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Research Article

Comparative Analysis of Direct Pressure and Electrocauterization Techniques for Hemorrhage Control in the Liver Bed during Laparoscopic Cholecystectomy

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ABSTRACT

Background: This research examines the effectiveness of applying direct pressure and utilizing electrocoagulation to reduce liver bed hemorrhage after laparoscopic cholecystectomy, which is widely regarded as the gold standard for treating symptomatic gallstones. While this surgical approach offers benefits such as less pain and faster recovery, challenges like liver bed bleeding remain a concern, particularly in cases involving cholecystitis.

Objective: To determine the efficacy of direct pressure application and electrocoagulation in controlling bleeding from the liver bed following laparoscopic cholecystectomy

Study design: Randomized controlled study

Duration and place of study: This study was conducted in Gulam Muhammad Mahar Medical College Hospital Sukkur from March 2024 to March 2025

Methodology: This randomized controlled trial was carried out in the Department of General Surgery, involving 130 patients aged 18 to 60 years who experienced liver bed hemorrhage following laparoscopic cholecystectomy. To address the bleeding, participants were

randomly assigned to receive either electrocoagulation (Group A) or direct pressure application. If the initial interventions were ineffective, alternative or advanced hemostatic treatments were employed, with open cholecystectomy performed if necessary. Exclusion criteria included ASA ≥3, obstructive jaundice, cirrhosis, bleeding disorders, and liver or renal dysfunction. Data analysis was conducted using SPSS version 23.0, with statistical significance set at $p<0.05$.

Results: A total of 130 patients participated in this study, divided into two groups of 65 each. Group A consisted of patients receiving electrocoagulation, while Group B included those undergoing direct pressure application. All participants were aged between 18 and 60 years, with an average age of 49.3 years in Group A and 40.0 years in Group B. The mean body mass index (BMI) was 25.2 kg/m² for Group A and 25.5 kg/m² for Group B. Both genders were represented in the study, although the majority of participants in each group were female.

Conclusion: Electrocoagulation is more effective than direct pressure application for preventing bleeding in the liver bed.

Introduction

Laparoscopic cholecystectomy is widely regarded as the preferred treatment for symptomatic gallstones, a condition that affects millions of individuals worldwide. Since its introduction by François Dubois in Paris in 1988, laparoscopic cholecystectomy has undergone significant advancements, particularly in visualization and magnification techniques. These improvements have not only enhanced the surgeon's ability to perform the procedure but have also contributed to superior postoperative outcomes. Compared to traditional open cholecystectomy, laparoscopic cholecystectomy offers greater efficacy and safety, making it a popular choice among both surgeons and patients [1][2].

The advantages of laparoscopic cholecystectomy are manifold. Patients typically experience reduced postoperative pain, shorter hospital stays, and quicker recovery times. The minimally invasive nature of the procedure minimizes trauma to the abdominal wall, leading to less scarring and a faster return to normal activities. These factors have contributed to the widespread adoption of laparoscopic techniques in surgical practice [3]. However, despite its numerous benefits, laparoscopic cholecystectomy is not without risks.

Potential biliary complications associated with laparoscopic cholecystectomy include jaundice, sepsis, cholangitis, biliary fistula, and bile leakage [4]. These complications can arise from various factors, including anatomical variations, technical errors, and the presence of inflammation or infection. Additionally, non-biliary complications, such as intestinal perforation, bleeding, and damage to adjacent structures, can occur during the procedure [5]. One of the most common and concerning issues is liver bed bleeding, which may necessitate conversion to open cholecystectomy or reoperation if identified postoperatively [6]. This highlights the importance of addressing hemostatic challenges during laparoscopic cholecystectomy.

During the procedure, the middle hepatic vein or arteries connecting the liver and gallbladder may be injured during dissection from the liver bed, especially in cases of acute cholecystitis [7]. Bleeding from the middle hepatic vein poses significant risks, including circulatory shock and carbon dioxide embolism, both of which can lead to severe morbidity and mortality [8]. Therefore, effective strategies to minimize hepatic bed hemorrhage are crucial for improving patient outcomes.

