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Comparison between open and laparoscopic surgery for liver hydatid cyst: a retrospective cohort study

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Abstract

Background Comparative evidence on laparoscopic versus open surgery for hepatic hydatid-cyst disease in endemic regions remains limited.

Methods We reviewed records of 43 consecutive patients who underwent surgery for liver hydatid cysts at two tertiary hospitals in Khorramabad, Iran. Twenty-two patients had laparoscopic cyst evacuation and 21 had open surgery. Primary outcomes were postoperative complications, including surgical-site infection (SSI), bile leakage, and 1-year recurrence, while secondary outcomes were operative time, postoperative pain (Numeric Rating Scale, NRS), and length of hospital stay (LOS).

Results Baseline demographics were comparable between groups. Laparoscopy yielded significantly less intra-operative blood loss (all cases < 100 mL vs 71% in the open cohort; $p = 0.009$), fewer bile leaks (0% vs 19%; $p = 0.048$), and a lower SSI rate (4.5% vs 28.6%; $p = 0.046$). Mean operative time was halved (29 ± 2.9 min vs 63.8 ± 7.7 min; $p < 0.001$), postoperative pain scores were lower (NRS 3.4 ± 0.7 vs 7.2 ± 1.1; $p < 0.001$), and LOS was shorter (2.6 ± 0.5 vs 5.2 ± 0.7 days; $p < 0.001$). Local recurrence (0% vs 14.3%; $p = 0.108$) and 1-year overall recurrence (4.5% vs 9.5%; $p = 0.607$) did not differ significantly, and there were no deaths.

Conclusions In this endemic-region cohort, laparoscopic management of hepatic hydatid cysts was associated with markedly fewer peri-operative complications, faster recovery, and no increase in short-term recurrence compared with open surgery. Whenever adequate expertise and equipment are available, laparoscopy should be considered the preferred first-line approach; larger multi-center trials are warranted to confirm these findings.

Keywords Hepatic hydatid cyst, Hydatidosis, Surgery, Laparoscopic surgery, Open surgery

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Introduction

Hydatidosis, or hydatid disease, results from infection with the cestode "Echinococcus granulosus." Dogs, jackals, hyenas, and wolves are the parasite's definitive hosts [1]. Transmission is typically fecal-oral. After a person or an intermediate host, such as sheep or goats, ingests or inhales the eggs, the released oncosphere penetrates the intestinal wall and enters the portal circulation. Roughly 70% of oncospheres lodge in the liver; the lungs are the next most common site, and in fewer than 10% of cases, the larvae pass the pulmonary filter to seed other organs. Within the affected parenchyma, the oncosphere develops into a spherical, multinucleated mass that matures into a cyst. Cyst growth is influenced by host age, immune response, and the organ involved [2]. A recent global review of cystic and alveolar echinococcosis classifies Iran, like much of the Middle East countries, as endemic for "*E. granulosus*" [3]. Iran is an established endemic setting for human cystic echinococcosis. In a national systematic review and meta-analysis (1985–2015), the pooled seroprevalence was 6.0% (95% CI 4.0–7.0%), rising with age and showing modest female predominance. Rates differed widely across provinces, tending to peak in western and southwestern regions and to be lowest in Tehran, underscoring ongoing community exposure and the need for prevention [4].

Diagnosis is confirmed by identifying protoscoleces in aspirated cyst fluid. Laboratory findings may include anemia and eosinophilia, while computed tomography and magnetic resonance imaging delineate cysts [5]. Serological assays, such as indirect hemagglutination and ELISA, can yield false-positive results owing to cross-reactivity, for example with "*Taenia solium*" cysticercosis [6].

Management depends on clinical presentation. Asymptomatic patients with small cysts may be treated with anti-helminthic agents alone. Symptomatic, enlarging, or multifocal cysts usually require surgery, particularly when a pericyst is present [7]. Indications for operative treatment include (1) hepatic cysts ≥ 10 cm, especially those containing multiple daughter cysts; (2) superficially located solitary cysts at risk of rupture; and (3) complicated cysts that obstruct or compress neighboring structures, communicate with the biliary tree, or become super-infected [8]. Percutaneous drainage is reserved for patients who are poor surgical candidates, have medically refractory or recurrent cysts, or decline surgery; it is contraindicated in pulmonary disease. The most common postoperative complications are bile leakage and external biliary fistula, both of which often necessitate surgical or endoscopic intervention [9]. Comparative studies of open versus laparoscopic management of hepatic hydatidosis remain limited. We therefore undertook the present study to evaluate intra-operative and postoperative differences between the two approaches.

