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Nutritional Assessment in Chronic Liver Diseases

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ABSTRACT

Rationale: *Chronic liver disease (CLD) in children significantly disrupts hepatic functions essential for maintaining nutritional homeostasis, notably the synthesis, storage, and metabolism of macro- and micronutrients. These impairments commonly result in protein-energy malnutrition and growth retardation, both of which contribute to heightened morbidity, delayed neurodevelopment, immune dysfunction, and unfavorable post-transplant outcomes. In this context, we conducted a retrospective descriptive study over a three-year period (November 2020 to November 2023) in a pediatric gastroenterology and nutrition department, aiming to evaluate the nutritional status of children with CLD and explore associations with underlying etiologies.*

The study included 64 children aged 1 month to 13 years (mean age: 33.5 months; M: F sex ratio = 1.2). Data collection focused on anthropometric parameters (weight, height, BMI, Waterlow index, and mid-upper arm/head circumference ratio), clinical signs, biological markers (including albumin, total proteins, cholesterol, calcium, phosphorus, ferritin, and fat-soluble vitamins), and nutritional interventions. Malnutrition was identified in more than 80% of patients, with moderate to severe forms particularly prevalent among those with metabolic liver diseases and biliary cirrhosis. Clinically, the most frequently observed signs included pallor (49%), ascites (35%), edema (31%), and muscle wasting (20%), often masked by fluid retention. Biochemical abnormalities were also common, with hypoalbuminemia in 31%, hypoproteinemia in 35%, and vitamin D deficiency in 22% of cases. The predominant etiologies were biliary cirrhosis (39%)—notably biliary atresia—and metabolic liver diseases (35%).

Nutritional management primarily consisted of supplementation with fat-soluble vitamins (D in 76%, K in 80%, A and E in 68%), iron (52%), and the use of medium-chain triglyceride-enriched diets in cholestatic patients. The findings underscore the high prevalence of malnutrition in pediatric CLD, particularly in biliary and metabolic forms, and highlight the necessity of early, targeted nutritional assessment and intervention as an integral part of the comprehensive care strategy for these patients.

Keywords

Nutritional assessment, Chronic liver disease, Malnutrition, Nutritional status.

Introduction

The liver plays a central role in nutritional homeostasis due to its multiple metabolic functions, which include the synthesis, storage, breakdown, and regulation of macro- and micronutrients [1,2]. Chronic liver disease disrupts these functions, resulting in significant nutritional disturbances. In children, these disturbances primarily manifest as protein-energy malnutrition and impaired statural and weight growth [3,4]. Such complications increase morbidity and mortality, impair quality of life, weaken the immune system, hinder neurocognitive development, and raise the risk of postoperative complications, especially after liver transplantation [5]. Therefore, nutritional assessment and management in children with chronic liver disease must be considered fundamental components of comprehensive treatment. This study aims to

evaluate the nutritional status of children with CLD in detail by analyzing anthropometric, clinical, and biological parameters. We also aim to correlate these findings with the different underlying hepatic etiologies.

Methodology

A retrospective descriptive study was conducted over a three-year period, from November 2020 to November 2023, within the Department of Pediatric Gastroenterology and Nutrition. The objective was to evaluate the nutritional status of children with chronic liver disease (CLD) and its association with underlying etiologies.

Inclusion Criteria

All children aged between 1 month and 13 years with a confirmed diagnosis of chronic liver disease, regardless of etiology, were eligible for inclusion. Patients with incomplete medical records were excluded.

Data Collection

Clinical data were extracted from medical records using a standardized data collection form. The parameters analyzed included:

- **Anthropometric measurements**: weight, height, body mass index (BMI), Waterlow index (height-for-age), and mid-upper arm circumference/head circumference (MUAC/HC) ratio for children under four years.
- **Clinical signs of malnutrition**: including pallor, edema, ascites, and muscle wasting.
- **Biological parameters**: serum albumin, total protein, ferritin, calcium, phosphorus, cholesterol, and levels of fat-soluble vitamins (A, D, E, K).
- **Nutritional management** : details on dietary interventions and micronutrient supplementation.

Study Population

A total of 64 pediatric patients were included in the study. There was a slight male predominance (male-to-female ratio: 1.2), with a mean age of 33.5 months (range: 1 month to 13 years). The average follow-up duration was two years, ranging from one to four years.

Results

Analysis of nutritional parameters revealed a high prevalence of malnutrition among the studied children. Mild malnutrition predominated in children with autoimmune hepatitis (21%), indicating a moderate impact on nutritional status. Moderate malnutrition was most frequent in cases of biliary cirrhosis (50%), while severe malnutrition was particularly prevalent in children with metabolic liver disease (36%), highlighting the significant nutritional burden in this group.

The most commonly observed clinical signs were mucocutaneous pallor (49%), edema (31%), muscle wasting (20%), and ascites (35%), reflecting advanced nutritional deficiency often masked by fluid retention.

The most frequent biological abnormalities were hypoalbuminemia (31%), hypoproteinemia (35%), hypocholesterolemia (14%), hypocalcemia (11%), and hypophosphatemia (3%). Iron-deficiency anemia was present in 52% of children, and vitamin deficiencies were identified: vitamin D (22%), vitamin A (1.5%), and vitamin E (1.5%), confirming the extent of metabolic impairment.

