ORIGINAL PAPERS

Impact of dietary intake and nutritional status on outcomes after liver transplantation

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ABSTRACT

Objective: the aim of our study was to examine, in a prospective way, whether any nutritional parameter could predict outcomes after liver transplantation.

Material and subjects: a nutritional assessment was performed in 31 consecutive patients six months prior to undergoing orthotopic liver transplantation (OLT) at a single center (Hospital U. Río Hortega) and after six months of OLT (December 2002-June 2004). The nutritional evaluation included Subjective Global Assessment (SGA), Mini Nutritional Assessment test (MNA), anthropometry, laboratory tests, and three-day diet diary completed. The body composition analysis was performed by tetrapolar body electrical bioimpedance and skin folds in a standard way.

Results: our patients had an average age of 56.2 ± 8.11 years; weight was 72.9 ± 15.3 kg, and body mass index was 26.6 ± 4.1 . The anthropometric evaluation showed the following data: tricipital skin fold 12.2 ± 6.1 mm, mid-arm circumference 24.5 ± 4.1 cm, fat-free mass 54.5 ± 10.9 kg, fat mass 18.4 ± 6.5 mm, and body water 41.4 ± 9.1 kg. After six months from liver transplantation, these parameters remained unchanged. Energy intake, as corrected by weight, was similar pre- and post-liver transplantation (28.1 ± 6 kcal/kg vs. 27.5 ± 5.8 kcal/kg; ns). Albumin, pre-albumin and transferrin improved after 6 months from transplantation. Length of stay in hospital was 22.4 ± 14.9 days, and length of stay in ICU was 0.7 ± 1.7 days. The nutritional status (SGA and MNA tests) of patients did not influence length of stay in either hospital or ICU. No intercurrent events (infections: urinary tract infection, pneumonia, and peritonitis) were recorded during the 6-month study period. Two patients died after liver transplantation (6.5%), and 3 patients had acute rejection (9.6%). Patients with malnutrition (SGA and MNA tests classification) showed no differences in rejection and mortality.

Conclusions: our liver transplantation population had normal nutritional status and dietary intake. Nutritional parameters showed no association with outcomes after liver transplantation. Liver transplantation improved serum protein levels and did not modify weight or dietary intake. Further studies are needed to

clarify the role of liver transplantation on nutritional status and of nutritional status on liver transplantation outcomes, considering different populations of patients.

Key words: Dietary intake. Liver transplantation. Nutritional status.

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INTRODUCTION

Chronic liver disease may be associated with malnutrition (1), the severity of which ranges from subclinical status to overt energy-protein malnutrition. In patients with decompensated cirrhosis, protein-energetic malnutrition is universal with low dietary intakes (2).

The presence of energy-protein malnutrition has been associated with increased morbidity and mortality in patients undergoing liver transplantation (3,4). Preoperative malnutrition has been reported to be associated with length of stay in intensive care units (4) and mortality (5). Screening for malnutrition has been proposed as a part of liver transplantation protocols.

Developing such a strategy has been unclear due to the heterogeneity of methods to assess nutritional status. Much of the difficulty in identifying an optimal method for nutritional assessment in patients with cirrhosis arises from the fact that many of the traditionally measured parameters of nutritional status vary with severity of liver disease.

The aim of our study was to examine, in a prospective way, whether some nutritional parameters could predict clinical parameters after liver transplantation.

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SUBJECTS AND METHODS

Patients

A nutritional assessment was performed in 31 consecutive patients six months prior to undergoing orthotopic liver transplantation (OLT) at a single center (Hospital Universitario Río Hortega) and in the first nutritional revision, after six months from liver transplantation (December 2002-June 2004). Patients underwent a nutritional evaluation and a body composition analysis. The nutritional evaluation included Subjective Global Assessment (SGA), Mini Nutritional Assessment test (MNA), body composition analysis, laboratory tests, and a three-day diet diary completed. The body composition analysis was performed by tetrapolar body electrical bioimpedance and skin folds in a standard way.

Weight and anthropometric data

Body weight was measured to an accuracy of 0.5 kg, and body mass index was computed as body weight/(height)² (2). Regional changes in body mass were estimated by measuring the tricipital skin fold of the forearm, and midarm circumference (6).

Body composition analysis

Tetrapolar body electrical bioimpedance was used to determine body composition (7) using a specific equation. An electric current of 0.8 mA and 50 kHz was produced by a calibrated signal generator (Biodynamics Model 310e, Seattle, WA, USA) and applied to the skin using adhesive electrodes placed on the right-side limbs. Resistance and reactance were used to calculate total body water, fat, and fat-free mass.

