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Clinical efficacy and safety of laparoscopic radical surgery and radiotherapy for the treatment of early-stage gallbladder cancer

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► ***Short report***

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ABSTRACT

Background: Gallbladder cancer (GBC) is a challenging malignancy with poor prognosis. Although radical cholecystectomy is the accepted surgical approach, the safety and effectiveness of laparoscopic radical surgery and radiotherapy are remained under-studied. ***Materials and Methods:*** A single-center, prospective study was conducted from May 2020 to May 2023. One hundred patients diagnosed with early-stage GBC were categorized into two groups: an Intervention Group (n=50) that underwent laparoscopic radical surgery and radiotherapy, and a Control Group (n=50) that received conventional open surgery. Key indicators such as surgical conditions, postoperative rehabilitation, and survival rates were evaluated in both groups. ***Results:*** The Intervention Group demonstrated superior surgical outcomes, including a significantly reduced surgical bleeding volume (198.5±23.1 vs. 286.3±18.7 ml, P-value <0.001), shorter operative duration (168.6±64.8 vs. 261.1±55.3 min, P-value <0.001), and smaller incision length (1.1±0.3 vs. 8.2±1.2 cm, P-value <0.001). Postoperatively, the Intervention Group also showed marked improvements in hospital stay duration (7.5±1.4 vs. 9.3±2.9 days, P-value <0.001), time to first ambulation (2.1±0.8 vs. 6.9±1.1 days, P-value <0.001), and gastric function recovery (2.2±0.6 vs. 3.5±1.3 days, P-value <0.001). Complication rates were lower, with abdominal infections observed in 0 cases in the Intervention Group compared to 4 cases (8%) in the Control Group (P-value:0.041). Long-term follow-up indicated a trend toward better 3-year survival rates in the Intervention Group (84% vs 68%, P-value: 0.061). ***Conclusion:*** Our findings suggest that laparoscopic radical cholecystectomy is a viable and safe option for treating early-stage GBC, aligning with existing literature that advocates for minimally invasive surgical approaches.

INTRODUCTION

Gallbladder cancer (GBC) is a prevalent malignancy in the digestive system, known for its aggressive nature and poor prognosis [1]. Current treatments primarily include radical surgical resection and radiotherapy. Radical cholecystectomy has been identified as the standard surgical approach to manage GBC. However, conventional open surgeries have been criticized for causing significant patient trauma, while laparoscopic methods are being studied for their reduced invasiveness and quicker recovery time [2-5]. Despite these advancements, there is scarce evidence regarding efficacy and safety of laparoscopic radical cholecystectomy for GBC [6-8].

The use of laparoscopic technology in treating GBC has been a subject of interest among many experienced surgical centers [7, 8]. This trend is attributed to several benefits of laparoscopic surgery over open surgery, such as clearer anatomy, smaller incisions, and faster recovery. However, questions remain about the scope of laparoscopic radical surgery, including appropriate lymph node dissection, and the management of unexpected GBC complications post-surgery [9-12].

The preoperative diagnosis and evaluation of GBC present significant challenges due to its insidious onset and rapid progression. Imaging techniques like computed tomography (CT) and high-resolution ultrasound are essential for a comprehensive preoperative evaluation, particularly for identifying high-risk patients [13-15].

Given these gaps in the current literature, our study aims to investigate the clinical efficacy and safety of laparoscopic radical surgery and radiotherapy in the treatment of early-stage GBC. We also focus on post-operation complications, rehabilitation, and 3-year survival.

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MATERIALS AND METHODS

Study design and participants

This is a single-center, prospective study conducted from May 2020 to May 2023. Patients who met the diagnostic criteria for early-stage GBC and who chose to undergo radical surgery were considered for this study. The total number of 100 patients with early-stage GBC diagnosis were categorized into two groups: (A) an "Intervention Group" that underwent laparoscopic radical surgery and (B) a "Control Group" that received routine treatment for GBC.

Eligibility criteria

The inclusion criteria were: patients aged 18 years or older, fulfilled the diagnostic criteria for early-stage GBC, and had voluntarily opted for radical surgery. On the other hand, patients with other malignancies or failed to complete the required follow-up period were excluded.

