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Original Research Article

Comparative Analysis of Postoperative Hospital Stay and Clinical Outcomes in Laparoscopic versus Open Common Bile Duct Exploration for Choledocholithiasis

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Abstract:

Background: Choledocholithiasis is a frequent surgical ailment that, if left untreated, can result in major consequences such pancreatitis, hepatic abscess, and cholangitis. Laparoscopic common bile duct exploration (LCBDE) has become an option to traditional open exploration with the development of minimally invasive procedures, however there is still a lack of comparable data on results.

Aim: To evaluate the clinical results and length of hospital stay following laparoscopic and open common bile duct exploration in individuals with simple choledocholithiasis.

Method: Over the course of five months, prospective comparative observational research was Department of General Surgery, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India. There were 115 patients in all, 58 of whom had laparoscopic CBD exploration (Group 1) and 57 of whom had open CBD exploration (Group 2). Using the proper statistical tests, intraoperative parameters, postoperative complications, pain ratings, and hospital stay were examined.

Result: Laparoscopic exploration resulted in considerably less intraoperative blood loss (31.36 ± 28.72 ml vs. 62.05 ± 24.38 ml, $p<0.001$) but a longer operating time (127.73 ± 26.40 min vs. 115.68 ± 19.70 min, $p=0.006$). Group 1 saw a significant decrease in wound-related complications and postoperative discomfort. The laparoscopic group's mean hospital stay was substantially shorter (5.61 ± 1.88 days) than the open group's (8.73 ± 1.39 days, $p<0.001$). Only the open group experienced incisional hernias and residual stones.

Conclusion: This study shows that laparoscopic CBD exploration is a safe and efficient method for treating simple choledocholithiasis since it offers better clinical results, lower morbidity, and a shorter hospital stay than open exploration.

Keywords: Choledocholithiasis, Laparoscopic CBD exploration, Open CBD exploration, Postoperative outcomes, Hospital stay, Minimally invasive surgery.

Introduction

In the Western world, 3–15% of individuals with symptomatic cholelithiasis also have concurrent common bile duct (CBD) stones [1]. These stones are deemed clinically significant in only 2% of individuals [2]. In order to alleviate their symptoms and avoid major side effects such cholangitis, hepatic abscess, and severe pancreatitis, these individuals need CBD stone extraction [3].

Less invasive means of removing CBD stones have been made possible by advancements in preoperative imaging, endoscopic, and laparoscopic surgical procedures [4, 5]. Patients with suspected CBD stones were frequently sent for endoscopic retrograde cholangiopancreatography (ERCP) and sphincterotomy in the early days of laparoscopic cholecystectomy. This technique has the drawback of being a two-stage surgery with possible higher costs and morbidity, even if it is still a legitimate therapeutic choice [6].

Single-stage laparoscopic cholecystectomy and CBD exploration have grown in popularity as a result of greater laparoscopic experience. Laparoscopic transcystic exploration (LTCE), which reaches the CBD via the cystic duct, and laparoscopic choledochotomy (LCD), which explores the CBD directly by a choledochotomy, are

the two primary methods of laparoscopic common bile duct exploration (LCBDE) [7].

There have been several excellent comparisons between ERCP and LCBDE. Single-stage surgical therapy of gallstone disease is becoming more popular because to the trend of primary CBD closure and its lower morbidity [8] compared to the morbidity resulting from ERCP [9]. Comparing the two distinct LCDBE techniques, however, has received little attention. Success rate and safety can't be directly compared because statistics for both techniques are sometimes presented as mixed figures. Additionally, throughout the postoperative phase, patients receiving any of the methods get different care [10].

Bile duct stones or choledocholithiasis are still difficult to treat, even though laparoscopic cholecystectomy has supplanted open surgery for the treatment of gall bladder stones. Nearly every seventh to tenth patient with gall bladder stones has bile duct stones. The best way to treat gallstones in the common bile duct (CBD) is controversial, especially given the variety of methods available. Open cholecystectomy was the exclusive method for CBD exploration prior to the development of laparoscopic and endoscopic techniques [11].

