



ORIGINAL ARTICLE

Predictive Factors for Drain Placement after Laparoscopic Cholecystectomy

Mohamed Abdallah Abozied, Mostafa Bayomi Mohamed, Ahmed Sabry Elsayed Ahmed*, Mohamed Adel Ahmed Saleh

Department of General Surgery, Faculty of Medicine, Zagazig University, Zagazig, Egypt

*Corresponding author:

Ahmed Sabry Elsayed
Ahmed

E-mail:

ahmedsabryme@gmail.com

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ABSTRACT

Background: The use of prophylactic drains after laparoscopic cholecystectomy (LC) remains controversial. Although drains have traditionally been employed to detect bleeding, bile leakage, or intra-abdominal collections, recent evidence questions their necessity and highlights potential disadvantages such as increased pain, infection, and delayed recovery. This study aimed to identify predictive factors associated with drain placement after LC and to evaluate their impact on postoperative outcomes.

Methods: This retrospective cross-sectional study, which involved 405 patients who had a laparoscopic cholecystectomy. Patients were divided into two groups; Group I (n = 88) had drains installed, whereas Group II (n=317) did not. Analysis was done on preoperative demographics, intraoperative factors, and postoperative results.

Results: The distribution of sexes did not significantly change between the groups, however patients in the drain group were considerably older ($p=0.03$) and had a higher BMI ($p=0.03$). Acute cholecystitis, longer operative time, technical difficulties, blood loss $>10\text{ml}$, and procedures performed by experienced surgeons were significantly associated with drain placement ($p<0.001$). Patients with drains had significantly longer operative duration (106vs. 58 minutes), prolonged hospital stay (3.5vs. 1.3 days), higher postoperative pain scores, and increased rates of intra-abdominal fluid collections, port-site hernia, and bile contamination compared to the non-drain group.

Conclusion: Drain placement after LC is not influenced by demographics but is strongly associated with intraoperative complexity. Drains were linked to worse postoperative outcomes, including longer hospitalization, higher pain, and greater morbidity. Routine use of drains is not recommended and should be reserved only for selected high-risk cases.

Keywords: Hospital stay; Predictive factors; Laparoscopic cholecystectomy; Drain placement

INTRODUCTION

In both elective and emergency situations, cholecystectomy has emerged as one of the most common surgical procedures carried out globally [1]. Since the development of minimally invasive surgery, laparoscopic procedures have quickly emerged as the industry standard, offering superior outcomes compared to the open technique. Laparoscopic cholecystectomy (LC) is linked to a quicker recovery period, less pain following surgery, and improved cosmetic results, thereby leading to earlier improvement in patients' quality of life [2,3].

Traditionally, prophylactic abdominal drainage has been employed after cholecystectomy to evacuate intra-abdominal collections and make it possible to identify postoperative issues like bleeding or bile leakage early. In tainted processes, such as LC for acute cholecystitis, drains were believed to reduce the risk of intra-abdominal infection by preventing fluid accumulation. However, mounting evidence suggests that routine drain placement may be unnecessary. Prophylactic drainage following LC does not lower postoperative complications and may slow down recovery, according to a new

meta-analysis [4]. Advances in surgical techniques, increased operator experience, and an aging patient population have further challenged the traditional role of drains in LC [5]. Drains are still used in certain situations even though there is mounting evidence that they should not be used frequently, especially in high-risk or elderly patients where intraoperative findings raise concerns [6]. Yet, their potential disadvantages, such as increased surgical site infection, prolonged hospital stay, and greater postoperative pain, cannot be overlooked [7]. Moreover, most available studies are limited by heterogeneous populations and inconsistent criteria for drain insertion [8].

These ambiguities emphasize the necessity of more precisely defining the predictive criteria for drain installation following LC, especially to pinpoint patient subgroups who can profit from its application. Our study's objectives were to determine the prognostic parameters for drain insertion following laparoscopic cholecystectomy and to assess their validity considering existing research focusing on early recovery and surgical complications.