The main identified etiologies were biliary cirrhosis (39%), metabolic liver disease (35%), autoimmune hepatitis (10%), and indeterminate causes (16%). Among biliary cirrhosis cases, biliary atresia accounted for the majority (64%), followed by Alagille syndrome (16%), genetic cholestasis (16%), and sclerosing cholangitis (4%).

Regarding nutritional management, fat-soluble vitamin supplementation was initiated in most children: vitamin D (76%), vitamin K (80%), and vitamins A and E (68% each). Iron supplementation was prescribed in 52% of cases, and zinc in 3.1%. Albumin infusion was administered in 31% of cases in the context of severe hypoalbuminemia. From a dietary perspective, children with chronic cholestasis received diets enriched with medium-chain triglycerides (MCTs) and maltodextrin. Those with tyrosinemia followed a diet restricted in tyrosine and phenylalanine (21%), while a galactose-free diet was introduced in children with galactosemia (1.5%).

Discussion

Malnutrition is a common and severe complication of chronic liver diseases (CLD) in children. According to available studies, its prevalence ranges from 50% to 85%, particularly among children with cholestasis or metabolic liver disorders [6,7]. In our study, over 80% of children with CLD were found to have some form of malnutrition, a rate consistent with data reported in the literature. One study reported impaired linear and weight growth in 68% of children with cirrhosis [8], while another estimated that severe malnutrition affects 30% to 50% of pediatric patients with CLD [6]. Similar findings were reported elsewhere, underscoring the high prevalence of nutritional impairment in this population [9].

Pathophysiological mechanisms underlying malnutrition in CLD are multifactorial and interconnected. Anorexia is common and may result from systemic inflammation, hepatomegaly, prolonged medication use, or gastrointestinal symptoms such as nausea and bloating [7,10]. In children with cholestatic liver diseases such as biliary atresia or Alagille syndrome fat malabsorption is frequently observed due to reduced bile secretion [11,12]. This leads to deficiencies in fat-soluble vitamins (A, D, E, and K), which were also noted in our study, with vitamin D and vitamin A deficiencies present in 22% and 1.5% of children, respectively. These results are aligned with previous studies that reported 30–40% of children with chronic cholestasis suffer from fat-soluble vitamin deficiencies [12,13].

Hypercatabolism and Muscle Mass Loss

Protein hypercatabolism is another significant contributor to malnutrition in hepatic insufficiency. Chronic inflammation

increases both energy and protein demand while suppressing anabolic pathways [7,11]. Muscle wasting is a key clinical sign of malnutrition but may be obscured by ascites or edema. In our study, muscle wasting was identified in 20% of patients, a figure likely underestimated, particularly in children under five years, where body composition assessment is more challenging [14]. Upper-arm circumference (UAC), and the UAC/head circumference ratio, are useful indicators of malnutrition in young children [8]. These parameters helped reveal nutritional deficiencies masked by fluid retention. Regular monitoring of these anthropometric markers is essential in children with CLD, especially in those being assessed for liver transplantation [9].

Nutritional Management

Nutritional management is critical for improving nutritional status and preventing long-term complications in children with CLD. Supplementation with fat-soluble vitamins is essential, particularly in cases of cholestasis. In our cohort, 76% received vitamin D and 80% received vitamin K supplementation, with satisfactory correction of deficiencies. Previous studies have shown that such supplementation improves clinical and biochemical outcomes in children with cholestasis [12,13].

The use of medium-chain triglycerides (MCTs) has proven effective in improving fat absorption in cholestatic children, especially those with bile acid insufficiency. MCTs are absorbed directly into the portal circulation, bypassing the need for bile [11]. We recommended that 30–50% of total fat intake consist of MCTs, in accordance with guidelines that advocate this strategy in managing chronic cholestasis [12].

In addition, children with metabolic liver diseases such as tyrosinemia, galactosemia, and Wilson disease require tailored dietary restrictions to prevent the accumulation of toxic metabolites. In our study, 21% of children followed a tyrosine- and phenylalanine-restricted diet due to tyrosinemia, while 1.5% followed a galactose-free diet to prevent complications related to galactosemia, in line with international guidelines [7,15].

Long-term Consequences

Uncorrected nutritional deficiencies in children with CLD may result in serious complications, including impaired linear growth, neurocognitive delay, and weakened immune function. These children are also at higher risk of post-transplant complications, reinforcing the importance of early and continuous nutritional support [6,11]. Additionally, fat-soluble vitamin deficiencies can worsen clinical outcomes, such as osteoporosis or night blindness, which are frequently observed in prolonged cholestasis [12,13].

Conclusion

This study confirms the high prevalence of malnutrition in children with chronic liver diseases, particularly in those with cholestasis and metabolic liver disorders. Nutritional support is essential to improve patient outcomes, promote growth, and reduce the risk of complications, particularly in the context of liver transplantation. Multidisciplinary collaboration including pediatricians, hepatologists, nutritionists, and dietitians is fundamental to optimize the care of children with CLD. Early correction of nutritional deficiencies contributes to a better long-term prognosis, reducing morbidity and mortality and enhancing quality of life.

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