

A COMPARATIVE STUDY TO ASSESS THE EFFICACY OF OPEN VS LAPAROSCOPIC APPROACH TO SURGICAL MANAGEMENT OF RUPTURED LIVER ABSCESS IN TERTIARY CARE INSTITUTE

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ABSTRACT

Background: Ruptured liver abscess is a life-threatening surgical emergency associated with significant morbidity and mortality. While open surgical drainage has traditionally been the standard treatment, laparoscopic management is increasingly being adopted due to its minimally invasive advantages. However, its efficacy in ruptured cases remains under evaluation. The objective is to compare the efficacy of open versus laparoscopic surgical management of ruptured liver abscess in terms of intraoperative duration, postoperative pain, hospital stay, postoperative complications, recovery parameters, and quality of life. **Materials and Methods:** A prospective comparative study was conducted at MGMMC and MY Hospital, Indore, including 30 patients diagnosed with ruptured liver abscess. Patients were randomly allocated into two groups: Group A (open surgery) and Group B (laparoscopic surgery), with 15 patients in each group. Data regarding demographic variables, clinical features, operative findings, postoperative outcomes, and complications were collected and analyzed using appropriate statistical tests. **Result:** The majority of patients were males (73.3%) and belonged to the 40–50-year age group. Laparoscopic surgery demonstrated reduced postoperative pain, shorter hospital stay, and earlier recovery compared to open surgery. Open surgery was associated with higher rates of wound-related complications such as surgical site infection and wound dehiscence. **Conclusion:** Laparoscopic management of ruptured liver abscess is a safe and effective alternative to open surgery in selected patients, offering advantages of reduced postoperative pain, shorter hospitalization, and faster recovery. However, open surgery remains essential in critically ill patients with generalized peritonitis or hemodynamic instability.

INTRODUCTION

A liver abscess is a localized collection of pus within the hepatic parenchyma caused by bacterial, parasitic, or rarely fungal pathogens.^[1] Ruptured liver abscess represents a life-threatening complication of hepatic suppurative disease, characterized by breach of the abscess wall and spillage of infected contents into adjacent spaces such as the peritoneal, pleural, or pericardial cavities. The condition is associated with significant morbidity and mortality, particularly when diagnosis or intervention is delayed. Understanding the underlying pathophysiological mechanisms and clinical manifestations is essential for early

recognition and timely management.^[2] As the abscess enlarges, it compromises surrounding hepatic sinusoids and microvasculature, leading to ischemia and further necrosis. The hepatic capsule, particularly in subcapsular abscesses, becomes thinned due to sustained pressure and enzymatic tissue destruction, increasing susceptibility to rupture.^[3]

The management of liver abscesses has evolved considerably over the past few decades, with multiple treatment strategies ranging from medical therapy with antibiotics to image-guided percutaneous interventions and finally, to surgical intervention in complex cases. The emergence of minimally invasive techniques such as laparoscopy

has introduced a paradigm shift in surgical management, warranting rigorous evaluation of its efficacy compared to traditional open approaches.^[4] In the context of liver abscesses, laparoscopic drainage offers several theoretical benefits: decreased postoperative pain, reduced wound-related complications, shorter hospital stay, and faster return to baseline activities compared to open surgery. A systematic review and meta-analysis examining the role of laparoscopy in liver abscess treatment reported that laparoscopic drainage was a safe and feasible approach with a low rate of residual or recurrent abscess and no reported mortality. in the included studies, suggesting its potential applicability in both ruptured and non-ruptured cases.^[5] However, the role of laparoscopic surgery in ruptured liver abscesses remains debated due to concerns about adequate peritoneal decontamination, technical challenges posed by inflammation and adhesions, and limited availability of expertise in emergency settings. Consequently, the decision to opt for laparoscopic versus open surgical management often depends on the clinical setting, surgeon experience, and hospital resources. Clinically, patients with ruptured liver abscess often exhibit severe abdominal pain, signs of systemic infection, and hemodynamic instability, necessitating prompt surgical management to prevent further deterioration. In such scenarios, surgical intervention aims not only to drain the abscess but also to address peritoneal contamination and prevent ongoing sepsis. Open surgery has traditionally been preferred in this emergency setting due to its perceived ability to ensure thorough peritoneal lavage and decontamination; however, recent evidence suggests that laparoscopic techniques may also be safely employed in selected patients.^[6] Open surgical intervention becomes mandatory when patients fail to respond to antibiotics and percutaneous drainage or when such minimally invasive options are not feasible due to extensive rupture or complex abscess anatomy.^[7] Comparative clinical studies examining open versus laparoscopic approaches in liver abscess management provide valuable insights into outcomes and efficacy and hence the study was conducted to compare the efficacy of both the procedures in surgical management of ruptured liver abscess.

