ORIGINAL RESEARCH

Comparing Catheter Drainage and Percutaneous Needle Aspiration for Liver Abscess Treatment: A Prospective Cohort Study

[1]Dr. Rajeev Ranjan, [2]Dr. Vineeta Pathak Haror

[1]Associate Professor, Department of General Surgery, Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh, India
[2]Assistant Professor, Department of Microbiology, Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh, India

Corresponding Author: Dr. Vineeta Pathak Haror
Assistant Professor, Department of Microbiology, Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh, India

Received: 17 April, 2021 Accepted: 19 May, 2021

ABSTRACT

Background: Liver abscesses are a significant cause of morbidity and mortality worldwide, posing a challenge to both clinicians and patients due to their potential for severe complications and prolonged hospital stays. This study aimed to compare the efficacy and outcomes of catheter drainage (CD) versus percutaneous needle aspiration (PNA) in the management of liver abscesses, focusing on resolution time, success rates, hospital stay, recurrence, and complications.**Materials and Methods:** A prospective cohort study was conducted on 100 patients diagnosed with liver abscess and allocated into two treatment groups: PNA (n=50) and CD (n=50). Patients were selected based on predefined inclusion and exclusion criteria. CD was performed using an 8–12 Fr pigtail catheter under ultrasound guidance, while PNA was performed using an 18–21G needle. All patients received empirical antibiotic therapy and were monitored for clinical improvement. The primary outcomes included resolution time, success rates, and recurrence, while secondary outcomes included complications and hospital stay. Follow-up was conducted for six weeks with ultrasound evaluation at 1, 3, and 6 weeks. **Results:** The mean resolution time was significantly shorter in the CD group (9.8 ± 2.7 days) compared to the PNA group (12.5 ± 3.4 days, p=0.002). Complete resolution was achieved in 96% of CD patients versus 84% of PNA patients (p=0.045), while recurrence was higher in the PNA group (16%) than in the CD group (4%, p=0.029). The CD group had a shorter hospital stay (6.1 ± 1.8 days vs. 8.4 ± 2.1 days, p=0.001). Complication rates were similar, but the need for repeat procedures was significantly higher in the PNA group (20% vs. 4%, p=0.009). At six-week follow-up, ultrasound-confirmed resolution was observed in 94% of CD patients and 82% of PNA patients (p=0.032).**Conclusion:** Catheter drainage proved to be a more effective and reliable treatment for liver abscesses compared to percutaneous needle aspiration. CD resulted in a significantly faster resolution, higher success rates, shorter hospital stays, and lower recurrence rates. Given these advantages, CD should be considered the preferred treatment, particularly in cases of larger abscesses or those requiring prolonged drainage.

Keywords: Liver abscess, Catheter drainage, Percutaneous needle aspiration, Recurrence

INTRODUCTION

Liver abscesses are a significant cause of morbidity and mortality worldwide, posing a challenge to both clinicians and patients due to their potential for severe complications and prolonged hospital stays. The management of liver abscesses has evolved over time, with interventional radiology playing a crucial role in their treatment. Traditionally, open surgical drainage was the primary approach for managing

liver abscesses, but with advancements in imaging techniques and minimally invasive procedures, catheter drainage and percutaneous needle aspiration have emerged as the preferred methods. However, the optimal choice between these two minimally invasive approaches remains a subject of ongoing debate.[1,2]A liver abscess is a localized collection of pus within the liver parenchyma, most commonly resulting from bacterial, parasitic, or fungal infections. Among these, pyogenic liver abscesses are the most frequently encountered, often caused by polymicrobial infections originating from the biliary tract, portal circulation, or direct extension from adjacent infections. Amebic liver abscesses, on the other hand, are primarily caused by *Entamoebahistolytica* and are more prevalent in certain geographic regions. The clinical presentation of liver abscesses is often nonspecific, with patients experiencing fever, right upper quadrant pain, nausea, vomiting, and malaise. Timely diagnosis and appropriate intervention are critical to preventing complications such as rupture, sepsis, and multi-organ failure.[3,4]The management of liver abscesses involves a combination of antimicrobial therapy and drainage procedures. While small abscesses may respond to antibiotics alone, larger abscesses typically require drainage to expedite resolution and prevent complications. The two primary minimally invasive drainage techniques—catheter drainage and percutaneous needle aspiration—offer distinct advantages and limitations, influencing their selection based on patient-specific factors, abscess characteristics, and institutional expertise.[5] Catheter drainage involves the placement of a pigtail catheter within the abscess cavity under imaging guidance, allowing continuous drainage of pus over an extended period. This method is particularly beneficial for large, multiloculated, or thick-walled abscesses that may not completely resolve with a single aspiration attempt. The continuous drainage mechanism facilitates gradual decompression of the abscess, reducing the likelihood of recurrence and improving clinical outcomes. However, catheter drainage may be associated with complications such as catheter displacement, blockage, secondary infections, and patient discomfort due to prolonged catheter placement.[6.7] Percutaneous needle aspiration, in contrast, is a simpler and less invasive procedure that involves a single or multiple aspirations of the abscess content using a fine needle under imaging guidance. This approach is often preferred for smaller, unilocular abscesses with low viscosity pus that can be adequately drained in one or two sessions. Needle aspiration has the advantage of being less invasive, with a lower risk of catheter-related complications and shorter hospital stays. However, the primary limitation of this technique is the potential for inadequate drainage, necessitating repeat aspirations or conversion to catheter drainage in cases of persistent or recurrent abscesses.[8]

