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Diagnostic Utility of Ultrasound-Guided Liver Abscess Wall Biopsy and Fluid Aspiration in Determining the Etiology of Liver Abscesses: A Cross-Sectional Study

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Abstract

Background: Liver abscess remains an important cause of morbidity in developing countries. Although imaging techniques facilitate diagnosis, establishing the precise etiology is often difficult because aspirated fluid frequently yields non-specific findings. Ultrasound-guided liver abscess wall biopsy may improve diagnostic accuracy by providing tissue for histopathological evaluation. **Aim:** To evaluate the diagnostic utility of ultrasound-guided liver abscess wall biopsy and fluid aspiration in determining the etiology of liver abscesses. **Materials and Methods:** A hospital-based cross-sectional study was conducted on 35 clinically suspected and radiologically confirmed cases of liver abscess. All patients underwent ultrasound-guided fluid aspiration and abscess wall biopsy. Aspirated fluid was subjected to cytological and microbiological analysis, while biopsy specimens underwent histopathological examination. Demographic, clinical, radiological, pathological, and complication-related data were recorded and analyzed using appropriate statistical tests. A p-value <0.05 was considered statistically significant. **Results**: The mean age of the patients was 59.8 ± 13.9 years, and males constituted 82.9% of the study population. Right lobe involvement was observed in 80.0% of cases. Abdominal pain (91.4%) and fever (60.0%) were the most common presenting symptoms. Fluid aspiration established an etiological diagnosis in only 2 (5.7%) patients, whereas abscess wall biopsy identified a specific diagnosis in 9 (25.7%) patients. Histopathological examination revealed amoebic abscess in 5 (14.3%), tubercular abscess in 2 (5.7%), and malignant lesions in 2 (5.7%) patients. The diagnostic yield of abscess wall biopsy was significantly higher than that of fluid aspiration (25.7% vs. 5.7%, p=0.021). Procedure-related complications were minimal, with pain at the puncture site in 8.6%, mild fever in 5.7%, and minor bleeding in 2.9% of patients. No major complications or mortality were observed. **Conclusion:** Ultrasound-guided liver abscess wall biopsy significantly enhances the etiological diagnosis of liver abscesses compared with fluid aspiration alone. It is a safe, effective, and minimally invasive procedure that facilitates the detection of uncommon causes such as tuberculosis and malignancy, thereby enabling targeted management and improving diagnostic confidence.

Keywords: Ultrasound-guided biopsy; Liver abscess; Fluid aspiration; Histopathology; Etiological diagnosis

INTRODUCTION

Liver abscess is a localized collection of pus within the hepatic parenchyma caused by bacterial, parasitic, fungal, or, less commonly, neoplastic and granulomatous diseases. It remains a significant cause of morbidity and mortality, particularly in developing countries where amoebic and pyogenic liver abscesses are common. Pyogenic liver abscesses usually arise from biliary tract infections, portal venous seeding, hematogenous spread, or direct extension from adjacent structures, whereas amoebic liver abscesses are caused by *Entamoeba histolytica* and are prevalent in tropical regions.[1]

Clinical manifestations are often nonspecific and include fever, right upper quadrant abdominal pain, anorexia, weight loss, and hepatomegaly. Although ultrasonography (USG) and computed tomography (CT) have greatly improved the detection of liver abscesses, determining the exact etiology remains challenging in many cases. Conventional fluid aspiration with microbiological and cytological analysis is routinely performed; however, aspirated material frequently yields nonspecific results due to extensive necrosis, prior antibiotic therapy, or low organism burden. Consequently, important etiologies such as tuberculosis, fungal infections, and underlying malignancies may remain undiagnosed. Ultrasound-guided liver abscess

wall biopsy has emerged as a valuable adjunctive diagnostic procedure because viable inflammatory, infectious, or neoplastic tissue is often present within the abscess wall rather than the necrotic cavity.[2]
Histopathological examination of biopsy specimens can reveal granulomatous inflammation, malignancy, parasitic infestation, or specific infectious organisms that may not be detected in aspirated fluid alone. Furthermore, image-guided biopsy is minimally invasive, safe, cost-effective, and can be performed simultaneously with therapeutic aspiration or drainage. Several studies have demonstrated that tissue diagnosis obtained from abscess wall biopsy improves etiological characterization and facilitates targeted treatment. Early identification of uncommon causes such as hepatic tuberculosis, hepatocellular carcinoma, metastatic adenocarcinoma, or fungal infections can significantly alter clinical management and improve patient outcomes.[3]

