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Original Research Article

Morphological Spectrum of Pediatric Liver Diseases: An Institutional Experience

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Abstract:

Background: Pediatric liver diseases encompass a broad spectrum of disorders with diverse etiologies, clinical presentations, and outcomes. Histopathological examination of liver biopsy specimens plays a crucial role in establishing the diagnosis, determining disease severity, and guiding clinical management. The present study was undertaken to evaluate the morphological spectrum of pediatric liver diseases encountered in a tertiary care institution.

Material and Methods: This retrospective descriptive study was conducted in the Department of Pathology of a tertiary care teaching hospital. A total of 112 liver biopsy specimens obtained from pediatric patients aged ≤18 years were included in the study. Relevant clinical details and laboratory data were collected from medical records. Biopsy specimens were fixed in 10% neutral buffered formalin, processed routinely, and stained with hematoxylin and eosin. Special stains were applied when indicated. Histopathological evaluation was performed to determine the morphological diagnosis and to assess the degree of hepatic fibrosis. Data were analyzed using descriptive statistics and presented as frequencies and percentages.

Results: Among the 112 cases, the majority of patients were in the 1–5 years age group (32.1%), followed by children younger than 1 year (25.0%). Males constituted 57.1% of the study population. The most common clinical indication for liver biopsy was persistent jaundice (33.9%), followed by hepatomegaly or hepatosplenomegaly (25.0%). Histopathological evaluation revealed neonatal hepatitis (23.2%) as the most frequent diagnosis, followed by biliary atresia (16.1%) and glycogen storage disease (12.5%). Non-alcoholic fatty liver disease (10.7%), autoimmune hepatitis (8.9%), and chronic hepatitis (8.9%) were also observed. When categorized broadly, cholestatic disorders accounted for 39.3%, followed by metabolic liver diseases (25.0%) and inflammatory liver diseases (17.9%). Evaluation of fibrosis demonstrated no fibrosis in 35.7%, mild fibrosis in 28.6%, moderate fibrosis in 21.4%, and advanced fibrosis or cirrhosis in 14.3% of cases.

Conclusion: Pediatric liver diseases show considerable histopathological diversity, with cholestatic and metabolic disorders being the most prevalent. Liver biopsy remains an essential diagnostic modality for accurate disease characterization and assessment of hepatic fibrosis in pediatric patients.

Keywords: Pediatric liver diseases, liver biopsy, neonatal hepatitis, biliary atresia, metabolic liver disease, histopathology.

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Introduction

Pediatric liver diseases represent a heterogeneous group of disorders that differ significantly from those encountered in adults with respect to etiology, clinical presentation, and disease progression. These conditions include congenital, metabolic, infectious, inflammatory, and obstructive hepatobiliary disorders that may manifest during infancy or childhood. Early recognition and accurate diagnosis are essential because many of these diseases can lead to chronic liver disease, cirrhosis, or liver failure if not appropriately managed [1,2].

The clinical manifestations of liver disease in children are often nonspecific and may include jaundice, hepatomegaly, hepatosplenomegaly, failure to thrive, or abnormal liver function tests. Although laboratory investigations and imaging techniques provide valuable information, they may not reliably establish the underlying etiology in many cases. Consequently, a comprehensive diagnostic approach integrating clinical, biochemical, radiological, and histopathological

findings is often required for definitive diagnosis [2,3].

Liver biopsy remains an important diagnostic modality in the evaluation of pediatric liver disorders. Histopathological examination not only aids in identifying the specific disease process but also helps in assessing the severity of inflammation, degree of fibrosis, and stage of liver damage. This information is crucial for determining prognosis and guiding therapeutic decisions in several pediatric hepatobiliary conditions [3,4]. Despite the increasing availability of non-invasive diagnostic tools, liver biopsy continues to play a pivotal role in selected cases where clinical and laboratory findings are inconclusive [5].

Several pediatric liver conditions such as neonatal hepatitis, biliary atresia, autoimmune hepatitis, and metabolic liver diseases show characteristic histopathological features on biopsy. Accurate interpretation of these features is essential for distinguishing between different etiologies of cholestasis, chronic hepatitis, or metabolic disorders, many of which have overlapping clinical presentations [4,6]. Furthermore, histological evaluation allows grading of necroinflammatory activity and staging of fibrosis, which are important determinants of disease progression and treatment response [5].

