

## ORIGINAL RESEARCH

# To compare the effectiveness of percutaneous catheter drainage and percutaneous needle aspiration in the treatment of liver abscesses

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### ABSTRACT

**Aim:** This study aims to compare the effectiveness of percutaneous catheter drainage and percutaneous needle aspiration in the treatment of liver abscesses. The goal is to assess key outcomes such as hospital stay, time to abscess resolution, success rates, complication rates, and the need for additional procedures to determine the optimal treatment method. **Materials and Methods:** The study was conducted during November 2021 to July 2022 at Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India. A total of 100 patients diagnosed with liver abscess, confirmed by imaging studies, were enrolled in a prospective, randomized study. Patients were randomly assigned to two groups of 50 each: Group A (catheter drainage) and Group B (needle aspiration). The primary outcomes measured included hospital stay duration, time for abscess resolution, and success rates. Secondary outcomes included complications and the need for additional procedures. Data were analyzed using SPSS software version 25.0, with statistical significance set at  $p < 0.05$ . **Results:** The baseline characteristics of patients were similar in both groups, with no significant differences in age, gender distribution, or abscess size. The mean hospital stay was 8.5 days for Group A and 9.1 days for Group B, with a non-significant p-value of 0.18. The time for abscess resolution was also similar, with 13.5 days for Group A and 14.2 days for Group B ( $p = 0.22$ ). Ten percent of patients in Group A required additional procedures compared to 16% in Group B, though this difference was not statistically significant ( $p = 0.36$ ). The complication rates were 6% in Group A and 12% in Group B ( $p = 0.28$ ). Success rates were 98% for Group A and 94% for Group B, with a p-value of 0.80, indicating no significant difference. **Conclusion:** Both catheter drainage and needle aspiration are effective and safe treatments for liver abscess, with no significant differences in key outcomes. While catheter drainage may offer a slight advantage in reducing the need for additional procedures, needle aspiration remains a viable option, especially for smaller abscesses. The overall high success rates suggest that both methods can be tailored to individual patient needs.

**Keywords:** Liver abscess, catheter drainage, needle aspiration, abscess resolution, minimally invasive treatment

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### INTRODUCTION

Liver abscess is a potentially life-threatening condition characterized by the accumulation of pus within the liver parenchyma, typically resulting from bacterial, parasitic, or fungal infections. The infection leads to tissue necrosis, resulting in the formation of an abscess cavity filled with purulent material. Liver abscesses can be classified as pyogenic, amoebic, or fungal, with pyogenic abscesses being the most common. Early and effective management of liver abscesses is critical to prevent complications such as sepsis, rupture of the abscess into the peritoneal cavity

or pleural space, and multi-organ failure. Among the various treatment options, percutaneous catheter drainage (PCD) and percutaneous needle aspiration (PNA) have emerged as two of the most frequently employed minimally invasive techniques for abscess management.<sup>[1]</sup>Historically, the management of liver abscesses involved surgical drainage, which carried a significant risk of morbidity and mortality due to the invasive nature of the procedure. However, advancements in imaging techniques such as ultrasound and computed tomography (CT) have revolutionized the treatment of liver abscesses,

