HAND GRIP STRENGTH AS A MODALITY FOR SARCOPENIA IN PATIENTS WITH CHRONIC LIVER DISEASE

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ABSTRACT

Objective: To determine the frequency of normal and abnormal handgrip strength in patients with chronic liver disease.

Methodology: This descriptive cross-sectional study has been conducted in the Department of Medicine Khyber Teaching Hospital in Peshawar, Pakistan. Data was collected over six months from October 2020 to April 2021 after the approval by the institutional ethical board. Each participant gave their informed consent before being included in the study. A total of 254 patients were included. Every patient was asked to hold the Hand Dynamometer in the dominant hand as per the set criteria. Three readings were taken with a resting period of ten seconds between each, and the highest reading in kilograms was considered final. Calliper (Lange®) was used to measure the thickness of the Triceps skin fold (TSF) and Adductor pollicis muscle (APMT). The anthropometric value of TSF and abdominal circumference (AC) was taken, and measurements were also made of the mid-arm muscle circumference (MAMC).

Results: Among 254 patients, the mean age was 48 ± 10.59 years while145 (57%) patients were male, while 109 (43%) were female. Moreover, 125 (49%) patients had normal handgrip strength (HGS), while 129 (51%) had abnormal handgrip strength. The mean APMT was 16.5 ± 3.4 mm, the mean MAMC 24.2 ± 3.7 cm, and the mean TSF was 15 ± 13.11 mm.

Conclusion: Abnormal handgrip strength was reported in more than half of patients with chronic liver disease. HGS test is a convenient and cost-effective bedside tool to determine sarcopenia in chronic liver disease patients.

Keywords: Handgrip Strength; Sarcopenia; Chronic Liver Disease.

INTRODUCTION

The liver is a major predictor of one's health and has a pivotal contribution to the wellbeing of humans. Chronic liver diseases (CLD) account for 844 million people around the globe having an annual mortality of two million.[1] The prevalence of chronic liver disease (CLD) induced cirrhosis is 4.5% to 9% worldwide.[2] An estimated 20-25% of cirrhotic patients become decompensated, representing 150,000 to 200,000 patients annually.[3] In Pakistan, over ten million are infected with hepatitis C and around nine million cases are due to hepatitis B.[4]

In chronic liver diseases, poor energy intake due to anorexia, pro-inflammatory state, ascites, and low protein diet leads to malnutrition resulting in fat loss and wasting of muscles (sarcopenia).[5,6] About 20% of those with compensated liver disease and 60% or more of those with decompensated liver disease have malnutrition.[6] A common phenomenon of malnutrition due to chronic diseases is impaired muscle strength. As total body proteins and muscle function are intimately linked, loss of body proteins invariably results in muscle wasting, reflecting deteriorating muscle function and morphology.[7] Reduced muscle strength leads to reduced physical functionality, negatively impacting the patient's recovery from chronic illnesses or surgeries. Body mass index (BMI) and global subjective assessment (GSA) can be used to predict malnutrition.[8]

Sarcopenia on the basis of loss of muscle mass and muscle volume loss (MVL), is closely related to malnutrition in chronic liver diseases and can be estimated by handgrip strength (HGS), Tricep skin fold (TSF), mid-arm muscle circumference (MAMC), adductor pollicis longus tendon (ADPT), DXA Scan (Dual-energy X-ray absorptiometry) or by CT scan.[5,6] MVL and muscle function loss can be indicators of prognosis and quality of life in CLD's patients. HGS is representative of muscle strength of whole-body. It is a convenient, effective, and inexpensive technique of detecting malnutrition and muscle loss (sarcopenia) in CLDs patients, predicting the incidence of significant complications, including mortality.[9]

Ciocerlan et al concluded that lower HGS values were associated with increased severity of hepatic cirrhosis as per CP (Child-Pugh) score and MELD (Model for end-stage liver disease) score.[8] Another study by Gaikwad et al states that a decrease in HGS was significantly associated with the severity of hepatic cirrhosis as per the MELD score. [10] A study done in Moscow shows that one kilogram escalation in the strength of hand-grip was associated with a 6% and 8% decline in mortality of males and females respectively.[11] Hiraoka et al. concluded that a one kg reduction in HGS was associated with 12% increased hepatic complications, and 20% of the patients with Muscle volume loss experienced frequent episodes of fall.[12]

Handgrip strength is a bedside technique with prognostic relevance to muscle loss. The association of reduced HGS and muscle volume loss with adverse consequences such as sarcopenia, malnutrition, and progression of liver failure forms the basis for this study. This study applies simple and economic bedside techniques to calculate the association of handgrip strength and muscle loss in patients of CLD's, which is deficient in most national and international studies. Nationwide, this study may be brainstorming for future research on handgrip strength and muscle loss.