MATERIALS AND METHODS

The prospective comparative study was conducted in the Department of General Surgery, Mahatma Gandhi Memorial Medical College (MGMMC) and Maharaja Yeshwantrao (MY) Hospital, Indore, over a period of one year after approval from the Institutional Ethics Committee. 30 patients fulfilling the inclusion criteria were selected for the study.

Inclusion & Exclusion Criteria

Patients aged 18 to 70 years, diagnosed with ruptured liver abscess based on imaging studies such as ultrasonography or computed tomography (CT) scan, planned for surgical intervention, who provided written informed consent for participation in the study were included.

Patients who were hemodynamically unstable and deemed unfit for surgery, not ready to provide consent, who lost to follow-up during the study period were excluded.

Procedure

All patients with proven ruptured liver abscess were kept nil per oral and managed initially with Ryles tube aspiration. Patients received intravenous antibiotics, including injection ciprofloxacin 1 g IV twice daily and injection metronidazole 800 mg IV thrice daily, along with analgesics and antacids.

Radiological investigations including chest X-ray, abdominal X-ray, and ultrasonography of the whole abdomen were performed. Blood investigations such as complete hemogram, total leukocyte count, liver function tests, and coagulation profile were evaluated. Patients with deranged coagulation profiles were treated with injection vitamin K for three days and fresh frozen plasma as required.

Patients subsequently underwent either exploratory laparotomy Group A (Open Surgery Group) or laparoscopic surgery Group B (Laparoscopic Surgery Group) during which thorough peritoneal lavage was performed. Abdominal drains were placed in the right sub hepatic space and pelvis, and pus samples were sent for culture and sensitivity analysis. Postoperatively, patients were followed up regularly during hospital stay and after discharge.

Data were collected using a pre-designed structured proforma, which included demographic details, clinical findings, laboratory values, intraoperative observations, postoperative course, complications, and follow-up outcomes.

Data were entered into Microsoft Excel and analysed using JAMOWI statistical software. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Statistical analysis was performed using the unpaired t-test for continuous variables and the Chi-square test for categorical variables. A p-value < 0.05 was considered statistically significant.

RESULTS

The largest proportion belonged to the 40–50 year's age group (30.0%), followed by the 30–40 years and 50–60 year's groups (23.3% each). A marked male predominance was observed, with males accounting for 73.3% of participants. Most patients were from rural areas (60.0%) and belonged to the lower socioeconomic class (60.0%). Regarding comorbid conditions, 46.7% of patients had no associated comorbidity, while Diabetes Mellitus (30.0%) and Hypertension (23.3%) were the most commonly

observed comorbidities. These findings indicate that ruptured liver abscess predominantly affected

middle-aged males from rural and lower socioeconomic backgrounds.

Table 1: Baseline Characteristics of Study Participants (N = 30)

Variable	Category	Frequency (N)	Percentage (%)
Age Group (Years)	18–30	3	10.0
	30–40	7	23.3
	40–50	9	30.0
	50–60	7	23.3
	60–70	4	13.3
Gender	Male	22	73.3
	Female	8	26.7
Residence	Urban	12	40.0
	Rural	18	60.0

Table 2: Baseline Comparability Between Open and Laparoscopic Groups (N = 30)

Variable	Category	Group A – Open (N=15) n (%)	Group B – Laparoscopic (N=15) n (%)	Test Statistic	p-value
Type of Liver Abscess	Amoebic	9 (60.0)	10 (66.7)	$\chi^2 = 0.144$, df = 1	0.705
	Pyogenic	6 (40.0)	5 (33.3)		
Age Group (Years)	18–30	1 (6.7)	2 (13.3)	$\chi^2 = 0.730$, df = 4	0.948
	30–40	4 (26.7)	3 (20.0)		
	40–50	5 (33.3)	4 (26.7)		
	50–60	3 (20.0)	4 (26.7)		
	60–70	2 (13.3)	2 (13.3)		

[Table 2]. demonstrates the baseline comparability of the two study groups with respect to age distribution and liver abscess etiology. Amoebic liver abscess was the predominant type in both Group A (Open Surgery) and Group B (Laparoscopic Surgery), accounting for 60.0% and 66.7% of cases, respectively, while pyogenic abscesses constituted 40.0% and 33.3% of cases. The difference in abscess etiology between the groups was not statistically significant ($\chi^2=0.144$, $p=0.705$), indicating a similar disease profile at baseline.