Biochemical parameters

A basal blood sampling was performed at the same time as the nutritional status study to measure albumin (3.5-4.5 g/dl), prealbumin (18-28 mg/dl), transferrin (250-350 mg/dl), and lymphocytes (1.2-3.5.10³/uL) with an autoanalyzer (Hitachi, ATM, Mannheim, Ger).

Dietary intake

All patients were instructed to keep a three-day diet diary to record food, incorporating the use of food scales to enhance portion size accuracy. Records were reviewed by a dietician and analyzed with our own computer-based data-evaluation system. National composition food tables were used for reference (8). Before and after liver trans-

plantation patients received an oral diet with 30 cal/kg/day and 1 g protein/kg/day.

SGA (subjective global assessment)

SGA was performed as described by Detsky and modified by Hasse (9,10). SGA comprises a nutritional evaluation of height, current weight, weight before illness, and weight change in the previous 6 months; nutritional history (appetite, intake, gastrointestinal symptoms); physical appearance (subjective assessment of fat loss, edema, muscle wasting, and ascites), and existing conditions (infections, encephalopathy, renal insufficiency). Based on this evaluation patients were classified into three groups: well nourished, mildly malnourished, and severely malnourished. Patients were classified into two groups: 0 (well nourished) and 1 (midly and severely malnourished).

MNA (Mininutritional Assessment Test)

The MNA test is composed of simple measurements and brief questions that can be completed in about ten minutes. These include: anthropometric measurements (weight, height, and weight loss), global assessment (six questions related to lifestyle, medication, and mobility); dietary questionnaire (eight questions related to number of meals, food and fluid intake, and autonomy of feeding), and subjective assessment (self perception of health and nutrition) (11). MNA scores distinguish between the following groups of patients: a) adequate nutritional status (MNA > 24); b) at risk of malnutrition: MNA between 17 and 23.5; and c) those with frank malnutrition: MNA < 17. Patients were classified into two groups: 0 (adequate nutritional status) and 1 (at risk of malnutrition and with overt malnutrition).

Outcomes

The following postoperative data were recorded: mortality at one year (from database of Admission Service), length of stay in ICU (days), length of stay in hospital (days), infection, acute cellular rejection (number of treated episodes). Infection was defined as any infection episode in which one or more organisms were identified, and requiring antibiotic treatment (pneumonia, urinary tract infection, and peritonitis). All episodes of acute rejection were diagnosed by biopsy.

Statistical analysis

Results were expressed as mean $\pm$ standard deviation. The distribution of variables was analyzed using the Kol-

mogorov-Smirnov test. Quantitative variables with normal distribution were analyzed with Student's *t* test. Non-parametric variables were analyzed using the Mann-Whitney *U* test. Discrete variables were analyzed with the Chi square test, with Yates correction as necessary, and Fisher's test. Pearson and Spearman test were used to study correlation among variables. A *p*-value below 0.05 was considered statistically significant.

RESULTS

Baseline evaluation

Thirty-one patients were enrolled in the study. Table I shows the demographic characteristics of the studied population. Our patients were predominantly males with a normal body mass index and weight.

Table I. Characteristics of patients with liver transplantation at baseline

Characteristics	Group <i>n</i> = 31
Age (yr)	56.2 ± 8.11
Weight (kg)	72.9 ± 15.3
Body mass index	26.6 ± 4.1
Sex (male/female)	25/6
Type of liver disease	
Viral cirrhosis	12
Alcoholic cirrhosis	17
Other	2
Child Pugh stage	
A	3
B	8
C	20

Anthropometric measurements and dietary intake

Anthropometric evaluation showed the following data: tricipital skin fold 12.2 ± 6.1 mm, mid-arm circumference 24.5 ± 4.1 cm, fat-free mass 54.5 ± 10.9 kg, and fat mass 18.4 ± 6.5 kg. After six months of liver transplantation, these parameters remained unchanged (Table II). No changes were detected in dietary intake for 6 months after transplantation (Table II). Energy intake, as corrected by weight, was similar (pre OLT: 28.1 ± 6 cal/kg vs. post OLT: 27.5 ± 5.8 cal/kg; ns).

Biochemical parameters

Albumin, prealbumin and transferrin improved after 6 months from transplantation (Table III).

Table II. Anthropometric parameters and dietary intake

	Basal time	Six months	<i>p</i>
Weight (kg)	72.9 ± 15.3	72.4 ± 15.1	ns
BMI (kg/m ²)	26.6 ± 15.3	26.4 ± 3.9	ns
Tricipital skinfold (mm)	12.2 ± 6.1	11.6 ± 4.8	ns
Mid-arm circumference (cm)	24.5 ± 4.1	23.7 ± 2.9	ns
Fat-free mass (kg)	54.5 ± 10.9	53.9 ± 10.2	ns
Fat mass (kg)	18.4 ± 6.5	18.5 ± 6.3	ns
Body water (kg)	41.4 ± 9.1	40.7 ± 8.3	ns
Calories per day	2017 ± 474	1993 ± 445	ns
Carbohydrates (g/day)	233.8 ± 58.1	1993 ± 445	ns
TCV 46.2%			
Proteins (g/day)	94.1 ± 28.8	94.2 ± 18.9	ns
TCV 18.6%			
Lipids (g/day)	81.9 ± 41.6	79.8 ± 22.9	ns
TCV 35.1%			

TCV: total caloric value.