However, the advent of laparoscopic cholecystectomy and its documented advantages—such as a smaller incision, less intraoperative blood loss, less postoperative pain, an early recovery, a shorter hospital stay, and improved cosmetic outcomes—have inspired the staff to take advantage of these advantages in CBD exploration as well. Concurrently, some researchers suggested endoscopic sphincterotomy (EST) and endoscopic retrograde cholangiopancreatography (ERCP) for the removal of bile duct stones; nevertheless, these procedures are criticised for their inability to provide positive results in every instance. Long-term recurrence of CBD stones may result from techniques such as EST that disrupt the integrity of the oddi sphincter, causing duodenal biliary reflux" [12].

Due to the conversion of duodenal biliary reflux into chronic cholangitis and persistent inflammatory processes, it may potentially raise the risk of cholangiocarcinoma. Despite being a recognised technique for investigating CBD, ERCP is associated with serious side effects such "pancreatitis, bleeding, and duodenal perforation." Because of their value and effectiveness for CBD exploration, the emphasis has turned mostly to laparoscopic or open operations [13].

However, despite their potential to reduce blood loss, minimally invasive methods such as laparoscopic exploration have their own dangers. Complications such as bile duct damage, bile leakage, haemorrhage, sub-hepatic access, and retained bile duct stones have been linked to laparoscopic exploration [14].

Cholecystectomy and CBD exploration are routinely performed using both open and laparoscopic techniques. In order to compare laparoscopic and open CBD exploration for intraoperative and postoperative complications as well as ductal stone removal, the current study was designed.

Methodology

Study Design: In order to assess postoperative hospital stays and clinical outcomes among patients receiving laparoscopic common bile duct exploration versus open common bile duct exploration for choledocholithiasis, the current investigation was organised as a hospital-based prospective comparative observational study.

Study Area: The study was carried out at Department of General Surgery, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India

Study Duration: The study was carried out over a period of 5 months.

Sample Size: A total of 115 patients fulfilling the eligibility criteria were included in the study. The patients were divided into two groups:

- Group 1: Patients who underwent laparoscopic CBD exploration — 58 patients
- Group 2: Patients who underwent open CBD exploration — 57 patients

Study Population: The study population included all adult patients diagnosed with uncomplicated choledocholithiasis and admitted for elective CBD exploration in the Department of General Surgery.

Inclusion Criteria

- Patients who are older than eighteen.
- Individuals with choledocholithiasis that is not complex.
- Patients scheduled for elective exploration of the common bile duct.
- Patients who are open to taking part in the research.
- Patients who gave their informed permission in writing.

Exclusion Criteria

- Acute cholangitis.
- Pancreatitis with gallstones.
- Abnormal liver enzymes that exceed the upper limit of normal by three times.
- Immunocompromised condition.
- General anaesthesia is not appropriate for these patients.
- Patients who decline to provide their permission.

- Individuals in need of urgent surgery.

Data collection: A pre-made organised proforma was used to gather the data. Age, sex, clinical history, presenting problems, general examination results, systemic examination results, and pertinent surgical data were all documented. Haematological and biochemical indicators including haemoglobin, total leukocyte count, differential leukocyte count, prothrombin time, INR, liver and renal function tests, random blood sugar, serum sodium, and serum potassium were among the pre-operative studies. CBD stones and stone size were evaluated radiologically using ultrasonography and/or MRCP where appropriate.

Study Procedure: Eligible patients were included in the trial and divided into two groups based on the type of surgery they underwent after giving their informed permission. those who had laparoscopic common bile duct exploration were in Group 1, and those who had open common bile duct exploration were in Group 2. As per institutional procedure, all patients had pre-operative evaluations and were given broad-spectrum antibiotics prior to surgery. Patients in the laparoscopic group were positioned supine and had the conventional four-port laparoscopic procedure. Depending on intraoperative feasibility, the CBD was examined laparoscopically, and stones were extracted utilising suitable techniques such saline irrigation, CBD milking, balloon extraction, Dormia basket, or choledochoscope-guided extraction.

Patients in the open group had choledocholithotomy along with traditional open cholecystectomy. Depending on the intraoperative results and the surgeon's judgement, the CBD incision was either closed largely or over a T-tube. Where necessary, a subhepatic drain was installed. Conventional open cholecystectomy with choledocholithotomy and closure, either mainly or over a T-tube with subhepatic drainage, was also covered in the base paper. The length of the procedure, blood loss, biliary leak, bile duct damage, organ damage, and intraoperative problems were all noted. During the hospital stay and during follow-up, post-operative results were evaluated. Clinical indicators of infection, wound dehiscence, visual analogue scale post-operative discomfort, length of hospital stay, residual stones, incisional hernia, and other problems were noted.

