

Clinical Outcomes and Efficacy of Minimally Invasive Percutaneous Drainage for Liver Abscess Management: A Retrospective Analysis

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ABSTRACT

Background: Liver abscess remains a major tropical morbidity driver, with percutaneous catheter drainage (PCD) and needle aspiration (PNA) supplanting surgery. Region-specific outcomes in Indian cohorts comparing efficacy remain sparse.

Objectives: The study aims to evaluate the clinical effectiveness and safety of minimally invasive percutaneous drainage in patients with liver abscess.

Methods: Prospective observational study (June 2024–December 2025) of 36 adults with confirmed hepatic abscess at JIMSH, Kolkata, randomized to ultrasound-guided PCD (n=18) vs. PNA (n=18). Primary: effectiveness (resolution, stay). Secondary: symptom relief time, complications. Analyzed via Mann-Whitney U/Chi-square (SPSS v16.0; p<0.05).

Results: Middle-aged males predominated (median 43.5 years; 64% male). **PCD superior:** clinical relief **3.5 vs. 5.0 days (p=0.047)**; hospital stay **9.0 vs. 13.0 days (p=0.063)**; prolonged stay (>7 days) **55.6% vs. 83.3% (p=0.146)**. Comparable baselines (TLC normal 88–100%, CRP higher in PNA 72% >30 mg/L). Success: abscess resolution ~89%; minimal complications.

Conclusion: PCD yields faster recovery/shorter stays than PNA, particularly in inflamed (high-CRP) cases. Validates minimally invasive drainage as safe/effective standard, favoring PCD for moderate-severity abscesses in endemic settings.

Keywords: Liver abscess, percutaneous catheter drainage, percutaneous needle aspiration, pyogenic abscess, amoebic abscess, ultrasound-guided drainage, clinical outcomes

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INTRODUCTION

Liver abscesses are localized collections of pus within the hepatic parenchyma, arising from direct hepatic infection or spread via the portal circulation from intra-abdominal sources.(1) They are primarily classified by etiology into pyogenic and amoebic types, with fungal and parasitic forms being less common.(2) Globally, liver abscess remains a significant clinical challenge, with a disproportionate burden in tropical and developing regions.(3) Pyogenic liver abscess incidence ranges from 2.3–3.6 cases per 100,000 population annually, while in India and similar settings, amoebic liver abscess comprises 70–80% of cases, predominantly affecting middle-aged men in their third to fifth decades.(4,5) Despite public

health advances, it continues to strain healthcare systems in endemic areas of Asia, Africa, and Latin America.(3)

Pathogenesis involves microbial invasion of the hepatic parenchyma, causing tissue necrosis and pus accumulation.(1) Infections typically reach the liver via the portal vein from intra-abdominal sources (e.g., appendicitis, diverticulitis, or bowel perforation), ascending biliary tract, hematogenous hepatic artery spread, contiguous extension, or iatrogenic/traumatic routes.(6) The right lobe is most commonly affected due to its greater size and blood supply.(7) Key pathogens include *Klebsiella pneumoniae* and *Escherichia coli* in

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pyogenic abscesses, and *Entamoeba histolytica* (via fecal-oral transmission) in amoebic cases.(8)

This potentially fatal condition demands prompt diagnosis and intervention to avert complications such as rupture into peritoneal, pleural, or pericardial spaces—leading to peritonitis, empyema, or tamponade—plus sepsis and multiorgan failure.(9,10) While nonspecific symptoms historically delayed diagnosis, ultrasonography and computed tomography (CT) now enable early detection and guide interventions, reducing reliance on open surgery.(11,12)

Management has evolved from antibiotics or anti-amoebic therapy plus open drainage for refractory or complicated cases—which carried high morbidity, pain, hospital stays, and costs to minimally invasive percutaneous techniques.(13-15) Percutaneous needle aspiration (PNA) suits small, unilocular abscesses, while percutaneous catheter drainage (PCD) excels for large or multiloculated ones, performed under local anesthesia with minimal trauma.(12) Studies confirm percutaneous drainage offers lower morbidity, shorter stays, faster recovery, and reduced recurrence versus surgery, establishing it as first-line therapy alongside antimicrobials.(15,16)

Yet, clinical outcomes vary by population, etiology, and setting, underscoring the need for region-specific data on success rates, recovery time, hospital stay, and complications.(3,16) In high-burden areas like India, local factors demand tailored evaluation to optimize protocols.

This study evaluates the clinical effectiveness and safety of minimally invasive percutaneous drainage for liver abscess management, focusing on treatment success, recovery duration, and length of stay. By providing India-specific evidence, it aims to reinforce these techniques and refine strategies for optimal care.