METHODS

The General Surgery Unit at Zagazig University's Department of General Surgery, Faculty of Medicine, was the site of this retrospective cross-sectional study. All patients who had a laparoscopic cholecystectomy between February 2024 and February 2025 were included in the study. Based on hospital records, a thorough sample of 405 cases was enrolled. Depending on whether a postoperative drain was used, patients were divided into two groups: those who underwent laparoscopic cholecystectomy with drain insertion were in Group 1, and those who did not undergo the procedure were in Group 2. The study protocol was reviewed and approved by Zagazig University's Faculty of Medicine's Institutional Review Board and Research Ethical Committee (IRB# 119/25-Feb-2024). All participants provided their informed verbal and written consent after being fully approved of the study's objectives and procedures. Confidentiality and individual privacy were always maintained, and all data were handled anonymously in compliance

with institutional ethical standards. The 1964 Declaration of Helsinki and its later amendments, as well as the World Medical Association's Code of Ethics, were followed in the conduct of the study.

Patients who underwent a laparoscopic cholecystectomy during the study period and were at least 18 years old were eligible. The preoperative exclusion criteria were not complete intraoperative, or postoperative data; associated morbidities such as pancreatitis or malignancy; conversion to open surgery; and combined surgical procedures, such as laparoscopic cholecystectomy with hernia repair or additional interventions like intraoperative cholangiography.

Preoperative Assessment

A systematic procedure of clinical examination, investigations, and operational treatment was used to every patient that was part of the trial. Every patient had a thorough medical history that included personal information (name, age, sex, occupation, and residence), previous surgical procedures, and a history of medical comorbidities such as diabetes mellitus, hypertension, and bronchial asthma. The date of hospital admission was also recorded. A specially designed sheet was used to document all patient information in a uniform manner.

General examination was performed for all patients, including evaluation of cardiovascular, neurological, respiratory, blood pressure, and pulse, in addition to weight measurement. Local abdominal examination was carried out to detect any abdominal wall weakness or other abnormalities.

Preoperative investigations were performed in all patients. Laboratory tests included complete blood count, liver and kidney function tests, fasting blood sugar, coagulation profile, and blood grouping with Rh typing. Radiological imaging consisted of plain abdominal X-ray and ultrasound, with CT abdomen reserved for selected cases when indicated.

Operative Technique

General anesthesia was used for all surgical operations. The Hasson procedure with CO₂ insufflation was used to produce

pneumoperitoneum after infraumbilical incision. Following the infraumbilical insertion of the initial 10-mm trocar, two 5-mm and additional 10-mm trocars were positioned at the subxiphoid, subcostal midclavicular, and subcostal anterior axillary sites, respectively. A CO₂ flow rate of 2 L/min was used to maintain the pneumoperitoneum at a pressure of 10 mmHg. Using 10-mm clips, the cystic duct and artery were clipped and divided during a typical retrograde laparoscopic cholecystectomy (Figure 1A). The gallbladder was then completely dissected from its bed (Figure 1B). The epigastric port was used to remove the gallbladder (Figure 1C), and irrigation with suction of the gallbladder bed

was routinely performed to ensure adequate clearance of any bile or blood contamination (Figure 1D).

Drain placement was performed selectively according to the operating surgeon's decision at the end of the procedure. Patients in Group A had a tube drain (size 18) inserted (Figure 1E), while Group B underwent the procedure without drain placement. Operative parameters including duration of surgery (from infraumbilical skin incision to trocar removal), estimated intraoperative blood loss, amount of irrigation and suction, occurrence of bile spillage, and evidence of bile contamination or additional intraoperative complications were systematically recorded.

