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Liver Abscess and the Prognostic Role of Liver Function Tests in the Changing Etiological Spectrum: A Prospective Observational Study from a Tertiary Care Centre in North-West India.

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Abstract

Background: Liver abscess remains an important cause of hospital admission in the Indian subcontinent, with a shifting etiological spectrum increasingly dominated by pyogenic disease. Radiological size alone may not fully reflect disease severity, and simple biochemical markers are needed for risk stratification. This study evaluated the relationship between abscess volume and liver function test (LFT) parameters, and assessed their utility as prognostic markers. ***Methods:*** A prospective observational study was conducted in the Department of General Medicine, MGMCH, Jaipur, from April 2024 to September 2025. Eighty-seven consecutive adult patients with ultrasonography-confirmed liver abscess were enrolled. Clinical, microbiological, radiological and biochemical parameters were recorded at admission and discharge. ALP, SGOT, SGPT, total bilirubin, serum albumin and INR were correlated with abscess volume using Pearson/Spearman analysis. A paired t-test was used to compare admission and discharge values. A p-value < 0.05 was considered significant. ***Results:*** The mean age was 42.29 ± 14.18 years, with marked male predominance (80.46%; M:F ≈ 4:1). Pyogenic liver abscess accounted for 79.31% of cases, with Klebsiella pneumoniae being the leading isolate. The right lobe was involved in 72.41% and solitary lesions were seen in 64.37%; segment VII was the most frequently involved (34.48%). Mean abscess volume reduced from 212.89 ± 110.24 cc to 76.84 ± 52.67 cc (p < 0.01). All LFT parameters improved significantly (p < 0.01) from admission to discharge. Abscess volume showed significant positive correlations with ALP (r = 0.542), SGOT (r = 0.493), SGPT (r = 0.479), total bilirubin (r = 0.401) and INR (r = 0.265), and a significant negative correlation with albumin (r = −0.266). ***Conclusion:*** Liver function tests — particularly ALP, albumin and INR — correlate significantly with abscess volume and improve in parallel with radiological regression after treatment. LFTs are simple, inexpensive, widely available, and useful prognostic markers for risk stratification and monitoring response in patients with liver abscess.

Keywords: Liver abscess; Pyogenic liver abscess; Amoebic liver abscess; Klebsiella pneumoniae; Liver function tests; Alkaline phosphatase; Albumin; INR; Prognostic markers.

INTRODUCTION

Liver abscess remains a significant cause of morbidity in the tropical and subtropical world. Although it can afflict patients of any age, it is most often encountered in men between the second and fifth decades of life, with the right hepatic lobe involved in approximately 60% of cases owing to its preferential portal venous supply.[1] Historically, intra-abdominal infections such as appendicitis were considered the principal source of hepatic seeding, but contemporary series identify the biliary tree as the leading cause, accounting for nearly 40% of pyogenic cases. The reported incidence of pyogenic liver abscess (PLA) ranges from 8 to 22 cases per million population, with substantial regional variability.[2]

The microbiological landscape has also evolved. While Escherichia coli predominates in Western series, Klebsiella pneumoniae has emerged as the leading pathogen in Asia, frequently in association with diabetes mellitus and the hypermucoviscous phenotype.3,4 Amoebic liver abscess, although declining in absolute numbers, continues to contribute substantially to disease burden in endemic settings; up to 15% are refractory to medical therapy alone, and approximately 20% develop secondary bacterial superinfection.5,6 Reported morbidity and mortality for PLA range from 10% to 47%, underscoring the need for early risk stratification and timely intervention.8,9

The management of liver abscess often involves a choice between conservative medical therapy and image-guided percutaneous interventions, with decisions influenced by abscess size, location and the patient's clinical state. However, radiological assessment alone may underestimate hepatic compromise. Liver function tests (LFTs) — including alkaline phosphatase (ALP), serum albumin, INR, total serum bilirubin, SGOT and SGPT — offer a multidimensional view of cholestasis, hepatocellular injury and synthetic function, and may parallel disease severity.[10] An expanding abscess can compress intrahepatic biliary radicals (raising ALP and bilirubin), induce systemic and local inflammation (lowering albumin and prolonging INR), and damage adjacent parenchyma (raising transaminases). Demonstrating that biochemical derangement tracks with abscess burden would justify the use of these inexpensive, ubiquitous tests as objective prognostic markers, particularly in resource-limited settings.

Against this background, the present study was designed to (a) evaluate the prognostic significance of LFT parameters in liver abscess, (b) characterise the contemporary etiological and microbiological spectrum, and (c) examine the correlation between abscess volume and biochemical derangement at admission and after treatment.

