Nutritional integration in liver transplantation for 14 year old children in the 108 Military Central Hospital: A case report

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Summary

A 14 year old girl diagnosed with primary biliary cirrhosis, gastrointestinal bleeding, and esophageal varices underwent an assessment of her nutritional status using SGA, BAZ (Body Mass Index for age), and MUAC (Middle Upper Arm Circumference). Prior to transplantation, her SGA score was categorized as C, her BAZ was -1.63 standard deviations, and her MUAC measured 18.5cm. Patients receive specialized care tailored to the different stages of their condition following transplantation. In the early post-transplant period, nutritionists employ a combination of enteral and parenteral nutrition. By the end of the first week after surgery, the patient's total energy intake reached 1582.7 kcal, with a protein intake of 1.7g/kg, and her SGA score improved to B. Starting from Day 21, protein and energy intake increased to 2.4g/kg and 30kcal/kg/24h, respectively. Upon discharge, the patient exhibited enhanced nutritional status, with an SGA score of B, a BAZ of -1.56 standard deviations, and a MUAC measurement of 20.0cm. She also experienced a weight gain of 1.5kg within one month of leaving the hospital. Consequently, the implementation of a Nutritional Management Plan, structured around the distinct stages of liver transplantation, is of paramount importance, particularly for pediatric patients.

Keywords: Liver transplantation, nutritional status, nutritional management plan.

1. Background

Liver transplantation (LTx) is a well-established treatment for patients with end-stage liver disease [3, 4]. Biliary atresia accounts for most chronic liver failure cases in children, and many of these patients require liver transplantation while on the waiting list [9]. Pediatric liver transplantation represents 10-15% of all liver transplants in this age group [4]. The one-year survival rate following pediatric liver transplantation is approximately 90%, remaining 75% up to 15 years post-transplantation [9]. Malnutrition is a common chronic liver disease complication associated with prolonged hospital stays, increased post-transplantation infection risk, higher mortality rates, impaired mobility, and linear growth deficits [5, 9]. Therefore, implementing a nutritional intervention strategy is crucial in the perioperative to postoperative period of pediatric liver transplantation to optimize nutritional support [13].

We have writen this report with the aim of: Sharing experiences in implementing a nutritional management plan structured according to individual liver transplant stages. is of particular importance, especially for pediatric patients.

2. Case presentation

A girl born in 2005 with a height of 1.52 meters and a weight of 36.0 kilograms, diagnosed with primary biliary cirrhosis, gastrointestinal bleeding, oesophageal varices, Child-B classification, and a MELD score of 21. Her medical history included

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severe jaundice and a six-month period of decreased weight, during which she dropped to 12 kilograms. She exhibited fatigue, a prolonged history of being a picky eater, aversion to food smells, anorexia, and pale stools. Over the past two years, she experienced gastrointestinal bleeding on 17 occasions and had limited physical activity. Prior to her enrollment at the 108 Military Central Hospital, she did not receive any nutritional counseling or interventions. Her nutritional risk screening score (NRS-2002) was six. The assessment of her nutritional status in children was conducted using the Subject Global Assessment form (SGA) and the Body Mass Index-for-age Z-scores (BAZ), which indicated values below -2 standard deviations based on the WHO Child Growth Standard [12].

Nutritional therapy was divided into three distinct phases, each with specific objectives [11]:

(I) Pre-transplantation phase: This phase aims to provide sufficient nutrients to prevent severe complications resulting from the original end-stage liver diseases.

(II) Short-term post-transplantation phase: The focus is on providing adequate energy and protein to meet the recommended dietary allowance (RDA).

(III) Long-term post-transplantation phase: This phase focuses on supplying essential nutrition to support catch-up growth and enhance the quality of life for these pediatric patients.

Table 1. Recommendation diet allowance for pediatric undergoing liver transplantation [2, 11] ESPEN 2019

	Preoperation	Acute postoperation	Post-transplantation
Energy (E)	1.3 x BEE [7] 30-35kcal/kg [11]	30–35kcal/kg 1.2 × BEE [13]	1.5 x BEE
Protein (P)	0.29g per cm height or 1.2 - 1.5g/kg weight [1, 11]	1.5g/kg [11]	2-3g per kg of body weight [13]
BCAA	16% protein [3]	0.25g/kg [11]	0.25g/kg [11]
Fat (F)	1g/kg/day 30% E [3, 10]	1-4g/kg/day 15-30% E [11]	5-6g/kg/day[13]
Carbohydrate (C)	50-65% E	6-8g/kg/day [13] 50-65% E	6-8g/kg/day
Fluid	1500ml	1000-1500 ml	1500ml

*BEE (Basal Energy Expenditure) = 655 + (9.56 × weight in kilogram) + (1.85 × height in centimeters) - 4.68 × age in years = 1222kcal.