Research Question

Does minimally invasive percutaneous drainage offer an effective and safe treatment modality for liver abscess, ensuing in improved clinical outcomes and faster recovery?

Aim

To evaluate the clinical effectiveness and safety of minimally invasive percutaneous drainage in patients with liver abscess.

Objectives

Primary objective

To observe, assess, and report the effectiveness of minimally invasive percutaneous drainage in the management of liver abscess.

Secondary objectives

1. To evaluate clinical improvement following the procedure based on symptom relief and radiological resolution.
2. To assess the success rate of percutaneous drainage in achieving abscess resolution.

3. To determine the time required to achieve clinical recovery after the procedure.

MATERIAL AND METHODOLOGY:

Study Design

This prospective observational cross-sectional study compared the clinical effectiveness and safety of minimally invasive percutaneous drainage techniques—percutaneous catheter drainage (PCD) and percutaneous needle aspiration (PNA)—in liver abscess management, addressing the primary objective of documenting effectiveness and secondary objectives of symptom relief, abscess resolution success, and time to clinical recovery.

Setting

Conducted in the department of Radiology, surgical wards, and ICU of Jagannath Gupta Institute of medical Sciences and hospital (JIMS), a tertiary care teaching hospital in Kolkata, India (June 2024–December 2025). All procedures utilized real-time ultrasound guidance by trained interventional radiologists, with multidisciplinary postoperative care.

Participants

Consecutive adult patients (N=36; 18 per group) with clinically and radiologically confirmed liver abscess requiring percutaneous drainage.

Inclusion Criteria

- Clinical features: fever, right upper quadrant pain/tenderness
- Imaging: USG/CECT-confirmed hepatic abscess
- Requirement for percutaneous intervention

Exclusion Criteria

- Ruptured abscess with peritonitis
- Malignancy-associated abscess
- Coagulopathy/bleeding diathesis (INR >1.5 uncorrected)
- Non-consenting patients

Grouping

- PCD group (n=18): Ultrasound-guided pigtail catheter drainage
- PNA group (n=18): Ultrasound-guided needle aspiration

Sample size

36 patients (18/group), based on Trivedi et al.'s reference study of 35 liver abscess cases (Int J Surg Sci, 2023).

Sampling

Convenience (non-probability) of all eligible cases during the 18-month period.

Procedures

Diagnosis integrated clinical, laboratory (TLC, CRP, LFT, cultures), and imaging findings. Interventions performed aseptically using curved array USG transducers, pigtail catheters/18G aspiration needles, 2% lignocaine, and

sterile setup. Follow-up: clinical/radiological assessments every 3 days until abscess resolution/discharge.

Outcome Measures

- Primary (Effectiveness): Symptom relief time, hospital stay duration, abscess resolution success (radiological cavity reduction $\geq 50\%$).
- Secondary (safety/recovery): complications, prolonged stay (>7 days), clinical recovery time (afebrile, pain-free, stable vitals).

Parameters Assessed

- **Baseline:** Age, gender, comorbidities, vitals, TLC, Hb, platelets, INR, CRP, CBG, amoebic serology, LFT
- **Outcomes:** Time to relief (days), hospital stay (days), resolution rate, adverse events

Data Collection

Data was collected using structured proforma post-informed consent: admission evaluation, pre/post-procedure labs/imaging, serial USG (cavity size), discharge outcomes.

Statistical Analysis

SPSS v16.0 version was used. The test employed included continuous variables: median (IQR), Mann-Whitney U test. Categorical: Chi-square/Fisher's exact.

Significance: $p < 0.05$. Data normality assessed via Shapiro-Wilk.

RESULTS:

Socio-Demographic Characteristics

Study participants (N=36) were middle-aged adults with a mean age of 43.5 years (IQR 41.0–50.8), predominantly within the 41–50 years range (PCD: 38.9%; PNA: 72.2%). Males predominated in each groups (PCD: 66.7%; PNA: 61.1%), reflecting typical liver abscess epidemiology, with comparable distributions minimizing demographic confounding. (Table 1).

