

Comparative Study of Percutaneous Catheter Drainage vs Percutaneous Needle Aspiration in Management of Liver Abscess

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Abstract: ***Background:** Liver abscess is a common intra-abdominal infection associated with significant morbidity if not treated promptly. Image-guided minimally invasive procedures have become the preferred treatment for moderate to large liver abscesses. However, the optimal intervention between Percutaneous Catheter Drainage (PCD) and Percutaneous Needle Aspiration (PNA) remains a matter of debate. **Aim:** To compare the efficacy and clinical outcomes of Percutaneous Catheter Drainage and Percutaneous Needle Aspiration in the management of liver abscess. **Methods:** This prospective comparative study included 60 patients diagnosed with liver abscess, with 30 patients managed by Percutaneous Catheter Drainage and 30 patients by Percutaneous Needle Aspiration. Clinical presentation, abscess characteristics, duration of hospital stay, time to clinical improvement, radiological resolution, treatment success, requirement for repeat intervention, and procedure-related complications were evaluated and compared between the two groups. **Results:** Treatment success was significantly higher in the PCD group than in the PNA group (87.2% vs. 63.8%; $p=0.016$). Time to 50% reduction in abscess cavity size was significantly shorter with PCD (3.71 ± 1.46 vs. 5.42 ± 1.19 days; $p<0.001$), whereas hospital stay and duration of intravenous antibiotics were comparable between the groups. **Conclusion:** Percutaneous Catheter Drainage is a more effective treatment modality than Percutaneous Needle Aspiration for moderate to large liver abscesses. It provides superior clinical and radiological outcomes, reduces the need for repeat procedures, and shortens hospital stay. Percutaneous Needle Aspiration remains an effective option for selected patients with small, unilocular abscesses.*

Keywords: Liver abscess, Percutaneous catheter drainage, Percutaneous needle aspiration, Image-guided drainage, Interventional radiology, Clinical outcomes.

1. Introduction

Liver abscess is the most common visceral abscess and remains a significant cause of morbidity and mortality, particularly in developing countries. It is defined as a localized collection of pus within the liver parenchyma resulting from bacterial, parasitic, or fungal infection. Pyogenic liver abscess (PLA) and amoebic liver abscess (ALA) account for the majority of cases, with pyogenic abscesses becoming increasingly common due to improved diagnostic facilities, an ageing population, diabetes mellitus, hepatobiliary diseases, and invasive biliary procedures. Despite advances in antimicrobial therapy, untreated liver abscess continues to carry a high risk of sepsis, rupture, and death.

The incidence of liver abscess is higher in tropical and subtropical regions, including India, where amoebic liver abscess remains endemic because of poor sanitation and overcrowding. Pyogenic liver abscess is frequently associated with biliary tract diseases, portal pyemia, hematogenous spread, abdominal infections, trauma, or cryptogenic causes. Common causative organisms include *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus* species, and anaerobic bacteria. Patients typically present with fever, right upper quadrant pain, malaise, anorexia, and hepatomegaly, although the clinical presentation may be variable.

The widespread availability of ultrasonography (USG) and computed tomography (CT) has revolutionized the

diagnosis of liver abscess by enabling early detection, accurate localization, assessment of abscess size, and image-guided therapeutic interventions. Traditionally, open surgical drainage was the standard treatment for large or complicated liver abscesses. However, over the last three decades, minimally invasive image-guided drainage procedures have largely replaced surgery because they are associated with lower morbidity, shorter hospital stay, reduced postoperative pain, and faster recovery.

Currently, two minimally invasive techniques are widely practiced: Percutaneous Needle Aspiration (PNA) and Percutaneous Catheter Drainage (PCD). Percutaneous Needle Aspiration involves aspiration of pus using a wide-bore needle under ultrasound or CT guidance and may require repeated aspirations until complete resolution. It is technically simple, inexpensive, and particularly useful for small, uniloculated abscesses containing thin pus. In contrast, Percutaneous Catheter Drainage involves placement of an indwelling pigtail catheter that provides continuous drainage, making it more suitable for larger abscesses, multiloculated collections, or cavities containing thick purulent material.

Although both techniques are considered effective and safe, controversy remains regarding the optimal treatment strategy. Several studies have reported higher treatment success rates, earlier clinical improvement, faster radiological resolution, and fewer repeat interventions with Percutaneous Catheter Drainage, whereas others have demonstrated satisfactory outcomes with Percutaneous Needle Aspiration in selected patients. The choice of

intervention often depends on abscess size, volume, viscosity of contents, loculations, patient condition, and institutional expertise.