Nutritional status

Various methods were employed to evaluate the nutritional status during the follow-up period, as outlined in Table 2.

Table 2. Nutritional status assessment

Indicators	Pre-LTx	The first-week post-LTx			Post-LTx		
		D-0 to D-2	D-3	D-7	D-14	D-28	D-60
Weight	36	36	36	35	35	36	37.5
Height-for-age*, SD	-1.09	-1.10		-1.10	-1.11	-1.13	-1.15
BMI-for-age*, SD	-1.63	-1.9		-2.18	-2.18	-2.2	-1.56

Indicators	Pre-LTx	The first-week post-LTx			Post-LTx		
		D-0 to D-2	D-3	D-7	D-14	D-28	D-60
MUAC, cm	18.5	-		-	-	18.0	20.0
Muscle loss (triceps)	Mode-rate	Mode-rate	Mode-rate	Mode-rate	Mode-rate	Mode-rate	Low
Weight loss	6kg/ months					1kg/1 month	increase 1.5kg
Energy Dietary intake	60% RDA	No EN	36% RDA	60% RDA	100% RDA	100% RDA	111% RDA
Gastrointestinal symptoms							
None					×	×	×
Nausea	×		×				
Vomiting	×		×				
Diarrhea			×	×			
Anorexia	×		×				
Progression			Getting worse	Unchan ged	Getting better	Getting better	Unchan ged
SGA	C		C	C	B	B	B

*The BAZ and HAZ were calculated based on WHO Growth Standard 2007 [12].

Nutrition support in pre-transplantation

The patient underwent 14 days of pre-surgery care. During this time, Patients received 14 days of preoperative care to support physical condition, improve nutritional status and limit the risk of refeeding syndrome. Electrolytes were closely monitored and were within normal limits (Mg^{2+}: 0.81mmol/l, Na^{+}: 107.4mmol/l, K^{+}: 4.1mmol/l). The ideal weight was determined using the BAZ standard for 14-year-old children, estimated at 40kg [12]. The dietary composition included 25% fat and 55% carbohydrates as a percentage of total energy, with daily water consumption limited to 1.5 litres [2]. The diet plan involved six meals daily, consisting of liquid foods such as soup, porridge, fruit smoothies, and specialized formula milk for liver disease patients (Leanmax-Ligos). Given the implications of the disease, the oral diet was designed to provide 60% of the Recommended Dietary Allowance (RDA). The actual energy intake was calculated using the Vietnamese Food Composition data [8]. Consequently, parenteral feeding using Branched-Chain Amino Acids (BCAA) was administered to meet the protein requirements and maintain weight.

Before the transplantation, the patient's nutritional status was assessed as SGA-C, weighing 36kg, albumin: 39.2g/l, protein 69.7g/l. Table 3 shows details on the practical dietary support provided during this period.

Table 3. The practical dietary support provided during followup

Contents	Pre-LTx	The 1st-week post-LTx			Post-LTx			
		D1 to D2	D3	D4 to D7	D8 to 14	D15 to 21	D21 to 28	D-60
Energy by RDA, Kcal	1600	1500			1500	1800		
Parenteral								
Glucose 5%, ml		500	500	125	125	125		
Albumin 20%, ml		200	200	200				
Aminoleban 8%, ml		250	250					

Contents	Pre-LTx	The 1st-week post-LTx			Post-LTx			
		D1 to D2	D3	D4 to D7	D8 to 14	D15 to 21	D21 to 28	D-60
Type of diet (number of servings)								
Solid meal (rice + food)	2				1-2	2	2	2
Porridge/ soup/ liquid	1		6	5	4	2	1	1
Leanmax Ligos, 33g/serving	1			1-2	1-2	2	3	2
Detailed ingredients								
Rice, g	100		60	60	230	250	250	300
Mung bean, g				60	50	40	40	40
Dried Lotus seed, g					25	60	60	40
Meat, g	30			30	70	150	150	200
Freshwater Fish, g	100				100 2 times	100 4 times	100	100
Egg, g	50			50			3 eggs/ a week	3 eggs/ a week
Vegetables, g	200			100	250	250	250	
Fruits, g	200							200
Cooking oil, ml	5			9	12	9	9	9
Salt, g	3		2	4	4	4	4	4
Dietary energy, Kcal*	968	340	546	902	1583	1859	2000	2000
Dietary protein, g/kg/24h*	1.2	1.5	1.6	1.7	1.6	2.3	2.4	2.3
Vitamins, minerals (Cenevit)	Basic dose							

*The energy and nutrients was calculated based on Vietnamese Food composition table [8].

