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Handgrip dynamometer: A useful tool for nutritional assessment of alcoholic liver disease

Vikas Pandey, Pathik Parikh, Jignesh Patel, Prabha Sawant

ABSTRACT

Aims: Proper nutritional assessment of patients who have liver diseases carries its own challenges. Primary objectives of the study were to assess the prevalence of nutritional deficiency in alcoholic liver disease (ALD) with special reference to handgrip (HG) strength. Methods: The prospective case control study evaluated nutritional status by anthropometry parameters including BMI, triceps skinfold thickness (TSFT) and midarm muscle circumference (MAC) and laboratory measurements for hemoglobin, and albumin. Skeletal muscle function was assessed by measuring HG using novel handgrip dynamometer. Results: The study included 75 male patients of ALD and age matched 75 male controls. Among 75 patients, 24 were in CTP class A, 35 in CTP B and 16 in CTP class C. Mean alcohol consumption was 70.3 grams per day for 14.8 years. Mean BMI in cases group (22.2±4.84) and controls (23.1±4.03) were statistically not significant. TSSF and MAC were higher in control group (17.5±4.4 and 25.85±3.07 respectively) as compared to cases (12.1±5.6 and 22.58±4.37 respectively) (p <0.05) Hemoglobin level did not correlated well with malnutrition between two groups. Serum albumin level was significantly low (2.49±0.66) as compared to controls (4.1±0.31) (low synthesis) Patients had significantly less right (25.9 versus 41; p < 0.01) and left (23.02 versus 40.18; p < 0.01) HGS than controls. Among the cases, Handgrip measurement also correlated well with disease severity with CTP class. Conclusion: HG seems to be a simple, inexpensive, and effective method to detect protein-calorie malnutrition in patients with ALD.

Keywords: Alcoholic liver disease, Child-Turcotte-Pugh class, Hand grip dynamometry, Protein-calorie malnutrition

Vikas Pandey[1], Pathik Parikh[1], Jignesh Patel[1], Prabha Sawant[1]
Affiliations: [1]Department of Gastroenterology, Lokmanya Tilak Municipal Medical College and General Hospital
Corresponding Author: Dr. Vikas Pandey, Mumbai, Maharashtra, India, 400084; Ph: 09619265036; E-mail: reenaupadhyay66@gmail.com

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INTRODUCTION

An association of malnutrition and chronic liver disease is well established [1, 2]. Protein calorie malnutrition (PCM), a common finding in patients with chronic liver disease, has been found to be inversely correlated with survival in patients with alcoholic liver disease (ALD) [3]. Prevalence of PCM varies between 29% and 100% depending on whether ALD is well compensated or there is association of acute alcoholic hepatitis [4, 5]. Improved nutritional status has been shown to be associated with greater food intake and improved survival [6]. The association of PCM with adverse outcomes has increased the importance of

identifying reliable and cost-effective methods for assessing the nutritional status of patients with ALD. Assessment of nutritional status in cirrhotics is difficult. Many of the commonly used markers like weight is not a reliable indicator of malnutrition, because of the presence of ascites and edema which increases the measured weight, whereas lean body mass which actually is reduced. Concentrations of albumin and prealbumin could be low because of low levels of synthesis, rather than because of poor nutritional status [7, 8]. A commonly used method of anthropometric measurement includes triceps skinfold thickness (TSFT) and midarm muscle circumference (MAC) which assess fat storage and skeletal muscle mass respectively [9]. There is a poor interobserver reproducibility and overestimation of these values because of the third spacing of fluid as well because of the stretchability of the elastic measuring tapes used. This is the first study establishing reference values for hand grip strength from a tertiary care hospital in India. Primary objectives of this study was to assess the prevalence of nutritional deficiency in ALD by anthropometric criteria using BMI, MAC, TSFT, handgrip strength (HGS) and laboratory criteria using hemoglobin and serum albumin. Secondary objectives were to correlate the nutritional status and severity of ALD with Child-Turcotte-Pugh (CTP) class.