The choice between catheter drainage and percutaneous needle aspiration is influenced by several factors, including abscess size, location, number of abscesses, viscosity of the pus, and patient comorbidities. Although multiple retrospective and observational studies have evaluated the efficacy and safety of these techniques, there remains a lack of consensus on their relative superiority. Some studies suggest that catheter drainage is more effective for larger abscesses with complex morphology, whereas needle aspiration is suitable for smaller, simple abscesses. Other studies have reported comparable outcomes in terms of clinical resolution, hospital stay, and complication rates, highlighting the need for further prospective research to establish definitive treatment guidelines.[9,10]This prospective cohort study aims to compare the clinical outcomes of catheter drainage versus percutaneous needle aspiration in the treatment of liver abscesses. By evaluating factors such as treatment success rate, time to clinical resolution, duration of hospital stay, complication rates, and need for additional interventions, this study seeks to provide evidence-based recommendations for optimal treatment selection. The findings of this study will contribute to a better understanding of the efficacy, safety, and cost-effectiveness of these two commonly used drainage techniques, ultimately guiding clinical decision-making and improving patient outcomes.

AIM AND OBJECTIVES

This study aimed to compare the efficacy and outcomes of catheter drainage (CD) versus percutaneous needle aspiration (PNA) in the management of liver abscesses, focusing on resolution time, success rates, hospital stay, recurrence, and complications.

MATERIALS AND METHODS

Study Design

This study was conducted as a prospective cohort study to compare the efficacy and clinical outcomes of catheter drainage (CD) versus

percutaneous needle aspiration (PNA) in the treatment of liver abscesses.

Study Population

A total of **100 patients** diagnosed with liver abscesses were enrolled in the study. Patients were allocated into two groups based on physician recommendations and patient preferences:

- **Group A (n = 50):** Underwent **percutaneous needle aspiration (PNA)**.
- **Group B (n = 50):** Underwent **catheter drainage (CD)**.

Study Place

This study was conducted in the Department of General Surgery, Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh, India, in collaboration withDepartment of Microbiology, Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh, India.

Study Duration

The study was conducted over a period of two years months from April 2019 to February 2021, including patient enrollment, intervention, follow-up, and data analysis.

Ethical Considerations

- The study was approved by the Institutional Ethics Committee (IEC).
- Written informed consent was obtained from all participants.
- Patient confidentiality was maintained throughout the study.
- The study adhered to the Declaration of Helsinkiguidelines.

Inclusion Criteria

- Patients aged 18–70 years diagnosed with liver abscess via ultrasound (USG) or computed tomography (CT).
- Abscess size ≥5 cm in diameter.
- Single or multiple abscesses confined to the liver.
- No prior treatment for liver abscesses.

Exclusion Criteria

- Patients with ruptured liver abscess.
- Presence of malignancy or co-existing severe systemic illness.
- Pregnant or lactating women.
- Patients with coagulopathy contraindicating percutaneous procedures.

For a study comparing catheter drainage and percutaneous needle aspiration in the treatment of liver abscess, the following investigations are typically performed:

1. **Clinical Assessment:**

- Detailed history and physical examination
- Symptoms evaluation (fever, abdominal pain, jaundice, weight loss, etc.)

