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Creatinine height index as a predictor of nutritional status among patients with liver cirrhosis

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Assessment of nutritional status in cirrhotic patients is very difficult, and there is no gold-standard method used for nutritional evaluation of these patients. The study aims to assess the role of creatinine height index in evaluation of nutritional status of patients with liver cirrhosis, and to compare its results with different ordinary methods used for nutritional assessment. The study was cross sectional observational study, carried out at El-Rajhi Liver Hospital and internal medicine department in Assiut University on 103 patients with liver cirrhosis after obtaining their informed consent form May to September 2015. 24 h urine collection was obtained from all patients, then measurement of their urine creatinine was done, after that, creatinine height index (CHI) was calculated for every patient, furthermore, All patients did the followings investigations: Serum albumin, Anthropometric measurements, Subjective Global Assessment. Then its results were compared with their CHI. According to CHI, malnutrition was present in 89.2% of patients: 11 patients (11.8%) were mildly malnourished, 38 (40.8%) were moderately malnourished and 35 (36.6%) were severely malnourished, Subjective Global Assessment detects malnutrition in 92.2% of patients. Furthermore, 87.4% of the patients were malnourished according to Mid Arm Muscle Circumference while 86.4% of them were malnourished according to Triceps Skin Fold Thickness. Mean value of CHI was decreased markedly from 86.1, 64.5 to 39.1% in Child score A, B and C respectively (P value= 0.000). CHI is a good predictor of muscle mass in patients with liver cirrhosis.

Key words: CHI, nutritional status, liver, cirrhosis, assessment.

INTRODUCTION

Liver cirrhosis results from different mechanisms of liver injury among which nutritional factors may be claimed (Schuppan and Afdhal 2008), and clinically, cirrhosis has been regarded as an end-stage disease that invariably leads to death, unless liver transplantation is done (D'Amico et al., 2006). It is well documented that liver

performs essential functions in food digestion and in absorption, metabolism, storage, transport, activation and utilization of nutrients (Bémeur et al., 2010). Compromising these functions in patients with liver cirrhosis can result in the development of protein calorie malnutrition (PCM) (Moriwaki, 2002). Although PCM is

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not always diagnosed, it is a frequent complication in patients with liver cirrhosis, and its onset and/or severity increases with the progression of liver dysfunction mainly in situations of metabolic stress associated with the presence of infection and/or hospitalization (Roongpisuthipong et al., 2001; Caregaro et al., 2001; Sobhonslidsuk et al., 2001).

Previous studies in western patients have documented malnutrition rates from 20% in compensated liver cirrhosis up to 100% in decompensated liver cirrhosis (Caly et al., 2003). Causes for malnutrition in liver cirrhosis are known to include a reduction in oral intake (for various causes), increased protein catabolism and insufficient synthesis, malabsorption and maldigestion associated with portal hypertension (Merli et al., 2011). Although a consequence of the disease, malnutrition alone can lead to further morbidity in patients with liver cirrhosis. Increased rates of septic complications, poorer quality of life, and a reduced life span have all been observed in cirrhotic with poorer nutritional status compared to those with good nutritional status (Dan et al., 2008).

Furthermore, assessment of nutritional status is difficult in cirrhotic patients as fluid retention hinders the interpretation of simple criteria such as body weight and Body Mass Index (BMI) as the fluid excess causes weight to height parameters to underestimate the prevalence of chronic liver disease which itself causes alteration in visceral protein synthesis, cellular immunity, and total lymphocyte count independent of PCM (Hasse, 2008).

Subjective global assessment has been shown to be effective at identifying malnutrition in a variety of hepatic patients either suffering from cirrhosis or not (Fiaccadori et al., 1999). Malnutrition may unfavorably affect the natural history of cirrhotic patients. The rate of complications has been shown to be lower in those patients receiving nutritional intervention that is able to increase nutrient intake than in untreated patients. Further, malnutrition is associated with a higher incidence of refractory ascites and in patients with esophageal varices, it may be a predictor of the first bleeding episode. Malnutrition is strongly associated with deterioration in liver function, Merli et al. (2002) reported that a reduction in muscle mass was associated with a lower cumulative survival in cirrhotic patients.