Therefore, combining ultrasound-guided abscess wall biopsy with fluid aspiration may enhance the diagnostic yield compared to fluid analysis alone. The present study was undertaken to evaluate the diagnostic utility of ultrasound-guided liver abscess wall biopsy and fluid aspiration in determining the etiology of liver abscesses and to assess their role in guiding appropriate clinical management.[4]

AIM

To evaluate the diagnostic utility of ultrasound-guided liver abscess wall biopsy and fluid aspiration in determining the etiology of liver abscesses.

OBJECTIVES

1. To assess the diagnostic yield of ultrasound-guided liver abscess wall biopsy in identifying the etiology of liver abscesses.
2. To compare the etiological diagnosis obtained from abscess fluid aspiration with that obtained from abscess wall biopsy.
3. To evaluate the safety and complications associated with ultrasound-guided liver abscess wall biopsy and fluid aspiration procedures.

MATERIALS AND METHODS

Source of Data

Data were collected from patients clinically suspected and radiologically confirmed to have liver abscesses who attended the Department of Radiodiagnosis and were referred for ultrasound-guided intervention. Clinical, radiological, cytological, microbiological, and histopathological findings were recorded in a predesigned case record form.

Study Design

A hospital-based cross-sectional observational study was conducted.

Study Location

The study was conducted in the Department of Radiodiagnosis in collaboration with the Departments of Medicine, Surgery, Pathology, and Microbiology at a tertiary care teaching hospital.

Study Duration

The study was conducted over a period of 18 months after obtaining approval from the Institutional Ethics Committee.

Sample Size

A total of **35 patients** fulfilling the inclusion and exclusion criteria were enrolled consecutively during the study period.

Inclusion Criteria

- Patients aged ≥18 years.
- Both male and female patients.
- Clinically suspected and ultrasonographically confirmed cases of liver abscess.
- Patients with normal coagulation profile (BT, CT, PT/INR within acceptable limits).
- Patients willing to provide written informed consent.
- Patients undergoing both ultrasound-guided abscess fluid aspiration and abscess wall biopsy.

Exclusion Criteria

- Patients younger than 18 years.
- Patients with bleeding disorders or deranged coagulation profile.
- Patients with active skin infection at the biopsy site.
- Critically ill or hemodynamically unstable patients.
- Uncooperative patients.

- Patients unwilling to undergo the procedure or provide consent.

Procedure and Methodology

After obtaining informed written consent, detailed clinical history and physical examination findings were recorded. Baseline investigations including complete blood count, liver function tests, coagulation profile, viral markers, and imaging findings were documented.

All patients underwent ultrasonographic evaluation using a real-time ultrasound machine equipped with 3.5–5 MHz convex transducers. Under strict aseptic precautions and local anesthesia using 2% lignocaine, the liver abscess was localized. Ultrasound-guided aspiration of abscess fluid was performed using an appropriate aspiration needle attached to a sterile syringe. The aspirated material was collected for microbiological, cytological, and biochemical analysis.

Subsequently, ultrasound-guided abscess wall biopsy was performed using an 18-gauge automated cutting biopsy needle. The needle was advanced through normal liver parenchyma whenever feasible and directed towards the viable abscess wall under continuous real-time ultrasound guidance. Multiple tissue cores were obtained from the abscess wall.

Following the procedure, patients were monitored for vital signs, bleeding, pain, fever, and other procedure-related complications for at least 12–24 hours.

Sample Processing

Abscess Fluid Analysis

- Gross examination.
- Gram staining and bacterial culture.
- Ziehl–Neelsen staining where indicated.
- Fungal staining and culture where required.
- Cytological examination for inflammatory, parasitic, or malignant cells.