2. **Laboratory Investigations:**

- Complete Blood Count (CBC): To assess leukocytosis (infection)
- Liver Function Tests (LFTs): To evaluate liver enzyme levels (ALT, AST, ALP, bilirubin)
- C-Reactive Protein (CRP) & Erythrocyte Sedimentation Rate (ESR): Markers of inflammation
- Blood Culture: To detect bacterial infections (e.g., Klebsiellapneumoniae, Escherichia coli)
- Serology for Amoebiasis: If amoebic liver abscess is suspected (Entamoebahistolytica)
- Coagulation Profile (PT, INR, APTT): To assess bleeding risk before interventions

3. **Radiological Investigations:**

- **Ultrasound Abdomen:** First-line imaging to detect liver abscess, determine size, and guide aspiration
- **Contrast-Enhanced CT (CECT) Abdomen:**
  - Confirms diagnosis
  - Assesses abscess size, number, and location
  - Detects complications (rupture, biliary involvement)
- Magnetic Resonance Imaging (MRI) Abdomen (if needed): In complex or uncertain cases

4. **Microbiological Analysis:**

- **Pus Culture & Sensitivity:** To identify causative bacteria and guide antibiotic therapy
- **Gram Staining &Ziehl-Neelsen Staining:** To check for bacterial and tubercular infections

5. **Follow-up Investigations:**

- **Repeat Ultrasound/CT:** To assess response to treatment and check for residual abscess
- **Serial Inflammatory Markers (CRP, WBC Count):** To monitor clinical improvement

Surgical Techniques

1. **Percutaneous Needle Aspiration (PNA)**

- Performed under ultrasound guidance to ensure accurate localization.
- An 18–21G needle was used for aspiration.
- Aimed at complete evacuation of the abscess in a single sitting.

- If abscess persisted, repeat aspirations were performed as needed.
- Patients received empirical antibiotic therapy and were monitored for:
  - Fever resolution
  - Pain reduction
  - Overall clinical improvement

2. Catheter Drainage (CD)

- Conducted under ultrasound guidance using an 8–12 Fr pigtail catheter.
- The catheter was connected to a drainage bag for continuous evacuation.
- Daily monitoring of drainage output was performed.
- Catheter removal was done when output was minimal, indicating resolution.
- Empirical antibiotic therapy was administered, and clinical response was observed.

Outcome Measures

Primary Outcomes

- Resolution time (measured in days).
- Overall clinical improvement (assessed through fever resolution and pain relief).
- Success rate (defined as complete resolution without recurrence during follow-up).

Secondary Outcomes

- Complications such as secondary infection, bleeding, or abscess recurrence.
- Length of hospital stay (compared between groups).
- Follow-up imaging (USG performed at 1, 3, and 6 weeks post-procedure).
- Recurrence or post-procedural complications were documented.

Statistical Analysis

- Data was analyzed using SPSS version (21.0).
- Continuous variables (e.g., resolution time, length of hospital stay) were presented as mean ± standard deviation (SD) and compared using the Student's t-test or the Mann-Whitney U test for non-normally distributed data.
- Categorical variables (e.g., success rate, complications) were compared using the chi-square test.
- A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of Patients

Variable	PNA Group (n=50)	CD Group (n=50)	p-value
Age (years, mean ± SD)	45.2 ± 10.1	46.5 ± 9.8	0.58
Male (%)	35 (70%)	37 (74%)	0.64
Female (%)	15 (30%)	13 (26%)	0.64
Diabetes Mellitus (%)	12 (24%)	14 (28%)	0.79
Hypertension (%)	10 (20%)	9 (18%)	0.82
Alcohol Use (%)	18 (36%)	20 (40%)	0.67

Table 1 presents the baseline characteristics of patients in both the percutaneous needle aspiration (PNA) and catheter drainage (CD) groups. The mean age of patients was similar in both groups (45.2 ± 10.1 years for PNA and 46.5 ± 9.8 years for CD), with no statistically significant difference (p=0.58). The distribution of male and female patients was also comparable, with 70% males in the PNA group and 74% in the CD group (p=0.64). Comorbid conditions such as diabetes mellitus and hypertension were similarly distributed, with no significant differences between the two groups (p=0.79 and p=0.82, respectively). Additionally, alcohol use, a known risk factor for liver abscess, was observed in 36% of PNA patients and 40% of CD patients (p=0.67). These findings indicate that both groups were well-matched in terms of demographic and clinical characteristics, ensuring that differences in outcomes could be attributed to treatment modality rather than baseline disparities.