Serum albumin concentration is the most frequently used laboratory measure of nutritional status. Although nonspecific, it has been used to assess change in nutritional status. The normal range of serum albumin is 3.5-5.5 g/dl (Lim et al., 2000). The ESPEN guidelines recommend the use of simple anthropometric parameters in evaluating malnutrition which are also not affected by the presence of ascites and peripheral edema. These parameters consist of mid-Arm Circumference (MAC), Triceps Skin Fold Thickness (TSFT) and Mid-Arm Muscle Circumference (MAMC) (Ferguson et al., 1999).

The amount of creatinine excreted in the urine over a

24 h can be used in estimating body muscle mass. Creatinine is the only metabolite of creatine, a nitrogenous compound formed from amino acids in the liver and taken up by many tissues, but mainly by muscle. Ninety eight percent of the body creatine is found in muscle. Creatine spontaneously dehydrated to form creatinine, which is then excreted in the urine; therefore measurement of creatinine in 24 h urine collection should reflect total body creatinine and consequently total muscle mass (Stephenson et al., 2001).

CHI is a ratio of patient measured 24 h urinary creatinine excretion and the expected excretion of normal individual of same sex and height. The index is calculated from the following formula: $CHI = \frac{24\text{h-urine creatinine excretion (mg)}}{\text{expected 24h-urine creatinine excretion (mg)}} \times 100$ its result is as follows: If $CHI \geq 80\%$, there is normal protein status. If $CHI 60\text{-} < 80\%$, there is mild protein depletion. If $CHI 40\text{-} < 60\%$, there is moderate protein depletion. If $CHI < 40\%$, there is severe protein depletion. The expected 24 h urinary creatinine excretion values for height for adult male and female. Creatinine height index is a good method for assessing protein status in cirrhotic patients where sarcopenia is a common complication in liver cirrhosis, however, several factors affect the reliability of CHI, and advanced age results in decreased creatinine excretion and renal impairment reduce the amount of creatinine filtered through the kidney. Trauma, infection, fever, physical activity and catabolic states increase short term creatinine excretion; and incomplete 24 h urine collection will invalidate creatinine excretion results (Huisman et al., 2011).

In Egypt, the high prevalence of virus C infection, has resulted in large numbers of people developing liver cirrhosis with its' associated complications. Most of the data on malnutrition in patients with cirrhosis have been derived from western patients in whom chronic alcohol ingestion has been the commonest etiology. Patients with cirrhosis should have a full assessment of nutritional status at presentation because malnutrition increases complications. Due to the high prevalence of malnutrition and its relationship with morbidity and mortality in patients with liver cirrhosis as well as the absence of a gold-standard method for nutritional evaluation of these patients, we conducted the present study.

METHODOLOGY

This study is an observational cross sectional hospital based study carried out on 103 cirrhotic patients admitted to El-Rajhi Liver Hospital and internal medicine department in Assiut University, Egypt, started in May 2015 and ended in February 2016. All eligible patients who fulfilled the predetermined inclusion criteria are invited to participate in the study after getting their consent, inclusion criteria was Adult patients (18 years and more) with liver cirrhosis, diagnosed of liver cirrhosis was based on a combination of clinical features, blood profile and radiological imaging. Clinical features included those of portal hypertension, that is, ascites and/or gastrointestinal varices. Blood profile included evidence of thrombocytopenia and/or coagulopathy.

Radiological features, either with trans-abdominal ultrasound or computerized tomography, had to demonstrate a small shrunken liver and ascites with or without splenomegaly (Jones, 2004). Exclusion criteria were: Patients with any renal diseases as patients with renal diseases have low creatinine excretion in urine, which may decrease creatinine height index values and act as a confounding variable. Younger patients less than 18 years, patients with hepatocellular carcinoma as carcinoma is considered an additional factor for causing malnutrition beside cirrhosis, and patients with severe hepatic encephalopathy were also excluded, that is, Grade 3 or 4 due to difficult body compositions measurement.