MATERIALS AND METHODS

Study design and setting: This prospective, observational, hospital-based study was conducted in the Department of General Medicine, Mahatma Gandhi Medical College & Hospital (MGMCH), Jaipur — a tertiary care teaching institution serving both urban and rural populations — between April 2024 and September 2025.

Ethical approval: Institutional Ethics Committee approval was obtained prior to commencement. Written informed consent was obtained from all participants; where a participant was unable to consent, consent was taken from a legally authorised attendant. Patient confidentiality was strictly maintained.

Participants: Consecutive adult inpatients (≥18 years) with ultrasonography-confirmed liver abscess were enrolled. Pregnant women, patients with ruptured liver abscess requiring emergency surgical intervention at presentation, patients with psychiatric illness or substance use disorders, and those unwilling to consent were excluded.
Sample size: The sample size of 87 was estimated using MedCalc statistical software based on correlation coefficient analysis ($\alpha = 0.05$, $\beta = 0.001$, expected correlation coefficient = 0.5).

Data collection: A structured proforma was used to record demographic data, comorbidities, presenting complaints, vital signs, and examination findings. Routine investigations included complete blood count, random blood sugar, electrolytes, renal function, ESR, and chest radiograph. Liver function tests (total and direct bilirubin, AST, ALT, ALP, total protein, albumin, PT/INR, aPTT) were obtained at admission and at discharge. Blood cultures and ultrasound-guided pus cultures were sent where applicable. Serological screening for HIV, HBsAg and anti-HCV was performed. Abdominal ultrasonography was performed at admission and discharge to document the number, lobe, segment, maximum diameter and estimated volume of abscess(es), and to identify complications (pleural effusion, ascites, rupture). Contrast-enhanced CT was obtained where clinically indicated.

Treatment: All patients received standard institutional treatment based on clinical condition, abscess characteristics, and treating physician judgement. This included intravenous antibiotics with or without antiamoebic therapy, supportive care, ultrasound-guided needle aspiration or pigtail catheter drainage as indicated, and surgical management for complicated cases. No experimental drug or procedure was used.

Statistical analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 29.0. Continuous variables are presented as mean ± SD and categorical variables as frequency and percentage. A paired t-test was used to compare admission and discharge values; the χ^2 test or Fisher's exact test was used for categorical data; Pearson/Spearman correlation was used to assess the relationship between abscess volume and LFT parameters. A two-tailed p-value < 0.05 was considered statistically significant.

RESULTS

Eighty-seven consecutive patients fulfilling the inclusion criteria were analysed. The demographic profile is summarised in Table 1.

Table 1. Demographic profile of the study population (n = 87).

Variable	Frequency (n=87)	Percentage (%)
Age group (years)		
<20	5	5.75
21–30	13	14.94
31–40	24	27.59
41–50	14	16.09
51–60	20	22.99
61–70	11	12.64
Mean age ± SD (years)	**42.29 ± 14.18**	
Gender		
Male	70	80.46
Female	17	19.54
Male : Female ratio	**≈ 4 : 1**	

Liver abscess predominantly affected middle-aged adults, with the 31–40-year age group most frequently involved (27.59%); the mean age was 42.29 ± 14.18 years. There was a striking male predominance (80.46%; M:F ≈ 4:1).

Clinical presentation: Fever was universal (100%) and abdominal pain near-universal (90.80%). Hepatomegaly (85.06%), abdominal tenderness (65.52%), anorexia (52.87%) and nausea (47.13%) were also frequent. Thoracic manifestations (cough 31.03%; pleural effusion 26.44%) and ascites (37.93%) were noted in a substantial minority. Intraperitoneal rupture occurred in 6.90% of patients (Table 2).

Table 2. Clinical features at presentation (n = 87).

Clinical Feature	Frequency (n=87)	Percentage (%)
Fever	87	100.00
Pain abdomen	79	90.80
Hepatomegaly	74	85.06
Abdominal tenderness	57	65.52
Anorexia	46	52.87
Nausea	41	47.13
Ascites	33	37.93
Vomiting	28	32.18
Cough	27	31.03
Pleural effusion	23	26.44
Jaundice	21	24.14
Intraperitoneal rupture	6	6.90

Etiological and microbiological profile: Pyogenic liver abscess accounted for 79.31% of cases and amoebic liver abscess for 20.69%. Among the pyogenic group, Klebsiella pneumoniae was the leading isolate (29 of 69 pyogenic cases), followed by Escherichia coli (8 cases) and Streptococcus viridans (2 cases); 30 cases were culture-negative/cryptogenic (Table 3).