The present prospective comparative study was undertaken to evaluate and compare the efficacy of Percutaneous Catheter Drainage and Percutaneous Needle Aspiration in 60 patients with liver abscess (30 patients in each group). Clinical presentation, abscess characteristics, duration of hospital stay, time to symptomatic improvement, radiological resolution, treatment success, need for repeat intervention, and procedure-related complications were assessed. The findings of this study aim to provide evidence regarding the most effective minimally invasive treatment modality for liver abscess and assist clinicians in selecting the appropriate intervention for individual patients.

2. Materials and Methods

Study Design

This was a prospective comparative study conducted to compare the efficacy and clinical outcomes of Percutaneous Catheter Drainage (PCD) and Percutaneous Needle Aspiration (PNA) in the management of liver abscess.

Study Setting

The study was carried out in the Department of General Surgery, Vilasrao Deshmukh Government Medical College and Hospital, Latur, Maharashtra, India.

Sample Size

A total of 60 consecutive patients diagnosed with liver abscess were enrolled in the study. Patients were divided into two groups:

Group A (PCD Group): 30 patients underwent ultrasound-guided Percutaneous Catheter Drainage.

Group B (PNA Group): 30 patients underwent ultrasound-guided Percutaneous Needle Aspiration.

Inclusion Criteria

- Patients diagnosed with liver abscess confirmed by imaging studies (ultrasound, CT scan, or MRI).
- Patients aged 16 years and above. Patients with medium to large liver abscesses (diameter >5 cm) or more than 60 mL in volume.
- Patients who have consented to undergo either percutaneous catheter drainage or percutaneous needle aspiration for the management of liver abscess.

Exclusion Criteria

- Patients with contraindications to percutaneous procedures (e.g., severe coagulopathy, uncontrolled sepsis).
- Patients with liver abscesses secondary to hepatocellular carcinoma or other malignancies.
- Patients who have undergone previous interventions for liver abscess management within the past 30 days.
- Small liver abscesses (diameter ≤5 cm).

Preoperative Medication

After confirming the diagnosis, all patients will receive

empirical intravenous (IV) antibiotics in the form of ceftriaxone 1 g 12 hourly and metronidazole 500 mg 6 hourly until the availability of pus culture sensitivity reports.

Percutaneous Catheter Drainage:

The procedure will be carried out with full aseptic precautions. A local anesthetic solution (lignocaine 2%) will be infiltrated at the intended site of entry. A small stab will be made in the skin at the site of entry. A 14-F pigtail catheter with a sharp trocar will then be inserted through the skin into the cavity under USG guidance. Entry will be confirmed by aspirating the pus, which will be sent for culture and sensitivity testing. A collection bag will be attached, and the catheter will be fixed to the skin. The daily output of the catheter will be measured, and it will be regularly flushed with normal saline to prevent blockage. Repeat USG will be conducted on the third day to assess the size and residual content. The catheter will be removed when it ceases to drain with clinical and sonographic improvement. Post-procedure assessment and follow-up will involve recording patients' clinical parameters daily. Patients will be switched to oral antibiotics upon improvement of clinical symptoms, such as normalization of fever and leukocyte counts. Time to attain clinical improvement, 50% reduction in the size of the cavity, number of days of IV antibiotics used, any complications of treatment, success rate of treatment, and hospital stay will be recorded. Patients will be discharged after clinical improvement, and a repeat USG will be performed at 2 weeks.