Data of the study were collected by structured questionnaire which was filled by the researcher herself who explained aims of the study to each patient before participation in the study. The questionnaire asked about demographic variables as age, sex, occupation, marital status, residence and educational level, the questionnaire also asked about medical history of the disease as etiology of the liver cirrhosis and Child-Pugh score which used in classification of severity in liver cirrhosis, data about presence of complications as hepatic encephalopathy, oesophageal varices and spontaneous bacterial peritonitis, the data were obtained from patient sheet in health information system of the hospital, then the patients were asked for presence of co-morbidities as hypertension and diabetes. Measurement of creatinine was done by modified Jaffe method using pentra 400 auto-analyzer. The index is calculated from the following formula:

$$\text{CHI} = \frac{24\text{-hour urine creatinine excretion (mg)}}{\text{expected 24-hour urine creatinine excretion (mg)}} \times 100.$$

Interpretation of the obtained results is as follows, If $\text{CHI} \geq 80\%$, there is normal protein status, if $\text{CHI} 60\text{-} < 80\%$, there is mild protein depletion, if $\text{CHI} 40\text{-} < 60\%$, there is moderate protein depletion and if $\text{CHI} < 40\%$, there is severe protein depletion (Huisman et al., 2011). Measurement of serum albumin was done by colorimetric determination using Pentra 400 auto-analyzer. All measurements were taken by the same investigator, to avoid any inter-observer variation. The following anthropometric measures were used: Mid-Arm Circumference (MAC), Triceps Skin-Fold Thickness (TSFT), Mid-Arm Muscle Circumference (MAMC), and Body Mass Index (BMI).

Statistical analysis

Data were analyzed using statistical package for social sciences (SPSS) software package version 16. Descriptive statistics were done in the form of frequencies, mean and SD then analytic statistics were done as Chi square, Independent sample T-test and one way ANOVA. Values were considered significant when P values equal or less than 0.05.

Ethical consideration

Informed consent was obtained from all participants; it was explained to all participants that the collected data will be confidential and for the purpose of the scientific research only. All investigations were free without any financial burden on the participants. Furthermore, any faulty dietary habits were advised through health education.

Obstacles and limitations of the study

The main obstacle of the study was collection of 24 h urine to calculate creatinine height index, creatinine height index was

calculated for ninety three patients instead of 103 with a drop out less than 10% which is accepted in medical research.

RESULTS

Mean age of patients was 52.14 ± 10 years and was ranged from 19 to 83 years. 57.3% of patients were males while 42.7% were females, regarding etiology of liver cirrhosis, 60.2% of patients were postviral C aetiology, 9.7% of postviral B aetiology, while the aetiology was not known in 27.2% of patients, moreover, 2.9% of patients had other aetiology (like autoimmune cirrhosis and bilharzial cirrhosis). According to Child score, 1.9% of the cases were classified as Child A, 34% classified as Child B score and 64.1% classified as Child C. Complications of liver cirrhosis as tense ascities and spontaneous bacterial peritonitis were present in 34% of cases, oesophageal varices in 24.3%, hepatic encephalopathy in 27.1%. On the other hand, 51.5% of cases were hypertensive and 35% were diabetic, both co-morbidities were present in 5.8% of cases and absent in 7.7% of them.

Figure 1 shows that according to creatinine height index, malnutrition was present in 89.2% of patients, 11.8% of them were mildly malnourished, 40.8% were moderately malnourished and 36.6% were severely malnourished. Table 1 and Figure 2 show that creatinine height index differed significantly between the Child A, B and C patients (P value= 0.000) where the mean value of CHI was 86.1, 64.5 and 39.1% in Child score A, B and C respectively.

Table 2 shows that the value of creatinine height index in all patients was ranged from 4.4 to 91.1% with mean value of $49.4 \pm 20.5\%$. It also shows that the mean value of CHI was $46.7 \pm 21.4\%$ and $52.8 \pm 18.9\%$ in both males and females respectively with no statistical significant difference between them (P value=0.154), it also shows that there is statistical significant difference between mean values of TSFT between males and females (P value= 0.001), where the mean value in males was 8.9 ± 1.4 mm and in females was 10.4 ± 2.8 mm. Furthermore, there is no statistical significant difference between mean values of MAC between males and females (P value= 0.278). Lastly, mean value of MAMC in males was 20.6 ± 2.5 cm and in females was 20.7 ± 3.6 cm with no statistical significant difference (P value= 0.987).