METHODOLOGY

This descriptive cross-sectional research with a convenient consecutive sampling technique was carried out in the Khyber Teaching Hospital's Department of Medicine in Peshawar, Pakistan. After getting approval from the Institutional ethical committee (reference No. 456/ADR/KMC Dated 07-5-2018), all those CLD patients with or without complications were assessed per protocol and variables. The study's participants gave their informed consent before being included. Data collection was started and went from October 2020 to April 2021. The sample size of this study was 254 patients based on a previous study.[8] With a confidence interval of 95% and an error margin of 4%, the sample size for this study was calculated utilizing the WHO calculator for determining sample size in health sciences.

The criteria for inclusion were: age ≥18 years, patients of either gender and chronic hepatitis patients with or without complications. Complications were ascites, hepatic encephalopathy (Grade I, II, III) upper GI bleeding, SBP (Spontaneous Bacterial Peritonitis), and HRS (Hepato-Renal Syndrome). The criteria for exclusion were: patients aged <18 years, patients with Grade IV Hepatic encephalopathy, hepatocellular carcinoma, a history of liver transplantation, and chronic hepatitis patients with a history of poliomyelitis. The SPSS software (IBM Corp., 2011 release) was used to analyze the data. The Windows version of IBM SPSS Statistics is 20.0 (IBM Corporation, Armonk, NY).

The frequency and percentages of categorical variables, such as gender and abnormal HGS, were calculated. Age, APMT, MAMC, TSF, and HGS are numerical variables for which the mean and SD (Standard Deviation) were calculated. Frequency of Normal and abnormal HSG was stratified based on age, gender, socioeconomic status (poor [monthly income <PKR 25,000] and satisfactory [monthly income >PKR 25,000]), and grades of hepatic encephalopathy (Grade I to grade III as per operational definition) to see the effect modification.

Using a dynamometer, handgrip strength (HGS) is the dominant hand's maximum strength of three values in a non-comatose patient. Patients were seated, the elbow was flexed at a 90^{o} angle, and they were encouraged to maximize their efforts to enhance their muscle strength. The highest reading was considered by applying three attempts with 10 seconds resting between each. Cut-off values were applied as per the criteria of JSH (Japan Society of Hepatology) for HGS.[8] Normal HGS was >26 kg for men, while HGS <26kg was considered abnormal. HGS >18 kg was considered normal for women, while HGS < 18 kg was considered abnormal.[8]

Muscle loss was calculated on the anthropometric measurement of any of the following three: Triceps skin fold (TSF) was calculated by finding the midpoint of olecranon and acromion and processes.[8] Skin fats over Tricep were pinched by the Caliper (Lange), and TSF was measured. A value of less than 27mm was considered significant for muscle loss. Mid-arm muscle circumference (MAMC) is the midpoint of the acromion and olecranon processes of the non-dominant arm lying relaxed on the knee with a 90^{o} angle at the elbow joint.[8] Mid-arm muscle circumference (MAMC) and Tricuspid skin fold (TSF) were measured anthropically.

To calculate MAMC, the following formula was used: MAC (cm) - 3.14 (TSF in cm) = MAMC (in cm). MAMC less than 30 cm was taken as significant for muscle volume loss. A value of less than 30 cm was considered significant for muscle loss. Adductor pollicis muscle thickness (APMT) was measured by asking the Patient to keep his dominant arm relaxed at the knee at a 90-degree angle. The adductor muscle was pinched between the thumb and fingers, and three readings had taken. The final reading was considered to be the mean of these three readings.