Similarly, age-group distribution was comparable between the two treatment arms. The majority of patients in both groups belonged to the 40–50 year's age category, followed by the 30–40 years and 50–60 year's age groups. Statistical analysis showed no significant difference in age distribution between Group A and Group B ($\chi^2=0.730$, $p=0.948$).

These findings confirm that the open and laparoscopic groups were well matched with respect to important baseline clinical characteristics. Such homogeneity minimizes selection bias and reduces

the likelihood that postoperative differences in pain, recovery, complications, hospital stay, or quality-of-life outcomes were influenced by demographic or disease-related factors. Therefore, subsequent outcome comparisons can be interpreted with greater confidence as being primarily attributable to the surgical approach rather than pre-existing differences between the groups.

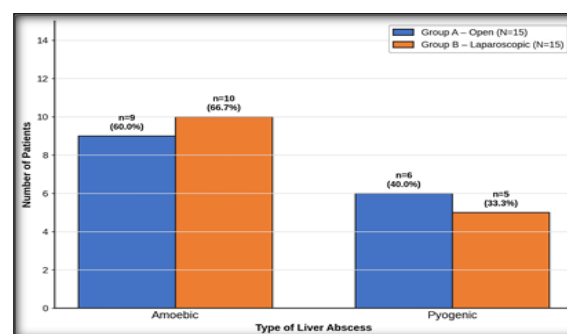


Figure 1: Comparison of Type of Liver Abscess Between Group A and Group B

Table 3: Comparison of Postoperative Pain (VAS Score) Between Group A and Group B (POD 1–6)

Post-operative Day	Group A – Open (Mean ± SD)	Group B – Laparoscopic (Mean ± SD)	t-value (Welch)	p-value
POD 1	7.20 ± 1.42	5.80 ± 1.15	2.966	0.006
POD 2	6.13 ± 1.30	4.73 ± 0.70	3.664	0.001
POD 3	5.20 ± 1.15	3.80 ± 0.56	4.249	< 0.001
POD 4	4.27 ± 0.70	2.93 ± 0.46	6.151	< 0.001
POD 5	3.20 ± 0.68	2.13 ± 0.52	4.856	< 0.001
POD 6	2.40 ± 0.51	1.40 ± 0.51	5.401	< 0.001
Statistical Test	Unpaired Welch t-test (two-tailed)		—	All p < 0.05

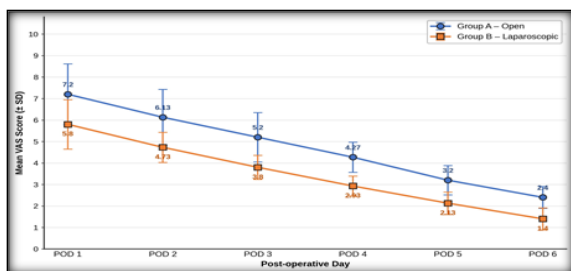


Figure 2: Mean VAS Score Trend (POD 1 to POD 6): Group A vs Group B

[Table 3]. shows the mean postoperative Visual Analogue Scale (VAS) pain scores recorded on post-operative days 1 through 6 for both surgical groups; Group A (Open Laparotomy) consistently

demonstrated higher mean VAS scores across all observed days, declining from 7.20 ± 1.42 on POD 1 to 2.40 ± 0.51 on POD 6, compared to Group B (Laparoscopic) which recorded values of 5.80 ± 1.15 and 1.40 ± 0.51 on the same days respectively. Welch's unpaired t-test demonstrated statistically significant differences at each post-operative day, with t-values ranging from 2.966 (POD 1, $p=0.006$) to 6.151 (POD 4, $p<0.001$), confirming that patients in the laparoscopic group experienced significantly less postoperative pain throughout the recovery period.