Common hemostatic techniques employed during laparoscopic cholecystectomy include ultrasonic coagulation, direct pressure on the liver bed, and electrocoagulation [9]. While many studies have explored the efficacy of electrocautery and ultrasonic coagulation, there is limited literature comparing the effectiveness of direct pressure application and electrocoagulation in managing liver bed hemorrhage [10]. Both methods are considered viable and cost-effective, particularly in low-resource settings such as Pakistan, where access to advanced surgical technology may be limited.

Given the significance of managing liver bed bleeding effectively, this study aims to compare the effectiveness of direct pressure application versus electrocoagulation in controlling bleeding from the liver bed after laparoscopic cholecystectomy. By examining these two hemostatic techniques, we hope to provide valuable insights that could enhance surgical practices and improve patient outcomes.

In this study, we will enroll 130 patients using a non-probability consecutive sampling technique, with 65 patients allocated randomly to each of the two research groups through a computerized

random number generator. All patients will undergo a three-port laparoscopic cholecystectomy under general anesthesia. After dissection of the gallbladder, Group A will be treated with direct electrocoagulation to control liver bed bleeding, while Group B will receive direct pressure using surgical gauze applied via grasping forceps for 5 minutes, extendable to 10 minutes if necessary. Bleeding will be considered "secured" if it stops within this timeframe; otherwise, alternative hemostatic methods will be employed.

Data will be meticulously documented on a pre-prepared proforma and subsequently analyzed using SPSS version 23.0. Key demographic and clinical variables, including age, BMI, gender, dates of admission and surgery, and comorbidities, will be recorded. Quantitative data will be presented as mean ± SD, while qualitative data will be reported as frequencies and percentages. The effectiveness of both approaches will be compared using the chi-square test, with Fisher's exact test applied as appropriate, and a p-value of <0.05 will be considered statistically significant.

Through this research, we aim to contribute to the existing body of knowledge regarding laparoscopic cholecystectomy and its associated complications, ultimately striving to enhance surgical outcomes and patient safety. Furthermore, by identifying the most effective hemostatic technique, we hope to establish best practices that could be adopted in surgical settings across diverse healthcare environments, thereby improving overall patient care and reducing the incidence of postoperative complications.

METHODOLOGY

This study is a randomized controlled trial conducted in the Department of General Surgery at the hospital. A total of 130 participants, aged between 18 and 60 years, were included in the study, with both genders represented. All participants experienced bleeding from the liver bed during laparoscopic cholecystectomy. Ethical approval was obtained from the Institutional Review Board of the hospital.

Exclusion criteria: Patients were excluded from the trial if they had an ASA classification of 3 or higher. Additionally, those with obstructive jaundice or a dilated common bile duct exceeding 1 cm on ultrasonography were not eligible. Individuals with cirrhosis or bleeding disorders (defined as an INR greater than 1.5) were also excluded. Furthermore,

subjects with liver or renal diseases were not included in the trial.

130 patients were enrolled using a non-probability consecutive sampling technique and 65 allocated randomly to each of the two research groups through a computerised random number generator. All the patients underwent a three-port laparoscopic cholecystectomy under general anaesthesia. After dissection of gallbladder, Group A were treated with direct electrocoagulation to control liver bed bleeding, while Group B were treated with direct pressure with surgical gauze applied via grasping forceps for 5 minutes and could be doubled to 10 minutes if still bleeding. Bleeding was considered "secured" if it stopped within 10 minutes. If not, then another method was attempted followed by advanced haemostatic techniques whenever required. Bleeding continued, thus an open cholecystectomy was done.