A value of <26 mm in males and <18 mm in females were considered significant for muscle loss. Hand Dynamometer is a dual-scale readout instrument for testing or screening handgrip strength. The outer scale reads the hand grip in kg (Kilograms) while the inner scale registers the results in lbs (pound mass). It also consists of a hydraulic system having adjustable hand spacing. This study used a Jamar Handgrip Dynamometer, and reading was recorded in Kgs.

RESULTS

The mean age in this study was 48 ± 10.59 years. Forty-six (18%) patients' ages ranged from 18-30 years, and 208(82%) patients were in the age range of 31-60 years. There were 145(57%) male patients and 109(43%) patients were female. The status of poor economics was documented in 180(71%) patients and good economics in 74(29%) patients. Thirty (12%) patients had grade I portosystemic encephalopathy (PSE), 84(33%) grade II, and 140(55%) had grade III PSE (table 1). The mean APMT was 16.5 ± 3.4 mm, the mean MAMC 24.2 ± 3.7 cm, and the mean TSF was 15 ± 13.11 mm. Handgrip strength was analyzed as normal in 125(49%) patients and abnormal in 129(51%) patients (Table 2; Figure 1). Stratification according to age, gender, socioeconomic status, and Hepatic Encephalopathy Grades is shown in Table 2.

Table 1: Baseline Characteristics

Variables	Group	Frequency	Percentage (%)
Age	18-30 years	46	18
	31-60 years	208	82
Gender	Male	145	57
	Female	109	43
Socioeconomic Status	Poor	180	71
	Satisfactory	74	29
Hepatic Encephalopathy Grades	Grade I	30	30
	Grade II	84	33
	Grade III	140	55

Table 2: Stratification According to Age, Gender, Socioeconomic Status, and Hepatic Encephalopathy Grades

Stratification	Subgroup	Handgrip Status	
		Normal	Abnormal
Age	18-30 years	24(52%)	22(48%)
	31-60 years	101(49%)	107(51%)
Gender	Male	70(48%)	75(51%)
	Female	55(51%)	54(49%)
Socioeconomic Status	Poor	87(48%)	93(52%)
	satisfactory	38(51%)	36(49%)
Hepatic Encephalopathy Grades	Grade I	15(50%)	15(50%)
	Grade II	41(49%)	43(51%)
	Grade III	69(49%)	71(51%)

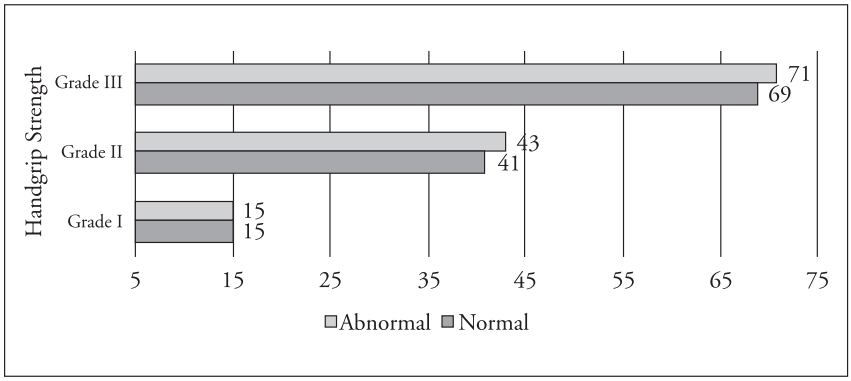

Figure 1: Hand grip status with relation to grades of hepatic encephalopathy

DISCUSSION

Patients suffering from chronic liver diseases have profound nutritional deficiencies. This problem is further intensified in our society, where many taboos regarding dietary advice for CLD patients play their worst roles. The ultimate consequence is extreme malnutrition and sarcopenia.[1] Our study documented this finding of sarcopenia, as evidenced by abnormal HGS in 51% of patients. The HGS is a simple, convenient bedside clinical technique to determine sarcopenia in CLD Patients.

Depletion of muscles was documented in 49.1% cases by Kotoh Y et al.[13] Male and female patients had median handgrip strengths of 28.1 kg and 15.2 kg, correspondingly. Twenty-five (47.2%) patients had low HGS and 15 (28.3%) patients had sarcopenia, as defined by criteria of JSH.