Table 4: Postoperative Recovery and Complications Between Open and Laparoscopic Groups

Parameter	Group A – Open (N=15)	Group B – Laparoscopic (N=15)	Test Statistic	p-value
Hospital Stay (days)	12.4 ± 3.54	7.6 ± 2.23	$t = 4.442$	$<0.001^*$
Surgical Site Infection	7 (46.7%)	1 (6.7%)	Fisher's Exact Test	0.035*
Wound Dehiscence	4 (26.7%)	0 (0.0%)	Fisher's Exact Test	0.100
Oral Feed Initiation (POD)	3.20 ± 0.86	1.80 ± 0.77	$t = 4.679$	$<0.001^*$
Mobilisation Without Support (POD)	4.13 ± 0.83	2.20 ± 0.68	$t = 6.975$	$<0.001^*$

*Statistically significant ($p < 0.05$)

[Table 4] summarizes key postoperative recovery parameters and complications among patients undergoing open and laparoscopic surgery for ruptured liver abscess. Patients managed laparoscopically demonstrated significantly better postoperative recovery, as evidenced by a shorter mean hospital stay (7.6 ± 2.23 vs. 12.4 ± 3.54 days, $p<0.001$), earlier initiation of oral feeding (1.80 ± 0.77 vs. 3.20 ± 0.86 days, $p<0.001$), and earlier independent mobilisation (2.20 ± 0.68 vs. 4.13 ± 0.83 days, $p<0.001$).

With respect to postoperative complications, the incidence of surgical site infection was significantly lower in the laparoscopic group (6.7%) compared with the open surgery group (46.7%) ($p=0.035$). Although wound dehiscence occurred only in the open surgery group (26.7% vs. 0%), the difference did not reach statistical significance ($p=0.100$), likely due to the limited sample size.

Overall, these findings indicate that laparoscopic surgery is associated with faster postoperative recovery, reduced wound-related morbidity, and shorter hospitalization compared with open laparotomy. The observed advantages are likely attributable to the minimally invasive nature of laparoscopy, which reduces tissue trauma, facilitates early restoration of physiological function, and minimizes postoperative infectious complications. Such benefits support the preferential use of

laparoscopic management in appropriately selected patients with ruptured liver abscess.

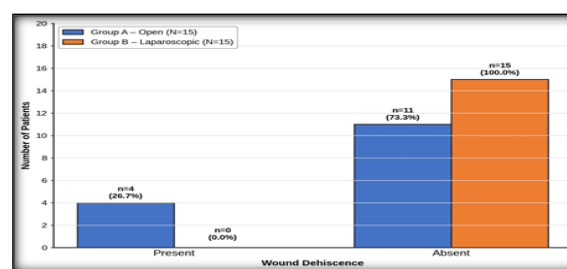


Figure 3: Comparison of Wound Dehiscence Between Group A and Group B

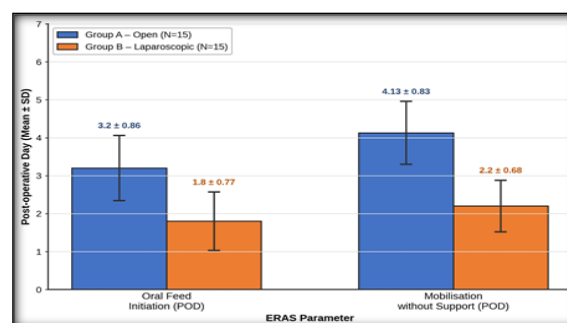


Figure 4: Comparison of ERAS Outcomes Between Group A and Group B

Table 5: Comparison of Health-Related Quality of Life (EQ-5D Score) at 6-Month Follow-Up

Parameter	Group A – Open (N=15)	Group B – Laparoscopic (N=15)	t-value (Welch)	p-value
Mean ± SD	0.72 ± 0.08	0.84 ± 0.06	4.611	< 0.001
Minimum Score	0.56	0.73	—	—
Maximum Score	0.87	0.96	—	—
Statistical Test	Unpaired Welch t-test $t = 4.611$		—	$p < 0.001$

[Table 5] describes the health-related quality of life outcomes assessed using the EQ-5D utility index at 6-month post-operative follow-up; Group B (Laparoscopic Surgery) demonstrated a significantly higher mean EQ-5D score of 0.84 ± 0.06 (range: 0.73–0.96) compared to Group A (Open Laparotomy) with a mean score of 0.72 ± 0.08 (range: 0.56–0.87). Welch's unpaired t-test yielded $t=4.611$ with $p<0.001$, indicating a statistically significant superiority in long-term quality of life outcomes associated with the laparoscopic approach at the 6-month follow-up.