Nutritional support in the ICU (The first week of post-transplantation)

She received the right liver from her father as an honorary donor. Within 24 hours after the procedure, the patient experienced gastrointestinal motility, but enteral feeding was delayed until 48 hours post-surgery due to episodes of nausea and vomiting. Initially, the patient's diet consisted of a liquid mixture comprising rice and water at a ratio of 1:15. This liquid diet was administered six times a day, with each serving amounting to 50ml, providing 100kcal. Additionally, she received a 500ml infusion of 5% glucose (100kcal).

Starting from Day 3 (D-3), her diet transitioned to a liquid food and formula combination, including LeanMax Ligos (33g) mixed with 150ml of water. The total energy intake during this period was 300kcal. Throughout D-3 to D-7, the patient's energy and protein intake were gradually increased. She experienced symptoms such as jaundice, pain, loss of appetite, nausea, and vomiting, which led to her occasionally skipping meals. She consumed approximately 50% of her diet, equivalent to an estimated 800kcal, with a protein intake of 0.8 grams per kilogram daily.

Nutritional support in post-transplantation

After seven days in the ICU, she was transferred to a regular patient room. During this time, she showed improvement, with reduced pain, diminished anorexia, an increased appetite, and an emphasis on high protein supplementation. Her diet consisted of a combination of liquid and soft foods, four daily meals, and two formula-based meals (33g in 150ml). The overall energy intake amounted to 1300kcal, maintaining an appropriate balance of proteins, fats, and carbohydrates (P:F:C). She consumed around 70% of the oral diet, prompting the addition of parenteral protein nutrition to ensure she received an adequate amount. The protein intake was calculated at 1.2 grams per kilogram daily, and fluid intake reached 1.5 litres daily. Her improved nutritional status was evident with an SGA score of B, Electrolytes have limited value. Refeeding syndrome was not encountered, protein levels at 54g/l, and albumin levels at 44.2g/l.

Starting from Day 11, her diet transitioned to a mixture of liquid and solid foods, including porridge and rice, tailored to her dietary preferences. The porridge was prepared with rice (20g), mung beans (green bean, red bean), lotus seeds (10g), and poultry meats (20g). Total daily energy intake aligned with recommended dietary guidelines at 30-35kcal per kilogram per day. Her appetite continued improving, and she consumed nearly all of her oral diet. Protein intake was primarily derived from food sources like beans, fish, and eggs. Her daily meals consisted of four main meals (two porridge and two with rice, including various foods like rice, a main dish, and vegetables), supplemented by two formula-based meals. The diet plan was continuously adjusted to support her liver function and meet her dietary requirements.

By Day 14, her caloric intake had increased to 1800-2000kcal, with a protein intake of 2 grams per kilogram per day. Vitamins were sourced from vegetables and mung beans, with limited fruit consumption for food safety reasons. Her appetite remained normal throughout this period, showing no signs of jaundice. Her blood indicators consistently fell within the normal ranges. Protein levels at 75.6g/l, and albumin levels at 46.3g/l.

This dietary regimen continued until her discharge on Day 28, at which point her SGA score remained at B, her weight was 36kg, and her MUAC measured 20cm. One month after discharge, she exhibited continued improvement, maintaining an SGA score of B and achieving a weight gain of 1.5kg. Protein 72.0g/l, and albumin levels at 45.9g/l. Liver function was good. Essential nutritional consultations were scheduled monthly to ensure her ongoing well-being.

3. Discussion

The nutritional status of patients with ESLD is adversely affected by factors such as the healing process, recovery duration, and increased mortality risk following liver transplantation [7, 9, 11]. It is essential to screen and assess the nutritional status of these patients using validated tools, with recommendations including NRS-2002, MUST and SGA [11]. For pediatric patients, the Height for age (HAZ) and BMI for age (BAZ) was calculated instead of BMI as adults, with evaluation based on the The WHO Child Growth Standard [6, 12].

Based on the results obtained from SGA, a tailored nutrition management plan is developed for the patient. In this case, the patient's HAZ was -1.09, higher than the mean HAZ of -2.21 reported in a Canadian study [6]. This study highlighted that achieving an identified height at transplant was the most critical predictor of catch-up growth. Consequently, the nutrition management plan was adjusted to target the 25^{th} and 50^{th} percentiles for both height [6] and weight during 12 months post-transplantation [3], necessitating intensive nutritional support.