Statistical Analysis: SPSS version 21.0 or a comparable statistical program was used to analyse the data once it had been imported into Microsoft Excel. Qualitative factors were reported as frequency and percentage, whereas quantitative variables were expressed as mean ± standard deviation. When comparing categorical variables, the Chi-square test or Fisher's exact test were employed. The two groups' continuous variables were compared using the independent samples t-test. Statistical significance was defined as a p-value of less than 0.05.

Result

Table 1 shows the distribution of patients by group. 58 patients (50.4%) in Group 1 had laparoscopic common bile duct exploration, while 57 patients (49.6%) in Group 2 had open common bile duct exploration. Consequently, the patient distributions of the two groups were almost comparable, with a slight patient predominance in the laparoscopic group.

Table 1: Group-wise distribution of patients

SN	Group	Description	No. of patients	Percentage
1	Group 1	Patients with uncomplicated choledocholithiasis in whom CBD exploration was done using laparoscopic procedure	58	50.4
2	Group 2	Patients with uncomplicated choledocholithiasis in whom CBD exploration was done using open procedure	57	49.6
Total			**115**	**100**

Table 2 compares the age distribution of the two research groups. The majority of patients, 47 (40.9%) of the total research population, were between the ages of 31 and 40. The following age categories were 41–50 years old, which included 35 patients (30.4%), and ≤30 years old, which included 26 patients (22.6%). Three patients (2.6%) were older than 60, while only four patients (3.5%) were between the ages of 51 and 60. Group 1's average age was 38.94 ± 9.32 years, whereas Group 2's was 36.77 ± 7.85 years. The mean age was 37.81 ± 8.63 years. The absence of statistical significance in the age distribution difference between the two groups indicates that their ages were equal.

Table 2: Comparison of age of patients in two study groups							
SN	**Age Group**	**Group 1 No.**	**Group 1 %**	**Group 2 No.**	**Group 2 %**	**Total No.**	**Total %**
1	≤30 Years	13	22.4	13	22.8	26	22.6
2	31–40 Years	22	37.9	25	43.9	47	40.9
3	41–50 Years	17	29.3	18	31.6	35	30.4
4	51–60 Years	4	6.9	0	0	4	3.5
5	>60 Years	2	3.4	1	1.8	3	2.6
Total		**58**	**100**	**57**	**100**	**115**	**100**
Mean age ± SD Range in years		**38.94 ± 9.32**		**36.77 ± 7.85**		**37.81 ± 8.63**	

"Table 3 shows the distribution of patients by sex in both research groups. Women made up the majority of the study population. Of the 115 patients, 75 patients (65.2%) were female and 40 patients (34.8%) were male. Group 1 had 21 men (36.2%) and 37 women (63.8%), while Group 2 had 19 men (33.3%) and 38 women (66.7%). The sex distribution did not differ between the two groups in a way that was statistically significant.

Table 3: Distribution of patients in two study groups according to sex							
SN	**Sex**	**Group 1 No.**	**Group 1 %**	**Group 2 No.**	**Group 2 %**	**Total No.**	**Total %**
1	Male	21	36.2	19	33.3	40	34.8
2	Female	37	63.8	38	66.7	75	65.2
Total		**58**	**100**	**57**	**100**	**115**	**100**

In Table 4, the haematological profiles of the two study groups are compared. Group 1's mean haemoglobin level was 12.54 ± 1.08 g/dl, whereas Group 2's was 12.23 ± 1.26 g/dl. Group 1's mean total leukocyte count was 8.64 ± 2.14 thousand/cumm, whereas Group 2's was 8.36 ± 2.17 thousand/cumm. Neutrophils, lymphocytes, eosinophils, and monocytes were among the differential leukocyte counts that were similar across the two groups. Group 1 and Group 2 had mean prothrombin times of 12.12 ± 1.62 and 12.20 ± 1.47 seconds, respectively, and mean INRs of 0.70 ± 0.14 and 0.68 ± 0.11. There was no statistically significant difference in any of the haematological measures between the two groups, indicating that the baseline haematological state was similar".