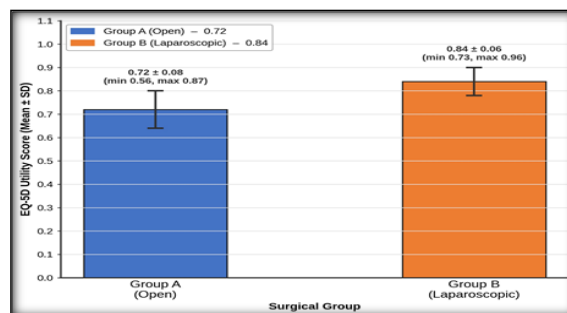


Figure 5: Comparison of EQ-5D Score at 6-Month Follow-Up Between Group A and Group B

Table 6: Comparison of Intraoperative Duration Between Open and Laparoscopic Groups

Parameter	Group A – Open (N = 15)	Group B – Laparoscopic (N = 15)	Test Statistic	p-value
Operative Time (minutes), Mean ± SD	68.4 ± 8.6	70.1 ± 9.2	t = 0.523	0.605

Statistical Test: Unpaired Welch's t-test (two-tailed) Table 6. compares the mean intraoperative duration between patients undergoing open surgery and laparoscopic surgery for ruptured liver abscess. The mean operative time was 68.4 ± 8.6 minutes in the open surgery group and 70.1 ± 9.2 minutes in the laparoscopic group. Statistical analysis using Welch's unpaired t-test demonstrated no significant difference in operative duration between the two groups ($t = 0.523$, $p = 0.605$).

These findings indicate that both surgical approaches required a comparable amount of operative time. Despite the technical demands of laparoscopic surgery, operative duration was not prolonged when compared with the conventional open approach. Therefore, the superior postoperative outcomes observed in the laparoscopic group—including lower pain scores, earlier recovery, reduced wound complications, and shorter hospital stay—are unlikely to be attributable to differences in operative duration, but rather to the minimally invasive nature of the laparoscopic technique.

DISCUSSION

Ruptured liver abscess is a serious intra-abdominal surgical emergency associated with significant morbidity, prolonged hospitalization, and risk of postoperative complications. Although open laparotomy has traditionally been the standard surgical approach in such cases, advances in minimally invasive techniques have created the possibility of laparoscopic management even in complicated infective abdominal conditions. The aim of the present study was to comparatively assess the efficacy of open surgery and laparoscopic surgery in the management of ruptured liver abscess in a tertiary care institute, with special emphasis on evaluating differences in postoperative pain, hospital stay, surgical site infection, wound dehiscence, early recovery parameters, and long-term quality of life.

The baseline characteristics of the study population demonstrated that ruptured liver abscess predominantly affected middle-aged adults, with the largest proportion of patients belonging to the 40–50 year's age group. A marked male predominance was observed, with males accounting for nearly three-fourths of the study population. Most patients were from rural areas and lower socioeconomic strata, while Diabetes Mellitus and Hypertension were the most common associated comorbidities. These findings are consistent with the recognized epidemiological profile of complicated liver abscess, where delayed healthcare access, poor sanitation, nutritional factors, and metabolic disorders contribute to disease progression. Similar observations have been reported by Singh et al,^[8] who documented a strong male predominance among patients presenting with ruptured liver abscess.

The distribution of liver abscess etiology was comparable between the two study groups, with amoebic liver abscess being the predominant pathology in both arms. The absence of a significant difference in abscess type ($p=0.705$) and age-group distribution ($p=0.948$) confirms satisfactory baseline comparability and strengthens the validity of subsequent outcome comparisons. Similar emphasis on baseline matching has been reported by Rajesh et al, Patra et al, and Bhadreshwara et al in comparative surgical studies.^[9–11]

Postoperative outcomes consistently favored the laparoscopic approach. Patients undergoing laparoscopic surgery experienced significantly lower postoperative pain scores throughout the recovery period, reflecting the advantages of smaller incisions, reduced tissue trauma, and less postoperative inflammatory response. Comparable reductions in pain and analgesic requirements have been reported by Rajesh et al, Patra et al, and Ahmed et al.^[9,10,12]

