Original Article

Relevance of the Mini Nutritional Assessment in cirrhotic liver disease patients

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Background and Objectives: Malnutrition is an important prognostic factor for patients with liver disease and a novel nutritional assessment tool is required for these patients. The aim of this study was to validate the Mini Nutritional Assessment (MNA) as a nutritional screening tool for patients with liver disease, by comparing MNA scores with other nutrition-related parameters. **Methods and Study Design:** Patients who were hospitalized at the gastroenterology division of Kyushu and Beppu Medical Center were enrolled. The study included 77 patients with liver disease (male/female, 46/31; mean±SD age, 68.5±10.7 years; liver cirrhosis, 64.9%; liver cancer, 61.0%). Correlations of MNA score at hospital admission with anthropometric parameters and blood test data were evaluated. **Results:** In patients with liver disease, MNA scores demonstrated that 18 (23.4%) had normal nutritional status, 41 (53.2%) were at risk of malnutrition, and 18 (23.4%) were malnourished, indicating that up to 76.6% of the liver disease group were malnourished. Especially, patients with liver cirrhosis had lower scores of nutritional markers and MNA. The MNA score in liver cirrhotic patients correlated with the following parameters: % arm circumference, % triceps skinfolds, ratio of % maximum grasp strength and arm circumference, maximum grasp strength, arm muscle circumference, calf circumference, serum albumin levels, the controlling nutritional status score, and Onodera's prognostic index, while patients without liver cirrhosis did not show such correlation. **Conclusions:** MNA scores correlated with nutrition-related data in patients with liver cirrhosis. The MNA is an appropriate tool for nutritional screening assessment in these cirrhotic patients of any etiology.

Key Words: liver cirrhosis, nutritional screening, malnutrition, body composition, MNA short-form

INTRODUCTION

Patients with malnutrition are identified by nutritional screening and assessment tools, of which the most widely used is the Subjective Global Assessment (SGA).[1,2] However, the accuracy and reproducibility of nutritional status based on the SGA is variable, and depends on the skill and experience of the physician.[3] In patients with liver cirrhosis, the SGA has been found to be insufficient for the identification of malnourished cases compared with other nutrition assessment methods.[4,5] Taniguchi et al reported that the effective screening rate of the SGA was 82.6% in biliary-pancreatic and gastrointestinal disease, whereas it was only 34.5% in liver disease (liver cirrhosis: 83 out of 86 patients), and it was concluded that the SGA is inappropriate for nutritional status screening in patients with liver disease.[6] Thus, a reliable nutritional assessment tool is urgently required for this patient population. The Mini Nutritional Assessment (MNA) is widely used for nutritional screening in the elderly,[7] particularly for elderly patients in Japan.[8] It is also suitable for determining the nutritional status in other patient populations, including orthopaedics,[9,10] chronic obstructive pulmonary disease,[11] and peritoneal dialysis.[12] Furthermore, the

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short-form MNA (MNA-SF), comprising the first six items on the MNA, was predictive of death in hospitalized young and middle-aged adults,[13] suggesting that this score is clinically relevant in both younger and older adults. In patients with liver cancer aged between 30 and 91 years, there was a significant correlation between MNA and quality of life (QOL) scores, highlighting the potential of using the MNA in adults with liver disease.[14] However, the relationship between the MNA and other nutritional parameters has not been investigated. The aim of this study was to evaluate the usefulness of the MNA in patients with liver disease, by analyzing the relationship between nutritional screening assessments based on the MNA and other nutrition-related parameters.

METHODS

Patients

The study enrolled 77 patients with liver disease who were hospitalized at the gastroenterology divisions of the Kyushu Medical Center (Fukuoka, Japan) and Beppu Medical Center (Oita, Japan) between July 2012 and September 2013. The study was approved by the ethics committees of all participating institutions (the project identification code, H24-2; the date of July 23, 2012 / 13-02; the date of approval, March 13, 2013). In accordance with the Declaration of Helsinki, all patients provided written or oral informed consent prior to enrollment.