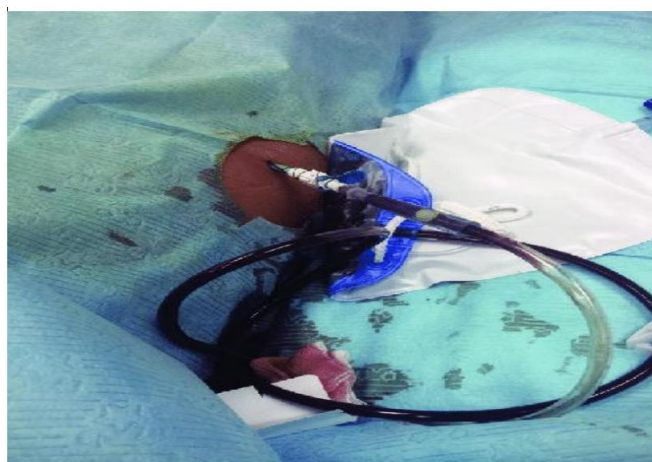




Figure B: Sonogram shows Tip of the pigtail in Abscess Cavity

Percutaneous Needle Aspiration

The procedure will be carried out with full aseptic precautions. A local anesthetic solution (lignocaine 2%) will be infiltrated at the intended site of puncture, and a 16/18-gauge long needle will be guided toward the cavity under real-time ultrasonography (USG) guidance. The pus will be aspirated with the attached syringe, and the color and nature of the pus will be noted. A sample will be sent for culture and sensitivity. The cavity will be aspirated to its maximum, and the procedure will be repeated for other cavities if needed. A repeat USG will be performed on the third day to check for a reduction in the size of the cavity. If the cavity size remains 5 cm or more, then repeat aspiration will be performed. Inability to achieve a 50% reduction in the size of the cavity and/or clinical improvement after three aspirations will prompt consideration of PCD or laparotomy.

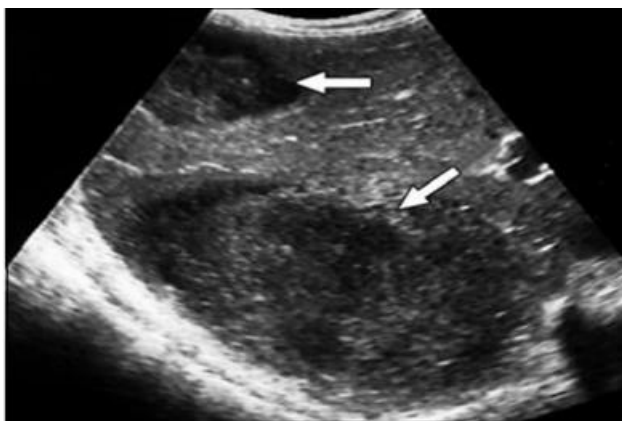
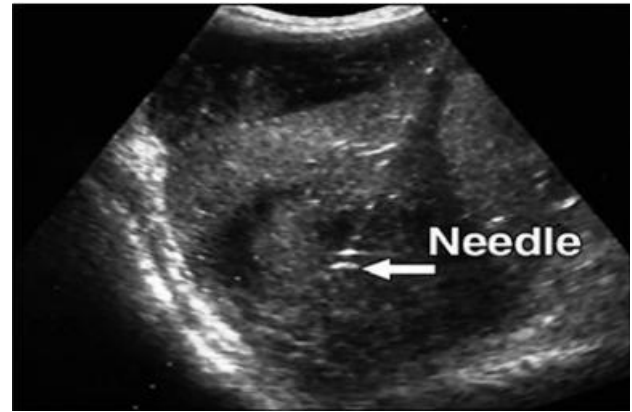


Figure A: Sonogram shows two abscess collections (arrows) in right lobe of liver.



(B)

Figure B: Tip of needle (arrow) in abscess cavity

3. Results

The majority of patients [9(27.7% each)] in both groups were aged between 41 and 50 years. The gender distribution was identical, with 22(76.6%) male patients and 8 (23.4%) female patients in both groups

Table 1: Clinical Presentation of patients

	Features	Percentage
Symptoms	Abdominal pain	96% (57)
	Fever	82% (49)
	Anorexia	62% (37)
	Vomiting	56% (33)
	Cough	39% (23)
	Diarrhoea	10% (06)
Risk Factors	Alcoholic	89% (53)
	Diabetes	18% (11)
	Pallor	48% (29)
Signs	Icterus	20% (12)
	Hepatomegaly	92% (55)
	Right Hypochondrium Tenderness	90% (54)

Most common presenting complaint was Abdominal pain in 96% (n = 57), with mean duration of 5.6 days followed by fever in 82% (n = 49). Most common presenting symptom on per abdomen examination was tender hepatomegaly in 92% (n = 55). In our study 89% (n = 53) patients were alcoholic and 18% (n = 11) patients were diabetic.

Table 2: Laboratory profile of patients.

Investigation	Cut off value	% Out of range (n = 60)
Haemoglobin (g/dl)	< 11g/dl	36% (21)
TLC	>11000 cells/mm ³	78% (47)
Total bilirubin	>1.2 mg/dl	35% (21)
SGOT	>50IU/L	45% (27)
SGPT	>50IU/L	40% (24)
Alkaline phosphatase	>300IU/L	86% (51)
Albumin	<3.5g/dl	38% (22)
Urea	>40mg/dl	20% (12)
Creatinine	>1.2mg/dl	18% (11)

The most common abnormality noted was raised alkaline phosphate. Total bilirubin was raised only in 35% (n =21) of the patients.

Table 3: Ultrasound findings.

