RESEARCH PAPER

A Randomized Control Study of Intracorporeal Knotting with Vicryl versus Titanium Clips for Ligating Cystic Duct in Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy has largely replaced open cholecystectomy due to reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes. Secure occlusion of the cystic duct is a critical step during the procedure. Titanium clips are widely used; however, complications such as clip slippage, migration, bile leakage, haemorrhage, and bile duct injury have been reported. Intracorporeal knotting using absorbable sutures (Vicryl) has emerged as a potential safe and costeffective alternative.

Aim: To compare intracorporeal knotting with Vicryl versus titanium clips for cystic duct ligation in laparoscopic cholecystectomy with respect to safety, feasibility, cost-effectiveness, and postoperative outcomes.

Methods: This prospective randomized controlled study included patients undergoing elective and emergency laparoscopic cholecystectomy. Participants were randomly allocated into two groups: intracorporeal knotting (Vicryl) group and titanium clip group. Intraoperative parameters (operative time, haemorrhage, technical difficulty) and postoperative outcomes (bile leak, bile duct injury, stricture, clip migration, pain score, hospital stay, and recovery time) were compared between the two groups.

Results: Both groups were comparable in baseline demographic characteristics, comorbidities, and disease profile. Intracorporeal knotting was associated with a significantly lower incidence of intraoperative haemorrhage and fewer postoperative complications such as bile leak, stricture formation, and clip migration. Postoperative pain scores, recovery time, and duration of hospital stay were significantly lower in the knotting group. No cases of common bile duct injury were observed in either group. However, operative duration and surgeon-assessed technical difficulty were significantly higher in the intracorporeal knotting group. In emergency laparoscopic cholecystectomy, complication rates were higher in the clip group compared to the knotting group.

Conclusion: Intracorporeal knotting with Vicryl is a safe, effective, and economical alternative to titanium clip application for cystic duct ligation in laparoscopic cholecystectomy. Although technically more demanding and associated with longer operative time, it reduces postoperative complications and enhances recovery, particularly in difficult and emergency cases. With adequate surgical expertise, this technique can be incorporated into routine laparoscopic practice to improve patient outcomes.

Keywords: Laparoscopic cholecystectomy, intracorporeal knotting, titanium clips, cystic duct ligation, bile leak, postoperative complications

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INTRODUCTION

Gallstone disease (cholelithiasis) is one of the most widespread hepatobiliary disorders worldwide and constitutes a significant cause of surgical admissions. Its increasing incidence has been attributed to changing dietary habits, sedentary lifestyles, rising obesity, and metabolic syndrome. Although many individuals with gallstones remain asymptomatic, a significant proportion develop complications such as acute or chronic cholecystitis, biliary colic, pancreatitis, and choledocholithiasis, necessitating definitive surgical intervention [1].

Since its first description by Philippe Mouret in 1987, laparoscopic cholecystectomy has become the gold standard treatment for symptomatic gallstone disease. The laparoscopic approach has become the preferred technique over open cholecystectomy because of its established benefits, such as decreased postoperative pain, shorter duration of hospitalization, faster resumption of routine activities, fewer wound-related complications, and superior cosmetic results [2]. Consequently, laparoscopic cholecystectomy is now one of the most commonly performed abdominal surgeries worldwide.

A crucial step in laparoscopic cholecystectomy is the meticulous dissection of Calot's triangle and secure

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ligation of the cystic duct and cystic artery. Effective closure of the cystic duct is essential to prevent postoperative complications such as bile leakage, biliary peritonitis, and injury to the common bile duct (CBD) [3]. Traditionally, cystic duct occlusion is achieved using titanium clips because of their ease of application, rapid deployment, and widespread availability. However, metallic clips are not devoid of complications. Documented issues qainclude clip slippage, dislodgement, migration into the biliary tree, bile duct strictures, and formation of calculi around migrated clips [4]. Additionally, the presence of a permanent foreign metallic body may contribute to long-term adverse outcomes in selected cases.