Mini Nutritional Assessment (MNA)

The MNA consists of 6 preliminary questions (up to 14 points) followed by 12 questions (up to 16 points), with a total score of up to 30 points. Cases are defined as "malnourished" (0–16 points), "at risk of malnutrition" (17–23.5 points), and "normal nutritional status" (24–30 points). In this study, the item "body weight loss in the last 3 months" was changed to "body weight gain or loss in the last 3 months". This was because liver disease is often accompanied by edema and ascites, and body weight tends to increase with poorer health status. At admission, all patients underwent nutritional status screening conducted by registered dietitians with training in the MNA.

Anthropometric parameters

Anthropometric measures were taken by registered, trained dietitians. Height, body weight, arm circumference (AC), triceps skinfolds (TSF), calf circumference (CC), and grasp strength were measured using specialized instruments: a tape measure, caliber, and hand dynamometer. AC was measured at the central point of the line connecting the acromion and ulna olecranon. TSF was measured by pinching the fat layer of the inferior side of the upper arm longitudinally, 1 cm to the central side of the central point used for AC, with a caliber. Body mass index (BMI) was calculated by the height and body weight of patients. Arm muscle circumference (AMC) was calculated using AC and TSF, according to the equation: AMC (cm) = AC (cm) − 0.314 × TSF (mm).[15] CC was assessed by bending the knee and ankle of each leg to a 90º angle, and measuring the circumference at the point with the largest diameter. Grasp strength was measured twice each on the left and right hands, and the highest value was used for analysis.

Blood serum chemistry

Blood serum samples were collected after 12 h fasting and analyzed at each facility. Serum albumin level, controlling nutritional status (CONUT) score,[16,17] and Onodera's prognostic index (PNI)[17,18] were measured as nutrition-related parameters, and C-reactive protein (CRP) as an inflammatory parameter.

Statistical analysis

Statistical analyses were performed with JMP software version 12.1 (SAS Institute, Cary, NA, USA). Data are expressed as the means±standard deviation (SD). A t-test was used for comparisons between two groups. The chi-square test was used for qualitative variables. The Pearson product-moment coefficient was used to analyze between-group correlations. One-way analysis of variance was used for comparisons among more than two groups, followed by Tukey's honest significant difference test for significant results. $p<0.05$ was considered to denote statistical significance.

RESULTS

Among the 77 patients with liver disease, there were 46 males and 31 females, with a mean age of 68.5±10.7 years. The clinical diagnoses were: chronic hepatitis C (51 patients), nonB-nonC hepatitis (11 patients), alcoholic hepatitis (8 patients), and chronic hepatitis B (7 patients). Liver cirrhosis and active hepatocellular carcinoma were present in 50 (64.9%) and 47 (61.0%) patients, respectively (Table 1).

Results of the MNA in patients with liver disease showed that 18 (23.4%) were normal, 41 (53.2%) were at risk of malnutrition, and 18 (23.4%) were malnourished, indicating that up to 76.6% of the liver disease was malnourished. When the mean body weight, BMI, AC, TSF, AMC, and CC of the liver disease were corrected against the median values for gender and age in the new Japanese anthropometric reference data 2001,[19] the results were within the standard range (Table 1). When maximum grasp strength was corrected against normative values from the physical fitness and exercise capacity survey 2011 (Japanese Ministry of Education, Culture, Sports, Science and Technology),[20] the mean value was low (75.0±23.0%) in patients with liver disease. Mean values for serum albumin, CONUT score, and Onodera's PNI were also low (Table 1). When patients with and without liver cirrhosis were compared, patients with liver cirrhosis had significantly higher chance of complications due to liver cirrhosis, diabetes development, etiology, and Child-pugh score. These patients also had a significantly lower nutritional status by MNA, low MNA score, Albumin, CONUT score, and Onodera's PNI. However, no difference in anthropometric measurements was found between these two groups. Additionally, nutritional status by MNA (p= 0.09) and MNA score showed no difference by the etiology of liver cirrhosis (chronic hepatitis C: 18.7±5.3 points vs. nonB-nonC hepatitis: 20.7±4.8 points vs. alcoholic hepatitis: 23.1±2.3 points vs. chronic hepatitis B: 21.9±2.2, p=0.053.) The correlation between MNA screening scores (normal nutritional status, at risk of mal-