Abscess Wall Biopsy

- Tissue specimens were fixed in 10% buffered formalin.
- Samples were processed routinely and stained with Hematoxylin and Eosin (H&E).
- Special stains such as Ziehl–Neelsen stain, PAS stain, or GMS stain were used whenever indicated.
- Histopathological examination was performed to identify amoebic infection, tuberculosis, malignancy, fungal infection, or nonspecific inflammatory pathology.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0.

- Continuous variables were expressed as mean ± standard deviation (SD).
- Categorical variables were expressed as frequencies and percentages.
- Diagnostic yield of fluid aspiration and wall biopsy was compared using Chi-square test or Fisher's exact test.
- Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated wherever applicable.
- A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a structured case record form that included:

- Demographic details (age, sex)
- Clinical presentation
- Comorbidities
- Laboratory investigations
- Ultrasonographic characteristics of liver abscess
- Abscess fluid analysis findings
- Histopathological findings of abscess wall biopsy
- Final etiological diagnosis
- Procedure-related complications and outcomes

All collected data were compiled, tabulated, and analyzed to determine the diagnostic utility of ultrasound-guided liver abscess wall biopsy and fluid aspiration in establishing the etiology of liver abscesses.

RESULTS

Table 1. Baseline Clinical and Demographic Profile of Liver Abscess Patients (N=35)

Variable	Value n (%) / Mean ± SD	Test Value	95% CI	p-value
Age (years)	59.8 ± 13.9	t=25.46	55.0–64.5	<0.001*
Male	29 (82.9)	χ^2=15.17	66.4–92.5	<0.001*
Female	6 (17.1)		7.5–33.6	
Right lobe abscess	28 (80.0)	χ^2=12.60	63.1–91.6	<0.001*
Left lobe abscess	2 (5.7)		1.0–18.6	
Bilobar abscess	3 (8.6)		2.3–23.1	
Multiple abscesses	2 (5.7)		1.0–18.6	
Abdominal pain	32 (91.4)	χ^2=24.03	76.9–98.2	<0.001*
Fever	21 (60.0)	χ^2=2.60	42.1–75.4	0.107
Diabetes mellitus	5 (14.3)	χ^2=12.14	5.6–29.2	<0.001*
Hypertension	4 (11.4)	χ^2=15.46	4.5–25.9	<0.001*

***Significant at p<0.05**

Table 1 presents the baseline clinical and demographic characteristics of the 35 patients diagnosed with liver abscess. The mean age of the study population was 59.8 ± 13.9 years (95% CI: 55.0–64.5 years), indicating that liver abscesses were more common among older adults. Male patients predominated, accounting for 29 (82.9%) cases, while females constituted only 6 (17.1%) cases, demonstrating a significant male preponderance (p<0.001). Regarding abscess location, the right lobe of the liver was involved in the majority of patients (80.0%), whereas left lobe, bilobar, and multiple abscesses were observed in 5.7%, 8.6%, and 5.7% of patients, respectively. Clinically, abdominal pain was the most common presenting symptom, occurring in 91.4% of patients (95% CI: 76.9–98.2; p<0.001), followed by fever in 60.0% of cases. Among the associated comorbidities, diabetes mellitus and hypertension were present in 14.3% and 11.4% of patients, respectively.

Table 2. Diagnostic Yield of Ultrasound-Guided Liver Abscess Wall Biopsy (N=35)

Histopathological Diagnosis	n (%)	Test Value	95% CI	p-value
Amoebic abscess	5 (14.3)	χ^2=8.14	5.6–29.2	0.004*
Tubercular abscess	2 (5.7)	χ^2=24.03	1.0–18.6	<0.001*
Malignancy	2 (5.7)	χ^2=24.03	1.0–18.6	<0.001*
Specific diagnosis obtained	9 (25.7)	χ^2=4.60	13.1–43.6	0.032*
Non-specific findings	26 (74.3)	χ^2=8.29	56.4–86.9	0.004*

***Significant at p<0.05**

Table 2 shows the diagnostic yield of ultrasound-guided liver abscess wall biopsy in determining the etiology of liver abscesses. Histopathological examination identified amoebic abscesses in 5 (14.3%) patients, tubercular abscesses in 2 (5.7%) patients, and malignant lesions in 2 (5.7%) patients. Overall, a specific etiological diagnosis was established in 9 (25.7%) patients (95% CI: 13.1–43.6; p=0.032), while non-specific inflammatory findings were observed in 26 (74.3%) patients. The detection of tubercular and malignant etiologies, which are often difficult to diagnose through conventional fluid analysis alone, highlights the additional diagnostic value of abscess wall biopsy.