Studies from various centers have reported considerable variability in the distribution of pediatric liver diseases depending on geographic location, referral patterns, and diagnostic facilities. Institutional studies evaluating the histomorphological spectrum of pediatric liver biopsies contribute valuable information regarding the prevalence and patterns of liver diseases in a particular population [3,7]. Such data also assist clinicians and pathologists in improving diagnostic accuracy and optimizing patient management.

Therefore, the present study was undertaken to evaluate the morphological spectrum of pediatric liver diseases based on histopathological examination of liver biopsy specimens in a tertiary care institution, and to analyze their distribution across different age groups and clinical indications.

Material and Methods

Study Design and Setting: A retrospective descriptive study was conducted at a tertiary care teaching hospital to evaluate the histomorphological spectrum of pediatric liver diseases. The study included liver biopsy specimens received from pediatric patients for diagnostic evaluation over a defined study period.

Study Population and Sample Size: All liver biopsy specimens obtained from pediatric patients (≤18 years of age) and submitted to the histopathology laboratory during the study period were considered for inclusion. Based on the availability of biopsy material and adequacy of clinical records, a total of 112 liver biopsy specimens were included for final analysis. The sample size was considered appropriate for describing the morphological spectrum of pediatric liver diseases in an institutional setting and is comparable to previously published histopathological series in pediatric hepatology.

Inclusion Criteria

- Liver biopsy specimens obtained from patients aged 0–18 years.
- Biopsies performed for evaluation of unexplained liver dysfunction, cholestasis, hepatomegaly, suspected metabolic liver disease, or chronic liver disease.
- Specimens with adequate tissue for histopathological evaluation.

Exclusion Criteria

- Biopsy samples with insufficient tissue or extensive fragmentation preventing proper evaluation.
- Cases with incomplete clinical or laboratory information**.**
- Autolyzed or poorly preserved tissue samples.

Clinical and Laboratory Data Collection: Relevant clinical information was retrieved from medical records and biopsy requisition forms. Data collected included age, sex, presenting symptoms, clinical diagnosis, biochemical liver function parameters, and relevant radiological findings when available.

Specimen processing and Histopathological Examination: Liver biopsy specimens were fixed in 10% neutral buffered formalin, routinely processed, and embedded in paraffin. Sections of approximately 3–4 μm thickness were prepared and stained with hematoxylin and eosin (H&E) for routine histopathological examination. Special stains were applied whenever indicated to assist in the evaluation of specific pathological processes. These included Periodic Acid–Schiff (PAS) stain with and without diastase digestion for glycogen and alpha-1 antitrypsin inclusions, Masson's trichrome stain for assessment of fibrosis, and reticulin stain for architectural framework evaluation. Additional stains were used when required to support specific diagnostic considerations.

Histopathological Evaluation: All slides were examined independently by experienced pathologists using light microscopy. Histological features assessed included lobular architecture, hepatocellular injury, inflammatory activity, cholestasis, steatosis, fibrosis, and presence of specific diagnostic features suggestive of metabolic,

infectious, inflammatory, or obstructive liver diseases. Based on morphological findings and available clinical information, cases were categorized into major diagnostic groups such as metabolic liver diseases, neonatal cholestatic disorders, inflammatory conditions, biliary tract abnormalities, and miscellaneous hepatic lesions**.**

Statistical Analysis: Data were entered into a spreadsheet and analyzed using standard statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using mean and standard deviation where appropriate. Results were presented in tables and charts to illustrate the distribution of various pediatric liver diseases.

Results

The majority of cases were observed in the 1–5 years age group, accounting for 36 cases (32.1%), followed by 28 cases (25.0%) in children younger than one year. Children aged 6–10 years constituted 24 cases (21.4%), while 16 cases (14.3%) were in the 11–15 years age group. The least number of cases were observed in adolescents aged 16–18 years, comprising 8 cases (7.1%) (Table 1).