Table 1. Characteristics of the cases and nutritional parameters in this study

	Total (n=77)		Liver cirrhosis (n=50)		Without liver cirrhosis (n=27)	
Sex, men/women	46/31		27/23		19/8	
Age, years	68.5±10.7		67.6±9.5		70.0±12.7	
Hypertension, yes/no (%)	27/50	(35.1)	18/32	(36.0)	9/18	(33.3)
Diabetes mellitus, yes/no (%)	35/42	(45.5)	27/23*	(54.0)	8/19	(29.6)
Chronic kidney disease, yes/no (%)	9/68	(11.7)	6/44	(12.0)	3/24	(11.1)
Heart disease, yes/no (%)	10/67	(13.0)	6/44	(12.0)	4/23	(14.8)
Cancer, yes/no (%)	47/30	(61.0)	32/18	(64.0)	15/12	(55.6)
Liver cirrhosis, yes/no (%)	50/27	(64.9)	50/0**	(100)	0/27	(0.0)
Etiology, Alc/HBV/HCV/nonBnonC	8/7/51/11		6/4/38/2**		2/3/13/6	
Child - Pugh score, A/B/C	42/22/13		15/22/13**		27/0/0	
Child - Pugh points, points	7.0±2.2		8.0±2.2**		5.2±0.3	
Ascites, yes/no (%)	20/57	(26.0)	19/31**	(38.0)	1/ 26	(3.7)
Hepatic encephalopathy, yes/no (%)	10/67	(13.0)	9/41	(18.0)	1/ 26	(3.7)
Esophageal varix, yes/no (%)	19/58	(24.7)	17/32**	(34.0)	2/ 25	(7.4)
MNA results, normal/at risk/malnourished	18/41/18		8/27/15*		10/14/3	
MNA score, points	19.7±5.0		18.8±5.5**		21.4±3.5	
MNA-SF score, points	10.2±2.7		10.2±2.8		10.1±2.5	
Height, cm	157.5±10.1		157.6±10.9		157.3±8.4	
Body weight, kg	61.4±15.3		62.1±15.7		60.2±14.7	
Body mass index, kg/m^2	24.5±4.6		24.8±4.8		24.1±4.2	
AC, cm (%)†	27.0±3.9	(102.9±14.2)	27.0±4.1	(102.4±15.5)	27.0±3.4	(104.0±11.6)
TSF, mm (%)†	14.1±7.2	(125.2±69.5)	13.9±7.8	(117.0±70.0)	14.4±6.1	(140.0±67.8)
AMC, cm (%)†	22.6±3.5	(102.0±13.4)	22.7±3.7	(102.4±13.4)	22.4±3.3	(101.5±13.8)
CC, cm (%)†	32.9±4.5	(99.9±12.9)	32.0±4.7	(100.0±13.6)	32.6±4.3	(99.6±11.6)
Maximum grasp strength, kgw††	25.2±10.1	(75.0±20.3)	24.8±10.6	(76.7±21.3)	25.9±9.7	(72.1±18.5)
Albumin, g/dL	3.3±0.8		3.0±0.7**		3.9±0.5	
CONUT score, points	6.1±3.0		7.1±2.9**		4.2±2.4	
Onodera's PNI	38.8±9.4		35.9±8.6**		44.0±8.6	
C-reactive protein, mg/dL	0.8±1.6		1.0±1.9		0.3±0.4	

