

Patterns and Clinico-Radiological Characteristics of Primary Liver Masses in Children Treated at a Tertiary Referral Hospital, in Ethiopia

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Background: Liver masses are a cause of morbidity and mortality in children worldwide. Although the patterns and clinical-radiological characteristics of primary liver masses have been studied in developed countries, few studies have been conducted in developing countries. Studying the patterns of liver mass in children helps to improve the outcome of liver masses and to design preventive strategies if the identified risk factors are preventable.

Material and Method: A hospital-based cross-sectional study was conducted on children who met the inclusion criteria, using a self-administered structured questionnaire. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Statistical significance was set at $P < 0.05$. Descriptive and logistic regression analyses were used to assess the determinant factors.

Results: A total of 74 children were included, with most patients being males (60.8%). More than one-third ($n = 27$) of the participants were between 1 and 4 years of age and the mean age at diagnosis of the liver mass was 4.6 years. The duration of illness at presentation to Tikur Anbessa Specialized Hospital was between 4 and 8 weeks, in 42% of the patients. The most common presenting symptom was abdominal swelling, accounting for 70.3% ($n = 52$) of the patients. Benign hepatic mass lesions accounted for 57.5% ($n = 42$), and 43.2% ($n = 32$) were malignant liver masses. Most lesions were solitary and involved the right lobe of the liver. The common benign hepatic masses were pyogenic liver abscesses (38.1%), and the most common malignant hepatic masses were hepatoblastomas (78.1%).

Conclusion: Pyogenic liver abscess was the most common benign hepatic mass and hepatoblastoma was the most common malignant hepatic mass in our study. Most lesions were solitary and involved the right lobe. Understanding the patterns of liver masses will help in the early diagnosis and improve treatment outcomes in children with liver masses.

Keywords: liver mass, liver abscess, hepatoblastoma, TASH, Ethiopia

Introduction

A wide variety of liver masses can be observed in the pediatric population and are one of the causes of morbidity and mortality in children and adolescents. Pediatric liver lesions are a heterogeneous group including infiltrative lesions that cause mass effects. Hepatic lesions can be congenital, infectious, or neoplastic.¹⁻⁴

The liver accounts for 5–6% of all intra-abdominal masses in children, and one-third of the masses are benign, whereas the two-thirds are malignant.^{5,6} Among these malignant causes, hepatoblastomas are the most common, followed by hepatocellular carcinoma and other rare tumors, such as soft tissue sarcoma and extragonadal germ cell tumors.⁷ The benign liver masses usually present during infancy and include hemangiomas, hamartomas, and hemangioendotheliomas.^{2,7} The patterns of the different types of infectious hepatic lesions vary from place to place and are related to the prevalence of hepatitis B virus (HBV) and human immunodeficiency virus (HIV).⁴

Hepatic lesions present a relatively common clinical dilemma, particularly with the increasing use of various imaging modalities for the diagnosis of abdominal and other vague symptoms.⁸ Accurate and reliable determination of the nature

of the hepatic lesion is important, not only to reassure individuals with benign masses but also to ensure that malignant lesions are diagnosed accurately with noninvasive modalities like abdominal ultrasound.^{8–11} Abdominal CT and MRI also help better delineate the characteristics and nature of liver masses.^{12–14} In developing countries in Africa, where access to medical care and sophisticated imaging technologies is limited, deep-seated hepatic tumors often grow to an enormous size before they are diagnosed and treated. Little is known about the epidemiology and outcomes of liver tumor management in children in Ethiopia.^{4,15} Appropriate diagnosis of hepatic masses allows the appropriate selection of optimal management, which is frequently reassured or followed up for benign hepatic lesions. For malignant liver masses or those at risk of malignant transformation, treatment depends on tissue biopsy, tumor staging, functional status of the free liver, and availability of medical and surgical management options.^{8,16,17}

Patients and Methods

Study Area

This study was conducted at the Tikur Anbessa Specialized Hospital, School of Medicine, College of Health Sciences, Addis Ababa University, which is the largest referral hospital in Ethiopia. It was established in 1964 and is now the main teaching center for both clinical and preclinical training in most disciplines. It is also an institution in which specialized clinical services that are not available in other public or private institutions are rendered nationwide. It is a tertiary hospital where pediatric liver masses are treated by a gastroenterologist and a hemato-oncologist.