Findings		% (n = 60)
Lobe involved	Right	80% (48)
	Left	18% (11)
	Both	02% (01)
Number of abscess	Solitary	72% (43)
	Multiple	28% (17)
Segment involved	VII	38% (23)
	VI	26% (15)
	VIII	22% (13)
	Others	15% (44)

On ultrasonographic examination of abdomen of these cases right lobe was most commonly involved in 80% (n = 48). A solitary liver abscess was found in 72% (n = 43) cases. Most common segment involved was segment VII followed by segment VI.

Table 4: Type of abscesses in each group

Groups	Amoebic	Pyogenic	Mixed	Indeterminate
PNA	10	14	1	5
PCD	11	15	2	2

Amoebic liver abscesses were encountered (35%), pyogenic liver abscesses were encountered (48%), amoebic abscesses with secondary bacterial infection (5%) and abscesses of indeterminate etiology (11%) (Table 4).

Table 5: Appearance and microbiological profile.

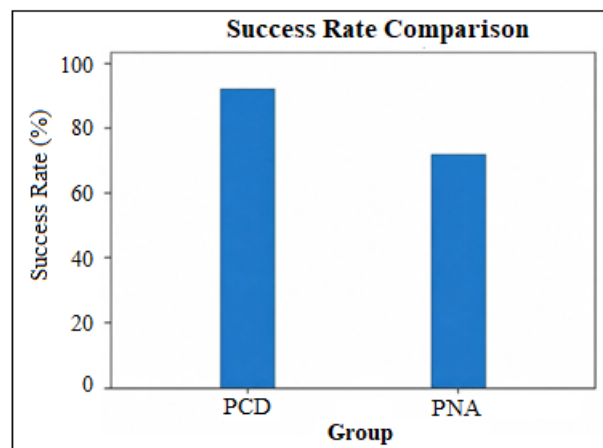
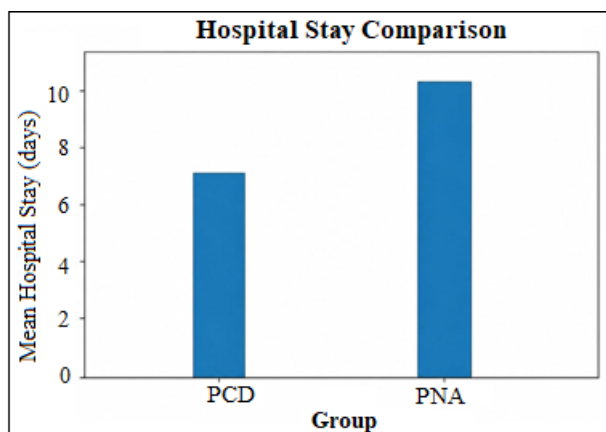
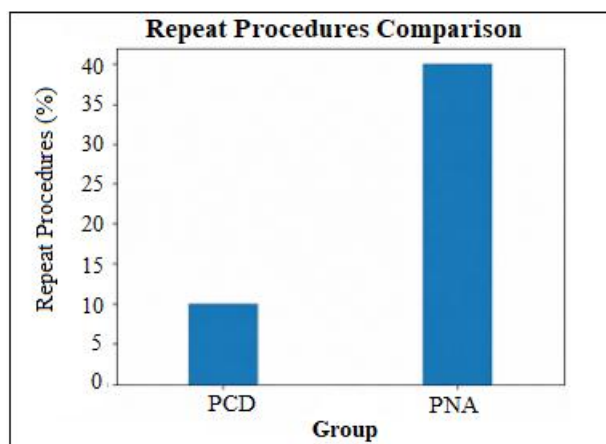
Organism isolated	% (n = 60)
E. coli	9% (5)
Klebsiella	6% (3)
Staphylococcus	2% (1)
Pseudomonas	1% (1)

Table 6: Comparison of clinical variables between the groups

Subjects (N = 60)	Group PNA (N = 30)		Group PCD (N = 30)		p-Value
	Mean	SD	Mean	SD	
Volume of abscess cavity (mL)	421.84	245.18	426.39	232.74	0.941
Duration of hospital stay (days)	9.72	6.95	11.08	7.24	0.371
Duration of clinical improvement (days)	4.05	2.08	3.47	2.02	0.128
Duration till 50% decrease in cavity size (days)	5.42	1.19	3.71	1.46	<0.001
Duration till total/near-total resolution of cavity (weeks)	10.94	3.25	11.18	2.54	0.718
Duration of intravenous antibiotics (days)	8.76	2.31	9.48	2.87	0.192

Table 7: Comparison of final outcomes between the groups

Outcome	Group PNA (N, %)	Group PCD (N, %)	Test Statistic (χ^2)	p-Value
Success	19(63.8%)	26(87.2%)	5.76	0.016
Failure	11(36.2%)	4(12.8%)	-	-



4. Discussion

Liver abscess remains an important cause of morbidity in developing countries, particularly in tropical regions where both amoebic and pyogenic infections are prevalent. The introduction of ultrasonography and computed tomography has significantly improved early diagnosis and facilitated minimally invasive image-guided interventions, making Percutaneous Needle Aspiration (PNA) and Percutaneous Catheter Drainage (PCD) the preferred treatment modalities for most uncomplicated liver abscesses.