According to Table 3, no cases were classified as underweight by using BMI classification, while 23.3% of cases were classified as normal weight, 32% of cases were overweight, 34% classified as grade I obesity, 7.8% of cases were classified as grade II obesity, and 2.9% of cases were classified as grade III obesity. The mean value of BMI was 29.3 kg/m^2 , and was ranged from 19.1 to 47.3 kg/m^2 , meanwhile according to subjective global assessment (SGA) grading, malnutrition was present in 92.2% of patients, 43 patients (41.7%) had mild to moderately malnourished, 52 patients (50.5%) had

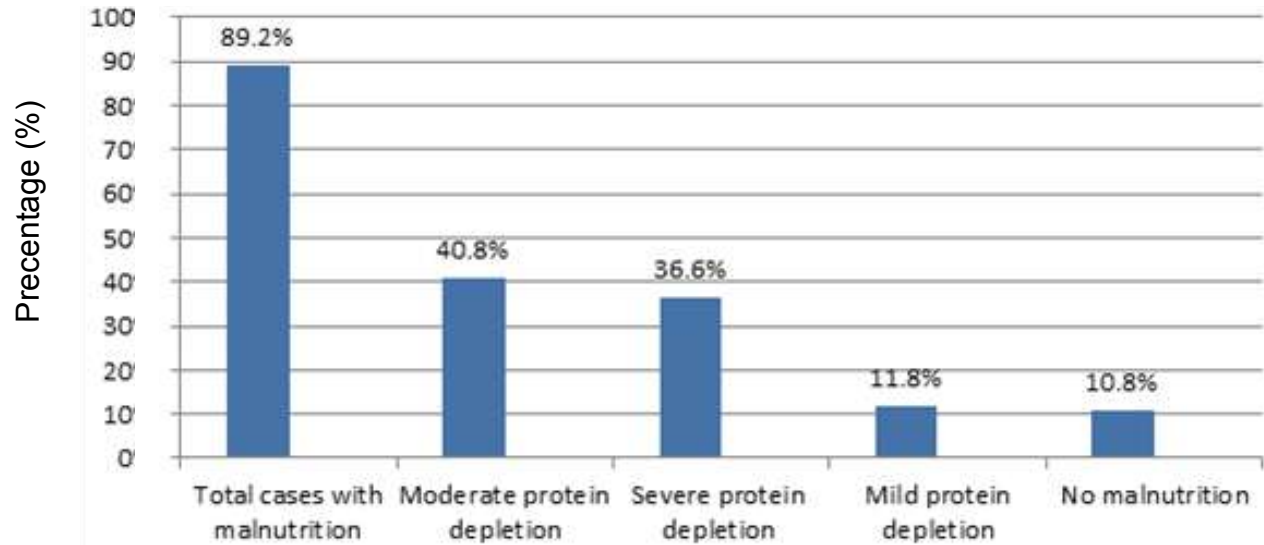


Figure 1. Percentage of malnutrition by creatinine height index in the studied patients, El-Rajhi Hospital, Assiut University 2015.

Table 1. Distribution of creatinine height index values in different child-pugh scores in the studied patients.

Variable	Child pugh score			F-value	*P-value
	A (n=2)	B (n=35)	C (n=66)		
	Mean ± SD	Mean ± SD	Mean ± SD		
CHI (%)	86.1±7.1	64.5±17.4	39.1±14.6	33.7	0

*One way ANOVA test

severe malnutrition and 7.8% of them had no malnutrition.

Figure 3 shows that according to Subjective Global Assessment, malnutrition was present in 92.2% of patients while, according to creatinine height index; it was present in 89.2% of them. It also shows that 87.4% of patients were malnourished according to both MAC and MAMC, meanwhile 86.4% of patients were malnourished according to TSFT. Table 4 shows that there is statistical significant difference between means of serum albumin and Child class A, B and C. As mean values of serum albumin showed significant deterioration in these parameters with disease progression from Child-Pugh class A to C (P value =0.000), mean values of serum albumin was 3.9±0.07, 2.8±0.28 and 2±0.32g/dl in Child class A, B and C respectively. There is also statistical significant difference between serum albumin and nutritional status assessed by SGA, As, mean serum albumin in SGA score A is 3±0.62 g/dl versus 2.5±0.44 g/dl and 2±0.39 g/dl in SGA score B and C, respectively (P value= 0.000).

Table 5 and Figure 4 shows relationship between

Child- Pugh classes and mean values of MAC, TSFT and MAMC. It reveals that mean values of these anthropometric measures showed significant deterioration with disease progression from Child-Pugh class A to class C. with statistical significant difference between means of MAC, TSFT and MAMC and Child score A, B and C (P value=0.000).