MATERIALS AND METHODS

The present prospective case control study was undertaken in the department of gastroenterology of a large public hospital of Mumbai. Seventy-five (all males) ALD patients presented to our department from January 2010 to December 2010 and seventy-five age and sex matched healthy controls were studied. Ethical Committee of the hospital approved the study (IRB No. IEC/25/10) and all human participants had given written informed consent. A total of 150 patients, 75 men with ALD (alcohol consumption >40 g/d for 10 years) and age and sex matched 75 controls were included in the study. Patients with Hepatitis (B and C), and other liver disease, hepatic encephalopathy, overt diarrhea, renal disease, diabetes mellitus, or malignant diseases were excluded.

Anthropometry

The measurements were body weight, BMI, TSFT and MAC. A single observer took all the readings. TSFT (mm) was measured by a Harpenden skinfold caliper (Figure 1) (Baseline Evaluation instruments, Fabrication Enterprises, U.S.A.) at the midpoint between the acromion and the olecranon of the non-dominant arm. To minimize the intraoperator variability, the average of three consecutive measurements was recorded. MAC (cm) was measured with a tape at the same site of TSFT. Percentage less than 25th percentile of normal taken as abnormal [10].

Laboratory measurements

Laboratory data were measured by established standard laboratory methods. These included values for hemoglobin, albumin and prothrombin time.

Handgrip dynamometer

Skeletal muscle function was assessed by measuring grip strength. It was measured on both arms with the novel portable hydraulic handgrip dynamometer (Figure 2) (Baseline Evaluation instruments, Fabrication Enterprises, U.S.A.). Subjects were instructed on its use, and became familiar with the apparatus by using the dominant hand. Then, with the non-dominant hand, subjects used the two shafts located in the lower part of the dynamometer. Three measurements were taken and the highest reading was considered [11].

Statistical Analysis

Results were expressed in mean±SD. Continuous variables were compared with Student's *t*-test or the Mann-Whitney test. Nonparametric statistical tests were used to avoid making assumptions about the distribution of data. The level of significance used was 5%. To correlate malnutrition with CTP class severity, Kruskal-Wallis test

Figure 1: Harpenden calipers

Figure 2: Hydraulic handgrip dynamometer.

was used. Analysis was done by SPSS software version 18.

RESULTS

A total of 150 age matched male patients, 75 of ALD and 75 controls were included in the study. Patient's baseline characteristics are elaborated in Table 1. Among 75 patients, 24 were in CTP class A, 35 and 16 were in CTP B and CTP class C, respectively.

Mean alcohol consumption was 70.3 grams per day for 14.8 years. (Volume of drinks) x (Alcohol contents of drinks) x 0.789 = grams of alcohol consumed. Out of 75 patients; the most common presentation (%) of ALD was jaundice (57) and ascites (55). Other symptoms were hematemesis (44), history of altered sensorium (9), abdominal pain (6.6) and fever (5.3). On examination 32(43%) patients had pedal oedema. Signs of malnutrition in the form of glossitis and stomatitis were found in only 7 (9%) patients. Results of anthropometric and biochemical parameters of both groups are given in Table 2. Mean BMI in case group was 22.2±4.84 while 23.1±4.03 in controls but the difference was statistically not significant. TSFT was higher in control group (17.5±4.4) as compared to cases (12.1±5.6) which was statistically significant (P <0.05). MAC was also higher in control group (25.85±3.07) as compared to cases (22.58 ±4.37) which was statistically significant. Hemoglobin did not correlate well with malnutrition between the two groups. Though serum albumin level was significantly low in case group (2.49±0.66) as compared to controls (4.1±0.31), the concentrations of albumin could be low because of low levels of synthesis, rather than because of poor nutritional status. Patients had significantly less right (25.9 vs 41; p < 0.01) and left (23.02 vs 40.18; p < 0.01) handgrip strength values than controls (Table 3). Amongst the cases, hand grip measurement also correlated well with disease severity when compared with CTP class which was statistically significant by Kruskal-Wallis Test (Table 4 and Figure 3).

