ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 7476-7481 (2026)
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BIOINFORMATION
Discovery at the interface of physical and biological sciences
BIOMEDICAL INFORMATICS
www.bioinformation.net
Volume 22(10)
Research Article

Received October 1, 2026; Revised October 31, 2026; Accepted October 31, 2026, Published October 31, 2026
DOI: 10.6026/973206300227476

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

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Citation: Bhadkariya *et al*. Bioinformation 22(10): 7476-7481 (2026)

Clinico epidemiological profile and outcome of pyogenic liver abscess in children: A prospective observational study

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ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 7476-7481 (2026)
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Abstract:
Liver abscess is a serious pediatric infection requiring early diagnosis and prompt treatment. This prospective study evaluated 86 children between June 2022 and June 2024 using clinical, laboratory, radiological and treatment related parameters. Prolonged fever (98.9%) and right upper quadrant abdominal pain (96.5%) were the most common presenting features, with a mean age of 9.2 years. Most children recovered and were discharged (90.7%), while complications occurred in 4.7%, mortality was 3.5% and mean hospital stay was 21 days. Thus, early ultrasonography, culture-guided antibiotic therapy and timely pigtail drainage were associated with favorable outcomes in pediatric liver abscess.

Keywords: Liver abscess, pigtail drainage, antibiotics

Background:
Liver abscess is characterized by the formation of pus-filled cavities within the liver parenchyma, a significant clinical entity in children **[1]**. In children, it presents unique diagnostic and management challenges due to distinct etiological factors, diverse clinical presentations and varying treatment responses **[2]**. Hence, understanding the clinical profile and outcomes of liver abscess in children is crucial for optimizing therapeutic strategies. The etiological spectrum of liver abscess in children ranges across various infectious agents, including bacteria, parasites and fungi **[3]**. In developing countries like India, both pyogenic and amoebic liver abscesses are important causes of hepatic infections in children. Amoebic liver abscess, caused by Entamoeba histolytica, is relatively common and may occasionally present with secondary bacterial infection, mimicking pyogenic abscess **[4]**. Infection sources may arise from contiguous sites, hematogenous spread, the adjacent gastrointestinal tract, or ascending biliary tract infections **[5]**. Clinical manifestations of liver abscess can be subtle, making early diagnosis and intervention paramount for effective management **[6]**. Even after advancements in medical imaging techniques and therapeutic modalities, the approach to liver abscess in children remains a subject of ongoing research **[7]**. Therefore, it is of interest to evaluate the rural–urban differences in the microbial profile and ultrasound-guided management outcomes of pediatric pyogenic liver abscess, with emphasis on demographic characteristics, clinical presentation, microbiological findings, treatment strategies, clinical outcomes and follow-up.

Materials and Methods:
This prospective observational study was conducted in the Department of Pediatrics over two years from June 1, 2022, to June 30, 2024. Ethical approval was obtained from the Institutional Ethics Committee and written informed consent was obtained from parents or legal guardians of all participants. The sample size was calculated based on the prevalence of abdominal pain among children with liver abscess, reported as 66.7%. Assuming a 5% level of significance and 10% absolute precision, the required sample size was calculated is 86. Participants were recruited through consecutive sampling. The study included children of age 1-16 years from both urban and rural areas presenting with prolonged fever (lasting more than 7–10 days without an obvious cause, despite initial investigations or treatment), right upper quadrant abdominal pain, loss of appetite and diagnosed liver abscess on abdominal ultrasonography(USG). Children who had received antibiotics prior to admission without documented prescription or investigation reports but sought symptomatic relief for fever, abdominal pain and diagnosed liver abscess in use were also included. Children excluded from study those who were tested positive for HIV, severely ill children with tuberculosis (as these children were not admitted in pediatrics, as they were admitted under the Chest and TB Department), diagnosed case hydatid cyst of the liver as these cases were admitted under pediatric surgery department. A detailed clinical history was obtained from parents or caregivers. Each child underwent a thorough physical examination and nutritional assessment. Nutritional status was categorized per WHO guidelines as severe acute malnutrition (SAM), moderate acute malnutrition (MAM), or normal. Liver function test (LFT) , Serological testing: HIV, hepatitis B surface antigen (HBsAg) and hepatitis C virus (HCV) were performed as part of baseline evaluation and to rule out underlying Immunocompromised states. Under strict aseptic precautions, liver aspirates were collected via ultrasound-guided percutaneous needle aspiration (18G) or pigtail catheter drainage. Concurrently, blood samples were drawn for culture. Samples were processed in the Microbiology Department. Blood cultures were initially incubated in brain-heart infusion (BHI) broth, followed by subculturing on blood agar and MacConkey agar. Liver aspirates were similarly cultured, with reporting by the microbiologist Imaging modalities included ultrasonography (USG) and contrast-enhanced computed tomography (CECT). USG features of pyogenic liver abscess included irregular hypoechoic lesion with internal echoes, debris, gas and posterior acoustic enhancement ,evaluation assessed lesion size, location, depth, pus volume, internal echogenicity, septations, wall thickness and used color doppler to rule out vascular structures in the needle path. In cases with inconclusive USG findings, CECT of the abdomen was performed for confirmation. The sampling approach was based on ultrasound findings and abscess characteristics. Ultrasound-