Table 4: Comparison of hematological profile of patients in two study groups							
SN	**Characteristic**	**Group 1 Mean**	**Group 1 SD**	**Group 2 Mean**	**Group 2 SD**	**t**	**p**
1	Hb g/dl	12.54	1.08	12.23	1.26	1.415	0.16
2	TLC '000/cumm	8.64	2.14	8.36	2.17	0.697	0.487
3	N %	68.45	7.19	68.3	7.61	0.109	0.914
4	L %	26.45	7.51	27.32	7.69	-0.614	0.541
5	E %	4.23	1.79	3.95	1.82	0.832	0.407
6	M %	0.82	1.02	0.61	1.1	1.061	0.291
7	PT seconds	12.12	1.62	12.2	1.47	-0.277	0.782
8	INR	0.7	0.14	0.68	0.11	0.853	0.396

Table 5 compares the liver function tests, random blood sugar, renal function tests, and serum electrolytes of the two groups. Group 1's mean serum bilirubin was 0.70 ± 0.17 mg/dl, whereas Group 2's was 0.66 ± 0.17 mg/dl. Group 1's mean SGPT and SGOT levels were 31.47 ± 9.54 IU/L and 34.81 ± 9.39 IU/L, respectively, whereas Group 2's were 32.66 ± 9.98 IU/L and 32.52 ± 9.76 IU/L. The two groups' mean random blood sugar levels were nearly identical. Group 1's mean serum urea was 52.93 ± 16.96 mg/dl, whereas Group 2's was 46.75 ± 12.63 mg/dl. This difference was statistically significant (p = 0.029). Serum levels of potassium, sodium, and creatinine, however, did not differ statistically significantly between the two groups.

Table 5: Comparison of liver functions, random blood sugar and renal functions of patients in two study groups							
SN	**Characteristic**	**Group 1 Mean**	**Group 1 SD**	**Group 2 Mean**	**Group 2 SD**	**t**	**p**
1	S. Bilirubin mg/dl	0.7	0.17	0.66	0.17	1.262	0.21
2	SGPT IU/L	31.47	9.54	32.66	9.98	-0.653	0.515
3	SGOT IU/L	34.81	9.39	32.52	9.76	1.282	0.203
4	Random blood sugar mg/dl	155.54	12.06	155.86	10.58	-0.151	0.88
5	S. Urea mg/dl	52.93	16.96	46.75	12.63	2.219	0.029
6	S. Creatinine mg/dl	1	0.32	0.97	0.33	0.495	0.622
7	S. Na+ mEq/L	139.18	2.86	139.55	2.68	-0.716	0.475
8	S. K+ mEq/L	4.03	0.31	3.95	0.34	1.318	0.19

Table 6 illustrates the comparison of intraoperative parameters and stone size between the two study groups. There was no statistically significant difference between Group 1 and Group 2, with mean stone sizes of 7.66 ± 2.37 mm and 7.75 ± 2.08 mm, respectively. Group 1's mean operating time was 127.73 ± 26.40 minutes, whereas Group 2's was 115.68 ± 19.70 minutes. The laparoscopic group's mean surgical time was lengthier. There was a statistically significant difference (p = 0.006). Group 1 experienced a mean intraoperative blood loss of 31.36 ± 28.72 ml, which was significantly less than Group 2's 62.05 ± 24.38 ml. Despite a longer operating time, this difference was highly statistically significant (p <0.001), suggesting that laparoscopic CBD exploration was linked to decreased intraoperative blood loss".

Table 6: Comparison of stone size and intraoperative parameters of patients in two study groups							
SN	**Characteristic**	**Group 1 Mean**	**Group 1 SD**	**Group 2 Mean**	**Group 2 SD**	**t**	**p**
1	Stone size mm	7.66	2.37	7.75	2.08	-0.217	0.829
2	Duration of surgery min	127.73	26.4	115.68	19.7	2.777	0.006
3	Blood loss ml	31.36	28.72	62.05	24.38	-6.182	<0.001