Table 2: Clinical Presentation of Liver Abscess

Variable	PNA Group (n=50)	CD Group (n=50)	p-value
Fever (%)	45 (90%)	47 (94%)	0.71
Abdominal Pain (%)	40 (80%)	41 (82%)	0.82
Jaundice (%)	5 (10%)	4 (8%)	0.72
Leukocytosis (%)	42 (84%)	44 (88%)	0.69
Abscess Size (cm, mean ± SD)	6.2 ± 1.5	6.5 ± 1.3	0.34

Table 2 highlights the clinical symptoms and laboratory findings at presentation. Fever was the most common symptom, affecting 90% of patients in the PNA group and 94% in the CD group (p=0.71), followed by abdominal pain, reported in 80% and 82% of patients, respectively (p=0.82). Jaundice was present in a small percentage of patients (10% in PNA and 8% in CD, p=0.72), indicating that hepatobiliaryinvolvement was uncommon. Leukocytosis, a marker of infection, was found in 84% of PNA patients and 88% of CD patients (p=0.69). The mean abscess size was slightly larger in the CD group (6.5 ± 1.3 cm) compared to the PNA group (6.2 ± 1.5 cm), but this difference was not statistically significant (p=0.34). These findings suggest that both groups had similar disease severity at baseline.

Table 3: Treatment Outcomes

Variable	PNA Group (n=50)	CD Group (n=50)	p-value
Resolution Time (days, mean ± SD)	12.5 ± 3.4	9.8 ± 2.7	0.002
Complete Resolution (%)	42 (84%)	48 (96%)	0.045
Recurrence (%)	8 (16%)	2 (4%)	0.029

Table 3 presents key treatment outcomes, demonstrating significant differences between the two procedures. The mean resolution time of the abscess was significantly shorter in the CD group (9.8 ± 2.7 days) compared to the PNA group (12.5 ± 3.4 days), with a p-value of 0.002, indicating that catheter drainage led to a faster resolution of infection. The rate of complete resolution was also higher in the CD group (96%) compared to the PNA group (84%) (p=0.045), suggesting that catheter drainage was more effective in achieving full recovery. Additionally, recurrence was significantly more common in the PNA group, occurring in 16% of patients, while only 4% of patients in the CD group experienced recurrence (p=0.029). These results indicate that CD is a more effective and reliable treatment modality for liver abscess in terms of faster recovery and lower recurrence rates.

Table 4: Length of Hospital Stay

Variable	PNA Group (n=50)	CD Group (n=50)	p-value
Hospital Stay (days, mean ± SD)	8.4 ± 2.1	6.1 ± 1.8	0.001

Table 4 compares the duration of hospital stay between the two groups. The mean hospital stay was significantly longer in the PNA group (8.4 ± 2.1 days) compared to the CD group (6.1 ± 1.8 days), with a p-value of 0.001. This finding suggests that patients who underwent catheter drainage had a shorter hospitalization period, likely due to the more efficient and continuous evacuation of pus through the catheter, leading to faster resolution of the infection.

Table 5: Complications

Complication	PNA Group (n=50)	CD Group (n=50)	p-value
Secondary Infection (%)	7 (14%)	3 (6%)	0.21
Bleeding (%)	1 (2%)	0 (0%)	0.31
Need for Repeat Procedure (%)	10 (20%)	2 (4%)	0.009

Table 5 and figure I, show the complication rates observed in both groups. Secondary infection occurred in 14% of PNA patients and 6% of CD patients, but the difference was not statistically significant (p=0.21). Bleeding was a rare complication, occurring in only one patient (2%) in the PNA group, while no cases of bleeding were reported in the CD group (p=0.31). However, a significant difference was observed in the need for repeat procedures, with 20% of PNA patients requiring additional interventions compared to only 4% in the CD group (p=0.009). This finding suggests that catheter drainage is a more definitive treatment, reducing the likelihood of re-intervention.