guided aspiration was performed using an 18–22G fine needle for diagnostic or therapeutic purposes in patients with well-defined anechoic or hypoechoic abscesses measuring <50–100 mL, without loculations or septations, having a safe percutaneous access and not requiring continuous drainage. Pigtail catheter drainage was performed by inserting an 8–14 Fr catheter for continuous drainage in patients with abscesses >100 mL, thick, loculated, heterogeneous, multiloculated, or recurrent collections. All patients were managed according to the institutional treatment protocol, receiving empirical intravenous ceftriaxone and amikacin, with antibiotics subsequently modified based on pus culture and sensitivity results. Patients with abscess cavities <40 cc received culture-sensitive antibiotics alone, those with cavities measuring 40–100 cc underwent ultrasound-guided percutaneous needle aspiration (18G) in addition to antibiotics and those with cavities >100 cc underwent pigtail catheter drainage along with antibiotic therapy. Patients were discharged once follow-up ultrasonography showed a residual pus volume of <10 mL and repeat ultrasonographic evaluation was performed at 1 and 3 months after discharge. Data were entered into Microsoft Excel and analyzed using Stata version 17.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables were presented as frequencies and percentages. Comparisons between categorical variables (such as rural vs urban residence, treatment modality and outcomes) were performed using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables between two groups were compared using Student's t-test or Mann–Whitney U test. A p value <0.05 was considered statistically significant. Representative ultrasonographic findings of a liver abscess involving the right hepatic, while a representative lesion involving the left hepatic lobe. In cases where USG findings were inconclusive, CECT of the abdomen was performed for confirmation and further characterization.

Results:

A total of 86 children with liver abscess were included in the study. The associations between demographic characteristics, clinical features, microbiological profile, ultrasonographic findings, treatment modalities and clinical outcomes are presented in (**Tables 1–5). Table 1** summarizes the demographic characteristics and their association with treatment modalities. Most patients were male (69.8%), while females constituted 30.2% of the study population. The majority of children were aged 6–10 years (50.0%), followed by 11–14 years (40.6%), whereas only 9.3% were between 1 and 5 years of age. A greater proportion of patients belonged to rural areas (62.7%) than urban areas (37.2%). Nearly half of the children had moderate acute malnutrition (47.6%), followed by normal nutritional status (46.5%) and severe acute malnutrition (5.8%). Among the demographic variables, weight-for-height status showed a significant association with treatment modality (p = 0.032), whereas sex (p = 0.339), age (p = 0.052) and residence (p = 0.073) were not significantly associated with the type of intervention.