Table 3. Comparison of Etiological Diagnosis Obtained by Fluid Aspiration and Abscess Wall Biopsy (N=35)

Diagnostic Method	Positive Etiological Diagnosis n (%)	Test Value	95% CI	p-value
Fluid aspiration	**2 (5.7)**	**Z=2.31**	**1.0–18.6**	**0.021***
Abscess wall biopsy	**9 (25.7)**		**13.1–43.6**	
Difference in diagnostic yield	**7 (20.0)**		**4.6–35.4**	

Etiology	Fluid Aspiration n (%)	Wall Biopsy n (%)
Amoebic	2 (5.7)	5 (14.3)
Tubercular	0	2 (5.7)
Malignant	0	2 (5.7)
Non-specific	33 (94.3)	26 (74.3)

***Significant at p<0.05**

Table 3 compares the etiological diagnostic yield of abscess fluid aspiration and ultrasound-guided abscess wall biopsy. Fluid aspiration established a definitive etiological diagnosis in only 2 (5.7%) patients, whereas abscess wall biopsy identified a specific cause in 9 (25.7%) patients. The difference in diagnostic yield between the two methods was 20.0% and was statistically significant (Z=2.31, p=0.021), indicating the superior diagnostic performance of wall biopsy. Fluid aspiration detected only amoebic abscesses in 2 patients and failed to identify any tubercular or malignant lesions. In contrast, wall biopsy diagnosed 5 amoebic abscesses, 2 tubercular abscesses, and 2 malignant lesions. Non-specific findings were considerably more common with fluid aspiration (94.3%) than with wall biopsy (74.3%).

Table 4. Safety and Complications Associated with Ultrasound-Guided Liver Abscess Wall Biopsy and Fluid Aspiration (N=35)

Complication	n (%)	Test Value	95% CI	p-value
Pain at puncture site	3 (8.6)	χ^2=20.03	2.3–23.1	<0.001*
Mild fever	2 (5.7)	χ^2=24.03	1.0–18.6	<0.001*
Minor bleeding	1 (2.9)	χ^2=31.03	0.2–14.9	<0.001*
Hemorrhage requiring intervention	0 (0)	χ^2=35.00	0–10.0	<0.001*
Pneumothorax	0 (0)	χ^2=35.00	0–10.0	<0.001*
Septic shock	0 (0)	χ^2=35.00	0–10.0	<0.001*
Procedure-related mortality	0 (0)	χ^2=35.00	0–10.0	<0.001*
No major complication	32 (91.4)	χ^2=24.03	76.9–98.2	<0.001*

Table 4 summarizes the safety profile and procedure-related complications associated with ultrasound-guided liver abscess wall biopsy and fluid aspiration. The procedures were generally well tolerated, with no major adverse events reported. Minor complications included pain at the puncture site in 3 (8.6%) patients, mild transient fever in 2 (5.7%) patients, and minor bleeding in 1 (2.9%) patient. Importantly, no cases of hemorrhage requiring intervention, pneumothorax, septic shock, or procedure-related mortality were observed. Overall, 32 (91.4%) patients experienced no major complications (95% CI: 76.9–98.2; p<0.001).

DISCUSSION

In the present study, the mean age of patients was 59.8 ± 13.9 years, with marked male predominance (82.9%). Right lobe involvement was most common (80.0%), and abdominal pain was the leading symptom (91.4%), followed by fever (60.0%). These findings are comparable with Ghosh et al. (2014)[1], who reported predominant right lobe involvement (71%) and solitary abscesses in most cases. Gupta et al. (2024)[2] also observed abdominal pain (87%), fever (84.5%), and right lobe involvement (75.9%) as common features. Similar male predominance and right upper abdominal pain were also reported by Sharmila et al. (2015)[3] and Hathila et al. (2014)[4], supporting that liver abscess commonly affects males and usually involves the right hepatic lobe.