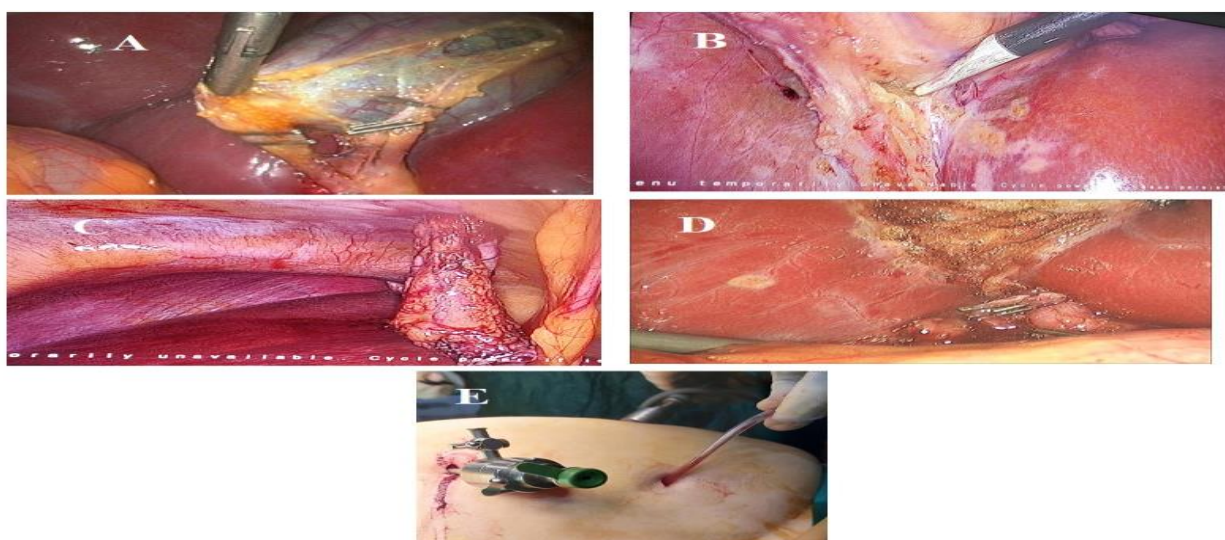


Figure (1): Laparoscopic cholecystectomy. **A)** Placement of clip at cystic artery and cystic duct. **B)** Complete Dissection of Bladder. **C)** The gall bladder is retrieved

through the epigastric port. **D)** Irrigation and suction of gallbladder bed. **E)** Drain placement in a case after laparoscopic cholecystectomy.

Post-operative Care

Postoperative management was standardized for all patients. Abdominal ultrasonography was performed only in cases where intra-abdominal collection was suspected, such as in patients presenting with persistent shoulder pain, fever, leukocytosis, or recurrent vomiting. Parenteral antibiotics were administered starting with induction of anesthesia and continued for the first two postoperative days. Routine wound care was provided, with particular attention to avoid the use of irritant adhesive tapes on the skin. Analgesics were given during the first

postoperative day, and patients were encouraged to ambulate early to minimize complications related to prolonged bed rest. In Group A, the quantity of drain output was monitored carefully. On the second postoperative day, if no adverse results were observed, the drain was regularly withdrawn. After a satisfactory clinical recovery, the patients were released, and on the seventh postoperative day, the sutures were taken out.

Follow-up

Patients were followed clinically during their hospital stay, with specific monitoring for pain, fever, wound condition, and quantity of

drain output in the drain group. Abdominal ultrasonography was selectively performed when postoperative complications were suspected. Outcomes including operative time, intraoperative blood loss, bile spillage, postoperative pain, surgical site infection, intra-abdominal collections, bile leakage, and length of hospital stay were recorded. Patients were discharged once stable and were re-evaluated at the outpatient clinic for stitch removal on the seventh postoperative day.

Statistical analysis

The recorded data was analyzed using the Statistical Package for Social Sciences (SPSS), version 23.0 (SPSS Inc., Chicago, IL, USA). Quantitative variables were shown as mean $\pm$ standard deviation (SD) and range, whereas qualitative variables were shown as frequencies and percentages. Using the independent-samples t-test, two means were compared. When the expected frequency in any given cell was less than five, Fisher's exact test was employed, and categorical data were compared using the Chi-square test. A 95% confidence range was employed, and a 5% allowed margin of error was established. Statistical significance was thus defined as a p-value of less than 0.05, and extreme significance as a p-value of less than 0.001. If a value exceeded 0.05, it was deemed statistically insignificant.

RESULTS

The study comprised 405 patients who had laparoscopic cholecystectomy; Group I consisted of 88 patients with drains, while Group II consisted of 317 individuals without drains.

Table 1 displays the demographic details of the two groups. The distribution of sexes in

Table (1): Demographic data of the studied groups

Variable		Group I (with drain) (n=88)		Group II (Without drain) (n=317)		MW	P
Age: (years)	Mean ± SD	49±17.86		43.67±18.55		2.19	0.03*
	Median	51.5		37			
	Range	19-72		19-80			
Variable		No	%	No	%	χ ²	P
Age:	≤64 years	60	68.2	237	74.8	1.53	0.22 NS
	>64 years	28	31.8	80	25.2		
Sex:	Male	40	45.5	158	50.2	0.53	0.47 NS
	Female	48	54.5	159	49.8		

the groups did not differ significantly. On the other hand, Group I patients were substantially older than Group II patients ($p=0.03$). Compared to Group II, the mean BMI of Group I patients were considerably higher (29.18 vs. 27.75 kg/m², $p=0.03$). Additionally, Group I patients were more likely to be obese (BMI ≥ 25 kg/m²) ($p=0.02$). The severity of disease and level of operating surgeon are shown in Table 2. Acute cholecystitis was significantly more common in Group I (50% vs. 20.2%, $p<0.001$). In addition, more experienced surgeons performed operations in Group I than in Group II ($p<0.001$).