Table 2 presents the association between clinical characteristics and treatment modalities. Fever was the predominant presenting complaint, occurring in almost all patients, followed by right upper quadrant abdominal pain. Statistically significant associations with treatment modality were observed for abdominal pain (p = 0.008), vomiting (p = 0.032), fatigue (p = 0.003), loss of appetite (p = 0.009), weight loss (p = 0.002) and ascites (p = 0.030). Children presenting with these symptoms were more likely to require invasive intervention, particularly pigtail catheter drainage. In contrast, fever (p = 0.444), hepatomegaly (p = 0.205), splenomegaly (p = 0.624) and intercostal tenderness (p = 0.795) did not show a significant association with treatment modality. The laboratory findings are summarized in **Table 3**. Leukocytosis was the most frequent laboratory abnormality, present in 72 (83.7%) patients, followed by elevated SGPT in 38 (44.1%), anaemia in 34 (39.5%) and elevated SGOT in 29 (33.7%) patients. Hypoalbuminemia was observed in 22 (25.5%), prolonged prothrombin time in 18 (20.9%), elevated serum bilirubin in 16 (18.6%) and increased international normalized ratio (INR) in 12 (13.9%), indicating varying degrees of hepatic dysfunction and systemic inflammatory response. The microbiological profile according to treatment modality is shown in **Table 4**. Blood culture isolates most commonly included *Staphylococcus aureus*, particularly among children undergoing pigtail drainage, followed by *Klebsiella pneumoniae* and Escherichia coli, although a substantial proportion of blood cultures remained sterile. No significant association was observed between blood culture isolates and treatment modality (p = 0.271). In contrast, pus culture findings demonstrated a significant association with treatment modality (p = 0.012). *Pseudomonas aeruginosa* was the most common organism isolated from pus samples, particularly in patients managed with pigtail drainage, followed by *Klebsiella pneumoniae* and *Staphylococcus aureus*. Antibiotic sensitivity testing showed that most isolates were susceptible to ceftriaxone, ceftazidime, piperacillin–tazobactam and vancomycin, supporting the institutional antibiotic protocol. Ultrasonographic findings and treatment outcomes are presented in **Table 5**. The right lobe of the liver was the most commonly affected site, followed by the left lobe and bilateral involvement. The mean abscess volume was 134 mL, explaining the high proportion of patients requiring catheter drainage. Although the location of the abscess was not significantly associated with treatment modality (right lobe: p = 0.091; left lobe: p = 0.423; bilateral: p = 0.060), clinical outcome differed significantly among treatment groups (p = 0.005). Overall, 78 (90.7%) patients were discharged successfully, 3 (3.5%) died during hospitalization, 3 (3.5%) left against medical advice and 2 (2.3%) required transfer to the pediatric surgery department. Most discharged patients had undergone pigtail catheter drainage, indicating favorable outcomes with timely image-guided intervention in appropriately selected cases. **Table 2** shows the association between clinical features and treatment modalities. Abdominal pain and fever were the most common presenting symptoms across all groups. Clinical features such as abdominal pain (p = 0.008), vomiting (p = 0.032), fatigue (p =

0.003), loss of appetite (p = 0.009), weight loss (p = 0.002) and ascites (p = 0.030) showed statistically significant association with the need for intervention. These findings suggest that more severe or systemic symptoms were associated with increased likelihood of invasive management. **Table 3** summarizes the laboratory findings of the study participants. Leukocytosis was the most common abnormality, observed in 83.7% of cases. Anemia was present in 39.5%, while elevated liver enzymes (SGPT and SGOT) were seen in 44.1% and 33.7% of patients, respectively. Hypoalbuminemia and deranged coagulation parameters were also noted in a subset of patients, reflecting systemic inflammation and hepatic involvement.

Table 1: Association of sex with the treatment modalities and demographic characteristics

Sex	Treatment modalities						P value
	USG Guided Drainage Only		Pigtail + USG Guided Drainage		Medication only		
	Number	%	Number	%	Number	%	
Female	7	21.20%	15	34.90%	4	40.00%	0.339
Male	26	78.80%	28	65.10%	6	60.00%	
Demographic Characteristics							
Variables	Numbers		Percentage				P value
Age							
1-5 Year	8		9.3				0.052
6-10 Year	43		50				
11-14 Year	35		40.6				
Residence							
Rural	54		62.7				0.073
Urban	32		37.2				
Weight for Height							
Normal	40		46.5				0.032
MAM	41		47.6				
SAM	5		5.8				