Data collection

Our objective was to rigorously investigate the clinical safety and efficacy of laparoscopic radical surgery as a treatment for early-stage GBC. To do so, key indicators were selected for comparison between the Intervention and Control Groups. These included surgical conditions, measured by parameters such as surgery duration and the volume of intraoperative blood loss. Further, we evaluated postoperative rehabilitation metrics, such as the post-surgery hospital length of the stay. In terms of postoperative complications, emphasis was placed on metrics like infection rates and readmission rates. The survival status of patients was systematically recorded during follow-up intervals at 6 months, 1 year, and 3 years post-surgery. All demographics and clinical data were meticulously retrieved from hospital medical records by trained medical staff, and periodic follow-ups were arranged for ascertaining survival status.

Procedures

For the intervention group undergoing laparoscopic radical surgery, a total of six abdominal ports were employed. A 12-mm trocar was placed at the umbilicus to establish pneumoperitoneum. Subsequently, the patient was positioned in a reverse Trendelenburg and laterally tilted to the left. A staging laparoscopy was executed to confirm the absence of distant metastasis before inserting the additional five trocars. Lymphadenectomy commenced at the intersection of the gastroduodenal and common hepatic arteries, and continued along the proper hepatic artery, extending to both the left and right hepatic arteries. Detailed procedural steps, as performed in laparoscopic radical cholecystectomy, were followed for tissue resection and anastomosis. Hemostasis was ensured before concluding the surgery. In the control surgery group, a midline incision was made, and surgical exposure achieved through manual retraction. The same steps for lymphadenectomy and anastomosis were followed as in the laparoscopic radical surgery group, but without the use of trocars or laparoscopic guidance. Hemostasis was confirmed visually and manually before wound closure. Patients in both groups underwent a similar radiotherapy regimen. Conformal radiotherapy planning was utilized, which involved a CT-based 3D reconstruction of the tumor site. The radiation oncologist outlined the target and critical structures, with the physicist planning the best angle and dose delivery.

Statistical analysis

For the statistical analysis, categorical data were presented as frequencies (%) and analyzed using either the chi-square or Fisher's exact test. Continuous variables were expressed as mean ± standard deviation and analyzed using an independent samples t-test. Data analysis was performed using SPSS version 22 (IBM Corp, Armonk, NY, USA), with a two-sided P-value of <0.05 indicating statistical significance.

RESULTS

In this study, we evaluated 100 patients undergoing gallbladder surgery, with 50 patients each in the Intervention and Control groups. The overall mean age was 64.0±4.2 years and 60.0% were female. We observed that mean age was 63.8±4.6 years in the Intervention group and 64.2±3.8 years in the Control group (P-value: 0.635). The distribution of sex and other baseline characteristics like gallbladder polyps and gallstones did not show a statistically significant difference between the two groups (table 1). The Intervention group demonstrated significantly better surgical outcomes compared to the Control group in terms of surgical bleeding volume (198.5±23.1 vs. 286.3±18.7 ml, P-value <0.001), operative duration (168.6±64.8 min vs 261.1±55.3 min, P-value <0.001), and cut length (1.1±0.3 cm vs 8.2±1.2 cm, P-value <0.001) (table 1).

Table 1. Demographics and operation characteristics.

		Intervention group (N=50)	Control group (N=50)	P-value*
Age (years)		63.8±4.6	64.2±3.8	0.635
Sex	Female	29 (58.0%)	31 (62.0%)	0.683
	Male	21 (42.0%)	19 (38.0%)	
Gallbladder polyps		18 (36.0%)	13 (26.0%)	0.280
Gallstones		32 (64.0%)	37 (74.0%)	0.280
Surgical bleeding volume (milliliters)		198.5±23.1	286.3±18.7	**<0.001**
Operative duration (minutes)		168.6±64.8	261.1±55.3	**<0.001**
Cut length (cm)		1.1±0.3	8.2±1.2	**<0.001**

Data are presented as mean ± standard deviation or number (%).
* Statistically significant P-values are bolded.