Among the 112 cases studied, 64 patients (57.1%) were males, while 48 patients (42.9%) were females, resulting in a male-to-female ratio of approximately 1.3:1 (Table 2).

The most frequent clinical indication for performing liver biopsy was persistent jaundice, observed in 38 cases (33.9%). This was followed by hepatomegaly or hepatosplenomegaly, seen in 28 cases (25.0%). Suspected metabolic liver disease accounted for 20 cases (17.9%), while unexplained elevation of liver enzymes was noted in 14 cases (12.5%). Evaluation for chronic liver disease was the indication in 12 cases (10.7%) (Table 3).

Histopathological examination demonstrated a diverse range of liver pathologies. Neonatal hepatitis was the most common diagnosis, identified in 26 cases (23.2%). Biliary atresia was the second most frequent condition, observed in 18 cases (16.1%). Glycogen storage disease was diagnosed in 14 cases (12.5%), while non-alcoholic fatty liver disease (NAFLD) was identified in 12 cases (10.7%). Both autoimmune hepatitis and chronic hepatitis were seen in 10 cases each (8.9%). Wilson disease accounted for 8 cases (7.1%), and other metabolic liver diseases were observed in 6 cases (5.4%). Cirrhosis was present in 5 cases (4.5%), while miscellaneous lesions constituted 3 cases (2.7%) (Table 4).

When grouped into broader categories, cholestatic disorders represented the largest proportion, comprising 44 cases (39.3%). Metabolic liver diseases accounted for 28 cases (25.0%), while inflammatory liver diseases were identified in 20 cases (17.9%). Fatty liver disease was observed in 12 cases (10.7%), and cirrhosis was present in 5 cases (4.5%). Miscellaneous conditions accounted for 3 cases (2.7%) (Table 5).

Assessment of hepatic fibrosis revealed no fibrosis in 40 cases (35.7%). Mild fibrosis was present in 32 cases (28.6%), while moderate fibrosis was observed in 24 cases (21.4%). Advanced fibrosis or cirrhosis was identified in 16 cases (14.3%) (Table 6).

Table 1: Age Distribution of Study Participants (n = 112)

Age Group (Years)	Number of Cases	Percentage (%)
<1 year	28	25.0
1–5 years	36	32.1
6–10 years	24	21.4
11–15 years	16	14.3
16–18 years	8	7.1
Total	**112**	**100**

Table 2: Sex Distribution of Study Participants (n = 112)

Sex	Number of Cases	Percentage (%)
Male	64	57.1
Female	48	42.9
Total	**112**	**100**

Table 3: Clinical Indications for Liver Biopsy (n = 112)

Indication	Number of Cases	Percentage (%)
Persistent jaundice	38	33.9
Hepatomegaly / hepatosplenomegaly	28	25.0
Suspected metabolic liver disease	20	17.9
Unexplained liver enzyme elevation	14	12.5
Chronic liver disease evaluation	12	10.7
Total	**112**	**100**

Table 4: Morphological Spectrum of Pediatric Liver Diseases (n = 112)

Histopathological Diagnosis	Number of Cases	Percentage (%)
Neonatal hepatitis	26	23.2
Biliary atresia	18	16.1
Glycogen storage disease	14	12.5
Autoimmune hepatitis	10	8.9
Non-alcoholic fatty liver disease (NAFLD)	12	10.7
Chronic hepatitis	10	8.9
Wilson disease	8	7.1
Metabolic liver disease (others)	6	5.4
Cirrhosis	5	4.5
Miscellaneous lesions	3	2.7
Total	**112**	**100**

Table 5: Distribution of Major Histopathological Categories (n = 112)

Category	Number of Cases	Percentage (%)
Cholestatic disorders	44	39.3
Metabolic liver diseases	28	25.0
Inflammatory liver diseases	20	17.9
Fatty liver disease	12	10.7
Cirrhosis	5	4.5
Miscellaneous	3	2.7
Total	**112**	**100**

Table 6: Degree of Hepatic Fibrosis Observed on Histopathology (n = 112)

Fibrosis Stage	Number of Cases	Percentage (%)
No fibrosis	40	35.7
Mild fibrosis	32	28.6
Moderate fibrosis	24	21.4
Advanced fibrosis / cirrhosis	16	14.3
Total	**112**	**100**

Discussion

Pediatric liver diseases comprise a diverse group of conditions with varying etiologies, clinical manifestations, and histopathological patterns. The present study evaluated the morphological spectrum of liver diseases in pediatric patients based on histopathological examination of liver biopsy specimens. Such institutional analyses are valuable for understanding the regional distribution and clinicopathological characteristics of pediatric hepatic disorders.