Table 2: Association of clinical characteristics with the treatment modalities

Clinical Characteristics		Treatment modalities						P value
		USG Guided Drainage only		Pigtail + USG Guided Drainage		Medication only		
		No.	%	No	%	No	%	
Abdominal Pain	NO	1	3.00%	0	0.00%	2	20.00%	0.008
	YES	32	97.00%	43	100.00%	8	80.00%	
Fever	NO	1	3.00%	0	0.00%	0	0.00%	0.444
	YES	32	97.00%	43	100.00%	10	100.00%	
Vomiting	NO	16	48.50%	15	34.90%	8	80.00%	0.032
	YES	17	51.50%	28	65.10%	2	20.00%	
Fatigue	NO	27	81.80%	19	44.20%	7	70.00%	0.003
	YES	6	18.20%	24	55.80%	3	30.00%	
Loss of appetite	NO	13	39.40%	9	20.90%	7	70.00%	0.009
	YES	20	60.60%	34	79.10%	3	30.00%	
Loss of weight	NO	21	63.60%	13	30.20%	8	80.00%	0.002
	YES	12	36.40%	30	69.80%	2	20.00%	
Hepatomegaly	NO	8	57.10%	4	28.50%	2	14.20%	0.205
	YES	25	34.70%	39	54.10%	8	11.10%	
Spleenomegaly	NO	30	40%	36	48%	9	12.00%	0.624
	YES	3	27.20%	7	63.60%	1	9.00%	
Ascites	NO	30	40.00%	29	38.60%	9	12.00%	0.03
	YES	4	36.60%	6	54.50%	1	9.00%	
Intercostal tenderness	NO	3	27.27%	6	54.50%	2	18.10%	0.795
	YES	30	40%	37	49.30%	8	10.60%	

Table 3: Clinical profile and Biochemical analysis of study participants

Anaemia	34 (39.5)
Increased total leukocyte count	72 (83.7)
Increased SGOT	29 (33.7)
Increased SGPT	38 (44.1)
Increased total serum bilirubin	16 (18.6)
Decreased serum albumin	22 (25.5)
Increased prothrombin time	18 (20.9)
Increased international normalised ratio	12 (13.9)

Table 4: Association of Blood and Pus culture with the treatment modalities and sensitive antibiots

Microbiological characteristics		Treatment modalities						Pvalue
		USG Guided Drainage Only		Pigtail+ USG Guided Drainage		Medication only		
Name of organisms	Sensitive Antibiotics	n	%	n	%	n	%	
Acinetobacter	Cefoparazone ,Vancomycin	0	0.00%	2	4.40%	0	0.00%	0.271

Baumannii								
Citrobacter species	Ceftriaxone , amikacin	0	0.00%	1	2.30%	0	0.00%	
E.coli	Piperacillin –Tazobactam, vancomycin	3	6.60%	1	2.30%	0	0.00%	
Klebsiella pneumoniae	Ceftriaxone, vancomycin	2	4.40%	8	17.70%	1	2.30%	
Staphylococcus Aureus	Ceftriaxone, vancomycin	9	20.00%	18	40.00%	0	0.00%	
Sterile		18	43.90%	14	34.10%	9	21.90%	
	Pus culture							
Acinetobacter Baumannii	Ceftazidime, vancomycin	0	0.00%	3	5.20%	0	0.00%	
E. Coli	Ceftazidime, vancomycin	2	3.50%	0	0.00%	0	0.00%	
Klebsiella pneumoniae	Ceftriaxone,Ceftazidime,piperacillin-Tazobactam ,vancomycin	4	7.00%	11	19.30%	2	3.50%	0.012
Pseudomonas aeroginosa	Ceftriaxone, Ceftazidime, piperacillin-Tazobactam ,vancomycin	2	3.50%	24	42.10%	3	5.20%	
Staphylococcus aureus	Ceftriaxone, Ceftazidime, vancomycin	2	3.50%	4	7.00%	0	0.00%	
Sterile		13	44.80%	10	34.40%	6	20.60%	