Alc: alcohol abuse; HBV: hepatitis B virus; HCV: hepatitis C virus; AC: arm circumference; TSF: triceps skinfold; AMC: arm muscle circumference; CC: calf circumference; MNA: mini nutritional assessment; SF: short form.
†(%) corrected against normative values from JARD2001 [19].
††(%) corrected against calculated as a % of gender- and age- corrected normative values from the Japanese physical fitness and exercise capacity survey (grasp strength level), 2011 [20].
Values are expressed as patient numbers and percentages or the mean±standard deviation.
*$p<0.05$, **$p<0.01$ vs. without liver cirrhosis by t-test.

nutrition, and malnourished) and each of the nutrition-related parameters was analyzed in liver disease patients (Table 2). Body weight, AC, AMC, CC, and maximum grasp strength were significantly associated with nutritional status. Although BMI was not, %AC, %TSF, and maximum grasp strength were dependent on nutrition status, even after correction by gender and age. Serum blood chemistry analysis showed that all nutrition parameters were significantly correlated with MNA nutritional status. This is due to the association of the nutritional status of liver cirrhosis and each nutritional marker. However, totally no correlation, except CONUT score, was found between the nutritional parameters and MNA nutritional status in non-cirrhotic patients (Table 2).

Further analysis revealed a significant correlation in the liver disease group between MNA score and all the anthropometric and blood serum parameters, except for BMI, TSF, %AMC, %CC (Table 3). This is due to correlation between the nutritional status in cirrhotic patients and each nutritional marker except BMI. On the other hand, only body weight and BMI showed significant correlation in non-cirrhotic patients (Table 3). The MNA-SF had a highly significant correlation with MNA in both cirrhotic patients (r=0.91) and non-cirrhotic patients (r=0.81). Thus, the MNA-SF score is as useful as the MNA score. However, they are useful in cirrhotic patients but not in patients without liver cirrhosis.

DISCUSSION

Malnutrition is an important prognostic factor in patients with liver cirrhosis.[21-23] However, the SGA nutrition evaluation of patients with liver disease (especially liver cirrhosis) hardly correlates with other nutrition assessment parameters,[4-6,24] and has been concluded that nutritional

Table 2. Correlation between nutritional parameters and MNA score in liver cirrhotic and non-cirrhotic patients