In the present study, the majority of cases were observed in younger children, particularly in the 1–5 years age group, with a male predominance. Similar demographic trends have been reported in several pediatric liver biopsy studies, where male patients constituted a slightly higher proportion of cases. For instance, a retrospective study analyzing pediatric liver diseases reported 61.4% male patients, indicating a comparable male predominance in pediatric hepatobiliary disorders [8]. The higher proportion of younger age groups observed in the present study may be explained by the early clinical manifestation of many congenital, metabolic, and cholestatic liver diseases during infancy and early childhood.

Persistent jaundice and hepatomegaly were the most common clinical indications for liver biopsy in this study. These findings are consistent with previous reports, which have shown that cholestatic jaundice and suspected biliary obstruction are among the leading indications for performing liver biopsy in pediatric patients [9]. Liver biopsy continues to play a crucial role in the diagnostic evaluation of pediatric cholestasis, particularly when clinical, biochemical, and imaging findings are inconclusive.

The present study demonstrated that neonatal hepatitis and biliary atresia were among the most frequent histopathological diagnoses. Neonatal cholestasis is a significant clinical problem in infants, and differentiating biliary atresia from other causes of cholestasis remains a critical diagnostic challenge. Histopathological examination of liver biopsy specimens is considered an essential component in the evaluation of neonatal cholestasis because specific histological features such as ductular proliferation, bile duct plugs, and portal fibrosis may help distinguish biliary atresia from other conditions [10,11]. Studies have reported high diagnostic accuracy of liver biopsy in differentiating biliary atresia from neonatal hepatitis and other causes of infantile cholestasis.

In the present study, metabolic liver diseases, including glycogen storage disease and Wilson disease, constituted a substantial proportion of cases. Metabolic disorders are well-recognized causes of pediatric liver disease and frequently present with hepatomegaly, abnormal liver function tests, or progressive liver dysfunction. Previous studies evaluating pediatric liver biopsy specimens have also reported metabolic disorders as an important category of pediatric liver disease, particularly in infants and young children [12].

Another notable finding in the present study was the presence of inflammatory liver diseases such as autoimmune hepatitis and chronic hepatitis. Autoimmune hepatitis is an increasingly recognized cause of chronic liver disease in children and may present with elevated liver enzymes, hepatomegaly, or features of chronic hepatitis on histopathology. Liver biopsy remains essential for confirming the diagnosis and for assessing the degree of inflammatory activity and fibrosis [13].

Evaluation of hepatic fibrosis in the present study revealed varying degrees of fibrosis ranging from mild to advanced stages. Histological assessment of fibrosis is important in determining disease severity and prognosis in pediatric liver disorders. Although several non-invasive methods for fibrosis assessment have been introduced, liver biopsy remains the reference standard for staging hepatic fibrosis in many pediatric liver diseases [14].

Overall, the findings of the present study highlight the wide histopathological diversity of pediatric liver diseases and underscore the continued importance of liver biopsy in their diagnosis and evaluation. Detailed histopathological examination not only assists in identifying the underlying etiology but also provides valuable information regarding disease severity, fibrosis progression, and potential therapeutic strategies.

Conclusion

The present study demonstrates that pediatric liver diseases exhibit a wide histomorphological spectrum, with cholestatic disorders and metabolic liver diseases constituting the predominant categories. Neonatal hepatitis and biliary atresia were the most frequently encountered diagnoses, particularly among infants and young children. Histopathological examination of liver biopsy specimens remains a valuable diagnostic tool for identifying the underlying etiology, assessing disease severity, and evaluating the degree of hepatic fibrosis. Early and accurate morphological diagnosis plays a crucial role in guiding appropriate clinical management and improving outcomes in pediatric patients with liver disorders.

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