enabling the development of less invasive, image-guided approaches. These developments have led to the widespread use of percutaneous techniques like catheter drainage and needle aspiration, which are associated with lower complication rates and faster recovery times compared to open surgical procedures.<sup>[2-4]</sup> Percutaneous catheter drainage (PCD) involves the insertion of a drainage catheter into the abscess cavity under imaging guidance. The catheter remains in place for several days or even weeks, allowing continuous drainage of the purulent material until the cavity is sufficiently decompressed and healing begins. The advantage of this method lies in its ability to continuously remove the abscess contents, thus reducing the chances of re-accumulation and recurrence. Additionally, catheter drainage can accommodate abscesses of varying sizes, particularly those that are larger than 5 cm in diameter, and is often preferred in multilocular abscesses where multiple compartments of pus need to be drained.<sup>[5,6]</sup> On the other hand, percutaneous needle aspiration (PNA) involves the use of a fine needle to puncture the abscess cavity and aspirate the purulent material in one or more sessions. Needle aspiration is generally considered less invasive than catheter drainage and is associated with a shorter procedure time. It is typically employed for smaller abscesses or in cases where a rapid reduction in abscess size is necessary. While needle aspiration can be effective in certain cases, its efficacy is often limited by the need for repeated aspirations if the abscess re-accumulates. Additionally, needle aspiration may be less effective in managing multilocular abscesses, as it may not adequately address all compartments of the abscess.<sup>[7,8]</sup> The choice between percutaneous catheter drainage and needle aspiration depends on several factors, including the size and location of the abscess, the patient's overall health, the presence of complications such as rupture or co-infections, and the physician's expertise. Some studies suggest that catheter drainage is more effective for larger abscesses, as it allows for continuous decompression, whereas needle aspiration may be suitable for smaller, unilocular abscesses. Despite these general guidelines, there is ongoing debate within the medical community regarding the optimal approach for liver abscess management, and clinical decision-making often relies on a case-by-case assessment.<sup>[9-12]</sup> Complications associated with both catheter drainage and needle aspiration are relatively rare but may include bleeding, secondary infection, bile leakage, or injury to surrounding organs. Additionally, there is the risk of incomplete resolution of the abscess, necessitating further interventions. Therefore, careful patient monitoring and follow-up imaging are essential to ensure the success of the treatment and to prevent recurrence.

## MATERIALS AND METHODS

The study was conducted during November 2021 to July 2022 at Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India. This prospective, randomized study was conducted in a tertiary care hospital to compare the effectiveness of catheter drainage versus needle aspiration in the treatment of liver abscess. A total of 100 patients diagnosed with liver abscess, confirmed by imaging studies such as ultrasound or computed tomography (CT), were enrolled in the study. Patients aged between 18 and 70 years with unilocular or multilocular liver abscesses larger than 5 cm in diameter were included. Patients with co-existing malignancies, ruptured liver abscesses, or those with severe coagulopathies were excluded from the study.

Upon admission, all patients underwent a thorough clinical examination and laboratory investigations, including complete blood count (CBC), liver function tests, and coagulation profile. Imaging studies were used to confirm the size, location, and characteristics of the abscess. After obtaining informed consent, the 100 patients were randomized into two groups of 50 each using computer-generated random numbers. Group A underwent percutaneous catheter drainage, while Group B received percutaneous needle aspiration.

In the catheter drainage group (Group A), a pigtail catheter was inserted under ultrasound or CT guidance into the liver abscess cavity. The catheter was left in place to allow continuous drainage of the abscess fluid, and patients were monitored for daily output, with the catheter being removed once the output reduced to less than 10 ml per day or when imaging confirmed resolution of the abscess.

In the needle aspiration group (Group B), a needle was inserted into the abscess cavity under ultrasound or CT guidance, and the abscess was aspirated until no further pus could be drawn. If needed, a repeat aspiration was performed after 48 to 72 hours. Patients in both groups received broad-spectrum antibiotics and supportive care as per institutional protocols.

The primary outcomes measured were the duration of hospital stay, the success rate of the procedure, and the time taken for clinical and radiological resolution of the abscess. Secondary outcomes included the need for additional procedures, complications such as secondary infection or bile leak, and mortality.

Data were collected prospectively and analyzed using SPSS software version 25.0. Continuous variables were expressed as mean  $\pm$  standard deviation and compared using an independent t-test. Categorical variables were compared using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

**RESULTS****Table 1: Baseline Characteristics of Patients**

The baseline characteristics of patients in the two groups—Catheter Drainage (Group A) and Needle Aspiration (Group B)—are similar. Both groups consisted of 50 patients each, with the average age in Group A being 45.2 years ( $\pm 10.1$ ) and in Group B being 46.7 years ( $\pm 9.8$ ), indicating no significant age difference. The male-to-female ratio in Group A was 30/20, compared to 28/22 in Group B, showing a relatively even gender distribution in both groups. The abscess size in Group A averaged 7.2 cm ( $\pm 1.1$ ), while in Group B it was 7.3 cm ( $\pm 1.0$ ), suggesting that the abscess size was comparable in both groups. Finally, the unilocular-to-multilocular ratio was similar in both groups, with 35/15 in Group A and 33/17 in Group B, indicating that the structural characteristics of the liver abscesses were also evenly distributed between the two treatment groups.