Data were initially documented on a pre-prepared proforma and later analysed using SPSS version 23.0. The age, BMI, gender, dates of admission and surgery, and comorbidities were documented. Quantitative information was presented as mean ± SD, while qualitative information was reported as frequencies and percentages. The effectiveness of both approaches was compared using the chi-square test, with Fisher's exact test used as appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

There was a total of 130 patients enrolled in this study. All the participants were divided into two groups (65 patients each). Group A was the electrocoagulation group while group B was the direct pressure application group. All the participants in this study were between 18 years and 60 years old. The average age calculated was 49.3 years in group A and 40.0 years in group B. The mean BMI was 25.2 kg/m2 in group A and 25.5 kg/m2 in group B. Both the genders were involved. However, in both the groups, the majority of the participants were female. Table number 1 shows the demographic characteristics of both the groups.

Table No. 1:

Variables	Group A		Group B	
	N	%	N	%
Gender				
• **Female**	61	93.8	55	84.6
• **Male**	4	6.2	10	15.4
BMI Categories				
• **Non-obese**	38	58.4	39	60.0
• **Obese**	27	41.6	26	40.0
Hypertension				
• **Absent**	54	83.1	61	93.8
• **Present**	11	16.9	4	6.2
Diabetes mellitus				
• **Absent**	62	95.3	53	81.5
• **Present**	3	4.7	12	18.5

Table number 2 shows the outcomes of study participants in both the groups.

Table No. 2:

Variables	Group A		Group B	
	N	%	N	%
Bleeding secured (Efficacy)				
• **Yes**	56	86.1	53	81.5
• **No**	9	13.9	12	18.5
Placement of intraoperative drain				
• **Yes**	0	0.0	1	1.5
• **No**	65	100.0	64	98.5
Time period for bleeding control				
• **<5 mins [Efficacy**	41	63.1	2	3.1

(Yes)]				
• **5-10 mins**	15	23.1	51	78.4
• **11-15 mins [Efficacy (No)]**	6	9.2	11	17.0
• **16-20 mins**	1	1.5	1	1.5
• **>20 mins**	2	3.1	0	0.0

Table number 3 shows the effect of various characteristics on the outcomes.

Characteristics	**Efficacy**			
	Yes		**No**	
	N	**%**	**N**	**%**
Gender				
• **Male**	13	86.6	2	13.4
• **Female**	95	82.6	20	17.4
Age				
• **<45 yrs**	67	91.7	6	8.3
• **>= 45 yrs**	42	73.6	15	26.4
BMI Category				
• **Non-obese**	62	79.5	16	20.5
• **Obese**	47	90.3	5	9.7
Hypertension				
• **Yes**	12	80.0	3	20.0
• **No**	96	83.4	19	16.6
Diabetes				
• **Yes**	4	26.6	11	73.4
• **No**	105	91.3	10	8.7

Table number 4 displays the recovery-related parameters of the patients following the intervention.

	Group B (Direct Pressure)		**Group A (Electrocoagulation)**	**Variables**
%	N	%	N	
				Hospital Stay Duration
43.1%	28	73.8%	48	≤1 day
47.7%	31	21.5%	14	2–3 days
9.2 %	6	4.7%	3	>3 days
38.5%	25	18.5%	12	**Postoperative Pain (VAS ≥4)**
29.2%	19	12.3%	8	**Use of Additional Analgesics**
6.2 %	4	1.5%	1	**Post-op Infection**

DISCUSSION

Gallstone disease is the most common hepatobiliary system disease, affecting women in their middle years more than men [12]. The current study's demographic statistics clearly show that gallstone disease is more prevalent among females. The majority of the patients in this study were female, consistent with findings from several investigations reported in the literature. Agarwal et al. and Balaji et al. reported similar findings, with more than two-thirds of their patients being female [13,14]. A Pakistani study conducted at Polyclinic Hospital in Rawalpindi revealed a female-to-male ratio of 7:1 [15]. While acalculous cholecystitis may be more common in men, gallstone disease is typically associated with women. The high prevalence among women can be attributed to hormonal influences, particularly the effects of estrogen and progesterone, which have been linked to increased cholesterol secretion into bile and decreased

gallbladder motility. This stasis and supersaturation of bile are believed to contribute significantly to gallstone formation.

