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Original article

Nutritional status and the performance of multiple bedside tools for nutrition assessment among patients waiting for liver transplantation: A Canadian experience

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SUMMARY

Background: Malnutrition is an important predictor of morbidity and mortality among cirrhotic patients. Our objectives were to assess protein-calorie malnutrition (PCM) in cirrhotic pre-liver transplant patients and to study the correlation between subjective global assessment (SGA) and other objective measures of malnutrition.

Methods: We recruited pre-liver transplant adult patients at our center between October 2012 and Oct 2015. Nutrition status was assessed via SGA. PCM was assessed by comparing recommended to actual protein and calorie intake. SGA was correlated with body mass index (BMI), dry BMI, handgrip strength by calibrated dynometer (HGS), and mid-arm circumference (MAC). We used non-parametric statistical methods in our analysis.

Results: Seventy patients were included in this study. Majority were males (n = 46, 66%) with a median age of 58 years (IQR: 50-61). Moderate to severe malnutrition was prevalent in our cohort (SGA-A: n = 15 (21.4%), SGA-B: n = 30 (42.9%) and SGA-C: n = 25 (35.7%). There was a significant difference in the recommended calories consumed between SGA groups (A 98.5% vs. C 79.2%, P = 0.03). A similar trend was observed for the recommended protein consumed (A 85.4%, C 62.5%; P = 0.09). SGA correlated with BMI (A = 26.4, C = 22.4; P<0.01), Dry BMI (A = 25.9, C = 20.4; P<0.01), HGS (A = 67.0, C = 47.0 PSI; P = 0.03), and MAC (A = 29.5 cm, C = 22.0 cm; P<0.01). HGS and MAC were strongly correlated (Spearman correlation 0.49, P<0.01).

Conclusions: Cirrhotic patients have significant protein-calorie malnutrition. Multiple malnutrition tools including BMI, dry BMI, HGS and MAC were precisely able to assess malnutrition.

1. Background

More than half of patients with cirrhosis are malnourished [1,2]. Anorexia, malabsorption, and hypermetabolism due to hormonal changes are predisposing factors for malnutrition in cirrhosis [3]. Moreover, alteration of utilization of nutrients and metabolism contribute significantly to malnutrition.

Malnutrition is associated with significant morbidity and mortality in decompensated cirrhosis. Malnourished cirrhotic patients have higher mortality rates compared to their peers [4,5]. Furthermore, malnutrition has been found to be an independent predictor of mortality for patients awaiting liver transplantation [6]. In addition, malnourished patients have more post-transplant infections, increased length of stay in the ICU, and hospitalization duration [7].

Nutrition assessment in patients with liver disease continues to be challenging due to the lack of rigorously validated objective tools that can be easily applied in the clinical setting. Although a true

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gold standard to assess nutritional status in end stage cirrhosis is still lacking, the European Society of Parenteral and Enteral Nutrition (ESPEN) recommend using either the Subjective Global Assessment (SGA) or bedside anthropometric measures [8]. Unfortunately, there are some limitations to the SGA in this population. One limitation is that SGA considers changes in weight as a major part of the historical determinants of nutrition status, in addition to the presence of edema and ascites due to malnutrition as a physical examination finding. Patients with cirrhosis, in particular decompensated cirrhosis, often have clinical features of ascites and edema arising as a consequence of liver synthetic dysfunction, rendering the SGA inadequate to appropriately determine nutritional status [9].