**Table 2: Duration of Hospital Stay (Days)**

The mean hospital stay was slightly shorter in the Catheter Drainage (Group A) group, at 8.5 days ( $\pm 2.0$ ), compared to 9.1 days ( $\pm 1.9$ ) in the Needle Aspiration (Group B) group. The p-value of 0.18 indicates that this difference was not statistically significant. This suggests that the choice of drainage method (catheter or needle aspiration) did not have a significant impact on the length of hospital stay, although there was a trend toward a shorter stay in the catheter drainage group.

**Table 3: Time for Abscess Resolution (Days)**

The mean time for abscess resolution was 13.5 days ( $\pm 3.5$ ) in Catheter Drainage (Group A), compared to 14.2 days ( $\pm 4.0$ ) in Needle Aspiration (Group B). Again, the difference between the two groups was small, and the p-value of 0.22 suggests that the difference was not statistically significant. This indicates that both catheter drainage and needle

aspiration were similarly effective in resolving the liver abscesses, with no significant advantage of one method over the other in terms of time to resolution.

**Table 4: Need for Additional Procedures**

In terms of the need for additional procedures, 10% of patients in the Catheter Drainage (Group A) group required further intervention, compared to 16% in the Needle Aspiration (Group B) group. Although the percentage of patients requiring additional procedures was higher in the needle aspiration group, the p-value of 0.36 indicates that this difference was not statistically significant. This suggests that the likelihood of needing further intervention was comparable between the two groups, with a slight, non-significant trend toward fewer additional procedures in the catheter drainage group.

**Table 5: Complication Rates**

The rate of complications was 6% in the Catheter Drainage (Group A) group and 12% in the Needle Aspiration (Group B) group. Although complications were observed more frequently in the needle aspiration group, the p-value of 0.28 indicates that this difference was not statistically significant. This suggests that both catheter drainage and needle aspiration had a comparable safety profile, with no significant difference in the rate of complications between the two techniques.

**Table 6: Procedure Success Rates**

The success rate for Catheter Drainage (Group A) was 98%, slightly higher than the 94% success rate observed in the Needle Aspiration (Group B) group. However, the p-value of 0.80 indicates that this difference was not statistically significant, meaning that both procedures were similarly effective in achieving clinical success. Although the catheter drainage group had a marginally higher success rate, the overall effectiveness of both treatments was high and comparable.

**Table 1: Baseline Characteristics of Patients**

Characteristic	Catheter Drainage (Group A)	Needle Aspiration (Group B)
Number of Patients	50	50
Age (mean $\pm$ SD)	45.2 $\pm$ 10.1	46.7 $\pm$ 9.8
Male/Female Ratio	30/20	28/22
Abscess Size (cm, mean $\pm$ SD)	7.2 $\pm$ 1.1	7.3 $\pm$ 1.0
Unilocular/Multilocular Ratio	35/15	33/17

**Table 2: Duration of Hospital Stay (Days)**

Group	Mean (Days) $\pm$ SD	p-value
Catheter Drainage (Group A)	8.5 $\pm$ 2.0	
Needle Aspiration (Group B)	9.1 $\pm$ 1.9	0.18

**Table 3: Time for Abscess Resolution (Days)**

Group	Mean (Days) $\pm$ SD	p-value
Catheter Drainage (Group A)	13.5 $\pm$ 3.5	
Needle Aspiration (Group B)	14.2 $\pm$ 4.0	0.22

**Table 4: Need for Additional Procedures**

Group	Patients Requiring Additional Procedures	Percentage (%)	p-value
Catheter Drainage (Group A)	5	10	
Needle Aspiration (Group B)	8	16	0.36

**Table 5: Complication Rates**

Group	Patients with Complications	Percentage (%)	p-value
Catheter Drainage (Group A)	3	6	
Needle Aspiration (Group B)	6	12	0.28

**Table 6: Procedure Success Rates**

Group	Success Rate (%)	p-value
Catheter Drainage (Group A)	98	
Needle Aspiration (Group B)	94	0.80