DISCUSSION

For many years, malnutrition has been related to worse clinical outcomes and higher incidence of complications such as ascites, hepatic encephalopathy, infections and hepato-renal syndrome. Furthermore, protein calorie malnutrition (PCM) itself may accelerate deterioration of liver functions and adversely affects its clinical outcome (Plauth et al., 2000). PCM considered a major risk factor for morbidity and mortality before and after transplantation as well as in abdominal surgery (Vulcano et al., 2013).

This study try to assess nutritional status of cirrhotic

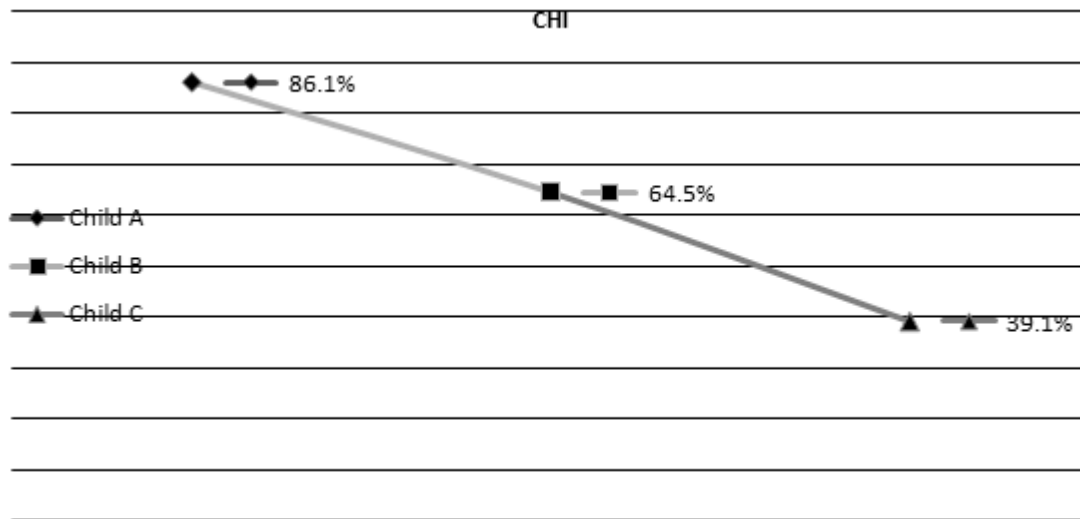


Figure 2. Distribution of creatinine Height Index values in different child-pugh scores in the studied patients.

Table 2. Distribution of anthropometric measurements according to sex, El-Rajhi Hospital, Assiut University, 2015.

Anthropometric measurements	All cases mean± SD	Male mean± SD	Female mean± SD	*P value
CHI (%)	49.4±20.5	46.7±21.4	52.8±18.9	0.154
MAC(cm)	22.8±2.9	22.9±2.7	22.4±3	0.278
TSFT(mm)	9.6±2.3	8.9±1.4	10.4±2.8	0.001
MAMC(cm)	20.6±3	20.6±2.5	20.7±3.6	0.987

*Independent sample T-test. MAC= mid-arm circumference. MAMC=mid-arm muscle circumference. TSFT=triceps skin-fold thickness.

patients using a combination of more than one tool of assessment as, subjective global assessment (SGA), creatinine height index (CHI), serum albumin and different anthropometric measurements as mentioned before, in order to compare the results obtained from these tools and find out the most appropriate method that can be used in these set of patients.

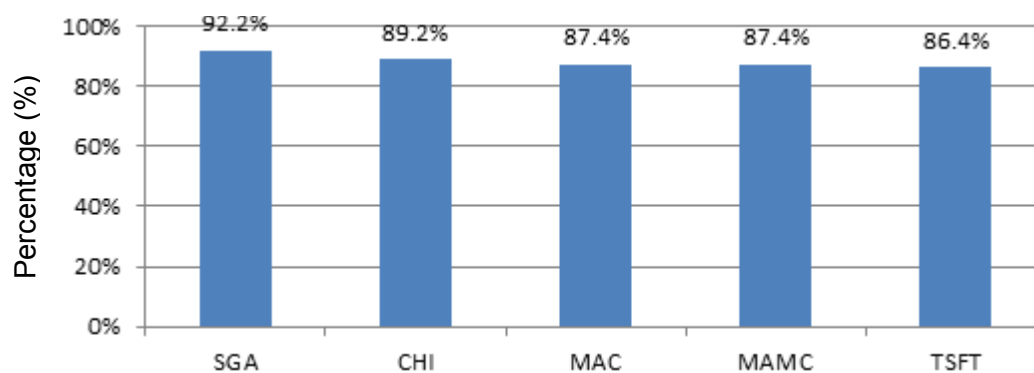
Generally, role of sex in malnutrition development is not well established, as female patients usually suffer from higher BMI than male with more fat contents, on the other hand, male patients usually have more lean body mass than females, these two factors usually mask the role of sex in malnutrition development, In our study, no statistical significant difference was observed between sex and occurrence of malnutrition by using SGA and CHI tools (P value = 0.224 and P value=0.154 respectively), which is agreement with Alberino et al. (2001), who found that sex has no role in development of malnutrition in hepatic patients.