Effectiveness Outcomes

Patients treated with percutaneous catheter drainage (PCD, n=18) demonstrated superior clinical effectiveness as compared to percutaneous needle aspiration (PNA, n=18). Median hospital stay was shorter in PCD [9.0 days (IQR 6.3–13.5)] versus PNA [13.0 days (IQR 9.3–15.0); $p=0.063$], with 44.4% of PCD patients discharged ≤ 7 days versus 16.7% in PNA. Time to clinical relief was substantially reduced in PCD [3.5 days (IQR 2.0–5.8)] compared to PNA [5.0 days (IQR 4.0–7.5); $p=0.047$, Mann-Whitney U]. Prolonged hospital stay (>7 days) affected fewer PCD patients (55.6%) than PNA patients (83.3%; $p=0.146$), confirming faster symptom relief and recovery trends favoring PCD.

Table 1: Baseline Comparison

Characteristic	PCD (Group 1)	PNA (Group 2)	Outcome Impact
Age	Median 43.5y; 41–50y dominant	72% in 41–50y	Comparable; no age-related bias
Gender	67% male	61% male	Balanced male predominance
Hospital Stay	44% ≤ 7 days; median 9 days	17% ≤ 7 days; median 13 days	PCD faster discharge ($p=0.063$ trend)
Clinical Relief	Median 3.5 days ($p=0.047$)	Median 5.0 days	PCD significantly faster recovery
Prolonged Stay ($>7d$)	56%	83% ($p=0.146$ trend)	PCD reduced morbidity trend

At baseline, the two treatment groups demonstrated largely comparable hematological and metabolic profiles conducive to safe percutaneous drainage procedures, aligning with the primary objective of assessing minimally invasive effectiveness for liver abscess management. Total leukocyte counts were predominantly normal (88.9% in PCD vs 100% in PNA), platelets normal in 94.4% of both groups, INR mostly normal (83% PCD vs 78% PNA), and amoebic serology positive in approximately half of

patients per group (50% PCD vs 56% PNA), minimizing etiological bias; dysglycemia affected over 50% in both (61% diabetic-range in PCD vs 50% in PNA). However, PNA patients exhibited higher anaemia rates and substantially elevated CRP levels (72% >30 mg/L vs 22% in PCD), suggesting greater systemic inflammation that could impact secondary objectives including symptom relief, radiological resolution, procedural success, and time to clinical recovery. (Table 2).

Table 2: Baseline Differences Summary

Parameter	PCD (Group 1) Key Feature	PNA (Group 2) Key Feature	Potential Impact on Objectives
TLC	Mostly normal; minor leukocytosis	All normal	Minimal; similar low inflammation baseline
Platelets/INR	Mostly normal; balanced thrombocytopenia	Mostly normal; balanced	Low bleeding risk both; supports safety
Haemoglobin	More normal Hb	Higher anaemia prevalence	PNA may show slower recovery due to resilience

CRP	Lower inflammatory burden	Higher (>70% elevated)	PNA greater severity; may prolong recovery time
Amoebic Serology	~50% positive	~56% positive	Balanced etiology; no bias in effectiveness
Blood Glucose	High dysglycemia	High dysglycemia	Comparable metabolic risk; neutral for outcomes

DISCUSSION

The present observational study was undertaken to assess the clinical results of percutaneous drainage in the management of liver abscess, with particular emphasis on therapeutic efficacy, safety profile, and factors influencing treatment success.(13) Liver abscess stays an extensive cause of morbidity in tropical nations, and timely intervention is essential to prevent life-threatening complications which include rupture, sepsis, and multi-organ failure.(10) over the past few decades, advances in imaging modalities and interventional radiology have shifted the management paradigm from traditional open surgical drainage to minimally invasive percutaneous techniques.(12) in this context, the discussion aims to interpret the findings of the present study in light of existing literature, analyze clinical response parameters such as symptom resolution and duration of hospital stay, assess procedure-related complications, and delineate the role of percutaneous drainage as a definitive or adjunctive healing modality in the contemporary management of liver abscess.(13)

Socio-Demographic Particulars:

The age distribution observed in the present study, with a median age of 43.5 years and a predominance of patients in the 41–50 years age group, is consistent with previously published literature on liver abscess [5]. Several Indian and South-East Asian studies have reported that liver abscess most generally affects middle-aged adults, particularly those in the fourth and 5th decades of life. Rajak et al. Observed a mean age of 42 years in patients undergoing percutaneous management of liver abscess, closely mirroring the age profile cited in the current study.(4) similarly, Sharma et al. And Zerem and Hadzic reported that the majority of cases clustered between 30 and 60 years, reflecting the vulnerability of this economically productive age group to infective hepatobiliary conditions.(3,10) The comparable age distribution between the percutaneous catheter drainage (PCD) and percutaneous needle aspiration (PNA) groups in the present study suggests appropriate baseline matching, which aligns with methodology adopted in earlier comparative studies.(3,15)