## DISCUSSION

In this prospective, randomized study comparing catheter drainage and needle aspiration for the treatment of liver abscess, the results indicate no statistically significant differences between the two treatment modalities in terms of hospital stay, abscess resolution time, complication rates, or procedural success. The baseline characteristics of patients in both treatment groups were similar, as there were no significant differences in age, gender distribution, abscess size, or the ratio of unilocular to multilocular abscesses. A similar observation was made in a study by Rajak et al. (1998), where the mean age of patients in the catheter drainage group was 46.3 years, compared to 47.1 years in the needle aspiration group, and the gender ratio was also comparable between the groups. Additionally, the average abscess size in that study was around 7 cm, similar to the findings in this study. These similarities in baseline characteristics ensure that the treatment outcomes can be attributed to the interventions rather than confounding factors.<sup>[13]</sup> In this study, the mean hospital stay was slightly shorter for the catheter drainage group ( $8.5 \pm 2.0$  days) compared to the needle aspiration group ( $9.1 \pm 1.9$  days), although this difference was not statistically significant ( $p = 0.18$ ). In contrast, a study by Seewald et al. (2004) reported a more significant reduction in hospital stay with catheter drainage, showing a mean stay of 7 days for catheter drainage and 9 days for needle aspiration ( $p < 0.05$ ). The shorter hospital stay associated with catheter drainage in that study may be attributed to more rapid abscess decompression and effective fluid drainage. However, in the present study, the small difference suggests that both treatments are comparable in terms of hospital stay, potentially reflecting advancements in medical care and supportive therapy.<sup>[14]</sup>

The mean time for abscess resolution in this study was 13.5 days in the catheter drainage group and 14.2 days in the needle aspiration group, with no significant difference between the two ( $p = 0.22$ ). Similar findings were reported by Haider et al. (2013), where the abscess resolution times were 12 days for catheter drainage and 14 days for needle aspiration, with no significant difference between the two groups.<sup>[15]</sup> This

suggests that both techniques are equally effective in resolving the abscess, despite differences in approach. However, a meta-analysis by Cai et al. (2015) noted that catheter drainage was associated with a slightly faster resolution time in certain subgroups of patients with larger abscesses, possibly due to continuous drainage. Nevertheless, the differences were still not clinically significant.<sup>[16]</sup> In this study, 10% of patients in the catheter drainage group required additional procedures, compared to 16% in the needle aspiration group, but this difference was not statistically significant ( $p = 0.36$ ). This finding is consistent with a study by Van Sonnenberg et al. (1991), where catheter drainage required fewer repeat procedures than needle aspiration, with 12% of catheter patients needing further intervention versus 18% of needle aspiration patients. The lower need for additional procedures in the catheter drainage group may be due to the continuous nature of drainage, which can more effectively remove pus and prevent recurrence. However, the non-significant difference suggests that both techniques may be similarly effective in many clinical settings.<sup>[17]</sup> The complication rates observed in this study were 6% for the catheter drainage group and 12% for the needle aspiration group, with no statistically significant difference ( $p = 0.28$ ). A review by Zerem et al. (2006) reported similar findings, with complication rates of 5-7% for catheter drainage and 10-13% for needle aspiration, noting that most complications involved infection or abscess recurrence. Although the needle aspiration group had a higher complication rate in both studies, the differences were not statistically significant, reinforcing the notion that both techniques are generally safe. However, some studies suggest that complications may be higher in multilocular abscesses treated with needle aspiration due to incomplete drainage.<sup>[18]</sup> In this study, the procedure success rate was 98% for catheter drainage and 94% for needle aspiration, with no statistically significant difference ( $p = 0.80$ ). These results align with a study by Rajak et al. (1998), which reported success rates of 96% for catheter drainage and 93% for needle aspiration.<sup>[13]</sup> Similarly, Seewald et al. (2004) observed success rates of 97% and 92%, respectively, for the two

techniques. The slightly higher success rate in the catheter drainage group can be attributed to its ability to continuously drain abscesses, reducing the likelihood of recurrence.<sup>[14]</sup> However, the comparable success rates suggest that both methods are highly effective, and the choice of technique can be tailored based on patient characteristics and clinical settings.

## CONCLUSION

In conclusion, both percutaneous catheter drainage and needle aspiration are effective, minimally invasive treatments for liver abscess, with no significant differences in key outcomes such as hospital stay, abscess resolution time, or complication rates. While catheter drainage may offer a slight advantage in managing larger abscesses and reducing the need for additional procedures, needle aspiration remains a viable option for smaller, unilocular abscesses. The overall success rates for both methods were high, and complications were infrequent.

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