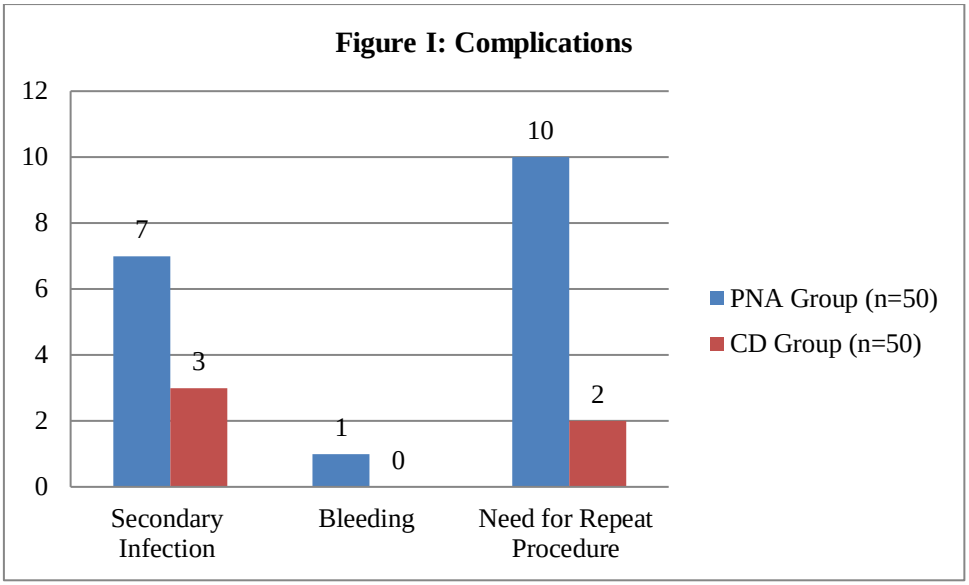

Table 6: Follow-Up Outcomes (6 weeks)

Variable	PNA Group (n=50)	CD Group (n=50)	p-value
Ultrasound-confirmed Resolution (%)	41 (82%)	47 (94%)	0.032
Symptom-free at 6 Weeks (%)	43 (86%)	49 (98%)	0.038

Table 6 presents follow-up results at six weeks post-procedure. Ultrasound-confirmed resolution of the abscess was achieved in 82% of PNA patients and 94% of CD patients, with a statistically significant difference (p=0.032). Similarly, the percentage of patients who remained symptom-free at six weeks was significantly higher in the CD group (98%) compared to the PNA group (86%) (p=0.038). These findings reinforce the superiority of catheter drainage in terms of sustained recovery and long-term treatment success.

DISCUSSION

The present study compares percutaneous needle aspiration (PNA) and catheter drainage (CD) in the management of liver abscesses, focusing on treatment efficacy and patient outcomes.Our findings indicate that CD is associated with a higher success rate, faster resolution, shorter hospital stays, and lower recurrence rates compared to PNA.

Liver abscess is a potentially life-threatening condition that requires prompt and effective intervention to prevent severe complications. The choice between percutaneous needle aspiration (PNA) and catheter drainage (CD) remains a subject of debate, with studies reporting varying efficacy and safety outcomes. While PNA is a less invasive approach, its efficacy may be limited in larger abscesses or cases with thick purulent material, leading to a higher likelihood of recurrence. On the other hand, catheter drainage allows continuous evacuation of abscess contents, which may facilitate faster recovery and a reduced need for repeat interventions. Several previous studies have attempted to compare these modalities, but there remains a need for further clinical data to guide optimal management strategies. Our study contributes to this ongoing discussion by comparing the clinical outcomes of PNA and CD in a cohort of patients with liver abscesses, providing insights into resolution time, treatment success rates, complications, and recurrence.

In our study, the mean resolution time for abscesses was significantly shorter in the CD group (9.8 ± 2.7 days) than in the PNA group (12.5 ± 3.4 days).This aligns with the findings of Rajak et al. (1998), who reported that catheter drainage led to a quicker reduction in abscess size compared to needle aspiration.[11]

The complete resolution rate observed in our CD group was 96%, significantly higher than the 84% observed in the PNA group.This is consistent with the study by Zerem and Hadzic (2007), which demonstrated that catheter drainage was curative in all patients, whereas needle aspiration had a lower success rate .[12]

Regarding hospital stay, patients in the CD group had a mean duration of 6.1 ± 1.8 days, notably shorter than the 8.4 ± 2.1 days observed in the PNA group.A meta-analysis by Cai et al. (2015)

also concluded that catheter drainage resulted in shorter hospital stays compared to needle aspiration.[13]