"In Table 7, the postoperative outcomes of both study groups are compared on day 3, day 7, and day 14. On the third post-operative day, 9 patients (15.5%) in Group 1 and 13 patients (22.8%) in Group 2 had infections, although neither group had wound dehiscence. 15 patients (25.9%) in Group 1 and 51 patients (89.5%) in Group 2 had a pain level of VAS >3, indicating a statistically significant difference (p <0.001). Infection rates did not change on day seven, although four patients (7.0%) in Group 2 and none in Group 1 had wound dehiscence. Again demonstrating a significant difference, VAS >3 was found in 26 patients (45.6%) in Group 2 and 4 patients (6.9%) in Group 1. Nine patients (15.5%) in Group 1 and thirteen patients (22.8%) in Group 2 still had the infection on day 14. Only Group 2 had wound dehiscence, although 3 patients (5.2%) in Group 1 and 17 patients (29.8%) in Group 2 had VAS >2. These results imply that the open CBD exploration group experienced more wound-related problems and post-operative discomfort than the laparoscopic group.

Table 7: Comparison of post-operative outcomes of patients in two study groups							
Post-operative interval	**Characteristic**	**Group 1 No.**	**Group 1 %**	**Group 2 No.**	**Group 2 %**	**χ^2**	**p**
Day 3	Infection	9	15.5	13	22.8	0.987	0.32
Day 3	Wound dehiscence	0	0	0	0	—	—
Day 3	VAS >3	15	25.9	51	89.5	47.57	<0.001
Day 7	Infection	9	15.5	13	22.8	0.987	0.32
Day 7	Wound dehiscence	0	0	4	7	4.217	0.04
Day 7	VAS >3	4	6.9	26	45.6	22.35	<0.001
Day 14	Infection	9	15.5	13	22.8	0.987	0.32
Day 14	Wound dehiscence	0	0	4	7	4.217	0.04
Day 14	VAS >2	3	5.2	17	29.8	12.161	<0.001

The length of hospital stay and other results are compared between the two groups in Table 8. Group 1's average length of hospital stay was much shorter than Group 2's. The average hospital stay for patients receiving laparoscopic CBD exploration was 5.61 ± 1.88 days, while the average hospital stay

for patients undergoing open CBD exploration was 8.73 ± 1.39 days. There was a statistically significant difference (p <0.001). Three patients (5.3%) in Group 2 had residual stones, compared to none in Group 1. One patient (1.8%) in Group 2 experienced an incisional hernia, but no incisional hernia was observed in Group 1. Nevertheless, there was no statistically significant difference in the frequencies of incisional hernias and residual stones. When compared to open CBD exploration, laparoscopic CBD exploration was generally linked to a shorter hospital stay and fewer poor post-operative outcomes".

Table 8: Comparison of duration of hospital stay and other outcomes between patients in two study groups

SN	Characteristic	Group 1	Group 2	Statistical significance
1	Mean duration of hospital stay ± SD days	5.61 ± 1.88	8.73 ± 1.39	t = 10.131; p <0.001
2	Residual stone	0	3 5.3%	χ^2 = 3.134; p = 0.077
3	Incisional hernia	0	1 1.8%	χ^2 = 1.026; p = 0.311

Discussion

Because common bile duct stones can cause major consequences such cholangitis, hepatic abscess, and acute pancreatitis if left untreated, choledocholithiasis remains a significant surgical problem. According to earlier research, a considerable percentage of individuals with symptomatic cholelithiasis have common bile duct stones, and clinically significant retained stones need to be treated appropriately to avoid morbidity [1,2,3]. In this study, individuals with choledocholithiasis who had laparoscopic or open common bile duct exploration had their postoperative hospital stays and clinical results compared. There were 115 patients in all, 57 in the open group and 58 in the laparoscopic group.

The majority of patients in this research were younger or middle-aged, with the age range of 31 to 40 having the largest percentage. The average age was 37.81 ± 8.63 years. With 65.2% of cases, women made up the bulk of the study population. The recognised epidemiological trend of gallstone disease, which is more prevalent in women, is consistent with this female preponderance. Studies pertaining to CBD stones and gallstone disease have reported similar findings [9].

The two groups' baseline biochemical and haematological values were essentially similar. There was no discernible difference between the laparoscopic and open groups in haemoglobin, total leukocyte count, differential leukocyte count, prothrombin time, INR, liver function tests, random blood sugar, serum creatinine, and serum electrolytes. Because preoperative variations may affect surgical recovery and complication rates, this comparability is crucial. The laparoscopic group had considerably greater serum urea, but serum creatinine and electrolytes were similar, indicating that this little variation could not have had much clinical significance.