Study Design and Methodology

A retrospective cross-sectional study was conducted in children aged \leq equal to 14 years, who had been treated for primary liver mass at Tikur Anbessa specialized hospital from June 2017 to May 2022, using a structured questionnaire that included sociodemographic characteristics and clinical, laboratory, and radiological imaging of children diagnosed with primary liver masses.

Data Collection and Analysis

Data were collected by the principal investigator using structured questionnaires. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Statistical significance was set at $P < 0.05$.

Results

Sociodemographic Characteristics of the Study Participants

Among the study patients, 45/74 (60.8%) were male, with a male-to-female ratio of 1.6:1. The mean age of the patients at presentation was 4.6 years. The majority of the cases; 27/72 (36.5%) were between 1 and 4 years and 18 (24.3%) were infants. Sixty percent ($n = 44$) of the study participants were from outside Addis Ababa. Almost all of the study cases, 73/74 (98.6%), did not have a sibling or parents who had a similar illness, two (2.7%) had HIV cases and one (1.4%) had a previous history of Hepatitis B (HBV) infection. The demographic characteristics of the children are presented in [Table 1](#).

Clinical Presentation of the Study Participants with Primary Liver Mass

Seventy cases (94.6%) had presenting symptoms, and the remaining four (5.4%) were incidental findings. Approximately 42% ($n = 31$) of the study participants had an illness duration of 4–8 weeks. Abdominal swelling (70.3%) was the common presenting symptom in 52/74 (70.3%) of children, followed by abdominal pain, in 29/74 (39.2%) ([Table 2](#)).

The Laboratory Characteristics of the Study Patients

Basic laboratory investigations were performed in children with primary liver masses. AST was elevated in 42 (58.3%), ALT was elevated in 24 (17.8%), and ALP was elevated in 70 (94.4%). INR was prolonged in 26 (61.9%), and AFP was high in 20 (45%) of patients. Forty-five (60.8%) patients were anemic, ESR was elevated in 37 (52%), and LDH was elevated in 42 (60.9%) of patients at presentation. Only one case was HBVsAg positive as shown in [Table 3](#).

Table 1 Demographic Characteristics of Children with Primary Liver Mass Attending at Tertiary Care Center, Addis Ababa, Ethiopia

Variable	Frequency	Percent
Age of the study participants in years		
<1	18	24.3
1–4	27	36.5
4–8	14	18.9
8–14	15	20.3
Sex of the study participants		
Male	45	60.8
Female	29	39.2
Residence of the study participants		
Addis Ababa	30	40.5
Outside Addis Ababa	44	59.5
Did you have a sibling, parent, or offspring who have a similar illness?		
Yes	1	1.4
No	73	98.6
Did have a previous liver problem		
Yes	1	1.4
No	73	98.6
HIV		
Yes	2	2.7
No	72	97.3

Table 2 Presenting Symptoms of Patients with Primary Liver Mass Who Were on Follow-Up in a Tertiary Care Center, in Addis Ababa, Ethiopia

Variable	Frequency	Percent
Duration of illness in weeks		
≤1wk	15	20.3
1–3wk	17	23.0
4–8wk	31	41.9
8–16wk	5	6.8
>16wk	6	8.1
Presenting symptoms		
Yes	70	94.6
No	4	5.4
Abdominal pain		
Yes	29	39.2
No	45	60.8
Abdominal swelling		
Yes	52	70.3
No	22	29.7
Jaundice		
Yes	11	14.9
No	63	85.1

(Continued)

Table 2 (Continued).