Methods

This retrospective cohort study reviewed patients who underwent laparoscopic or open surgery for hepatic hydatid cysts at Shohada'e Ashayer and Shahid Rahimi hospitals in Khorramabad, Iran, affiliated with Lorestan University of Medical Sciences. Inclusion criteria encompassed all patients treated surgically, open or laparoscopic, during the study period. Patients were excluded if medical records were incomplete, follow-up was inadequate, or a history of previous hydatid treatment existed. Forty-three patients met the criteria: 21 in the open-surgery group and 22 in the laparoscopic group. A standardized data-collection sheet captured demographic variables (age, sex, urban or rural residence), intra-operative details (operative time and blood loss), and postoperative outcomes (Numeric Rating Scale pain scores [10], surgical-site infection, bile leakage, length of stay, and recurrence at one year). The selection process of the study is shown in Fig. 1. The choice of surgical approach (laparoscopic vs open) was made by the attending surgeon and was based on patient factors and cyst characteristics, including anticipated segmental accessibility, size, and complexity on imaging, proximity to major vascular/biliary structures, and the surgeon's experience and available equipment; no random allocation was used.

Primary outcomes were postoperative complications, bile leakage, overall and local recurrence, and recurrence within 1 year. Secondary outcomes included operative time, hospital stay, and postoperative pain.

Statistical analysis was performed with IBM SPSS Statistics version 26. Significance was set at $p < 0.05$. Depending on data distribution, independent-sample *t*-tests, chi-square tests, or Fisher's exact tests were applied. The study was approved by the Lorestan University of Medical Sciences Ethics Committee (IR.LUMS.REC.1402.024). All patient identifiers were removed, and the principles of the Declaration of Helsinki were followed. Informed written consent was obtained from all participants prior to inclusion in the study.

Results

The cohort comprised 43 patients: 44.2% were female, the mean age was 35.5 ± 7.4 years, and 76.7% lived in urban areas (Table 1). Compared with open surgery, the laparoscopic approach was associated with significantly less intra-operative blood loss ($p = 0.009$), fewer bile leaks ($p = 0.048$), and a lower incidence of surgical-site infection ($p = 0.046$). Although local and 1-year recurrence rates were numerically lower after laparoscopy, the differences were not statistically significant ($p > 0.05$). There

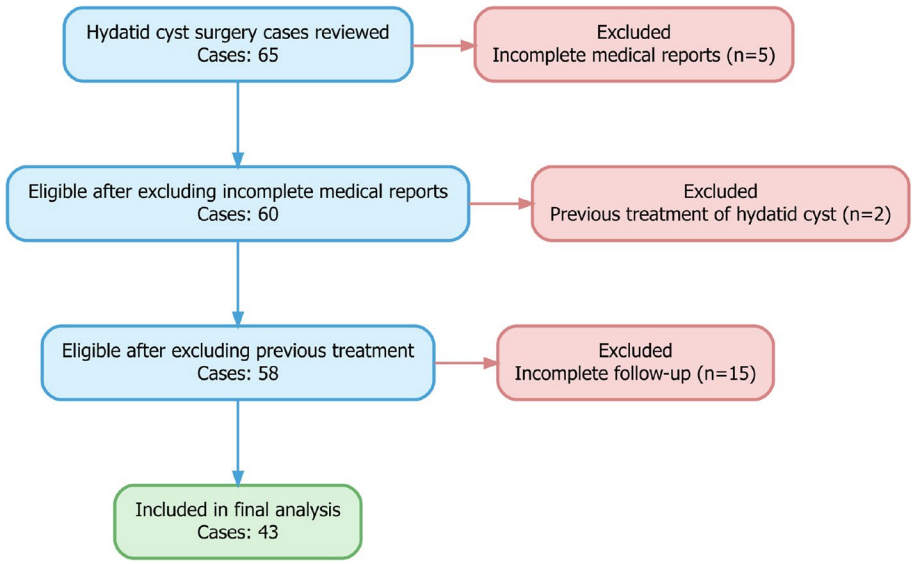

Fig. 1 Sample selection diagram

Table 1 Demographic details of the patients

Variable	Laparoscopic surgery (*n* = 22)	Open surgery (*n* = 21)	*p*-value	Test
Age, mean (SD)	37.0 (7.1)	36.45 (7.7)	0.661	Independent T
Gender, *n* (%)			0.864	Chi-square
Female	10 (45.5)	9 (42.9)		
Male	12 (54.5)	12 (57.1)		
Site of living, *n* (%)			1.00	Fisher's exact
Rural	17 (77.3)	16 (76.19)		
Urban	5 (22.7)	5 (23.81)		

were no deaths in either group (Table 2). Operative time, postoperative pain, and length of hospital stay were all significantly reduced in the laparoscopic group (all $p < 0.001$) (Table 3).