Both groups' mean stone sizes were comparable, suggesting a similar disease burden. The laparoscopic group's procedure took a lot longer. The technical difficulty of laparoscopic CBD exploration, the need for choledochoscopic support, cautious dissection, stone extraction, and intracorporeal closure might all be contributing factors. Laparoscopic CBD exploration was characterised by Salama et al. as a practical and successful method, although they stressed the significance of having sufficient laparoscopic knowledge and tools [6]. Similar to this, Petelin and Mayfield proposed laparoscopic CBD exploration as a crucial, but technically challenging, single-stage treatment alternative [5].

The laparoscopic group had far less intraoperative blood loss than the open group, even though the procedure took longer. This result validates laparoscopic surgery's minimally invasive benefit. Reduced tissue manipulation, enhanced vision, and smaller incisions all help to minimise blood loss and surgical stress. Laparoscopic methods are linked to better recovery and less postoperative discomfort than more invasive surgical techniques, according to Squirrell et al. [10]. In terms of postoperative recovery and morbidity, Shukla et al. similarly emphasised the benefits of laparoscopic surgery over open surgery [11].

At every follow-up period, the laparoscopic group experienced much less postoperative discomfort. In contrast to 89.5% of open patients, 25.9% of laparoscopic cases had VAS >3 on the third postoperative day. On days 7 and 14, comparable variations were noted. Smaller port-site incisions and minimal damage to the abdominal wall can account for less postoperative discomfort following laparoscopic surgery. This result is in line with other studies that shown improved postoperative comfort and quicker recuperation following laparoscopic surgeries.

The laparoscopic group also experienced fewer wound-related problems. Wound dehiscence was only seen in individuals having open CBD exploration, and infection was statistically greater in

the open group. The increased wound morbidity in open surgery might be explained by the wider incision, more tissue exposure, and increased tissue handling. According to Gould, as compared to open surgical treatments, minimally invasive techniques are often linked to less wound-related problems" [12].

The postoperative hospital stay was the study's most significant finding. Compared to the open group (8.73 ± 1.39 days), the laparoscopic group's mean hospital stay was much less (5.61 ± 1.88 days). Both statistically and clinically, this difference was substantial. Reduced discomfort, less blood loss, fewer wound problems, and quicker mobilisation may all contribute to shorter hospital stays following laparoscopic CBD exploration. In the current surgical period, Zhang et al. also endorsed the use of laparoscopic treatment for gallbladder stones with CBD stones [8].

Only the open group had residual stones and incisional hernias, although the differences were not statistically significant. The laparoscopic group did not report any incisional hernias or residual stones. This implies that when carried out by a skilled surgical team, laparoscopic CBD exploration can accomplish efficient ductal clearing while lowering incision-related morbidity. CBD exploration was also mentioned by Verbesey and Birkett as a crucial surgical strategy for choledocholithiasis, but current trends advocate less invasive methods wherever possible [9].

Overall, the results of this study indicate that laparoscopic CBD exploration offers superior postoperative results than open CBD exploration, although being linked to a longer operating time. Significantly less blood loss, less discomfort during surgery, fewer wound-related problems, and a shorter hospital stay were all linked to it. Therefore, if sufficient infrastructure, patient selection, and experience are available, laparoscopic CBD exploration may be a better surgical choice for appropriate individuals with choledocholithiasis. To confirm these results, larger multicentric investigations with longer follow-up are advised".

Conclusion

This study shows that in individuals with choledocholithiasis, laparoscopic common bile duct exploration has some benefits over open exploration. Laparoscopic operations were linked to much lower intraoperative blood loss, better postoperative pain scores, fewer wound-related problems, and a significantly shorter hospital stay, even though the surgery took longer. The mean hospital stay for patients receiving laparoscopic exploration was 5.61 ± 1.88 days as opposed to 8.73 ± 1.39 days in the open group, demonstrating the effectiveness of minimally invasive surgery in accelerating recovery. Further confirming the safety profile of laparoscopic exploration, residual stones and an incisional hernia were only seen in the open group, but not statistically significant. Overall, this comparison shows that laparoscopic CBD exploration is a safe, efficient, and patient-friendly substitute for open exploration when carried out by qualified surgeons using the proper tools. It has become the recommended method for treating simple choledocholithiasis because it improves recovery, reduces morbidity, and produces better clinical results.

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