Table 3. Etiological and microbiological distribution of liver abscess (n = 87).

Etiology / Organism	No. of cases	Percentage (%)
Pyogenic liver abscess	**69**	**79.31**
Klebsiella pneumoniae	29	42.03*
Escherichia coli	8	11.59*
Streptococcus viridans	2	2.90*
Cryptogenic / culture negative	30	43.48*
Amoebic liver abscess	**18**	**20.69**
Total	**87**	**100.00**

Radiological characteristics: The right lobe was involved in 72.41% of cases, with bilateral involvement in 9.20%. Solitary abscesses predominated (64.37%). Segment VII was the most commonly involved hepatic segment (34.48%), followed by segment VI (24.14%), reflecting the predilection for the posterior right lobe (Table 4).

Table 4. Radiological characteristics of liver abscess (n = 87).

Radiological Parameter	No. of patients (n=87)	Percentage (%)
Lobe involved		
Right lobe	63	72.41
Left lobe	16	18.39
Bilateral	8	9.20
Number of abscesses		
Solitary	56	64.37
Few (≤3)	10	11.49
Multiple (>3)	21	24.14
Hepatic segment involved		
Segment VII	30	34.48
Segment VI	21	24.14
Segment IV	9	10.34
Segment V	9	10.34
Segment VIII	9	10.34
Other segments	9	10.34

Treatment response — abscess volume and LFT parameters: Following treatment, abscess volume reduced significantly, and all LFT parameters improved (Table 5). Mean abscess volume decreased from 212.89 ± 110.24 cc at admission to 76.84 ± 52.67 cc at discharge, a mean reduction of 136.05 ± 64.10 cc ($p < 0.01$). At discharge, every patient (100%) had a residual abscess of < 200 cc, whereas at admission 44.82% had volumes ≥ 200 cc. Mean ALP fell from 134.66 ± 48.48 to 102.38 ± 34.26 IU/L; SGOT from 82.44 ± 55.12 to 46.27 ± 21.84 IU/L; SGPT from 60.11 ± 26.81 to 34.95 ± 16.42 IU/L; total bilirubin from 1.50 ± 0.73 to 0.92 ± 0.41 mg/dL; and INR from 1.43 ± 0.75 to 1.16 ± 0.32. Serum albumin rose from 3.22 ± 0.96 to 3.68 ± 0.72 g/dL. All changes were statistically significant ($p < 0.01$).

Table 5. Comparison of abscess volume and liver function test parameters at admission and discharge (n = 87).

Parameter	At admission (Mean ± SD)	At discharge (Mean ± SD)	Mean change	p-value
Abscess volume (cc)	212.89 ± 110.24	76.84 ± 52.67	↓ 136.05 ± 64.10	< 0.01
ALP (IU/L)	134.66 ± 48.48	102.38 ± 34.26	↓ 32.28	< 0.01
SGOT/AST (IU/L)	82.44 ± 55.12	46.27 ± 21.84	↓ 36.17	< 0.01
SGPT/ALT (IU/L)	60.11 ± 26.81	34.95 ± 16.42	↓ 25.16	< 0.01
Total bilirubin (mg/dL)	1.50 ± 0.73	0.92 ± 0.41	↓ 0.58	< 0.01
Serum albumin (g/dL)	3.22 ± 0.96	3.68 ± 0.72	↑ 0.46	< 0.01
INR	1.43 ± 0.75	1.16 ± 0.32	↓ 0.27	< 0.01

Correlation between abscess volume and biochemical parameters: Abscess volume at admission correlated significantly with all six biochemical parameters (Table 6). The strongest correlation was with ALP ($r = 0.542$, $p < 0.001$), followed by SGOT ($r = 0.493$), SGPT ($r = 0.479$) and total bilirubin ($r = 0.401$). INR showed a weak but significant positive correlation ($r = 0.265$, $p = 0.013$). Serum albumin showed a significant inverse correlation ($r = -0.266$, $p = 0.013$), indicating that albumin levels declined as abscess size increased.

Table 6. Correlation of abscess volume with biochemical parameters at admission (n = 87).

