing to poor clinical outcomes and reduced quality of life. Despite its clinical significance, there is no consensus on the optimal diagnostic approach for sarcopenia.[3]

The European Working Group on Sarcopenia in Older People (EWGSOP2) issued a widely accepted definition of sarcopenia in 2019. This operational definition includes three criteria: low muscle strength, low muscle quantity or quality and low physical performance. Criterion 2 serves to confirm the presence of sarcopenia, while Criterion 3 identifies severe sarcopenia The working group emphasized the importance for healthcare professionals to promote early detection and treatment, and to expand research efforts targeting individuals at risk of developing sarcopenia.[4]

According to the National representative Survey 2016, the prevalence of underweight individuals in Nepal was 15.83% among men and 18.30% among women.[5] These alarming figures indicate a significant burden of malnutrition, which may contribute to the high prevalence of sarcopenia in cirrhosis. Depending on the assessment method, the prevalence of sarcopenia in cirrhosis patients ranges from 30% to 100%.[6,7] Various diagnostic tools are used to assess sarcopenia, including CT scans, Handgrip Strength (HGS), Chair Stand Test, 400 metre Walk test and the SARC-F score. Each method has its own advantages and limitations. This paper aims to compare and evaluate

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various diagnostic tools used for the assessment of sarcopenia in patients with liver cirrhosis, providing insights into their efficacy, reliability, and clinical utility in a tertiary care hospital environment.

Material and Methods

Study Design: This study employed a retrospective observational design to investigate the efficacy, reliability, and clinical utility of various diagnostic tools used for the assessment of sarcopenia in patients with liver cirrhosis.

Study Setting: The study was conducted at a tertiary care hospital specializing in liver diseases, where patients with liver cirrhosis receive comprehensive medical care and management.

Study Duration: The study was done over a period of one and half year.

Study population: The study enrolled 51 adult patients (aged 18 years and older) diagnosed with liver cirrhosis. These participants underwent evaluations for sarcopenia with various diagnostic tools based on predefined cut off criteria. Sarcopenia was determined if the patient met the cut off criteria in each assessment tools: hand grip strength (HGS), the chair stand test, 400m Walk test and computed tomography (CT) measurements of either skeletal muscle area (SMA) or skeletal muscle index (SMI).

Data Collection: Data were extracted from electronic medical records, encompassing demographic information (age, gender), clinical characteristics (etiology of cirrhosis, severity of liver disease) and imaging findings (muscle mass assessment).

Assessment of Sarcopenia: Sarcopenia was evaluated using established diagnostic criteria, which typically involve measurements of muscle mass, strength, and function.

(i) Hand grip strength (HGS) was measured using a Camry hand dynamometer, a validated tool for this purpose. The assessment was performed on the dominant hand with the arm positioned by the side of the body and the elbow flexed at ninety degrees. Three readings were taken, and the highest value was recorded as the patient's HGS. Sarcopenia was defined by an HGS of less than 26 kg for males and less than 18 kg for females

(ii) Chair stand test: This test is based on measuring the strength of leg muscle (quadriceps group). It measures the amount of time needed for a patient to rise five times from a seated position without using his or her arms; timed chair stand test is a variation that counts how many times a patient can rise and sit in the chair over a 15 second interval. Less than five count in 15 second is reported as abnormal and help in diagnosis of sarcopenia.

(iii) 400m walk test: This test is based on ability of a patient to walk 20 laps of 20 meter, each lap as quickly as possible with two stops allowed. Need of more than 6 minutes helps in identifying sarcopenia.

(iv) SARC-F Assessment: The SARC-F tool is based on the patient's responses to five standard questions. It evaluates strength, walking ability, rising from a chair, climbing stairs, and the occurrence of falls (Table). Each of the five answers is scored on a scale from zero to two

	Question	0	1	2
Strength	How much difficulty do you have in carrying 10 pounds or 4.5 kg of weight?	No	Some	A lot or unable to do
Ability to walk	How much difficulty do you have in walking across the room?	No	Some	A lot or unable to do or uses aids
Rise from chair	How much difficulty do you have in transferring from a chair or bed?	No	Some	A lot or unable to do or uses aids
Climbing stairs	How much difficulty do you have in climbing a flight of 10 stairs?	No	Some	A lot or unable to do
Falls	How many times have you fallen in the past year?	No	1-3 Fall	4 or more falls

(v) CT Scan: For patients who underwent an abdominal CT scan for clinical indications, the skeletal muscle area (SMA) at the third lumbar vertebra was manually calculated. To obtain the skeletal muscle index (SMI), the SMA was divided by the square of the patient's height in meters. The specific cutoff values for SMA and SMI to define sarcopenia in males and females are taken as per protocol (SMA for male 144.3cm^2, female 92.2 cm^2 and SMI for male 34.4, female 45.4 cm^2/m^2).