Table III. Biochemical parameters

Parameters	Baseline	Six months	<i>p</i>
Albumin (g/L)	3.2 ± 0.7	3.8 ± 0.6	< 0.05
Prealbumin (mg/dl)	8.6 ± 4.7	19.5 ± 8.8	< 0.05
Transferrin (mg/dl)	190.8 ± 17.9	231.25 ± 21.1	< 0.05

Length of stay, intercurrent illness, and mortality

Length of stay in hospital was 22.4 ± 14.9 days, and length of stay in ICU was 0.7 ± 1.7 days. No intercurrent events (infections: urinary tract infection, pneumonia, and peritonitis) were recorded during the 6-month study period. The nutritional status of patients did not influence length of stay in hospital or ICU. This analysis was performed with SGA and MNA tests.

A total of 2 patients died after liver transplantation (6.4%), and 3 patients had acute rejection (9.6%). Patients with malnutrition (SGA and MNA tests classification) showed no differences in acute rejection and mortality.

Isolated parameters such as albumin, prealbumin, transferrin, weight, fat-free mass, and BMI did not correlate with any outcome parameters.

DISCUSSION

In our prospective study of nutritional status, dietary intake and outcome after liver transplantation, we did not find any associations. No single parameter of nutritional status or dietary intake was consistently associated with ICU stays, as Figueiredo et al. showed in their study (12).

The differences between the findings of some authors and ours are likely to be due to a combination of factors.

One-year mortality and frequency of infection was lower in our study when compared to other studies (3,13). Although the basis of the higher mortality seen in previous studies is not clear, differences in patient populations are apparent. The main characteristics of our population were different from those of other studies (well nourished status, male sex, and alcoholic cirrhosis). Before and after liver transplantation, weight and body mass index had normal values, with no modification in body water.

Acute cellular rejection is a common complication after liver transplantation, seen in 60-70% of liver transplant recipients (14). In our study, acute rejection had a low incidence. This low incidence resulted in no association between nutritional status and rejection in our patients –perhaps a type-II error played a major role in our results. Bagthgate et al. (15) have detected that the only significant predictor of decreased likelihood of acute graft rejection in those patients was a decreased mid-arm muscle circumference. Our patients had a better mid-arm circumference and a lower incidence of rejection.

Several parameters that are frequently used to assess nutritional status in patients with cirrhosis were not useful in predicting outcomes. Similar to other investigators, we explored the possibility of combining several tests into an index of nutritional status (16-19). We were not able to identify any combination of parameters, such as the SGA test or MNA test, capable of identifying patients at increased risk of adverse posttransplant outcomes. Our results were similar to those reported by Abbott et al. (20); however other authors found a positive association between SGA test scores and length of stay (21). Perhaps the normal nutritional status of our patients pre-transplantation produced this lack of association.

Adequate oral intake would reduce the need for artificial nutrition in these patients. There are several studies supporting the view that a modified eating pattern with four to seven small meals, including at least one late-evening carbohydrate-rich snack, improves nitrogen economy and partially reverses abnormal substrate oxidation in cirrhotic patients (17). However, the feasibility of these dietary modifications in cirrhosis is not well established, since there is only limited information about spontaneous energy intake patterns in these patients. In our population, energy intake (2000 cal/day) and macronutrient distribution had adequate values. When Madden et al. (22) measured resting energy expenditures (REE) by indirect calorimetry in 100 cirrhotic patients, mean REE was 1660 ± 337 cal/day. Le Cornu et al. (23) showed that pretransplant enteral supplementation did not increase nutritional intake and had no effect on outcome after liver transplantation. The still-insufficiently known relationship between nutritional status and extent of liver dysfunction is of great interest. In our country few studies have evaluated this area (24), and our group is the first to show data on liver transplantation in Spain.

In conclusion, our liver pre-transplantation population had a normal nutritional status and dietary intake. Nutri-

tional parameters showed no association with outcomes after liver transplantation, perhaps due to this normal nutritional status. Liver transplantation improved seric protein levels and did not modify weight and dietary intake in our sample. Further studies are needed to clarify the role of liver transplantation on nutritional status, and of nutritional status on liver transplantation, considering the various populations of patients.

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