To address this issue, many studies have evaluated the performance of objective methods of nutrition assessment in an endeavor to simplify the nutrition assessment process and increase the accuracy of predicting malnutrition in this population. These include body mass index (BMI), dry body mass index (BMI), mid-arm circumference (MAC), mid-arm muscle circumference (MAMC), triceps skin thickness, and handgrip strength (HGS). BMI was found to be inaccurate in patients with ascites [4,10,11]. Due to this, further studies have attempted to adjust weight for the ascites with promising results [12,13]. MAC has variable results and was not found to be a strong predictor of malnutrition in one study [10]. However, in a second study, it was as efficient as SGA at determining severe malnutrition [11]. HGS was found to be a better predictor of complications of cirrhosis than other tests, and it has been shown to be a better measure of malnutrition [10,14]. Due to the heterogeneous results of the aforementioned tools, SGA remains the clinical gold standard to determine malnutrition in the cirrhosis population. Body composition as a predictor of malnutrition in cirrhotics has previously been assessed through multiple modalities including dual-energy x-ray absorptiometry (DXA), total body protein by neutron activation analysis [15], and more recently using computed tomography (CT) scan at the level of the third lumbar vertebrae to determine the L3 skeletal muscle index [16]. Sarcopenia has been consistently associated with mortality in patients with cirrhosis. In fact, it has been suggested that scoring systems should include evaluation of sarcopenia to better assess mortality among patients with cirrhosis [16]. Utilizing CT scans to determine sarcopenia measurements is impractical in routine clinical practice due to potential complications that may arise consequently, including renal failure and radiation exposure in this cohort. In addition, the cost of multiple scans to monitor nutritional status would be prohibitive. Similarly, other measures of body composition such as DXA and total body protein by neutron activation analysis have been used primarily in research settings. There is a compelling need for simple, safe, and accessible bedside tools that can be used in every cirrhotic patient to predict nutrition status. To our knowledge, there has not been a direct comparison between SGA, MAC, HGS, BMI and dry BMI in their ability to detect malnutrition in patients awaiting liver transplantation.

The ESPEN guidelines on enteral nutrition in liver disease were published a decade ago, with evidence-based recommendations for the use of oral nutrient supplements, enteral feeding, energy and protein targets and methods to conduct a nutrition assessment in this patient population (8). At present, it is unclear whether these recommendations are implemented into clinical practice in patients on the pre-liver transplant list in Canada.

Our primary objectives were to describe the baseline nutritional characteristics of patients on the pre-liver transplant list, and to assess the calorie and protein intake in this population 10 years after the ESPEN guidelines were first released. In addition, we aimed to evaluate performance of different malnutrition assessment tools compared to subjective global assessment (SGA) and to identify the best bedside screening tool of malnutrition in cirrhotic pre-liver transplant.

2. Materials and methods

2.1. Study population

This prospective study included adult patients (≥18 years) on the liver transplant wait list referred by the treating hepatologist to the High Risk Malnutrition (HRM) Clinic at the University of Calgary between October 2012 and Oct 2015. Referral process was elective and depended on hepatologist perception for the need to evaluate for malnutrition. Two-thirds of the pre liver transplant patients were referred to HRM clinic. Two physician nutrition specialists and two registered dietitians (RD) with specialization in nutrition for liver diseases provided a nutrition assessment and nutritional recommendations for pre-liver transplant patients. Exclusion criteria included an inability to provide consent, poorly controlled hepatic encephalopathy, malignancy apart from hepatocellular carcinoma diagnosed within the 6 months prior to assessment, and alcohol use within the past 6 months. Each patient had baseline laboratory measurements and underwent anthropometric testing including BMI, dry BMI calculation, HGS, and MAC. The Research Ethics Board at the University of Calgary approved the study protocol.

2.2. Nutritional assessments

Each patient had a nutrition assessment completed by both the physician and registered dietitian in the HRM clinic, with recommendations for calorie and protein intake.

2.2.1. Three day food diary

Patients were required to complete a 3-day food diary prior to attending the first HRM clinic. The food diary was completed over 2 weekdays and one weekend day to ensure accuracy of intake. The RD subsequently interviewed the patient to confirm the intake and clarify details as needed.

2.2.2. Subjective global assessment

SGA classification was performed by both the HRM clinic physician and RD, with a rating achieved by consensus. As the SGA is considered the gold standard for nutrition assessment despite its limitations, it was used as the reference tool against which the additional methods of assessing nutrition status were compared.

2.2.3. Body mass index and dry body mass index (BMI)

Each patient had his or her height and weight recorded on the initial visit to the HRM clinic. Each patient was assessed for the presence and severity of ascites using ultrasound in addition to clinical assessment of pedal edema. Dry body weight was calculated by subtracting 5% of the body weight for mild ascites, 10% for moderate ascites, and 15% for severe ascites with an additional 5% of the body weight subtracted in the presence of bilateral pedal edema as previously reported [17]. These were used to calculate the BMI and dry BMI according to the formula: *(Dry) Weight (kg)/Height [2](m).*

2.2.4. Mid-arm circumference

MAC was obtained by measuring the circumference of the upper arm at a point half the distance between the olecranon and the humoral head. The HRM RD performed the mid-arm circumference in the non-dominant arm in all patients.

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