Table 3 revealed that Group I had a statistically significant reduction in operation time, which was linked to a considerably longer operating time (mean 106 vs. 58 minutes, $p<0.001$). Additionally, intraoperative blood loss >10 ml, technical issues, and the requirement for an extra trocar were substantially more common in Group I than in Group II ($p<0.001$ for all).

Table 4 displays the postoperative results. Compared to Group II, patients in Group I experienced greater postoperative pain scores ($p<0.001$) and a noticeably longer hospital stay (mean 3.5 vs. 1.3 days, $p<0.001$).

Lastly, Table 5 provides specifics on postoperative problems. Group I patients experienced considerably more intra-abdominal fluid collections, port site hernias, and bile contamination than Group II patients ($p<0.001$). The rates of biliary leakage and wound complications did not significantly differ across groups.

Variable		Group I (with drain) (n=88)		Group II (Without drain) (n=317)		MW	P
						t	P
BMI: (Kg/m ²)	Mean ± SD Range	29.18±4.93 19-39		27.75±5.5 18-40		2.21	0.03*
Variable		No	%	No	%	χ^2	P
BMI:	<18.5	0	0	1	0.3	7.63	0.02*
	18.5-24.9	20	22.7	121	38.2		
	≥25	68	77.3	195	61.5		

SD: Standard deviation, MW: Mann Whitney test, χ^2 : Chi square test, t: Independent t test, NS: Non-significant (P>0.05), *: Significant (P<0.05).

Table (2): Severity and operator among the studied groups

Variable		Group I (with drain) (n=88)		Group II (Without drain) (n=317)		χ^2	P
		No	%	No	%		
Severity:	Cholelithiasis only With cholecystitis	44 44	50 50	253 64	79.8 20.2		
1 st operator:	Resident Experienced surgeon	44 44	50 50	257 60	81.1 18.9	34.85	<0.001**

χ^2 : Chi square test, **: Highly significant (P<0.001).

Table (3): Operation time & intraoperative complications among the studied groups

Variable		Group I (with drain) (n=88)		Group II (Without drain) (n=317)		t	P
Operation time: (min)	Mean ± Sd Range	106.18±27.36 45-140		57.68±16.52 30-100		20.85	<0.001**
Variable		No	%	No	%	χ^2	P
Technical difficulties:	No	20	22.7	177	55.8	30.22	<0.001**
	Yes	68	77.3	140	44.2		
Needed additional trocar:	No	84	95.6	317	100	14.55	<0.001**
	Yes	4	4.4	0	0		
Blood loss:	≤ 10 ml	28	31.8	201	63.4	27.97	<0.001**
	> 10 ml	60	68.2	116	36.6		

SD: Standard deviation, t: Independent t test, χ^2 : Chi square test, **: Highly significant (P<0.001).

Table (4): Postoperative data among the studied groups

Variable		Group I (with drain) (n=88)		Group II (Without drain) (n=317)		t	P
Hospital stay: (Day)	Mean ± Sd Range	3.5±0.59 2-4		1.31±0.46 1-2		36.80	<0.001**
Pain score:	Mean ± Sd Range	4.11±0.55 3-8		2.51±0.48 2-6		27.62	<0.001**

SD: Standard deviation, t: Independent t test, **: Highly significant (P<0.001).

Table (5): Post operative complications type among the studied groups

Variable	Group I (with drain) (n=88)		Group II (Without drain) (n=317)		χ^2	P
	No	%	No	%		
Intra-abdominal fluid collection	6	6.8	2	0.6	13.62	<0.001**
Bile leak	1	1.1	0	0	3.61	0.06 NS
Wound complication	11	12.5	25	7.9	1.81	0.18 NS
Port site hernia	6	6.8	3	0.9	10.93	<0.001**
Bile contamination	10	11.4	4	1.3	21.06	<0.001**

χ^2 : Chi square test, NS: Non-significant ($P>0.05$), **: highly significant ($P<0.001$).