The recurrence rate in our study was significantly lower in the CD group (4%) compared to the PNA group (16%).This finding is supported by a systematic review and meta-analysis by Cai et al. (2015), which reported lower recurrence rates with catheter drainage.[13]

In terms of complications, our study found that 14% of patients in the PNA group experienced secondary infections, compared to 6% in the CD group, though this difference was not statistically significant.Similarly, a study by Zerem and Hadzic (2007) reported no significant difference in complication rates between the two methods.[12]

At the six-week follow-up, ultrasound-confirmed resolution was achieved in 94% of patients in the CD group, significantly higher than the 82% observed in the PNA group.This aligns with the findings of Rajak et al. (1998), who reported higher success rates with catheter drainage.[11]

LIMITATIONS OF THE STUDY

- Non-randomized allocation may introduce selection bias.
- Limited follow-up duration (6 weeks) may not capture long-term recurrence rates.
- Physician recommendation and patient preference could influence treatment selection.
- Single-centre study, small sample size, limiting generalizability to broader populations.

CONCLUSION

This study demonstrates that catheter drainage (CD) is a more effective treatment modality for liver abscess compared to percutaneous needle aspiration (PNA). CD was associated with a significantly shorter resolution time, higher complete resolution rates, lower recurrence rates, and reduced hospital stays. Although both procedures had comparable complication rates, CD required fewer repeat interventions, making it a more reliable approach. Based on these findings, CD should be considered the preferred treatment, particularly for larger abscesses or cases requiring efficient and sustained drainage.

REFERENCES

1. Mangukiya DO, Darshan JR, Kanani VK, Gupta ST. A prospective series case study of pyogenic liver abscess: Recent trends in etiology and management. *Indian J Surg.*2012;74(5):385-90. doi:10.1007/s12262-011-0397-0.
2. Trivedi M, Lad V, Anis M, Patel S. Liver abscess: An observational study of clinical presentation and its management. *Int J Surg Sci.* 2019;3(1):145-8.
3. Anjan AK, Malua S. Liver abscess—Different modalities of treatment and its outcome. *Glob J Res Anal.* 2019;8(5):1-3.
4. Sreedhar S, Nynasindhu A, Sahaja. A clinico-pathological study of liver abscess. *J Evol Med Dent Sci.* 2018; 7(11):1376-9. doi:10.14260/jemds/2018/313.
5. Singh S, Chaudhary P, Saxena N, Khandelwal S, Poddar DD, Biswal UC. Treatment of liver abscess: Prospective randomised comparison of catheter drainage and needle aspiration. *Ann Gastroenterol.* 2013;26(4):332-9.
6. Mukhopadhyay M, Saha AK, Sarkar A, Mukherjee S. Amoebic liver abscess: Presentation and complications. *Indian J Surg.* 2010;72(1):37-41.
7. Ghosh S, Sharma S, Gadpayle AK, Gupta HK, Mahajan RK, Sahoo R, et al. Clinical, laboratory, and management profile in patients of liver abscess from northern India. *J Trop Med.* 2014;1:8.
8. Ahsan T, Jehangir MU, Mahmood T, Ahmed N, Saleem M, Shahid M, et al. Amoebic versus pyogenic liver abscess. *J Pak Med Assoc.* 2002; 52(11):497-501.
9. Cai YL, Xiong XZ, Lu J, Cheng Y, Yang C, Lin YX, et al. Percutaneous needle aspiration versus catheter drainage in the management of liver abscess: A systematic review and meta-analysis. *HPB (Oxford).* 2015; 17(3):195-201.
10. Seeto RK, Rockey DC. Amebic liver abscess: Epidemiology, clinical features, and outcome. *West J Med.* 1999; 170(2):104-9.
11. Rajak CL, Gupta S, Jain S, Chawla Y, Gulati M, Suri S. Percutaneous treatment of liver abscesses: needle aspiration versus catheter drainage. *AJR Am J Roentgenol.* 1998; 170(4):1035-1039.
12. Zerem E, Hadzic A. Percutaneous treatment of liver abscesses: Catheter drainage versus needle aspiration. *AJR Am J Roentgenol.* 2007; 189(3):W138-W142.
13. Cai YL, Xiong XZ, Lu J, Cheng Y, Yang C. Percutaneous needle aspiration versus catheter drainage in the management of liver abscess: A systematic review and meta-analysis. *World J Gastroenterol.* 2015; 21(14):4316-4323.