Biochemical parameter	Correlation coefficient (r)	Type of correlation	p-value
ALP (IU/L)	0.542	Moderate positive	< 0.001
SGOT/AST (IU/L)	0.493	Moderate positive	< 0.001
SGPT/ALT (IU/L)	0.479	Moderate positive	< 0.001
Total bilirubin (mg/dL)	0.401	Moderate positive	0.012
INR	0.265	Weak positive	0.013
Serum albumin (g/dL)	−0.266	Weak negative	0.013

DISCUSSION

The present prospective study of 87 patients with ultrasonography-confirmed liver abscess offers a contemporary perspective on a disease that continues to carry significant morbidity in the Indian subcontinent. Three principal observations emerge: the disease predominantly affects middle-aged men with right hepatic lobe involvement as solitary lesions; the etiological spectrum has shifted decisively toward pyogenic disease, with Klebsiella pneumoniae as the leading pathogen; and liver function test abnormalities correlate significantly with abscess volume and improve in parallel with radiological regression after treatment — supporting their use as practical, inexpensive prognostic markers.[2,10]

The mean age of our cohort was 42.29 ± 14.18 years, with the highest case concentration in the 31–40 year group (27.59%) and a striking male predominance (80.46%; M:F ≈ 4:1). This distribution mirrors the broader Indian and Asian experience. Jana et al. reported the majority of cases in the 21–40 year group with 76.7% male predominance,[1] Singh et al. documented a mean age of 44 years with 93.3% male predominance,[11] and Bhutto et al. observed a marginally older mean age of 45.42 years.[13] The clustering of cases in middle-aged men is biologically and behaviourally coherent, reflecting a disproportionate burden of alcohol use disorder, diabetes mellitus, biliary tract disease, and delayed care-seeking in this demographic.[3,4] The relative protection observed in women has been attributed to oestrogen-mediated enhancement of cell-mediated immunity against Entamoeba histolytica, alongside sociocultural determinants of healthcare access.[6]

The clinical presentation was dominated by the classical triad of fever (100%), abdominal pain (90.80%) and hepatomegaly (85.06%), with abdominal tenderness (65.52%) and anorexia (52.87%) as additional frequent features. These figures align closely with those of Jana et al.[1] and of Singh et al., who reported abdominal pain in 90.4% and fever in 83.6% of their cohort.[11] Thoracic manifestations such as cough (31.03%) and pleural effusion (26.44%) reflect diaphragmatic irritation in patients with right lobe posterior segment disease.8,11 The 6.90% rate of intraperitoneal rupture in our cohort approximates the approximately 10% rupture frequency previously described by Jana et al.[1] and Pang T.12

Pyogenic liver abscess accounted for 79.31% of cases and amoebic disease for 20.69%, exemplifying the changing etiological landscape. A comparable distribution (73.97% vs 26.03%) was documented by Bhutto et al.,[13] whereas the earlier Jana et al. series recorded a modest amoebic predominance (53.3% vs 46.7%), highlighting the temporal evolution of the disease.[1] Several converging factors plausibly explain this shift: improving sanitation has reduced amoebic transmission; rising prevalence of diabetes and biliary disease has expanded the pyogenic risk pool; and enhanced microbiological diagnostics together with growing exposure to healthcare-associated organisms have increased pathogen detection.3,4,9 Within the pyogenic group, Klebsiella pneumoniae was the leading isolate, followed by Escherichia coli and Streptococcus viridans. This pattern is concordant with contemporary Asian epidemiology, where K. pneumoniae has emerged as the predominant cause, strongly associated with diabetes and — in a proportion of strains — the hypermucoviscous phenotype carrying a propensity for metastatic complications.3,14 Some Indian series, however, continue to report E. coli as the most frequent isolate, underscoring persistent regional heterogeneity.11,13

Right lobe involvement (72.41%), solitary lesions (64.37%) and posterior segment predominance (segments VII and VI together 58.62%) reflect the well-established anatomical fact that the right lobe receives approximately 75% of portal venous flow, facilitating preferential haematogenous seeding.1,4 Our right lobe figure is closely concordant with the 74.2% reported by Shi et al. in a large pyogenic abscess analysis,[14] and with the dominant patterns described by Singh et al.[11] and Bhutto et al.[13] The solitary lesion ratio mirrors 'Jana et al. s' observation of 65% single abscesses,[1] and the posterior segment localisation provides the anatomical basis for the thoracic manifestations seen in this cohort.[8]

A marked reduction in abscess volume was observed across the treatment period, with the mean falling from 212.89 ± 110.24 cc to 76.84 ± 52.67 cc (mean reduction 136.05 ± 64.10 cc; $p < 0.01$), and all 87 patients having residual cavities below 200 cc at discharge. This radiological regression confirms the effectiveness of combined antimicrobial therapy and image-guided percutaneous drainage. Jana et al. demonstrated the efficacy of percutaneous catheter drainage,[1] and Shi et al. established it as a first-line modality, particularly for abscesses exceeding 5 cm.[14] Heneghan et al.8 and Lo et al.4 have likewise emphasised the value of percutaneous techniques over surgical drainage in contemporary practice.