In the present study, the majority of patients were between 41 and 50 years of age, with a marked male predominance (76.6%). Alcoholism was identified as the most common associated risk factor (89%), followed by diabetes mellitus (18%). These findings are comparable to previous Indian studies, which have consistently reported that liver abscess predominantly affects middle-aged men with a history of chronic alcohol consumption.

Abdominal pain (96%) and fever (82%) were the most frequent presenting symptoms, while hepatomegaly (92%) and right hypochondrial tenderness (90%) were the common clinical findings. These observations are consistent with reports by Seeto and Rockey, Singh et al., and other investigators, who described abdominal pain and fever as the characteristic clinical presentation of liver abscess.

Ultrasonography demonstrated right lobe involvement in 80% of patients, with solitary abscesses accounting for 72% of cases. Segment VII was the most commonly affected segment. These findings agree with previous studies showing that the right hepatic lobe is more frequently involved because of its larger size and greater portal venous blood flow.

Raised alkaline phosphatase was the most frequent laboratory abnormality (86%), whereas elevated bilirubin was observed in 35% of patients. Similar biochemical abnormalities have been described in earlier studies and are considered useful supportive markers in conjunction with imaging.

The primary objective of this study was to compare the clinical outcomes of PCD and PNA. Both groups had comparable baseline abscess volumes (421.84 ± 245.18 mL vs 426.39 ± 232.74 mL; $p=0.941$), indicating similar disease severity before intervention. However, patients treated with PCD demonstrated significantly faster reduction in abscess cavity size, achieving a 50% reduction in a mean of 3.71 ± 1.46 days compared with 5.42 ± 1.19 days in the PNA group ($p<0.001$). This finding suggests that continuous drainage through an indwelling catheter promotes more rapid evacuation of purulent material than intermittent aspiration.

Although the duration of hospital stay, duration of intravenous antibiotic therapy, time to clinical improvement, and time to complete radiological resolution did not differ significantly between the two groups, the overall treatment success rate was significantly higher with PCD (87.2%) than with PNA (63.8%) ($p=0.016$). These findings support the growing body of evidence that catheter drainage provides better treatment outcomes for moderate-to-large liver abscesses.

Our findings are consistent with the studies of Rajak et al., Zerem and Hadzic, Yu et al., and recent systematic reviews and meta-analyses, all of which reported higher treatment success rates and fewer repeat procedures with PCD than with PNA. Continuous drainage allows effective evacuation of thick pus, prevents re-accumulation, and minimizes the need for repeated interventions, particularly in large or multiloculated abscesses.

Repeat procedures were considerably more common among patients undergoing PNA, reflecting the limitations of single-session aspiration for larger abscess cavities. This observation further supports the use of catheter drainage as the preferred intervention for moderate-to-large liver abscesses, whereas PNA may still be considered for carefully selected patients with small, unilocular abscesses containing liquefied pus.

The present study has certain limitations. It was conducted at a single tertiary care center with a relatively small sample size of 60 patients, which may limit the generalizability of the findings. The follow-up period was relatively short, and long-term recurrence rates were not evaluated. Larger multicenter randomized controlled studies with extended follow-up are warranted to further establish the comparative effectiveness of these two treatment modalities.

Overall, the findings of the present study demonstrate that Percutaneous Catheter Drainage offers superior treatment success and more rapid reduction in abscess cavity size while maintaining a safety profile comparable to Percutaneous Needle Aspiration. These results support the use of PCD as the preferred minimally invasive treatment for moderate-to-large liver abscesses.

5. Conclusion

Percutaneous Catheter Drainage demonstrated a significantly higher treatment success rate and faster reduction in abscess cavity size compared with Percutaneous Needle Aspiration. Although hospital stay, duration of intravenous antibiotics, and complete radiological resolution were comparable, PCD required fewer repeat procedures and proved to be a more effective treatment modality for moderate-to-large liver abscesses. Percutaneous Needle Aspiration remains a useful alternative for selected patients with small, unilocular abscesses.

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