A significant reduction in hospital stay was also observed in the laparoscopic group (7.6 ± 2.23 days) compared with the open group (12.4 ± 3.54 days; $p<0.001$). This finding suggests faster postoperative

recovery and earlier return to functional activity. Similar reductions in hospitalization following laparoscopic surgery have been documented by Kantamani et al, Bhadreshwara et al, Gohil et al, and Ansari et al.^[11,13-15]

With regard to postoperative complications, surgical site infection occurred significantly less frequently in the laparoscopic group (6.7%) than in the open surgery group (46.7%). Wound dehiscence was observed only among patients undergoing open surgery, although the difference did not achieve statistical significance, likely due to the limited sample size. These findings are consistent with reports by Gohil et al,^[14] Bhadreshwara et al,^[11] and Ansari et al,^[15] all of whom demonstrated lower wound-related morbidity following laparoscopic procedures.

The mean intraoperative duration was comparable between the open and laparoscopic groups, with operative times of approximately 68 and 70 minutes, respectively, without a statistically significant difference. Although laparoscopic procedures are often perceived to require longer operating times because of technical complexity and the learning curve, the present findings suggest that with adequate surgical expertise, laparoscopic management of ruptured liver abscess can be performed within a duration comparable to conventional open surgery. Similar observations have been reported in previous comparative studies evaluating minimally invasive surgery for hepatic and other intra-abdominal infections, where operative duration was not significantly different despite superior postoperative recovery following laparoscopy.

Enhanced Recovery After Surgery (ERAS) parameters further highlighted the benefits of laparoscopy. Patients in the laparoscopic group resumed oral feeding and achieved independent mobilization significantly earlier than those in the open group, indicating more rapid physiological recovery. Similar observations have been reported by Kantamani et al,^[13] Gohil et al,^[14] and Ansari et al.^[15] Importantly, these early postoperative advantages translated into significantly better health-related quality of life at six months, as evidenced by higher EQ-5D scores in the laparoscopic group.

The present study demonstrated no significant difference in operative duration between the open and laparoscopic groups, indicating that laparoscopic surgery can be performed with operative efficiency comparable to that of the conventional open approach. Similar observations were reported by Tu et al,^[16] who found no significant difference in operative time between laparoscopic and open surgery for pyogenic liver abscess with biliary pathology, while laparoscopic surgery was associated with earlier oral intake and shorter hospital stay. Furthermore, Tay et al,^[17] demonstrated that laparoscopic drainage is a safe and feasible alternative to open surgery with

acceptable operative duration and favorable postoperative recovery.

The present study's major strengths include its prospective comparative design, balanced allocation of patients between open and laparoscopic groups, and comparable baseline characteristics, which enhanced the validity of outcome comparisons. The assessment of multiple clinically relevant endpoints, including postoperative pain, hospital stay, wound complications, ERAS parameters, and 6-month quality of life, provided a comprehensive evaluation of both short- and medium-term outcomes. However, the study is limited by its small sample size, single-center setting, and use of odd-even randomization, which may restrict generalizability and introduce potential allocation bias. Additionally, factors such as abscess size, operative time, blood loss, cost-effectiveness, and long-term outcomes beyond six months were not evaluated. Therefore, while the findings support the advantages of laparoscopic surgery in selected patients with ruptured liver abscess, larger multicentric randomized studies are required to validate these results and strengthen their external applicability.

CONCLUSION

Taken together, the findings of the present study support the conclusion that laparoscopic surgery is a more effective and patient-friendly approach than open laparotomy for the surgical management of ruptured liver abscess in selected patients. Laparoscopic surgery demonstrated operative duration comparable to open surgery while providing significant advantages in terms of reduced postoperative pain, shorter hospital stay, lower wound infection rates, earlier oral intake, faster mobilization, and superior quality of life. Open surgery remains an important and viable option, particularly in situations where laparoscopy is not feasible, where expertise is unavailable, or where patient condition demands a more conventional approach. However, wherever adequate surgical skill, infrastructure, and patient stability permit, the laparoscopic approach should be preferred because of its clear recovery and morbidity advantages. Thus, the present study concludes that minimally invasive surgery has an important and promising role in the management of ruptured liver abscess at tertiary care centers and may contribute significantly to improving both short-term surgical outcomes and long-term patient wellbeing.

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