Variable	Frequency	Percent
Fever		
Yes	16	21.6
No	58	78.4
Weight loss		
Yes	10	13.5
No	64	86.5
Easily fatigability		
Yes	1	1.4
No	73	98.6
Bleeding		
Yes	1	1.4
No	73	98.6

Table 3 Frequency of Laboratory Parameters in Patients with Liver Mass Who Were on Follow-Up in a Tertiary Care Center, Addis Ababa, Ethiopia

Variable	Frequency	Percent	Mean (SD)
Liver test results			
AST (n=72)			
Normal	30	41.7	101.6 (171.6)
Elevated	42	58.3	
ALT (n=72)			
Normal	43	59.7	68.1 (116.4)
Elevated	29	40.3	
ALP (n=72)			
Normal	4	5.6	368.7 (281.7)
Elevated	68	94.4	
INR (n=42)			
Normal	16	38.1	1.42 (0.393)
Elevated	26	61.9	
PT (n=42)			
Normal	29	69.0	19.5 (6.87)
Elevated	13	31.0	
PTT (n=41)			
Normal	29	70.7	36.7 (10.61)
Elevated	12	29.3	
Bilirubin total (n=58)			
Normal	55	94.8	3.5 (7.34)
Elevated	3	5.2	
Bilirubin direct (n=56)			
Normal	35	62.5	1.84 (4.57)
Elevated	21	37.5	

(Continued)

Table 3 (Continued).

Variable	Frequency	Percent	Mean (SD)
Serum albumin (n=63)			
Hypoalbuminemia	1	1.6	3.57 (2.51)
Normal	62	98.4	
Alpha-fetoprotein (n=44)			
Normal	24	54.5	34,449.67 (126,130.87)
Elevated	20	45.5	
HBVSAg (n=74)			
Negative	73	98.6	
Positive	1	1.4	
HCVAbs (n=73)			
Negative	73	98.6	
Not available	1	1.4	
WBC (n=74)			
Normal	31	41.9	12.84 × 10 ³ (5.97)
Elevated	43	58.1	
Hemoglobin (n=74)			
Anemia	45	60.8	11.06 (3.15)
Normal	29	39.2	
Platelet (n=74)			
Thrombocytopenia	9	12.2	422.7 (244.34)
Normal	65	87.8	
Urine bilirubin level (=48)			
Negative	34		
Positive	14		
Urine urobilinogen level (=48)			
Negative	34		
Positive	14		
ESR (=71)			
Normal	34	47.9	36.34 (31.31)
Elevated	37	52.1	
CRP (n=46)			
Normal	31	67.4	25.17 (54.14)
Elevated	15	32.6	
Uric acid (n=52)			
Normal	30	57.7	4.83 (2.26)
Elevated	22	42.3	
LDH (n=69)			
Normal	27	39.1	644 (984.7)
Elevated	42	60.9	

Imaging Pattern of the Study Patients

An abdominal ultrasound was performed; benign hepatic mass lesions accounted for 42 (57.5%) and 32 (43.2%) were malignant liver masses. The common benign hepatic mass was pyogenic liver abscess, 16/42 (38.1%), and the common malignant hepatic mass was hepatoblastoma, 25/32 (78.1%). The right lobe of the liver was involved in 48 (64.9%), the left lobe was involved in 12 (16.2%), and both lobes were involved in 14 (18.9%) of cases (Table 4).

Table 4 Frequency of Abdominal Ultrasound Parameters in Patients with Liver Mass Who Were on Follow-Up in a Tertiary Care Center, Addis Ababa, Ethiopia

Variable	Category	frequency	Percent
Abdominal ultrasound	Yes	74	100
	Ultrasound findings		
	Hepatocellular carcinoma	6	8.1
	Hepatoblastoma	25	33.8
	Hemangioma	5	6.8
	Amebic abscess	2	2.7
	Pyogenic Abscess/bacterial cause	16	21.9
	Simple hepatic cyst	6	8.2
	Hydatid cyst	8	11.0
	Hepatic Adenoma	1	1.4
	Hemangioendothelioma	3	4.1
	Lymphangioma	1	1.4
	Caroli's disease	1	1.4
	Mass lobe		
	Single	55	73.9
	Multiple	19	26.1
	Lesion character		
	Benign	42	57.5
	Malignant	32	43.2
	Mass size in cms		
	<2	4	6.2
	2–5	25	38.5
	5–10	24	36.9
	>10	12	18.5
	Mass lobe		
	Right	48	64.9
	Left	12	16.2
	Both	14	18.9
	Mass Involved segment		
	Yes	51	68.9
	No	23	31.1
	1	10	19.6
	2	11	21.6
3	7	13.7	
4	19	37.3	
5	26	50.9	
6	21	41.2	
7	15	29.4	
8	26	50.9	
Spleen size			
Normal	63	86.3	
Enlarged	10	13.9	
Liver size			
Normal	15	20.3	
Enlarged	59	79.7	
Any portal vein thrombosis			
Yes	6	8.1	
No	68	91.9	

The size of the majority of lesions, 25 (38.5%) were between 2 and 5 cm, and 24 (36%) ranged 5–10 cm. Portal vein thrombosis was detected in 6 (8.1%), hepatomegaly in 59 (79.7%), and splenomegaly in 10 (13.9%), respectively.