With advancements in laparoscopic skills and instrumentation, intracorporeal knotting using absorbable sutures such as polyglactin 910 (Vicryl) has emerged as an alternative method for cystic duct ligation. Intracorporeal suturing eliminates the use of permanent metallic implants and allows customized ligation, particularly in challenging scenarios such as wide cystic ducts, inflamed or edematous Calot's triangle, and emergency surgeries [5]. Moreover, in resource-limited settings, reliance on reusable sutures instead of disposable clip cartridges may offer significant cost advantages without compromising surgical safety [6].

Although both techniques are routinely employed in clinical practice, robust high-quality comparative data assessing their safety, operative efficiency, postoperative outcomes, and cost-effectiveness remain limited. Most available studies are observational in nature, and randomized controlled data comparing intracorporeal knotting with titanium clip application are scarce. Given the high volume of laparoscopic cholecystectomies performed globally, even small differences in complication rates or cost-effectiveness could have substantial clinical and economic impact.

Therefore, the present study aims to compare intracorporeal knotting using Vicryl sutures with conventional titanium clip application for cystic duct ligation in patients undergoing laparoscopic cholecystectomy. By systematically evaluating intraoperative parameters, postoperative complications, technical feasibility, and cost implications, this study aims to generate evidence-based insights to guide the optimization of surgical techniques and improving patient outcomes, particularly in high-volume and resource-constrained healthcare settings.

MATERIALS AND METHODS

Study Design, setting and population

This prospective, single-centre, parallel-arm randomized controlled trial was conducted in the Department of General Surgery at SRM Medical College Hospital & Research Centre, a tertiary care teaching hospital serving both urban and rural populations, over a period of 18 months encompassing patient recruitment, surgical intervention, postoperative follow-up, data analysis, and reporting. Adult patients (>18 years) undergoing elective or emergency laparoscopic cholecystectomy for cholelithiasis, acute or chronic cholecystitis (calculous or acalculous), gallbladder polyps, or intraoperatively identified frozen Calot's triangle were enrolled after obtaining written informed consent. Patients with common bile duct stones (choledocholithiasis), suspected or confirmed gallbladder malignancy, pregnancy, previous upper abdominal laparotomy, or unwillingness to participate were excluded. Ethical approval was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was secured from all participants, confidentiality of patient data was strictly maintained, and participants were informed of their right to withdraw from the study at any time without affecting their standard medical care.

Sample Size Calculation

The sample size was calculated based on the anticipated difference in complication rates between the two groups, assuming a confidence level of 95% ($\alpha = 0.05$) and a study power of 80% ($\beta = 0.2$), using the standard formula for comparison of two proportions:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [P_1(1-P_1) + P_2(1-P_2)]}{(P_1 - P_2)^2}$$

where P_1 represents the expected complication rate in the intracorporeal knotting group and P_2 represents the expected complication rate in the titanium clip group, while $Z_{\alpha/2}$ and Z_{β} denote the standard normal deviates corresponding to the selected significance level and statistical power. Based on this calculation, a total of 86 patients were needed, with 43 patients allocated to each group. Eligible participants were randomized using a computer-generated random number sequence, and allocation concealment was maintained through sequentially numbered, sealed opaque envelopes opened immediately prior to cystic duct ligation. Patients were assigned either to the study group, in which intracorporeal knotting using No. 1 Vicryl suture was performed, or to the control group, in which titanium clips were applied for cystic duct ligation.

Surgical Technique

All procedures were conducted under general anesthesia with the patient in the supine position. Pneumoperitoneum was established using the Veress needle technique, and a standard four-port laparoscopic approach was utilized in all cases. The gallbladder was retracted to expose Calot's triangle, and meticulous dissection was carried out to clearly identify the cystic duct and cystic artery. The critical view of safety (CVS) was achieved prior to ligation and division of these structures. In the control group, the cystic duct was secured using titanium clips, with two clips applied proximally and one distally, and the cystic artery was clipped in a similar fashion before division; both structures were then divided between the clips, and the gallbladder was dissected from the liver bed and

retrieved through the epigastric port. In the study group, the cystic duct was ligated using intracorporeal knotting with No. 1 Vicryl suture, with two secure knots placed—one near the common bile duct and another near the gallbladder—followed by division of the duct between the ligatures; the cystic artery was clipped and divided, and the gallbladder was dissected and retrieved in the same manner as in the control group. Port sites were closed using Ethilon sutures, and all excised specimens were routinely sent for histopathological examination.