Oksuzyan et al. reported that age-standardized HGS was two kilograms and one kilogram lower in male individuals of Russian origin in comparison to patients from Denmark and England. [11] Female participants' age-standardized HGS in Russia was 1.9 kg and 1.6 kg lower than it was in Denmark and England, respectively. A one-kg increase in HGS was linked to a 4% (hazard ratio [HR] = 0.96) reduction in mortality among males and a 10% (HR = 0.90) reduction in mortality among females in Moscow. A one-kg rise in HGS, however, was linked to a 6% (HR = 0.94) and an 8% (HR = 0.92) drop in mortality among Danish males and females, respectively, as well as a 2% (HR = 0.98) and a 3% (HR = 0.97) reduction in mortality among English males and females, respectively.[11]

Handgrip strength is a valuable clinical criterion for determining malnutrition and sarcopenia in patients of CLD. The findings of our study are also complimented by research work by Hiraoka et al.[12] Hundred consecutive CLD patients without dementia participated in their study. Thirty-two patients had chronic hepatitis and 49 had liver cirrhosis in Class-A of Child-Pugh, 17 Child-Pugh Class-B, and 2 Child-Pugh Class-C categorization.[12] According to this study, 12.0% of the participants had a history of falls, including 8 (26.7%) of the 30 participants who had HGS decline and 4 (5.7%) of the 70 participants who did not (P=0.006). In respect to falling, 69.0 years of age was the cutoff value. In individuals with a history of falls compared to those without (16.7% vs. 2.3% and p=0.018), the fall was reported more frequently during hospitalization. Similarly, our study findings are comparable to that of Sharma et al.[14]

The convenience and impact of HGS in sarcopenia and malnutrition in CLD is well highlighted in our study, just like studies conducted by Sharma et al[14] and Luengpradidgun et al[15], Lovesley et al[16], Bunchorntavakul et al[17] and Aby et al .[18] HGS is a reliable, non-invasive, cost-effective bedside clinical tool and should be utilized to determine malnutrition and sarcopenia in cirrhotic and CLD patients. The significance of the HGS test is further increased in resource-limited countries like Pakistan.

The major shortcoming of this research is the cognitive status of these patients, especially in grade III hepatic encephalopathy. The best of three findings in non-comatose patients on HGS test was taken as the final reading to minimize this confounder. Moreover, minimental score of ≥ 20 was utilized in such cases to minimize the confounder. However, it is recommended to conduct future research only on grade I and II hepatic encephalopathy patients for generalization and validation. Other limitations are: single-centered, cross-sectional, and having a limited number of enrolled patients. Extensive multicenter randomized cohort studies are required to generalize and validate these findings.

CONCLUSION

Abnormal handgrip strength was documented in more than half of the patients with chronic liver disease. HGS test is a simple, convenient, and cost-effective bedside tool to determine malnutrition and sarcopenia in chronic liver disease patients.