Among the 43 patients in our series, hydatid cysts clustered predominantly in the right side of the liver: 29 cases (about two-thirds, 67%) arose in segments V–VIII. The left lobe (segments II–IV) accounted for 13 cases (30%), while only one patient (3%) had a caudate-lobe lesion (Table 4).

When we look at the surgical approach, the pattern is just as clear. Laparoscopic surgery handled 12 of the 22 right-lobe cysts (55%) and 10 of the 13 left-lobe cysts (77%), reflecting the easier access to anterior and

Table 2 Primary outcomes

Variable*	Laparoscopic surgery group (*n* = 22)	Open surgery group (*n* = 21)	Whole study population (*n* = 43)	*p*-value
Post operation infection (SSI[1]), *n*(%)	1(4.5)	6(28.6)	7(16.3)	**0.046**
Bile leakage, *n*(%)	0(0)	4(19.0)	4(9.3)	**0.048**
Local recurrence, *n*(%)	0(0)	3(14.3)	3(6.9)	0.108
Post operation recurrence at 1 year, *n*(%)	1(4.5)	2(9.5)	3(6.9)	0.607
Intraoperative hemorrhage, *n*(%)				**0.009**
Low (< 100 ml)	22(100)	15(71.4)	37 (86.0)	
Moderate(100–500 ml)	0(0)	6(28.6)	6 (24.0)	
High (> 500 ml)	0(0)	0(0)	0(0)	
Mortality, *n*(%)	0(0)	0(0)	0(0)	1.000

* Used test: Fisher's exact test, Significant *p*-values are bolded, *SSI*[1] surgery site infection

Table 3 Secondary outcomes

Variable*	Laparoscopic surgery group ($n=22$)	Open surgery group ($n=21$)	*p*-value
Surgery duration (min), mean (SD)	29.32 (2.9)	63.76 (7.7)	**< 0.001**
NRS score after surgery, mean (SD)	3.36 (0.7)	7.24 (1.1)	**< 0.001**
LOS[1] (day), mean (SD)	2.64 (0.5)	5.19 (0.7)	**< 0.001**

* Used test: independent *t*-test,*LOS*[1] length of hospitalization, significant p-values are bolded

Table 4 Distribution of cysts' location

Lobe	Laparoscopy	Lobe	Laparoscopy
Right (V–VIII)	12 (54.5%)	17 (80.9%)	29 (67.4%)
Left (II–IV)	10 (45.5%)	3 (14.3%)	13 (30.3%)
Caudate (I)	0 (0%)	1 (4.7%)	1 (2.3%)

left-sided segments. In contrast, 17 of the 21 open procedures (81%) were reserved for right-lobe disease, especially the deeper posterior segments where minimally invasive exposure is limited.

Discussion

This retrospective cohort study compared the outcomes of laparoscopic and open surgery approaches for the hepatic hydatid cyst. We found significant differences in primary outcomes (except for mortality and recurrence) and secondary outcomes. The patients who underwent laparoscopic surgery had significantly lower SSI at 4.5% which was 28.6% in the open surgery group ($p=0.046$). They also showed fewer instances of bile leakage (0% versus 19%, $p=0.048$). Additionally, the laparoscopic approach resulted in shorter surgery duration (approximately 29 min compared to 64 min, $p<0.001$), reduced postoperative pain scores (mean NRS score of 3.4 versus 7.2, $p<0.001$), and a markedly decreased length of hospitalization (2.6 days versus 5.2 days, $p<0.001$). The intraoperative bleeding was also significantly lower in the laparoscopic surgery group ($p=0.009$).

We observed no statistically significant differences in local or overall recurrence between groups. This finding aligns with the meta-analysis by Sokouti et al., which also reported comparable recurrence and mortality rates between laparoscopic and open procedures [11].