A specialized diet was customized to align with the patient's eating habits, appetite, and evolving disease status. However, maintaining an adequate energy diet proved challenging due to the patient's weakened liver function, frequent bleeding episodes, and declining protein synthesis. Energy and nutrient requirements were adjusted for

Vietnamese children according to guidelines from ESPEN, the United States of America, and Vietnam [2, 7, 11]. Various formulas were used to calculate these requirements, all yielding similar results. The intervention in preoperation focused on assuring the maximum energy diet via oral feeding to avoid weight loss, and muscle atrophy pre-operation, to reduce the implications in post-transplantation and promote wound healing. As a result, her weight remained for the two weeks before transplantation.

Following transplantation, early normal or enteral nutrition intake within 24 hours is recommended according to ESPEN guidelines [11]. However, due to the patient's severe stress, wound pain, ascites, and vomiting, enteral nutrition was delayed until 48 hours post-surgery. Total parenteral nutrition was administered during the first two days after transplantation. On Day 3, the patient was given her first oral liquid, which was low in energy (20kcal per 100ml) to prevent refeeding syndrome-related complications. In the first week postoperatively, the patient consumed less than 60% of the Recommended Dietary Allowance (RDA). Parenteral nutrition with protein supplements was introduced to achieve the RDA, considering the basal metabolic rate and catabolism requirements in ESLD patients [1]. The fat content from prepared foods met the recommended fat intake. Several studies have shown that unexpected weight loss can occur during transplantation, ranging from 2 to 9 kg [1, 11]. To prevent uncontrolled weight loss, intensive daily nutrition support was provided, with necessary modifications made as needed. As a result, significant weight loss was minimized.

In the subsequent weeks, there was an improvement in the patient's liver function, and she began feeling better, which allowed her to resume eating regular meals. During this period, there was no need for protein supplementation through parenteral nutrition. Her customized diet was developed based on her dietary preferences and the recommended dietary guidelines for liver disease in Vietnam [2]. The primary protein sources in her diet were fish, eggs, and BCAA-enriched formula. She also incorporated nutrition supplement products for liver disease into her diet, typically 1-2 times daily, to meet the BCAA requirement of 0.25g/kg/day [11]. Although she attempted to include some rice in her diet, her intake was limited this time. Consequently, her diet was divided into 6-8 meals featuring soft foods like porridge, soup, and formulas. She managed to consume around 70% of the provided diet. In instances where she declined animal protein, only 30g of meat was consumed, and she replaced vegetable protein with mung beans and lotus seeds. A nutritious porridge was prepared using mung beans, lotus seeds, and rice. These ingredients possessed an umami flavour and emitted fewer cooking odours, making it easier for the child to consume her meals and increase her intake. While the child was being fed, there was a belief that the consumption of eggs and prawns resulted in lighter-coloured skin around the wound area. Consequently, these foods were temporarily excluded from her diet during this period.

Starting from Day 14, as the liver function improved, her daily energy intake gradually increased from 1500kcal/day to 2000kcal/day within a week, and her protein intake reached 2g/kg/day [13]. A seven-day menu plan was created, and the quantity of food consumed was adjusted through sub-meals served with porridge or soup. The dietitian visited the patient every two days, counselling the mother and explaining the nutritional content of various foods, including eggs, prawns, and others. An exchange-food list was introduced to the mother to assist her in creating a menu for the child using locally available ingredients. Due to intensive nutrition counselling, the child agreed to reintroduce eggs into her diet by Day 21. However, prawns were not reintroduced because the child had never consumed them before and did not like their taste despite attempting various preparation methods (steaming, frying, grilling). The energy diet was maintained until the patient's discharge on Day 28. The allograft's function continued to improve steadily. After discharge, the dietitian provided ongoing phone

consultations and supported the child's transition to her daily routine. One month after discharge, the patient had gained 1.5kg in weight.

4. Conclusion

In conclusion, managing a pediatric patient undergoing liver transplantation is a comprehensive endeavour, encompassing a range of intricate nutritional considerations. The patient's journey exhibited notable improvements in her nutritional status, evident through positive shifts in her SGA score, weight gain, and overall well-being. Adopting a nutrition management plan structured around the three stages of liver transplantation, focusing on flexibility and alignment with the patient's dietary habits and locally available food, has shown promising initial effects on liver function and has contributed to improving the nutritional status of pediatric patients. More research is needed to have a general nutritional intervention regimen for pediatric liver transplant patients.

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