In the present study, ultrasound-guided liver abscess wall biopsy provided a specific etiological diagnosis in 9 (25.7%) patients. Amoebic abscess was detected in 5 (14.3%), tubercular abscess in 2 (5.7%), and malignancy in 2 (5.7%) patients. This highlights the importance of tissue diagnosis, particularly when routine fluid aspiration is non-diagnostic. Puri et al. (1994)[5] stated that hepatic tuberculosis is difficult to diagnose on imaging alone and usually requires histopathological confirmation. Similarly, Hassani et al. (2010)[6] reported isolated tubercular liver abscess in an immunocompetent patient and emphasized biopsy for confirmation. Thus, the detection of tubercular abscesses in the present study supports the added value of abscess wall biopsy.

Fluid aspiration detected etiology in only 2 (5.7%) patients, while wall biopsy detected etiology in 9 (25.7%) patients, showing a statistically significant improvement in diagnostic yield (p=0.021). This finding is clinically important because organisms, granulomas, or malignant cells may be present in the abscess wall rather than in necrotic aspirated fluid. Nasit et al. (2013)[7] also reported that image-guided FNAC/biopsy of hepatic lesions provides useful diagnostic information in focal liver lesions. In the present study, aspiration failed to identify tubercular and malignant causes, whereas biopsy detected both. This is consistent with reports by Yeh et al. (1998)[8], who described hepatocellular carcinoma presenting as pyogenic liver abscess, where histological confirmation was essential.

Regarding safety, minor complications were observed, including pain at puncture site in 3 (8.6%), mild fever in 2 (5.7%), and minor bleeding in 1 (2.9%) patient. No major hemorrhage, pneumothorax, septic shock, or procedure-related mortality was noted. These findings suggest that ultrasound-guided wall biopsy and aspiration are safe when performed under imaging guidance. Sukhjeet Singh et al. (2013)[9] and Heneghan et al. (2011)[10] also reported that image-guided percutaneous procedures are effective and safe in liver abscess management. Therefore, the present findings support ultrasound-guided abscess wall biopsy as a safe adjunct to aspiration, especially in cases where uncommon etiologies such as tuberculosis or malignancy are suspected.

CONCLUSION

The present study demonstrated that ultrasound-guided liver abscess wall biopsy significantly improved the etiological diagnosis of liver abscesses compared with fluid aspiration alone. While fluid aspiration identified a specific etiology in only a small proportion of patients, abscess wall biopsy successfully detected additional cases of amoebic infection, hepatic tuberculosis, and underlying malignancy that would otherwise have remained undiagnosed. The procedure proved to be safe, minimally invasive, and associated with only minor self-limiting complications. Ultrasound guidance enabled accurate targeting of the abscess wall, thereby increasing the diagnostic yield and facilitating appropriate disease-specific

management. Therefore, ultrasound-guided liver abscess wall biopsy should be considered a valuable adjunct to conventional fluid aspiration, particularly in patients with atypical presentations, recurrent abscesses, poor response to empirical therapy, or suspicion of tuberculosis or malignancy.

LIMITATIONS OF THE STUDY

1. The study was conducted at a single tertiary care center, limiting the generalizability of the findings.
2. The sample size was relatively small (N=35), which may have reduced the precision of estimates and statistical power.
3. The cross-sectional design did not permit long-term follow-up of patients to assess treatment outcomes and recurrence rates.
4. Microbiological confirmation was limited in some cases due to prior antibiotic exposure, which may have reduced culture positivity.
5. Advanced molecular diagnostic techniques such as PCR and gene-based pathogen detection were not routinely performed.
6. Inter-observer variability in histopathological interpretation was not assessed.
7. The study primarily evaluated diagnostic utility and did not compare biopsy findings with long-term clinical outcomes.
8. Rare etiologies of liver abscess may have been underrepresented because of the limited sample size.

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