Liver cirrhosis is caused by a variety of interacting factors; in this study main etiology of liver cirrhosis was

post viral C infection (60.2%), which is mismatched with Roongpisuthipong et al. (2001), who studied 60 patients with liver cirrhosis in Thailand, where the main etiology of cirrhosis was alcoholic in 51.7% of patients and non-alcoholic in 48.3% of patients. Also this finding disagree with Morgan et al. (2006), who studied 26 patients with cirrhosis at University College London where the main etiology also was alcoholic cirrhosis in 61% of cases, post viral cirrhosis in 23% of cases, biliary cirrhosis in 8% of cases and other etiologies in 8% of cases (Morgan et al., 2006). This mismatching in main etiology of cirrhosis may be related to customs and traditions that allow alcohol intake in these countries while in our eastern societies, traditions and religious restriction that prohibit alcohol intake, decrease the rate of alcoholic liver cirrhosis. Also high prevalence of virus C infection in Egypt plays the major role in occurrence of liver cirrhosis in Egyptian patients. On the other hand our finding is in agreement with Monsef et al. (2014), who studied 60 patients with liver cirrhosis treated in hepatology Department in Ain Shams University hospitals and wady

Table 3. Body mass index and subjective global assessment in the studied patients.

Grads of body mass index	No	Percentage (%)	Grads of SGA	No	Percentage (%)
Underweight(kg/m ²)	0	0	No malnutrition (score A)	8	7.8
Normal weight	24	23.3			
Overweight	33	32	Mild/Moderately malnourished (score B)	43	41.7
Obese grade I	35	34			
Obese grade II	8	7.8	Severely malnourished (score C)	52	50.5
Obese grade III	3	2.9			
Total cases	29.3±4.9	(19.1-47.3)	Total cases	103	92.2

**Figure 3.** Percentage of malnutrition by different methods in the studied patients, El-Rajhi Hospital, Assiut University, 2015.

El-Nile hospital during the period from June, 2012 to June, 2013 where, the main etiology of cirrhosis was post viral C cirrhosis in 65% of cases (Monsef et al., 2014).

Malnutrition in cirrhosis consists mostly of loss of skeletal muscle mass or sarcopenia, which is associated with higher mortality and worse quality of life. Therefore, Assessment of nutritional status of those cirrhotic patients must depends on estimation of muscle mass and protein contents of such patients instead of other ordinary anthropometric measures that usually used for nutritional assessment like BMI, these highlight the importance of using CHI as a nutritional tool that can estimates muscle mass and protein contents of cirrhotic patients.

In this study according to CHI, malnutrition was observed in 89.2% of cirrhotic patients, which is very high figure that reflects the bad nutritional status of such patients, and the drain of their muscle and protein contents, that leads to development of sarcopenia, which increased with deterioration of liver condition from child A to C, as there was a statistical significant difference between mean value of creatinine height index and Child score A, B and C, (P= 0.000). The mechanisms that contribute to sarcopenia include inadequate dietary intake, metabolic disturbances, and malabsorption.

Because cirrhotic liver tissue exhibits impaired synthesis and storage of glycogen, relatively short periods of fasting in patients with cirrhosis result in the breakdown of fat and muscle and promote gluconeogenesis from non-carbohydrate sources. Unless dietary protein intake is sufficient, this can lead to muscle wasting. About 15%-30% of cirrhotic patients are hypermetabolic and increased energy expenditure in cirrhotic patients accelerates the degradation of protein, which may aggravates muscle loss (Ferguson et al., 1999).