REFERENCES

1. Marcellin P, Kutala BK. Liver diseases: A major, neglected global public health problem requiring urgent actions and large-scale screening. Liver Int. 2018;38 Suppl 1:2-6. DOI:10.1111/liv.13682.
2. Liu Z, Mao X, Jin L, Zhang T, Chen X. Global burden of liver cancer and cirrhosis among children, adolescents, and young adults. Dig Liver Dis. 2020;52(2):240-3. DOI:10.1016/j.dld.2019.11.001.
3. Zaghla H, Omer E. The Incidence of Myocardial Diastolic Dysfunction in Patients with Decompensated Liver Disease. World J Cardiovasc Dis. 2019;9:404-18. DOI:10.4236/wjcd.2019.96036.
4. Mehmood S, Raza H, Abid F, Saeed N, Rehman HM, Javed S, et al. National prevalence rate of hepatitis B and C in Pakistan and its risk factors. J Public Health. 2020;28:751-64. DOI: 10.1007/s10389-019-01081-5.
5. Augusti L, Franzoni LC, Santos LA, Lima TB, letsugu MV, Koga KH, et al. Lower values of handgrip strength and adductor pollicis muscle thickness are associated with hepatic encephalopathy manifestations in cirrhotic patients. Metab Brain Dis. 2016;31(4):909-15. DOI:10.1007/s11011-016-9828-8.
6. Kuftinec G, Ram Bhamidimarri K, Pearlman M. Malnutrition in Cirrhosis: Frequent but Overlooked. Liver Transpl. 2019;25(12):1743-4. DOI:10.1002/lt.25660.
7. McNicholl T, Curtis L, Dubin JA, Mourtzakis M, Nasser R, Laporte M, et al. Handgrip strength predicts length of stay and quality of life in and out of hospital. Clin Nutr. 2020;39(8):2501-9. DOI:10.1016/j.clnu.2019.11.006.
8. Ciocîrlan M, Cazan AR, Barbu M, Mănuc M, Diculescu M, Ciocîrlan M. Subjective Global Assessment and Handgrip Strength as Predictive Factors in Patients with Liver Cirrhosis. Gastroenterol Res Pract. 2017;2017:8348390. DOI:10.1155/2017/8348390.
9. Yoo JI, Choi H, Ha YC. Mean Hand Grip Strength and Cut-off Value for Sarcopenia in Korean Adults Using KNHANES VI. J Korean Med Sci. 2017;32(5):868-72. DOI:10.3346/jkms.2017.32.5.868.
10. Gaikwad NR, Gupta SJ, Samarth AR, Sankalecha TH. Handgrip dynamometry: a surrogate marker of malnutrition to predict the prognosis in alcoholic liver disease. Ann Gastroenterol. 2016;29(4):509-14. DOI:10.20524/aog.2016.0049.
11. Oksuzyan A, Demakakos P, Shkolnikova M, Thinggaard M, Vaupel JW, Christensen K, et al. Handgrip strength and its prognostic value for mortality in Moscow, Denmark, and England. PLoS One. 2017;12(9):e0182684. DOI: 10.1371/journal.pone.0182684.
12. Hiraoka A, Tamura R, Oka M, Izumoto H, Ueki H, Tsuruta M, et al. Prediction of risk of falls based on handgrip strength in chronic liver disease patients living independently. Hepatol Res. 2019;49(7):823-9. DOI:10.1111/hepr.13322.
13. Kotoh Y, Saeki I, Yamasaki T, Sasaki R, Tanabe N, Oono T, et al. Effect of handgrip strength on clinical outcomes of patients with hepatocellular carcino-

ma treated with lenvatinib. Appl Sci. 2020;10(16):5403.
14. Sharma P, Rauf A, Matin A, Agarwal R, Tyagi P, Arora A. Handgrip Strength as an Important Bed Side Tool to Assess Malnutrition in Patient with Liver Disease. J Clin Exp Hepatol. 2017;7(1):16-22.
15. Luengpradidgun L, Chamroonkul N, Sripongpun P, Kaewdech A, Tanutit P, Ina N, et al. Utility of handgrip strength (HGS) and bioelectrical impedance analysis (BIA) in the diagnosis of sarcopenia in cirrhotic patients. BMC Gastroenterol. 2022;22(1):159. DOI:10.1186/s12876-022-02236-7.
16. Lovesley D, John S, Khakhar A, Ramakrishnan B, Ramamurthy A. Handgrip strength: A simple and effective tool to predict mortality after liver transplantation. Clin Nutr ESPEN. 2022;51:323-35. DOI:10.1016/j.clnesp.2022.08.006.
17. Bunchorntavakul C, Reddy KR. Review article: malnutrition/sarcopenia and frailty in patients with cirrhosis. Aliment Pharmacol Ther. 2020;51(1):64-77. DOI:10.1111/apt.15571
18. Aby ES, Saab S. Frailty, Sarcopenia, and Malnutrition in Cirrhotic Patients. Clin Liver Dis. 2019;23(4):589-605. DOI:10.1016/j.cld.2019.06.001.

Author's Contribution

IH conceived the idea, helped in data collection and supervised the study, and checked the manuscript for technical issues. AU, MU, and AM helped in data collection and manuscript writing. LH helped in data analysis and write-up of the manuscript. Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest

Authors declared no conflict of interest

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None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.