	Normal	At risk	Malnourished	Normal (%)	At risk (%)	Malnourished (%)
Total (n=77)						
n	18	41	18	18	41	18
Body weight, kg (%)	68.0±12.8[a]	61.2±12.0	55.3±21.6[b]			
Body mass index, kg/m^2	26.1±3.5	24.5±3.6	23.4±7.0			
AC, cm (%)†	28.4±3.3[a]	27.5±3.2[a]	24.3±4.7[b]	107.2±11.9[a]	104.6±11.2[a]	94.7±19.1[b]
TSF, mm (%)†	16.4±8.3	14.2±6.1	11.6±8.0	162.2±84.7[a]	128.6±60.6[a]	82.4±50.8[b]
AMC, cm (%)†	23.5±4.2[a]	23.1±3.1[a]	20.6±3.2[b]	100.1±12.0	104.0±13.3	99.5±15.1
CC, cm (%)†	34.5±3.8[a]	33.1±4.3	30.7±5.1[b]	102.6±10.8	99.8±12.7	97.5±15.2
Maximum grasp strength, kgw (%)†	31.7±10.6[a]	25.9±9.2[b]	17.3±6.1c	82.8±23.1[a]	76.8±17.3[a]	62.1±19.0[b]
Albumin, g/dL	3.7±0.4[a]	3.5±0.7[a]	2.7±0.7[b]			
CONUT score, points	4.7±2.4[a]	5.6±2.8[a]	8.7±2.8[b]			
Onodera's PNI	41.7±9.4[a]	40.4±8.1[a]	32.3±9.7[b]			
C-reactive protein, mg/dL	0.4±0.6	0.6±1.5	1.6±2.0			
Liver cirrhosis (n=50)						
n	8	27	15	8	27	15
Body weight, kg (%)	69.5±7.1	62.5±11.7	57.4±23.1			
Body mass index, kg/m^2	25.9±2.1	24.8±3.5	24.1±7.4			
AC, cm (%)†	29.1±3.0[a]	28.0±3.0[a]	23.9±5.0[b]	107.6±11.4	106.0±11.5[a]	93.0±19.9[b]
TSF, mm (%)†	17.4±11.1	14.1±6.1	11.7±8.6	160.5±109.2[a]	125.1±57.1	82.3±55.9[b]
AMC, cm (%)†	24.3±5.4[a]	23.5±2.7[a]	20.2±3.0[b]	98.2±13.9	106.1±11.6	97.5±14.7
CC, cm (%)†	35.5±1.8	33.3±4.5	31.2±5.5	102.7±8.1	100.1±13.5	98.6±16.5
Maximum grasp strength, kgw (%)†	36.6±7.4[a]	26.2±10.0[b]	16.1±4.4c	94.0±16.6[a]	79.0±18.7[a]	62.7±20.3[b]
Albumin, g/dL	3.7±0.5[a]	3.1±0.7[a]	2.5±0.6[b]			
CONUT score, points	4.9±2.3[a]	6.7±2.5[a]	8.9±2.9[b]			
Onodera's PNI	41.8±7.5[a]	36.9±7.2	31.2±9.5[b]			
C-reactive protein, mg/dL	0.3±0.6	0.8±1.9	1.8±2.1			
Without liver cirrhosis (n=27)						
n	10	12	3	10	12	3
Body weight, kg (%)	66.7±16.3	58.8±12.6	44.8±3.9			
Body mass index, kg/m^2	26.2±4.4	23.4±3.6	20.4±3.0			
AC, cm (%)†	27.8±3.6	26.6±3.6	25.9±2.7	106.9±12.9	102.1±10.6	103.0±14.5
TSF, mm (%)†	15.7±6.2	14.4±6.4	10.7±4.2	163.4±69.2	135.6±68.5	82.7±6.8
AMC, cm (%)†	22.8±3.0	22.1±3.6	22.6±4.0	101.4±11.1	99.8±15.5	109.2±16.1
CC, cm (%)†	33.8±4.9	32.7±3.9	28.2±0.6	102.5±13.1	99.2±11.3	91.9±3.7
Maximum grasp strength, kgw (%)†	27.9±11.5	25.1±7.5	23.3±11.0	73.8±24.4	72.8±14.5	57.9±3.4
Albumin, g/dL	3.7±0.4	4.1±0.4	3.4±1.1			
CONUT score, points	4.5±2.6	3.4±1.6[a]	7.3±2.3[b]			
Onodera's PNI	41.5±11.1	47.1±4.9	38.2±10.2			
C-reactive protein, mg/dL	0.5±0.6	0.2±0.3	0.1±0.1			

Normal: normal nutritional status; At risk: at risk of malnutrition; AC: arm circumference; TSF: triceps skinfold; AMC: arm muscle circumference; CC: calf circumference; PNI: Prognostic nutritional index.
†(%) is correction by JARD2001.
††(%) was calculated by "physical fitness and exercise capacity survey (grasp strength level)" 2011.
All values are indicated as mean±standard deviation.
a, b, and c, significant difference was found between the different symbols (p<0.05; Tukey－Kramer method).