The study results is in agreement with Caregato et al. (2001), who studied one hundred and twenty patients with liver cirrhosis in Italy, where the mean values of creatinine height index differ significantly between Child A, B and C scores (Caregato et al., 2001). Meanwhile, mean value of creatinine height index in the study patients was 49.4±20.5 %. This value is lower according to the study of Caregato et al. (1996), where the mean value of creatinine height index in his studied patients was 74.19±28.75%⁽²⁵⁾. Also our value is lower than that of Roongpisuthipong et al. (2001), where mean value of creatinine height index was 57.1±24.4% (Roongpisuthipong et al., 2001). The difference in the mean values of creatinine height index between our study

Table 4. Distribution of serum albumin level in different child-pugh scores and SGA scores in the studied patients.

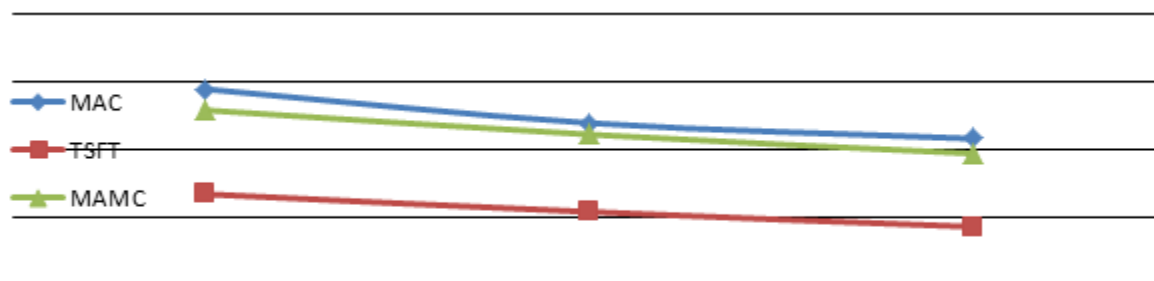
Variable	Serum albumin(g/dl) Mean \pm	F-value	*P-value
Child -pugh score			
A (n=2)	3.9 \pm 0.07	102.2	0.000
B (n=35)	2.8 \pm 0.28		
C (n=66)	2 \pm 0.32		
SGA score			
A (n=8)	3 \pm 0.62	27.3	0.000
B (n=43)	2.5 \pm 0.44		
C (n=52)	2 \pm 0.39		

* One way ANOVA test

Table 5. Distribution of anthropometric measurements in different Child-Pugh scores in the studied patients.

Anthropometric measures	Child Pugh score			F-value	*P-value
	A (n=2)	B (n=35)	C (n=66)		
	Mean \pm SD	Mean \pm SD	Mean \pm SD		
MAC	29 \pm 0.0	24 \pm 2.8	21.68 \pm 2.5	13.5	0.000
TSFT	13.5 \pm 2.1	10.9 \pm 2.5	8.69 \pm 1.6	16.8	0.000
MAMC	25.9 \pm 0.85	22.3 \pm 3.5	19.5 \pm 2	17.2	0.000

* One way ANOVA test.

**Figure 4.** Distribution of anthropometric measurements in different Child- Pugh scores, El-Rajhi Hospital, Assiut University, 2015.

and these two studies is related to the difference in the percentage of Child score A, B and C patients in these studies, where in Roongpisuthipong and Caregaro study, the majority of patients were Child A and Child B with better prognosis and good nutritional status, while in our study the majority of patients were Child C with bad prognosis, low muscle and protein contents and subsequent lower creatinine height index values.

The use of biochemical tests for nutritional assessment in patients with liver disease is questioned, because it may represent liver dysfunction and does not necessarily represent changes in nutritional status. Some authors use albumin as a nutritional index, the decrease in albumin in patients with cirrhosis is related to liver dysfunction and not due to nutritional indices. Albumin is a protein made specifically by the liver, and can be measured cheaply

and easily, furthermore, albumin level usually decreased in chronic liver diseases such as cirrhosis (Caly et al., 2003). This study estimated the nutritional status in different stages of liver cirrhosis by serum albumin and we found that mean values of serum albumin showed significant deterioration with disease progression from Child-Pugh class A to class C (P-value =0.000). This finding is in agreement with Tai et al. (2010), who studied sixty cirrhotic patients where mean values of serum albumin demonstrated significant differences in patients with SGA grades B and C, with a higher SGA grade correlating well with lower serum albumin and also serum albumin levels demonstrated to be significantly lower in patients with Child-Pugh C score compared to those with Child-Pugh B score (p-value= 0.001) (Tai et al., 2010). The study finding is also in agreement with Patricia et al. (2013) and Butt et al. (2009) where mean values of serum albumin showed significant deterioration in with disease progression from Child-Pugh class A to class C (Patricia et al., 2013; Butt et al., 2009).