Abdominal MRI scans were performed for eight patients; 62.5% were benign, and hepatoblastoma was the common malignant liver tumor (Table 5).

The Association of Independent Variables on Pyogenic Liver Abscess

In the binary logistic regression, residence, abdominal pain, and fever were statistically significant ($P = 0.05$). In multivariate logistic regression analysis, abdominal swelling and fever were significantly associated with pyogenic abscesses ($P = 0.05$) as shown in Table 6.

The Association of Independent Variables with Hepatoblastoma

In the binary logistic regression, age, sex, residence, duration of illness, and AST and LDH levels were statistically significant ($P = 0.05$). Infants had a 17.1-fold risk of developing hepatoblastoma disease compared to children aged >8

Table 5 Frequency of Abdominal MRI Scan Parameters in Patients with Liver Mass Who Were on Follow-Up in a Tertiary Care Center, Addis Ababa, Ethiopia

Variable	Category	Frequency	Percent
Abdominal MRI scan	Yes	8	10.8
	Hepatoblastoma	3	37.5
	Pyogenic abscess	1	12.5
	Simple hepatic cyst	1	12.5
	Hydatid cyst	1	12.5
	Caroli's disease	1	12.5
	Hepatocellular carcinoma	1	12.5
	Mass size		
	Single	7	87.5
	Multiple	1	12.5
	Lesion character		
	Benign	5	62.5
	Malignant	3	37.5

Table 6 Bivariate and Multivariate Logistic Regression in Patients with Liver Mass Who Were on Follow-Up in a Tertiary Care Center, in Addis Ababa, Ethiopia

Variable	Pyogenic abscess		P-value	COR with 95% CI	P-value	COR with 95% CI
	Yes	No				
Sex of the Children						
Male	13	32	0.069	3.5(0.91, 13.67)	0.710	1.5 (0.18, 12.24)
Female	3	26	1		1	
Residence of the study cases						
Addis Ababa	10	20	0.049	3.2(1.01, 9.98)	0.474	2.1 (0.29, 14.58)
Outside Addis Ababa	6	38	1		1	
Abdominal swelling						
Yes	3	49	0.000	0.04(0.01, 0.18)	0.001	0.03 (0.004, 0.26)
No	13	9	1		1	
Fever						
Yes	8	8	0.004	6.2(1.82, 21.42)	0.006	1.5 (1.22, 10.81)
No	8	50	1		1	

Table 7 Bivariate and Multivariate Logistic Regression Showing the Association of Independent Variables on Hepatoblastoma in Patients with Liver Mass Who Were on Follow-Up in a Tertiary Care Center, in Addis Ababa, Ethiopia

Variable	Hepatoblastoma		P-value	COR with 95% CI	P-value	COR with 95% CI
	Yes	No				
Age of the children's years						
<1	12	6	0.004	28.0 (2.94, 266.47)	0.045	17.1 (1.84, 3.498)
1–4	11	16	0.041	9.6 (1.10, 84.2)	0.134	10.5 (0.48, 228.78)
4–8	1	13	0.960	1.1 (0.06, 19.05)	0.746	0.39 (0.001, 10.6.46)
>8	1	14	1			
Sex of the study cases						
Male	11	34	1		1	
Female	14	15	0.037	2.9 (1.06, 7.81)	0.362	2.4 (0.36, 16.04)
Residence of the study cases						
Addis Ababa	6	24	1			
Outside Addis Ababa	19	25	0.043	3.0 (1.04, 8.91)	0.028	2.9 (1.41, 20.73)
Duration of illness in weeks						
<1	2	13	1		1	
1–3	5	12	0.283	2.7 (0.44, 16.68)	0.588	2.5 (0.09, 63.14)
4–8	12	19	0.094	4.1 (0.79, 21.48)	0.972	1.1 (0.04, 28.3)
8–16	4	1	0.016	26 (1.84, 367.69)	0.293	27.1 (0.06, 127.35)
>16	2	4	0.306	3.2 (0.34, 31.07)	0.855	0.67 (0.01, 51.03)
AST						
Normal	5	25	1		1	
Elevated	19	23	0.014	4.1 (1.33, 12.87)	0.163	4.5 (0.54, 37.08)
LDH						
Normal	1	26	1		1	
Elevated	23	19	0.001	31.4 (3.90,253.87)	0.016	6.9 (2.20, 219.4)