Table 1: Figure showing the baseline characteristics of cases and controls

Patients	Cases (mean±SD)	Control (mean±SD)	*p*-value
Age	45.40±4.53	46.86±5.02	NS
Sex(M/F)	75/0	75/0	NS
Alcohol intake	>70gm for >10yrs	Non alcoholic	NA
CTP Class (A/B/C)	24/35/16	NA	NA

Abbreviations: p<0.05 was considered significant, Student's t test was for continuous data and Chi Square test was used for discrete variables. CTP, Child Trucott Pugh scoew

Table 2: Comparison of biochemical parameters in cases and controls.

Parameter(mean±SD)	Cases (mean±SD)	Control (mean±SD)	*p*-value
BMI (kg/m^2)	22±4.84	23.1±4.03	NS
TSFT (mm)	12±5.6	17.5±4.4	<0.05
MAC (cm)	22.58±4.37	25.85±3.07	<0.05
Hb (gm/dl)	9.8±0.56	11.4±0.24	NS
Albumin(gm/dl)	2.49±0.66	4.1±0.31	<0.05

Abbreviations: p<0.5 was considered significant. Students's t test was for continuous data Chi Square test was used for discrete variables. BMI, Body Mass Index, TSFT, Triceps Skin Fold Thickness. MAC, Mid arm circumference.

Table 3: Hand Grip Strength of cases and controls.

Hand Grip (mean)	Cases	Control	*p*-value
Right (kg)	25.9	41	<0.001*
Left (kg)	23.02	40.18	<0.001*

Abbreviations: Statistical analysis – Mann Whitney test.(*)p value highly significant

Table 4: Hand Grip Strength according to child class.

CTP Class (n=75)	Hand Grip Rt (mean)(kg)	Hand Grip Lt (mean)(kg)
A(24)	30.3	29.5
B(35)	24.1	21.4
C(16)	20.2	18.6

DISCUSSION

Proper nutritional assessment of patients who have liver disease carries its own challenges [12]. There is no gold standard, perhaps because alcoholism and liver disease can influence the evaluation [13]. Cirrhosis is a catabolic disease, possibly associated with hypermetabolism [14,

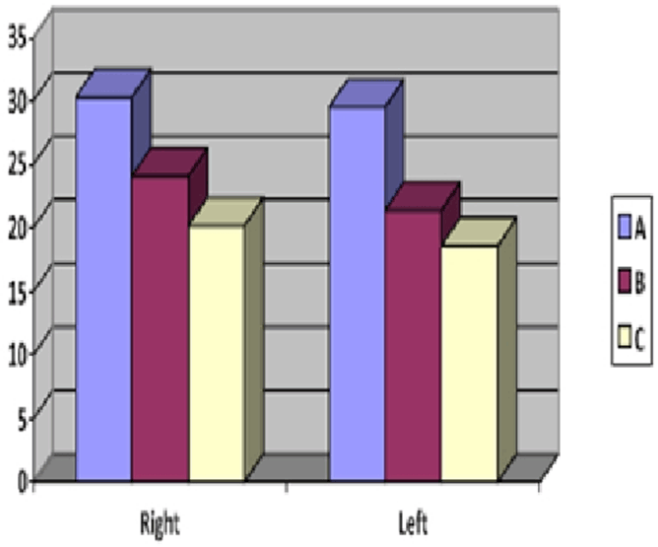

Figure 3: Comparison of hand grip strength according to child class.