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Significant improvements in post-operative outcomes were noted in the Intervention group. Specifically, the duration of hospital stays (7.5±1.4 vs. 9.3±2.9 days, P-value < 0.001), first time out of bed (2.1±0.8 vs. 6.9±1.1 days, P-value <0.001), and gastric function recovery (2.2±0.6 vs. 3.5±1.3 days, P-value <0.001) were better in the Intervention group (table 2). The Intervention group had fewer complications. Abdominal infection was observed in 0 cases in the Intervention group compared to 4 cases (8%) in the Control group (P-value: 0.041). Incision infection rates were also lower (2% vs. 6%, P-value: 0.307) (table 2).

Table 2. Post-operative outcomes.

	Intervention group (N=50)	Control group (N=50)	P-value*
Complications			
Abdominal infection	0	4 (8.0%)	**0.041**
Infection of incisional wound	1 (2.0%)	3 (6.0%)	0.307
Frightened	0	3 (6.0%)	0.079
Rehabilitation indicators			
Hospital stays (days)	7.5±1.4	9.3±2.9	**<0.001**
First time out of bed (days)	2.1±0.8	6.9±1.1	**<0.001**
Recovery time of gastric function (days)	2.2±0.6	3.5±1.3	**<0.001**
Follow-up survival			
Six months	50 (100%)	50 (100%)	1.000
One year	49 (98.0%)	46 (92.0%)	0.169
Three years	42 (84.0%)	34 (68.0%)	0.061

Data are presented as mean ± standard deviation or number (%).
* Statistically significant P-values are bolded.

Long-term follow-up revealed trends in better survival rates in the Intervention group. Although the 6-month and 1-year survival rates did not differ significantly (P-value: 1.000 and P-value: 0.169, respectively), the 3-year survival showed a trend towards improvement in the Intervention group (84% vs 68%, P-value: 0.061) (table 2).

DISCUSSION

Our study demonstrates the clinical efficacy and safety of laparoscopic radical surgery and radiotherapy in the treatment of early-stage GBC. These findings are consistent with a meta-analysis that showed laparoscopic cholecystectomy (LC) to have significant short-term efficacy without compromising long-term survival when compared to open cholecystectomy (OC) [16]. The reduced surgical bleeding volume, shorter operative duration, and smaller incision length in our laparoscopic intervention group align well with the laparoscopic advantages over open surgery as reported in other malignancies [17, 18].

At present, the choice of surgical approach for GBC in our study, like in broader clinical practice, is primarily guided by the staging of the tumor [19]. However, our approach diverges from conventional wisdom in that we advocate for laparoscopic intervention even in cases where expanded radical resection might be considered. This is contrary to some opinions that laparoscopic surgery is not recommended for patients requiring extensive resection due to high surgical risks [20]. Our study suggests that with adequate preoperative imaging and planning, laparoscopic surgery can be both safe and effective, a sentiment echoed in other studies [16, 21].

One of the challenges in the management of GBC is the occurrence of unexpected complications during or after laparoscopic cholecystectomy [22]. Our study proposes that for early-stage GBC, a second surgery may not be necessary, which aligns with the lack of consensus on the timing and necessity of a second surgery in the literature [23, 24]. The risk of local adhesion and fibrosis post-surgery makes some surgeons prefer open methods for secondary surgeries. However, our findings suggest that laparoscopic methods can be equally effective, especially when guided by detailed preoperative imaging [21].

Our study is not without limitations. The sample size is relatively small, and the study is single-centered, which may limit the generalizability of the results. Furthermore, there is a lack of large-scale, high-quality, prospective studies on GBC resection procedures, as noted in the literature [25, 26]. Despite these limitations, our study contributes to the growing body of evidence supporting the use of laparoscopic radical cholecystectomy in the treatment of early-stage GBC. Future research should focus on multi-center trials and the incorporation of advanced imaging technologies like 3D reconstruction to further validate these findings.

CONCLUSION

Our study adds to the growing evidence that laparoscopic radical cholecystectomy is a viable option for the treatment of early-stage GBC, offering benefits in terms of reduced surgical trauma and quicker recovery without compromising long-term outcomes.

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