Assessment of nutritional status by body weight can be misleading in patients with ascites and peripheral edema, because the presence of ascites and edema increase the measured weight, Furthermore, body mass index (BMI) usually gives underestimated results when used in cirrhotic patients for nutritional evaluation (Campillo et al., 2006). In our study mean value of BMI was 29.3 kg/m² and was ranged from 19.1 to 47.3 kg/m², this mean that no patients were classified as underweight as all patients had BMI above 18.5 kg/m². This finding is not matched with other methods used for nutritional evaluation which reported malnutrition in the majority of the studied patients (Campillo et al., 2006). Therefore; body weight and BMI as tools of nutritional assessment in cirrhotic patients should be used very rarely as tense ascites and edema increase the measured weight and underestimate malnutrition. When we correlate grads of BMI with SGA classes, we found that mean values of BMI did not differ significantly in the three classes (28.9±5.9, 29.4±4.2 and 29.3±5.5kg/m² respectively, p-value = 0.969).

Regarding other anthropometric measures used in the study for nutritional assessment, mean values of MAC, MAMC and TSFT showed significant deterioration with disease progression from Child-Pugh class A to class C (P-value =0.000). This finding is in agreement with Bémeur et al. (2010), who stated that mean values of MAC, MAMC and TST differ significantly between grades B and C of cirrhotic patients, with a higher. Subjective global assessment (SGA) is a practical method for nutritional diagnosis. Its applicability to cirrhotic patients and to liver transplant candidates is valid, since liver disease changes the majority of objective indicators. SGA is recommended by ESPEN as a practical bedside method in assessing undernourished patients (Wakahara et al., 2007).

In this study, adopting SGA as a tool to diagnose malnutrition revealed that 92.2% of patients were

malnourished, 50.5% of them were severely malnourished, and 41.7% of them were moderately malnourished, this percentage is higher than that found by Vulcano et al. (2013), where they found that 46.5% of the cirrhotic patients suffering from different degree of malnutrition according to SGA (Vulcano et al., 2013). Also this study results were higher than that of Teiusanue et al. (2012), where 76% of the patients were well nourished, 15% of the patients were mild to moderately malnourished and 9% only were severely malnourished (Teiusanue et al., 2012). This difference may be related to the high percent of Child class B and C in the study patients, while in Teiusanue (2012) study, the majority of patients were Child A and B with small percentage of Child C (4% only) in addition to the low socioeconomic and educational levels among our patients compared to patients of the mentioned two studies which may affect food availability and also affect selection of food with high nutritional values.

Finally, the study can conclude that, CHI is a valid and very simple tool for assessment of protein status in liver cirrhotic patients. However, it is dependent on complete 24 h urine collections, urinary losses and renal function. So, to overcome its two main limitations, we exclude patients with renal impairment and patients with incomplete urine collection. The percentage of malnutrition according to creatinine height index was lower than that detected by subjective global assessment. this difference was attributed to the fact that creatinine height index assess only protein and muscular status of the patients while subjective global assessment is a comprehensive method of nutritional assessment that includes assessment of patient history regarding weight changes, gastrointestinal symptoms, dietary intake, functional disability and patients clinical examination regarding subcutaneous loss and muscle wasting, so subjective global assessment is a broad method for nutritional assessment. But the value of CHI appears in assessment of protein and muscle status of liver cirrhotic patients.

CONCLUSION

Protein-calorie malnutrition is a common complication of liver cirrhosis in Egyptian patients. Nutritional disorders appeared to be related to the degree of liver injury and nutritional status is good in early stages of liver cirrhosis, and deteriorates in end stage liver disease. CHI is a very good predictor of muscle mass and protein contents of the hepatic patients

RECOMMENDATIONS

Creatinine height index is a good predictor of muscle mass in patients with liver cirrhosis, provided that there is

no renal impairment. Nutrient requirements of individuals with liver cirrhosis are specific and individualized depending on degree of liver failure, presence and degree of malnutrition. This study provides useful nutritional data which is currently lacking among Egyptian patients with liver cirrhosis.

Conflict of interests

The authors have none to declare.

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