years (AOR = 17.1, 95% CI: 1.84, 3.49), and patients with an elevated LDH level had a 6.9-fold higher chance of having hepatoblastoma than those with normal LDH levels (AOR = 6.9, 95% CI: 2.20, 219.4), shown in [Table 7](#).

Discussion

Our study showed that the mean age at diagnosis of a liver mass was 4.6 years and more than one-third of the children were between 1 and 4 years. The duration of illness from the onset of symptoms to the tertiary treatment center ranged from 4 to 8 weeks in nearly half of the patients. The most common presenting symptom was abdominal pain (74.8%), and based on ultrasound findings benign hepatic lesions accounted for 42 (57.5%) of the cases. Right lobe liver was involved in 48 (64.9%), and the left lobe was involved in 12 (16.2%) which is in line with other studies.^{18–20} The common benign hepatic mass was a pyogenic liver abscess, 16/42 (38.1%) in our study. The Multivariate logistic regression showed abdominal swelling and fever were significantly associated with pyogenic liver abscess at *P*-value of 0.05 (*P* = 0.001 COR, 95% CI: 0.03 (0.004, 0.26)) and 0.05 (*P* = 0.006; 95% CI: 1.5 (1.22, 10.81)), respectively.

Our study also showed that hepatoblastoma was the most common malignant tumor, which is similar to other studies.^{21–23} Patients aged <1 year had 17.1-fold high risk of hepatoblastoma diagnosis than children aged >8 years (AOR = 17.1, 95% CI: 1.84, 3.49), those with abdominal swelling had 6.7-fold increase in hepatoblastoma cases than the opposite compartment (AOR = 6.7, 95% CI: 2.15, 300), and patients with an elevated LDH level had 6.9-fold higher chance of hepatoblastoma than those with a normal LDH level.

In our study, the determinant factors that were significantly indicated for the presence of malignancy were female sex: had 2.1-fold malignant liver tumors than males (AOR = 2.1, 95% CI: 1.62, 7.08), and abdominal swelling; had 11.7-fold increased risk of malignancy (AOR = 11.7, 95% CI: 1.79, 7.17).

Conclusion

In our study, more than one-third of children with liver masses were aged 1–4 years with a mean age of 4.6 years. Benign hepatic masses were the most common. Pyogenic liver abscess was the most common benign hepatic lesion, whereas hepatoblastoma was the most common malignant liver tumor in children. Most lesions were solitary and involved the right lobe. Knowing the patterns of liver masses will help in early diagnosis and decrease the morbidity and mortality in children with liver masses.

Strengths and Limitations of the Study

The study was conducted in only one tertiary hospital, and the results may not reflect the exact characteristics of liver masses in Ethiopia. However, the results can be assumed to reflect the characteristics of liver mass, as the survey was carried out at the nation's largest referral tertiary hospital, where most cases were referred from all corners of Ethiopia.

Data Sharing Statement

Data are available on request from the corresponding author.

Ethical Approval

Ethical approval was obtained from the Research and Publication Committee of the Pediatrics and Child Health Department, School of Medicine, College of Health Sciences, Addis Ababa University, and College Institutional Review Board (IRB). The study was compiled with the Declaration of Helsinki and the requirement for informed consent was waived because of the anonymous nature of the data. Confidentiality was fully maintained during data collection and analysis.

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Disclosure

The authors declare no conflicts of interest in this work.

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