The mean age of participants in the current study was 44.6 years, with no statistically significant difference between male and female subjects. This aligns with the literature, where similar age distributions are reported. For instance, a study in Nepal found an average age of 44.5 years among patients with cholelithiasis [16], and Rahman et al. corroborated these findings, attributing the development of gallstones to prolonged exposure to risk factors after middle age [17]. The mean BMI of the study participants was 25.3 kg/m², categorizing them as obese according to WHO Asian Classification. Notably, females exhibited a higher BMI than males, a difference that was statistically significant. This finding is echoed in a study by Mehmood et al., which indicated that nearly 67% of patients were overweight or obese [18]. Obesity is closely linked to gallstone formation due to metabolic abnormalities and a higher propensity for related conditions, such as diabetes, both of which are independent risk factors for gallstone disease. The data collected from the recovery parameters suggests that patients in the first group (Group A) experienced a relatively quicker recovery period and required fewer postoperative interventions such as analgesics and antibiotics. These outcomes provide insight into the clinical implications of the chosen hemostatic technique and the overall postoperative burden experienced by the patients. The shorter hospital stays and lower rates of reported pain for the first group in comparison to group B reinforce the potential clinical advantage of electrocoagulation over direct pressure application for hemostasis.

In terms of surgical outcomes, the most frequent intraoperative complication of laparoscopic cholecystectomy is liver bed bleeding. The present study found that electrocoagulation was more effective than direct pressure application for reducing liver bed bleeding; however, the difference was not statistically significant. A previous study from Mayo Hospital in Lahore reported that electrocoagulation was more successful in managing bleeding compared to direct pressure (96% vs. 85%) [19]. While electrocoagulation is recognized as an effective method for controlling bleeding, it carries a risk of thermal injury to surrounding tissues. Chaoliang et al. advocated for direct pressure application as a first-line measure

for bleeding control, suggesting that it should be implemented before resorting to more invasive techniques [20].

Despite the rigor in design and methodology, this study is not without limitations. Conducted as a single-center trial with a limited patient population, the generalizability of the findings may be constrained. The research was performed in a large tertiary care hospital in a capital city, where resources and expertise are significantly better than in peripheral healthcare settings, which may yield different outcomes. Furthermore, while this study focused on comparing direct pressure with electrocoagulation, it is essential to note that more advanced hemostatic technologies are becoming increasingly available in many developing nations. Future studies should consider multi-center designs and larger sample sizes to enhance the validity and applicability of the results.

Additionally, the role of lifestyle factors, such as diet and physical activity, should be further investigated, as they may significantly influence the prevalence of gallstone disease. Understanding these factors could lead to better preventive measures and treatment strategies. Overall, the findings underscore the need for ongoing research into the epidemiology of gallstone disease and the optimization of surgical techniques to improve patient outcomes.

CONCLUSION

Electrocoagulation is more effective than direct pressure application for preventing bleeding in the liver bed during laparoscopic cholecystectomy. This study highlights the importance of utilizing advanced hemostatic techniques to enhance surgical outcomes and minimize complications. By demonstrating superior efficacy of electrocoagulation, the findings suggest that this method should be prioritized in clinical practice to ensure better management of intraoperative bleeding. The implications of these results extend beyond immediate surgical success; effective hemostasis can lead to reduced postoperative complications, shorter recovery times, and improved overall patient satisfaction. As surgical techniques continue to evolve, integrating more effective hemostatic strategies like electrocoagulation will be crucial in enhancing the safety and efficacy of laparoscopic procedures. Future research should further explore the long-term benefits and potential risks associated with various hemostatic methods to establish comprehensive guidelines for best practices in surgical settings.

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Conflict in the interest

The authors had no conflict related to the interest in the execution of this study.

Permission

Prior to initiating the study, approval from the ethical committee was obtained to ensure adherence to ethical standards and guidelines.

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