15]. This picture can be changed by early detection of PCM and timely nutritional intervention [13, 14]. In cirrhotic patients when estimation of visceral proteins and immunologic status is done, it leads to a high PCM rate [16]. Analysis of visceral proteins, even the most sophisticated ones such as albumin, prealbumin and retinol-binding protein are inaccurate as these factors are directly related to liver function hence they result in a higher percentage of PCM. Moreover, fluid retention can influence anthropometry [7, 8]. In our study, we also found the use of visceral proteins and anthropometry in cirrhotic patient was inappropriate to assess nutritional status. Albumin was significantly lower in cases as compared to control group, but we were not able to separate the impact of malnutrition from the effects of liver disease on biochemical and hematologic parameters. From this prospective study we found that in patients with ALD presence of one or more abnormalities of nutritional status is bound to be present. Only triceps skin fold thickness, muscle arm circumference and handgrip strength identified patients with malnutrition. However, these parameters are also operator dependent and not patient dependent and hence an element of interobserver variability as a result of elastic stretchability of measuring tapes which corrupts the mid arm circumference result. Secondly, subcutaneous tissue edema also interferes with the calipers measurement of triceps skin fold thickness. From a clinician's perspective, these results suggest that using handgrip dynamometry might be best for screening of one of the most important manifestations of malnutrition. As it a non-invasive patient dependent and easy to operate tool, it is easily accepted with reliable and reproducible results. Muscle wasting is a well-known complication of liver cirrhosis in patients referred for medical care. There are few studies of motor performance and functional disability in patients with alcoholic liver cirrhosis. Alcohol can induce changes in muscle function by inhibition of muscle membrane channels and pumps, as well as disturbances of protein synthesis and mitochondrial function [17]. Evaluation of muscle activity is considered a good nutritional index, and measuring non-dominant handgrip strength can correlate with level of disease progression.

Handgrip strength (HGS) is a functional method to assess nutritional status. Handgrip strength (HGS) reflects changes that occur in nobler muscle groups, such as the diaphragm, even in the earliest PCM phases and it is probably not directly influenced by liver disease [18, 19]. These properties of functional assessment could make it very suitable for evaluating patients with cirrhosis. In our study, handgrip strength was significantly lower in cases as compared to control group ($p < 0.01$). Mean value of HGS in patients was below 30 kg, and also correlated with CTP class. We agree with Jeejeebhoy et al. [18] when they state that the effects of PCM cannot be measured only by a loss of muscle mass but also by its functional changes. In addition, Figueiredo et al. [19] prospectively studied 53 cirrhotic patients before and after liver transplantation and showed association of lower preoperative HGS (but not anthropometry or Subjective Global Assessment) with longer stays in the intensive care unit and an increased likelihood of infections after transplantation. Handgrip dynamometer as screening tool for nutritional assessment of proposed criteria of less than 30 kg had sensitivity of 0.89, specificity of 0.69 and accuracy of 0.74.[20] We consider HG a better and sensible index for nutritional assessment because of its good correlation with the severity of the disease and timely nutritional intervention can be done at an early stage. The highlight of the study is

It is a first prospective study using the hydraulic handgrip dynamometer to evaluate nutritional status in alcoholic liver disease. Studies using handgrip dynamometer to evaluate nutritional status in chronic kidney diseases are available [21] but values of handgrip strength in alcoholic liver disease has not been established.

Limitations

The limitations of the present study are smaller number of patients, and limited biochemical parameters studied to assess malnutrition. The interobserver variation in MAC and triceps skin fold thickness cannot be ruled out.

CONCLUSION

Handgrip is a simple, inexpensive, and effective method to detect protein calorie malnutrition (PCM) in patients with alcoholic liver disease (ALD). Malnutrition can occur when conventional indices of nutritional status are unchanged. Additional studies are needed to determine the impact of screening for protein-calorie malnutrition followed by initiation of nutritional therapy on outcome of patients with ALD

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Author Contributions

Vikas Pandey – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Pathik Parikh – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published
Jignesh Patel– Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published
Prabha Sawant – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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REFERENCES