DISCUSSION

In this study we found that the two groups were comparable in age with the Mean $\pm$ SD in each of drain group and non-drain group was 49 ± 17.86 compared to 43.67 ± 18.55 respectively, as there is no statistically significant difference between the groups with p-value ($p=0.03$).

Asif et al. [9], who discovered that the average age of patients in Group A was 49.02 ± 11.94 years, and the average age of patients in Group B was 48.07 ± 12.94 years, corroborated our findings.

Additionally, Sharma and Gupta [10] found that patients in group A (with drain) were 36.25 years old on average, while patients in group B (without drain) were 37.90 years old on average.

With a p-value of $p=0.47$, we demonstrated in this study that there was no statistically significant difference between the groups. In the drain group, there were 40 patients (45.5%) and 48 patients (54.5%) who were male and female, respectively, whereas in the non-drain group, there were 158 patients (50.2%) and 159 patients (49.8%) who were male and female, respectively.

Similarly, Dharamdev et al. [11] discovered that whereas 42% of the drain group's members were male and 58% were female, in the members in the drain group, 56% were women and 44% were men. A statistically significant difference did not exist.

Moreover, Asif et al. [9] discovered that there were 52 males (23.64%) in total, with 30 receiving treatments in Group A and 22 receiving treatment in Group B. Of the 168 female patients, 80 (76.36%) were treated in

Group A, and the remaining 88 were treated in Group B.

Additionally, Sharma and Gupta [10] discovered that the total male to female ratio was 1:3.7, with the ratios in groups A and B being 1:3.5 and 1:4, respectively.

The mean BMI for the Drain Group in this study is 29.18 ± 4.93 , whereas the non-Drain Group's is 27.75 ± 5.5 . A statistically significant difference between the groups is indicated by the p-value (0.03).

Our results were supported by Samer et al. [12] found that comparison between the studied groups regarding age, BMI and sex didn't reveal statistically significant differences.

Additionally, Ishikawa et al. [13] discovered that the age, sex ratio, and BMI of the patients in the drain and non-drain groups were similar.

In this study we cleared that there was highly statistically significant higher mean value of operative time in Drain group was 106.18 ± 27.36 than non-drain group was 57.68 ± 16.52 , with p-value ($p=0.001$).

Similarly, Sharma and Gupta, [10] found that the average operating time for group B was 48.66 minutes, whereas that of group A was 54.82 minutes. The difference of 6.16 minutes in the mean operational time between groups A and B was statistically significant ($p<0.05$).

Also, Sarkar et al. [14] discovered that the drain group's average operation time was 108 minutes, which was noticeably longer than the no-drain group's 88 minutes. Compared to the no drain group, there are more patients in the drain group whose surgeries take longer than 70 minutes.

Additionally, Samer et al. [12] discovered that the average operating duration for the drain group was 61.8 ± 11.8 minutes, whereas the non-drain group was 53.0 ± 11.8 minutes. When compared to the non-drain group, the drain group's operating time was longer. At $p=0.024$, the difference was statistically significant.

With a p -value of $p<0.001$, we demonstrated that the mean hospital stay for the Drain group was 3.5 ± 0.59 , substantially higher than the mean for the non-drain group, which was 1.31 ± 0.46 .

Our findings were corroborated by Cirocchi et al. [15], They found that the no drain group had significantly shorter operational hours (MD -8.13, 95% CI -13.87 to -2.38; $I^2 = 92\%$) and hospital stays (mean difference (MD) -0.49, 95% CI -0.89 to -0.09; $I^2 = 69\%$).

Furthermore, Sharma and Gupta [10] found that group A had a greater proportion of patients who were in the hospital for more than two days, compared to group B, which included 14 (46.66%) and 8 (26.66%) patients ($p<0.05$).

Similarly, Gurusamy et al. [16] have also noted notable variations in the length of hospital stays for individuals with drains.

Also, Samer et al. [12] found that the drain group had a mean hospital stay of 30.4 ± 4.3 hours, compared to 18.8 ± 3.8 hours for the non-drain group. The differences have a significant statistical significance ($p=0.0001$).

Ishikawa et al. [13] found that the postoperative hospital stay for the no-drain group was much shorter than that of the drain group.

According to this study, the drain group experienced a higher rate of the previously documented post-operative complications wound infection, intra-abdominal fluid collection, and bile leakage while the two groups showed statistically significant differences with a p -value ($p<0.001$).