Statistical Analysis: Statistical analysis was conducted using appropriate methods, including descriptive statistics to summarize patient characteristics and analytical techniques (such as chi-square tests, ROC curve) to compare different diagnostic tools used for assessment of sarcopenia in liver cirrhosis. Statistical analysis was done using SPSS version 26.

Ethical Considerations: The study protocol was approved by Ethics Committee of the tertiary care hospital, ensuring compliance with ethical guidelines and protection of patient confidentiality and rights.

Informed Consent: Informed consent was obtained from all participants or their legal guardians prior to inclusion in the study, ensuring their voluntary participation and understanding of the research objectives and procedures. The eligible participants were explained, in their native language about the nature of the research.

Results

This study provides a comprehensive overview of the existing methodologies and criteria for diagnosing sarcopenia in liver cirrhosis by systematically comparing and evaluating various diagnostic tools. Total 51 patients were screened for sarcopenia using CT Scan, HGS, 400m walk test, chair stand test and SARC-F score method to confirm the presence of sarcopenia in liver cirrhosis. CT scan was taken as reference standard for diagnosing sarcopenia since it detects actual muscle mass at specific location and correlated with other performance scale and mortality.

Table 1 provide the baseline characteristics of the patients presenting with sarcopenia.

Baseline Character	Mean (N=51)
Gender (Female)	18 (35.3%)
Age (years)	50.8 +/- 10.2
MELD	23.8 +/- 7.4
CTP A CTP B CTP C	0 7 (13.8%) 44 (86.2%)
Hemoglobin (g/L)	9.1 +/- 2.0
Platelets (/cumm)	110686 +/- 54052
INR	2.2 +/- 0.8
Total Bilirubin (micromol/L)	129.6 +/- 152.7
AST (U/L)	139.2 +/- 128.5
ALT (U/L)	66.3 +/- 62.7
Albumin (g/L)	25.4 +/- 4.7
ALP (U/L)	139.8 +/- 132.3

Table 2 compares the performance of different assessment techniques (e.g. HGS, Chair stand test, 400m walk test and SARC -F scores) in quantifying muscle mass and detecting sarcopenia. CT Scan is highly accurate for measuring muscle mass and predicting both mortality and complications in cirrhotic patients. However, it is expensive and involves radiation exposure, which limits its frequent use. It is best used in settings where precise muscle quantification is essential and resources are available. HGS is advantageous due to its simplicity, low cost, and high accessibility. It provides a good indication of muscle strength and can predict adverse outcomes. However, it may not fully capture overall muscle mass and function, and results can be influenced by patient effort and technique. Similary chair stand test and 400m walk test are accessible and easy performance test to diagnose sarcopenia that identifies strength of muscle. SARC-F Score combines various aspects of sarcopenia, offering a comprehensive assessment. It has a high predictive value for adverse outcomes and is useful for a more holistic evaluation of the patient's muscle health. However, it is more complex and resource-intensive, requiring multiple assessments and specialized knowledge.

Table 2

Test Variable	Area Under the Curve
Chair Stand Test	0.965
Hand Grip Strength	0.516
400 m Walk Test	0.868
SARC-F Score	0.903

An analysis of SARC-F score, HGS, chair stand test and 400m walk test was conducted to diagnose sarcopenia using predefined cut off values. HGS, Chair stand test, 400m walk test, SARC-F score were compared with CT SMA/SMI for sarcopenia diagnosis, as shown in the ROC curve in the figure 1

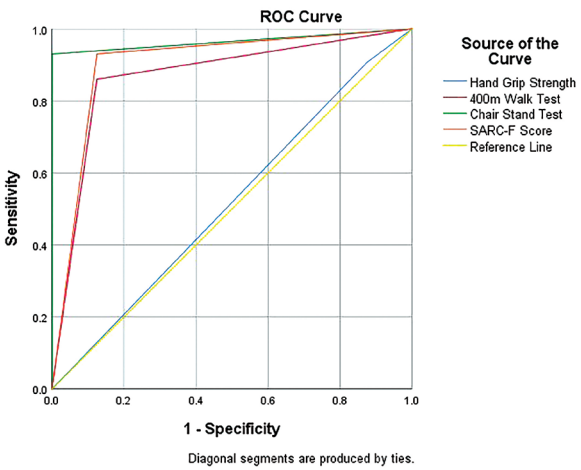

Figure 1 *ROC curve for HGS, 400m walk test, Chair stand test, SARC-F score and CT Scan in diagnosing sarcopenia.*

The plot visually represents the performance of these diagnostic tools compared with the CT Scan showing SARC-F score with highest sensitivity, specificity and area under curve.