Our bile-leak and length-of-stay data mirror those of Korkut et al., who attributed reduced biliary fistula formation and shorter admissions to the minimally invasive nature of laparoscopy. The higher fistula rate in their open-surgery cohort was linked to a greater proportion of complicated cases, a pattern also evident in our series [12]. Open surgery is often selected for ruptured, recurrent, or technically difficult cysts, and this higher-risk case mix can inflate leak rates even before the first incision [13]. In addition, conservative open procedures may harbor occult "insidious" communications that escape intraoperative detection and later present as external biliary fistula [14]. The plausible causes of bile leak in the laparoscopic group appear to be missed or incompletely sealed cysto-biliary communications (CBCs). Small (occult) CBCs are often clinically silent, difficult to diagnose before surgery, and may only become evident as postoperative external bile drainage [15, 16]. In addition, larger or centrally located cysts are more prone to CBC; any imbalance in cyst size or location between groups can therefore shift leak rates upward [15, 16]. Intraoperative leakage tests that reveal hidden biliary orifices have been shown to reduce postoperative biliary fistulas and may help mitigate this risk. Standardized leakage testing with targeted suturing has been shown to reduce postoperative biliary complications and may help harmonize outcomes across approaches [17].

Seven et al. reported zero mortality and an average length of stay of six days in a mixed cohort managed predominantly with open surgery, longer than the 5.2-day mean seen in our open group and substantially longer than the 2.6-day stay after laparoscopy in our study. Our one-year recurrence rate (6.3%) was likewise lower than the 9% reported by Seven et al. [18].

Operative time in our series was significantly shorter when the procedure was laparoscopic, contrasting with the non-significant increase noted by Zaharie et al. Such variation likely reflects differences in surgeon experience and cyst complexity. Nonetheless, both studies found fewer wound complications after laparoscopy, consistent with the lower surgical-site infection rate we observed [19].

Collectively, these findings and other contemporary reports support the expanding role of laparoscopy in the management of hydatid cysts [19, 20].

Roughly two-thirds of the cysts in our cohort sat in the right lobe, almost exactly the 60–70% right-sided predominance other endemic-area studies describe. That anatomy mattered in the operating room: right-lobe cysts, especially those buried in the posterior segments, were far more likely to be removed through an open incision, whereas most left-lobe cysts could be handled

laparoscopically. The preference is easy to understand once you picture the liver's layout. Segments VI and VII lie tucked high under the ribs, where a laparoscope struggles to find workable angles and keep the cyst cavity under control. Unsurprisingly, many surgeons place segment VII on the "laparoscopy with caution" list, and our experience echoes that caution; every one of our six-segment VII cysts ultimately required an open approach [7–9, 12]

Advantages include fewer postoperative complications, faster recovery, shorter hospitalization, and improved cosmetic results. Pre-operative assessment of biliary communication remains crucial when selecting laparoscopic candidates. With increasing expertise and modern instruments, only cysts in the posterior hepatic segments constitute an absolute contraindication; even cysto-biliary fistulae are becoming relative rather than absolute limitations.

This retrospective, two-center cohort ($n=43$; 22 laparoscopic and 21 open) is vulnerable to selection bias because the surgical approach was not randomized. More importantly, key cyst descriptors were not consistently recorded in our charts. We therefore could not report (or adjust for) cyst size, number of cysts, or cyst type using a standardized system (e.g., WHO/Gharbi). Although we described location in broad anatomical terms, right (V–VIII), left (II–IV), and caudate (I), we could not stratify segments by laparoscopic "accessibility" or separately present difficult segments (notably VII and I) within each group. These omissions may leave residual confounding and limit the generalizability of our comparisons. Future prospective, multi-center randomized trials are needed to validate the superiority of laparoscopy and to determine its long-term impact on quality of life and healthcare costs.

Conclusion

Laparoscopic treatment of liver hydatid-cyst disease delivers clear peri-operative advantages over the open approach: lower blood loss, fewer biliary and wound complications, reduced pain and a 2-day shorter hospital stay, all without sacrificing safety or increasing early recurrence. These benefits, together with improved cosmetic outcomes, justify offering laparoscopy as the default option in suitable patients, reserving open surgery for posterior-segment cysts or when advanced instrumentation is unavailable.

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Clinical trial number
Not applicable. This study is a retrospective cohort study.

Authors' contributions
All authors made significant contributions to the writing of the study and met the ICMJE criteria of authorship. AR, FNR, SKH, MA, HH, MBH, and DY wrote the manuscript draft. DY was the corresponding author and contributed to the review and editing of the manuscript. All authors have read and approved final manuscript.

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Data availability
The data and analytical script of this study are available from the corresponding author upon a reasonable request.

Declarations

Ethics approval and consent to participate
The Lorestan University of Medical Sciences review board and ethical committee approved this study (code: IR.LUMS.REC.1402.024).

Competing interests
The authors declare no competing interests.

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