Table 3. Correlation between nutritional parameters and MNA score in liver cirrhotic and non-cirrhotic patients

	Total (n=77)		Liver cirrhosis (n=50)		Without liver cirrhosis (n=27)	
MNA score vs						
Body weight (kg)	0.25 *		0.22		0.48 *	
Body mass index (kg/m^2)	0.16		0.11		0.48 *	
AC (cm) (%)	0.41 **	0.37 **	0.49 **	0.42 **	0.20	0.18
TSF (mm) (%)	0.20	0.37 **	0.18	0.34 *	0.26	0.38
AMC (cm) (%)	0.36 **	0.11	0.48 **	0.22	0.06	-0.10
CC (cm) (%)	0.35 **	0.21	0.37 **	0.19	0.43 *	0.36
Maximum grasp strength (kgw) (%)	0.52 **	0.38 **	0.63 **	0.51 **	0.17	0.13
Albumin (g/dL)	0.52 **		0.55 **		0.15	
CONUT score (points)	-0.30 **		-0.45 **		-0.15	
Onodera's PNI	-0.45 **		0.42 **		0.08	
C-reactive protein (mg/dL)	0.39 **		-0.30 *		0.25	
MNA-SF score	0.84 **		0.91 **		0.81 **	

AC: arm circumference; TSF: triceps skinfold; AMC: arm muscle circumference; CC: calf circumference; PNI: Prognostic nutritional index; MNA: mini nutritional assessment; SF: short form.
$^*p<0.05$, $^{**}p<0.01$ (vs. MNA score; Pearson product–moment correlation coefficient).

evaluation by SGA is difficult.[6] Thus, an efficient method to identify malnutrition in these liver disease patients is definitely in demand. This study compared the results of the MNA, which is commonly used in elderly patients, with other nutritional parameters, and verified the accuracy of the MNA as a nutritional screening tool in liver cirrhotic patients.

The results demonstrated that the nutritional status of patients with liver cirrhosis correlated with nutritional parameters. This is an important finding, with implications for the use of the MNA as a nutritional screening tool in this patient population. Certain anthropometric parameters are known to to be associated with the severity of nutritional and disease status, and to predict prognosis. AC in cirrhotic patients is predictive of disease status, energy metabolism abnormalities, and prognosis.[23,25] TSF and AMC are also related to the prognosis of cirrhotic patients.[26] Grasp power has been reported to be more accurate than the SGA for identifying cirrhotic patients with malnutrition and a poor prognosis.[4] Although body weight and BMI are included in MNA, we found its correlation with nutritional status in non-cirrhotic patients, but not cirrhotic patients. This is consistent with the increasing proportion of obese patients with liver cirrhosis,[27] and BMI is not an appropriate parameter due to edema and ascites.[28] Thus, analysis of body composition, not only body weight and BMI, is important in cirrhotic patients.

Blood chemistry data, including serum albumin level, CONUT score, and PNI, are also related to the severity of nutritional and disease status.[12,25,26] In the present study, MNA scores were associated with these blood chemistry values. Similarly, a previous study in 300 patients with liver cancer[14] demonstrated an association between MNA scores and serum albumin levels. It may be concluded that the MNA is a useful nutritional screening tool for patients with liver cirrhosis, and the scores correlate with representative nutrition-related anthropometric parameters and serum blood chemistry data. Furthermore, scores on the MNA, and the 6-item MNA-SF version, had a very high correlation coefficient of 0.91 (for cirrhotic patients). Use of the simpler MNA-SF should be recommended for cirrhotic patients requiring urgent clinical assessment of nutritional status.

On the contrary, the relationship between MNA scores and nutritional parameters was negative in non-cirrhotic cases, indicating that the MNA is not appropriate for evaluating nutritional status in these patients. Reasons for this difference include the overall health status of cirrhotic patients, which tends to be poor and mimics that of elderly individuals, for whom the MNA was designed. The limitations of this study are that it is of a limited number of cases from two medical facilities and that the nutritional score by MNA has not been evaluated with the prognosis of each case, as it has been for cases with chronic obstructive pulmonary disease.[11] It will be necessary to confirm the clinical relevance of MNA nutritional assessment of liver cirrhosis in multicenter, international studies as well as its relation with prognosis.

In conclusion, MNA scores were strongly associated with several important nutrition-related parameters in patients with liver cirrhosis, but not non-cirrhotic liver disease. The MNA was an effective nutritional screening tool in this cirrhotic patient population.

AUTHOR DISCLOSURES

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