- The **orange curve** representing the SARC-F score has the highest AUC of 0.903, indicating excellent diagnostic performance.
- The **green curve** representing chair stand test has an AUC of 0.965, indicating good diagnostic performance
- The **pink curve** representing 400m walk test has an AUC of 0.868, indicating fair diagnostic performance.
- The **blue curve** representing HGS has an AUC of 0.516, indicating fair diagnostic performance.

The closer the curve follows the left-hand border and then the top border of the ROC space, the more accurate the test. The diagonal line (yellow line) represents a random classifier with an AUC of 0.5. This ROC curves illustrate that both SARC-F and Chair stand test are fair tests for diagnosing sarcopenia when compared with CT scan, which shows superior performance.

Discussion

The comparison of various clinical performance techniques, such as HGS (Hand Grip Strength), chair stand test, 400m walk test and SARC-F scores, is crucial in assessing their efficacy in quantifying muscle mass and detecting sarcopenia. Sarcopenia, characterized by the progressive loss of skeletal muscle mass and strength, is a significant public health concern, particularly in the aging population. Accurate and reliable diagnostic methods are essential for early detection and effective management of this condition.

CT scans provide precise and detailed images that allow for accurate measurement of muscle mass, particularly in the lumbar region (e.g., L3 vertebra). The quantification of muscle area and quality is highly reproducible and less operator-dependent. CT scans can differentiate between muscle tissue and fat infiltration, providing a more comprehensive assessment of muscle quality. It is highly accurate for muscle mass measurement and predictive of mortality and complications, but involves radiation and high costs. In the study by Prado et al, 2008[8] on 325 patients, CT scan based diagnosis of sarcopenia was identified in 15 % of the patients with obesity and hazard ratio of 4.2 as independent predictor of survival. This finding suggests substantial patients with obesity had sarcopenia and it was an independent predictor of poor survival suggesting that CT scan as better predictor for sarcopenia even in obese patients. In the similar study by Montano-Loza et al., in 2012[9] among 112 patients studied, 45 patients (40%) had CT-defined sarcopenia with higher associated mortality with ascites (HR 2.12; P=0.04), encephalopathy (HR 1.99; P=0.04) which supports our finding. So it is considered as a gold standard method to diagnose sarcopenia.

Chair stand test is a simple, quick, and non-invasive method to assess muscle function. It directly measures muscle strength, which is a key component of sarcopenia and functional capacity. It is inexpensive and requires minimal equipment, making it accessible for routine clinical use. Study done by Ryu JY et al. and Kim Miji et al among Korean frailty and aging cohort showed good performance test to identify sarcopenia especially in frail patients.[10,11]

The SARC-F score combines various aspects of sarcopenia, offering a comprehensive assessment. It has a high predictive value for adverse outcomes and is useful for a more holistic evaluation of the patient's muscle health. However, it is more complex and resource-intensive, requiring multiple assessments and specialized knowledge. SARC-F scores show a prevalence of 40-42%. Singla N et al 2024[12] in his study on 100 cirrhosis patients reported that 69% of the patients had a SARC-F score of ≥4. Bahat G et, 2022[13] in his study reported that despite having moderate to high specificity, SARC-F has low to moderate sensitivity in detecting sarcopenia, leading to a significant number of individuals with sarcopenia going unrecognized.

Performance of hand grip strength, chair stand test, 400m walk test and SARC-F questionnaire was compared with CT scan, gold standard tests to diagnose sarcopenia. ROC curve analysis was done. Area under curve of both SARC-F questionnaire and chair stand test were fair compared to CT scan . It signifies that both SARC-F and chair stand test are fair tool for diagnosis of sarcopenia when compared with CT Scan, which shows superior performance. Yu T et al, 2023[14] reported that AUC 0.53 for SARC-F for diagnosing sarcopenia (sensitivity 6.25%, specificity 99.34%). Vogele D et al, 2024[15] done a study on 83 patients and find out that for the detection of sarcopenia, the accuracy was 0.90 ± 0.03, and the AUC was 0.96 ± 0.02.

Conclusion

By systematically comparing and evaluating diagnostic tools for sarcopenia in liver cirrhosis, this study aims to provide a comprehensive overview of existing methodologies and criteria for diagnosing sarcopenia. It seeks to identify the strengths and limitations of various imaging technique and functional tests in assessing muscle mass and function. Each diagnostic tool has significant clinical implications. Studies signifies that when compared with CT Scan, both SARC-F and chair stand test are fair tool for diagnosis of sarcopenia. CT scans provide detailed muscle mass assessment and are strong predictors of adverse outcomes but are costly and resource-intensive. Chair stand test is a simple and cost-effective tool with good prognostic value but limited to muscle strength assessment. The SARC-F score offers a comprehensive evaluation with high predictive value but requires multiple assessments and can be resource-intensive. Choosing the appropriate tool depends on the clinical context, patient needs, and available resources. Combining these methods can offer the most accurate and comprehensive assessment of sarcopenia in cirrhotic patients.

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