The central biochemical finding of this study is the demonstration of statistically significant correlations between abscess volume and all six liver function parameters, together with parallel improvement in each parameter following treatment ($p < 0.01$ for all admission-to-discharge comparisons). Alkaline phosphatase showed the strongest correlation ($r = 0.542$, $p < 0.001$), with the mean falling from 134.66 ± 48.48 to 102.38 ± 34.26 IU/L. Elevated ALP in liver abscess reflects mechanical compression of intrahepatic bile canaliculi by the expanding cavity and inflammation of adjacent biliary epithelium.15-17 The strength of this correlation suggests that cholestatic dysfunction is among the earliest quantitatively responsive consequences of abscess enlargement, a finding consistent with Singh et al.'s observation that raised ALP is a useful index of severity in this disease.[11]

The hepatocellular enzymes SGOT and SGPT correlated moderately with abscess volume (r = 0.493 and 0.479 respectively), reflecting peri-abscess parenchymal injury and cytokine-driven hepatic damage.[17] Total bilirubin demonstrated a moderate positive correlation (r = 0.401), although clinical jaundice was apparent in only 24.14% of patients, indicating that subclinical hyperbilirubinaemia is common and biologically meaningful.18 Serum albumin showed a significant inverse correlation (r = −0.266), with mean values rising from 3.22 to 3.68 g/dL by discharge. Hypoalbuminaemia in this setting is multifactorial: interleukin-6-driven suppression of hepatic albumin synthesis in favour of acute-phase proteins, capillary leak with extravascular redistribution, and nutritional deficit secondary to anorexia and catabolism.19,20 Importantly, Jana et al. identified low albumin as an independent predictor of ruptured or complicated abscess.[1] INR demonstrated a weak but significant positive correlation (r = 0.265), reflecting impaired hepatic synthesis of vitamin K-dependent clotting factors during the acute infective insult.[2]1

These associations are biologically coherent: an enlarging abscess exerts greater compressive force on biliary structures (raising ALP and bilirubin), inflicts greater parenchymal injury (raising transaminases), and generates a more intense inflammatory response (suppressing albumin and prolonging INR). Agarwal et al. previously reported a similar pattern of correlations — ALP (r = 0.40), SGOT (r = 0.41), SGPT (r = 0.39), INR (r = 0.54), and albumin (r = −0.28) — although they did not detect a significant association for total bilirubin.[15] The present study extends these observations by demonstrating significant correlations across all six parameters, including total bilirubin, and by documenting parallel biochemical recovery at discharge that mirrors radiological regression. Taken together, these findings support a clinically actionable framework in which ALP, albumin and INR — three simple, inexpensive and universally available tests — can be used alongside imaging to stratify risk, monitor therapeutic response, and identify patients requiring escalation of care, particularly in resource-limited settings.1,11,15

This study has several limitations. It was conducted at a single tertiary care centre with a moderate sample size, which may limit generalisability. A formal multivariate analysis of independent outcome predictors was not undertaken, and long-term follow-up beyond discharge was not performed. Microbiological yield was likely affected by prior empirical antibiotic exposure, which may have inflated the culture-negative subgroup. Larger multicentre prospective studies with longer follow-up and multivariate modelling are needed to validate specific LFT cut-off thresholds and to define their predictive performance for hard end-points such as rupture, sepsis and mortality.

CONCLUSION

Liver abscess in this contemporary North Indian cohort predominantly affects middle-aged men, with pyogenic disease — chiefly due to Klebsiella pneumoniae — now substantially outnumbering amoebic disease. The right hepatic lobe is the principal anatomical target, and posterior segments (VI and VII) are most frequently involved. Liver function test parameters — particularly alkaline phosphatase, serum albumin and INR — correlate significantly with abscess volume at admission and improve in parallel with radiological regression after treatment. LFTs are simple, economical and universally available, and they should be incorporated into routine prognostic assessment, monitoring of treatment response, and individualised management planning in patients with liver abscess, especially in resource-limited settings.

Declarations

Ethical approval: Obtained from the Institutional Ethics Committee, MGMCH, Jaipur, prior to commencement of the study.

Informed consent: Written informed consent was obtained from all participants or their legally authorised attendants.

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Conflicts of interest: The authors declare no conflicts of interest.

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