Table 5: Association of USG findings and outcome with the treatment modalities

USG findings		Treatment modalities						P value
		USG Guided Drainage Only		Pigtail+ USG Guided Drainage		Medication only		
		n	%	n	%	n	%	
Right liver lobe		25	37.80%	40	60.60%	1	1.50%	0.091
Left liver lobe		4	26.60%	9	60%	2	13.30%	0.423
Bilateral liver lobe		1	20%	4	80%	0	0.00%	0.06
Mean Pus Volume		134 ml						
Outcome	**Abscond**	0	0.00%	0	0.00%	0	0.00%	
	Discharge	29	37.10%	43	55.10%	6	7.60%	
	Expired	1	33.30%	2	66.60%	0	0.00%	0.005
	Lama	3	100%	0	0.00%	0	0.00%	
	Transfered to pediatric surgery	2	100%	0	0.00%	0	0.00%	

Discussion:

Pediatric liver abscess remains an important cause of morbidity in low- and middle-income countries despite substantial advances in diagnostic imaging, antimicrobial therapy and minimally invasive interventions. Delayed healthcare access, malnutrition and limited microbiological facilities continue to influence disease severity and treatment outcomes, particularly in rural populations. Recent pediatric studies have emphasized that early ultrasonographic diagnosis combined with image-guided drainage has significantly improved prognosis while reducing the need for open surgical intervention. In the present study, 90.7% of children recovered and were discharged, while the mortality rate was 3.5%, demonstrating favorable outcomes following standardized management. These findings are comparable with the recent multicenter pediatric study from Beijing by Xie *et al.* **[6]** which also reported excellent survival with prompt diagnosis and individualized drainage strategies and with the prospective Indian study by Rakholia *et al.* **[7].**, where no mortality was observed following timely ultrasound-guided management. Similar improvements in outcomes have also been attributed to advances in percutaneous drainage techniques and early antimicrobial therapy in recent pediatric literature. The mean age of presentation was 9.2 years, with half of the patients belonging to the 6–10-year age group and a clear male predominance was observed. This demographic profile is remarkably similar to recent reports from China and India, where school-aged children and boys represented the majority of affected patients. Male predominance has been hypothesized to result from greater environmental exposure, behavioral factors and sex-related immunological differences, although the precise mechanisms remain unclear. An important observation in the present study was that 62.7% of patients originated from rural areas. Rural children also demonstrated a greater requirement for pigtail catheter drainage, suggesting delayed presentation with larger abscesses. Similar epidemiological trends have been described in recent Indian studies, where socioeconomic factors, delayed referral, nutritional deficiencies and restricted healthcare accessibility contributed to advanced disease at admission. These findings reinforce the importance of strengthening primary healthcare services and improving early referral systems in rural communities **[8].** Laboratory evaluation revealed leukocytosis (83.7%), anemia (39.5%), elevated hepatic transaminases, hypoalbuminemia and coagulation abnormalities. Leukocytosis was the predominant laboratory abnormality, reflecting the intense inflammatory response associated with pyogenic infection. Comparable biochemical profiles have been documented in recent pediatric cohorts, where elevated inflammatory markers, anemia and mild hepatic dysfunction consistently accompanied liver abscess. These laboratory abnormalities therefore remain valuable adjuncts but should always be interpreted together with ultrasonographic findings. Management outcomes in the present study strongly support a stepwise treatment approach based on abscess volume. Small abscesses responded well to antibiotics alone, whereas larger collections benefited from ultrasound-guided aspiration or pigtail catheter drainage. Similar conclusions were reached by Qiu *et al.* (2025) **[9]**, who showed that early ultrasound-guided percutaneous catheter drainage safely shortened recovery even in incompletely liquefied abscesses. Likewise, Liu *et al.* (2023) **[10]** reported high clinical success with combined antibiotic therapy and ultrasound-guided drainage,

while Zerem *et al*. (2025) **[11]** emphasized individualized timing of image-guided drainage to optimize outcomes and reduce complications.

Conclusion:
Pediatric liver abscess remains a major cause of morbidity, with prolonged fever and abdominal pain being the commonest presentation. Early ultrasonographic diagnosis with prompt culture-guided antibiotic therapy improves clinical outcomes. Image-guided drainage, particularly pigtail catheterization for large abscesses, is safe, effective and warrants further multicenter evaluation.

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