1. Lautz HU, Selberg O, Körber J, Bürger M, Müller MJ. Protein-calorie malnutrition in liver cirrhosis. Clin Investig 1992 Jun;70(6):478–86.
2. Mendenhall CL, Moritz TE, Roselle GA, et al. Protein energy malnutrition in severe alcoholic hepatitis: diagnosis and response to treatment. The VA Cooperative Study Group #275. JPEN J Parenter Enteral Nutr 1995 Jul-Aug;19(4):258–65.
3. Mendenhall CL, Tosch T, Weesner RE, et al. VA cooperative study on alcoholic hepatitis. II: Prognostic significance of protein-calorie malnutrition. Am J Clin Nutr 1986 Feb;43(2):213–8.
4. Morgan MY, Madden AM. The assessment of body composition in patients with cirrhosis. Eur J Nucl Med 1996 Feb;23(2):213–25.
5. Mendenhall CL, Anderson S, Weesner RE, Goldberg SJ, Crolic KA. Protein-calorie malnutrition associated with alcoholic hepatitis. Veterans Administration Cooperative Study Group on Alcoholic Hepatitis. Am J Med 1984 Feb;76(2):211–22.
6. Alberino F, Gatta A, Amodio P, et al. Nutrition and survival in patients with liver cirrhosis. Nutrition 2001 Jun;17(6):445–50.
7. Merli M, Romiti A, Riggio O, Capocaccia L. Optimal nutritional indexes in chronic liver disease. JPEN J Parenter Enteral Nutr 1987 Sep-Oct;11(5 Suppl):130S–134S.
8. Morgan MY. Nutritional aspects of liver and biliary disease. In: McIntyre N, Benhamou JP, Bircher J, Rizzetto M, Rodes J eds. Oxford textbook of clinical hepatology. Oxford, United Kingdom: Oxford Medical Publications; 1991. P. 1339–88.
9. Blackburn GL, Bistrian BR, Maini BS, Schlamm HT, Smith MF. Nutritional and metabolic assessment of the hospitalized patient. JPEN J Parenter Enteral Nutr 1977;1(1):11–22.
10. Jelliffe DB. Assessment of nutritional status of the community. Geneva: World Health Organization; 1966. [Available at: http://apps.who.int/iris/handle/10665/41780]
11. Álvares-da-Silva MR, Silveira TR. Non-dominant handgrip strength study in healthy individuals. Determination of reference values to be used in dynamometry. GED 1998;17:203–6.
12. Matos C, Porayko MK, Francisco-Ziller N, DiCecco S. Nutrition and chronic liver disease. J Clin Gastroenterol 2002 Nov-Dec;35(5):391–7.
13. McCullough AJ. Malnutrition in liver disease. Liver Transpl 2000 Jul;6(4 Suppl 1):S85–96.
14. Donaghy A. Issues of malnutrition and bone disease in patients with cirrhosis. J Gastroenterol Hepatol 2002 Apr;17(4):462–6.
15. Müller MJ, Böttcher J, Selberg O, et al. Hypermetabolism in clinically stable patients with liver cirrhosis. Am J Clin Nutr 1999 Jun;69(6):1194–201.
16. DiCecco SR, Wieners EJ, Wiesner RH, Southorn PA, Plevak DJ, Krom RA. Assessment of nutritional status of patients with end-stage liver disease undergoing liver transplantation. Mayo Clin Proc 1989 Jan;64(1):95–102.
17. Fernández-Solà J, Junyent JM, Urbano-Márquez A. Alcoholic myopathies. Curr Opin Neurol 1996 Oct;9(5):400–5.
18. Jeejeebhoy KN, Detsky AS, Baker JP. Assessment of nutritional status. JPEN J Parenter Enteral Nutr 1990 Sep-Oct;14(5 Suppl):193S–196S.
19. Hirsch S, Bunout D, de la Maza P, et al. Controlled trial on nutrition supplementation in outpatients with symptomatic alcoholic cirrhosis. JPEN J Parenter Enteral Nutr 1993 Mar-Apr;17(2):119–24.
20. Figueiredo F, Dickson ER, Pasha T, et al. Impact of nutritional status on outcomes after liver transplantation. Transplantation 2000 Nov 15;70(9):1347–52.
21. Carrero JJ, Chmielewski M, Axelsson J, et al. Muscle atrophy, inflammation and clinical outcome in incident and prevalent dialysis patients. Clin Nutr 2008 Aug;27(4):557–64.