Our findings are consistent with those of Gurusamy et al. [16], who found that using a drain is linked to higher rates of morbidity.

Also, Sharma and Gupta, [10] discovered that although Group A experienced postoperative problems more frequently, the differences were statistically significant.

In the study of Kim et al. [17] Patients who had drain insertions (94 patients, 48.7%, Group A) or did not (99 patients, 51.3%, Group B) were assigned at random. There were 18 cases (9.3%) of post-operative morbidities, such as bleeding, bile leakage, wound infection, or abscess, and there were notable differences between the two groups.

Also, Ishikawa et al. [13] discovered that the postoperative complication rate differed significantly between the drain group and the no-drain group.

The findings of the study "Factors influencing complications after laparoscopic cholecystectomy: A large cohort study" are consistent with our findings. [18] Key finding: The likelihood of issues and suffering multiple complications was statistically significantly higher in the drain group than in the non-drain group.

Additionally, Satinský et al. [19] Reports indicated that the groups with and without drains experienced significantly different levels of post-operative nausea and vomiting. This study also revealed that 20 patients in Group B (25%), and 26 patients in Group A (32.5%), had complaints.

It is believed that leftover carbon dioxide in the belly following a laparoscopy is the source of postoperative shoulder tip pain. Gas drains were shown to be beneficial by Jorgensen et al. [20] by reducing shoulder pain following surgery. Compared to the no-drain group, the drain group in their study had a decreased incidence of postoperative shoulder pain.

In this study, we showed that the drain group's mean pain score was 4.11 ± 0.55 compared to the non-drain group's 2.51 ± 0.48 ; this difference was highly statistically significant ($p<0.001$).

Yong and Guang found that the group without a drain experienced less discomfort 24 hours following surgery (MD1.31; 95% CI, 0.96 to 1.65; $p<0.00001$) [21].

Our findings were corroborated by Sharma and Gupta [10], they found that group A experienced pain that was more than two points higher on average on the VAS after 24 and 48 hours, and that this difference was statistically significant ($p<0.05$).

Also, Uchiyama et al. [22] discovered that the drain group's mean VAS ratings at 24 and 48 hours were noticeably higher.

Moreover, Tzovaras et al. [23] indicated that routine drain usage in elective LC is linked to greater pain and offers no benefits.

In addition, Samer et al. [12] discovered that the non-drain group's mean pain scores were 3.9 ± 1.6 , while the drain group was 5.8 ± 2.1 . There is a significant difference ($p=0.003$).

Similarly, group A had a considerably higher number of patients experiencing pain, according to Asif et al. [9]. Of the 184 individuals who had discomfort, Mild discomfort was experienced by 74, moderate pain by 71, and severe pain by 39. Furthermore, Group A was substantially more uncomfortable than Group B.

This study demonstrated that the likelihood of a drain is increased by having cholecystitis, having an experienced surgeon, having an operation lasting more than 60 minutes, having technical placement issues, and losing more than 10 milliliters of blood. It is important to recognize the limitations of this study. First, there is an inherent risk of selection and information bias due to its retrospective cross-sectional design. Second, only one tertiary center provided the data, which would restrict how broadly the results can be applied to other populations. Third, there may have been operator bias and variability because the operating surgeon chose the drain placement rather than using standardized criteria. Fourth, long-term outcomes like late complications or quality of life were not evaluated, and the follow-up duration was restricted to the early postoperative phase. Lastly, despite the use of statistical analysis, the observational character of the study made it impossible to completely control potential confounders.

CONCLUSION

This study identified the main factors that influence surgeons' decisions to install a drain after laparoscopic cholecystectomy. Significant correlations were found between drain insertion and the following factors: the presence of acute cholecystitis, management by an experienced surgeon, operating time exceeding 60 minutes, intraoperative technical difficulties, and blood loss

surpassing 10 ml. These results imply that intraoperative complexity, not patient demographics, is the primary factor influencing drain utilization. To clarify the function of drains in these high-risk individuals and to provide precise evidence-based recommendations for their use, more randomized prospective studies are needed.

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Availability of the data: Upon reasonable request, the associated author will make the datasets created and/or examined during the current work available.

Authors contribution: In addition to writing and getting the book ready for publication, the writers oversaw gathering and analyzing the data. The final version was examined and approved by all authors.

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