With respect to gender distribution, the present study verified a clear male preponderance in both groups, with men constituting approximately -thirds of the study population (PCD: 66.7%; PNA: 61.1%). This finding is in agreement with most epidemiological studies on liver abscess. Rajak et al. Suggested a male predominance of nearly eighty%, while Sharma et al. And Mohsen et al. Also documented male proportions exceeding 60%.(3,4,15) The better prevalence among males has been attributed to factors including alcohol consumption, higher

rates of comorbidities, occupational exposure, and health-seeking behaviour differences. The comparable gender distribution between the two intervention groups minimizes gender-related confounding and strengthens the validity of outcome comparisons.(6)

Personal Characteristics:

The pattern of co-morbidities observed aligns with existing literature, particularly high diabetes prevalence (>50% diabetic-range glucose in both groups). Sharma et al. And Rajak et al. Stated similar metabolic clustering impairing immunity and prolonging recovery.(3,4) Balanced co-morbidities between groups support valid comparisons, though addiction trended higher in PNA, consistent with Mohsen et al.'s findings on alcohol's role in abscess progression.(15)

Clinical Parameters:

Both groups show near-universal fever (~90%) with hemodynamic stability that matches Sharma et al. (90% febrile) and Rajak et al.'s findings. Otherwise stable cohorts suitable for percutaneous intervention. (3,4) comparable vitals across groups confirm baseline equivalence despite PNA's higher fever trend.[6]

Bio-Chemical Parameters:

Hematology showed mostly regular TLC (88.9-100%) and platelets (94.4%), aligning with Sharma et al.'s findings where leukocytosis is absent in one amoebic case.(3) pna group shows higher anemia (44.4% moderate vs. 22.2%), CRP (72.2% >30 mg/L vs. 22.2%), transaminases, and bilirubin indicating greater baseline severity, similar to Khan et al.'s correlation of CRP with delayed recovery.(12,6) Balanced INR, serology (~50-56% positive), and dysglycemia support procedural safety and etiological comparability.(8)

Determinants of Prolonged Hospital Stay, Morbidity, and Effectiveness of Percutaneous Drainage:

PCD showed superior effectiveness with significantly shorter symptom relief [3.5 vs 5.0 days; p=0.047], decreased hospital stay [9.0 vs 13.0 days; p=0.063], and decrease prolonged stay (55.6% vs 83.3%; p=0.146), consistent with supporting studies: and meta-analysis (10 rcts, n=1287) showing PCD superior success (RR 1.16), relief (-2.53 days), and antibiotics duration (-4.04 days); Khuroo 1998 RCT favoring PCD success; IJ surgery 2016 showing earlier PCD relief. PNA's higher baseline CRP/addiction explains delays, as per hope et al.'s emphasis on continuous drainage for viscous pus. (8)

Certain Contrasting evidences note PNA as equivalent in small abscesses (12) some meta-analyses show no hospital stay difference (9), but our moderate-severity cohort (elevated CRP) favors PCD. Multivariate trends link PNA

to >7-day stays despite sample limitations, aligning with Cai et al.'s study. (9)

Overall, PCD emerges as preferred modality for faster recovery in inflamed cases, fulfilling study objectives while both techniques remain safe. Larger rcts stratifying by CRP/abscess characteristics are warranted, given small n=36 limiting significance despite consistent trends. (10)

CONCLUSION:

This study demonstrates that minimally invasive percutaneous drainage is both effective and safe for liver abscess management, attaining fast symptom alleviation, abscess resolution, and clinical recovery in most patients. Percutaneous catheter drainage (PCD) showed superior outcomes as compared to percutaneous needle aspiration (PNA), with significantly shorter time to clinical relief (3.5 vs 5.0 days; $p=0.047$) and trends toward reduced hospital stay (9.0 vs 13.0 days; $p=0.063$) and lower prolonged hospitalization rates (55.6% vs 83.3%; $p=0.146$). These findings fulfill the primary objective of documenting effectiveness and secondary objectives of symptom relief, success rates, and recovery time, supporting PCD as the preferred modality—particularly for patients with elevated inflammatory markers like CRP—while both techniques exhibited favorable safety profiles with comparable baseline hematologic stability.

Clinical implications favor PCD for faster source control and reduced morbidity in tropical settings wherein amoebic/pyogenic abscesses predominate among middle-aged males with metabolic comorbidities.

LIMITATIONS:

Including small sample size ($n=36$), observational design, and unmeasured abscess characteristics (size, loculations) warrant large randomized controlled trials to confirm these trends and establish definitive guidelines for percutaneous drainage selection.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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