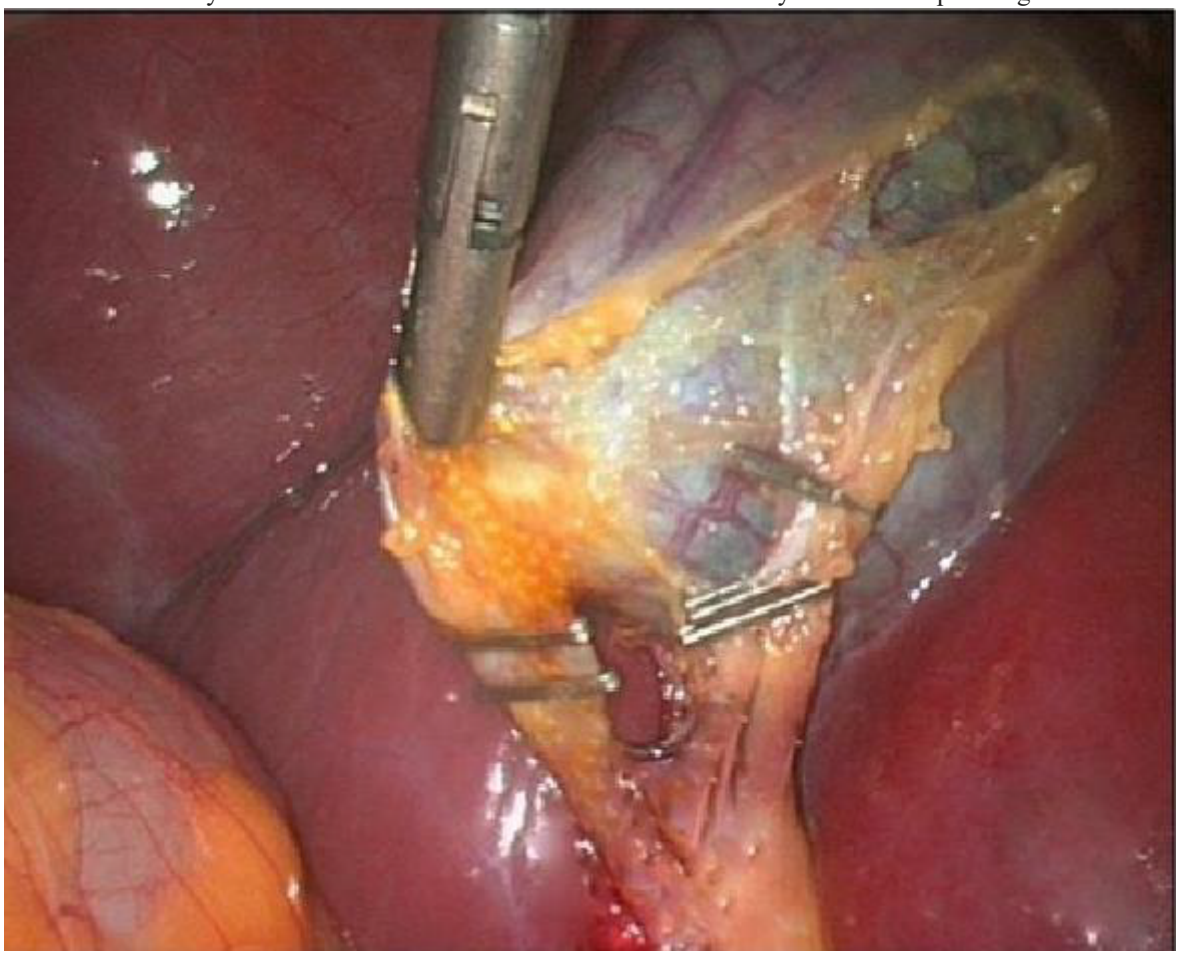

Figure: Cystic duct clipping

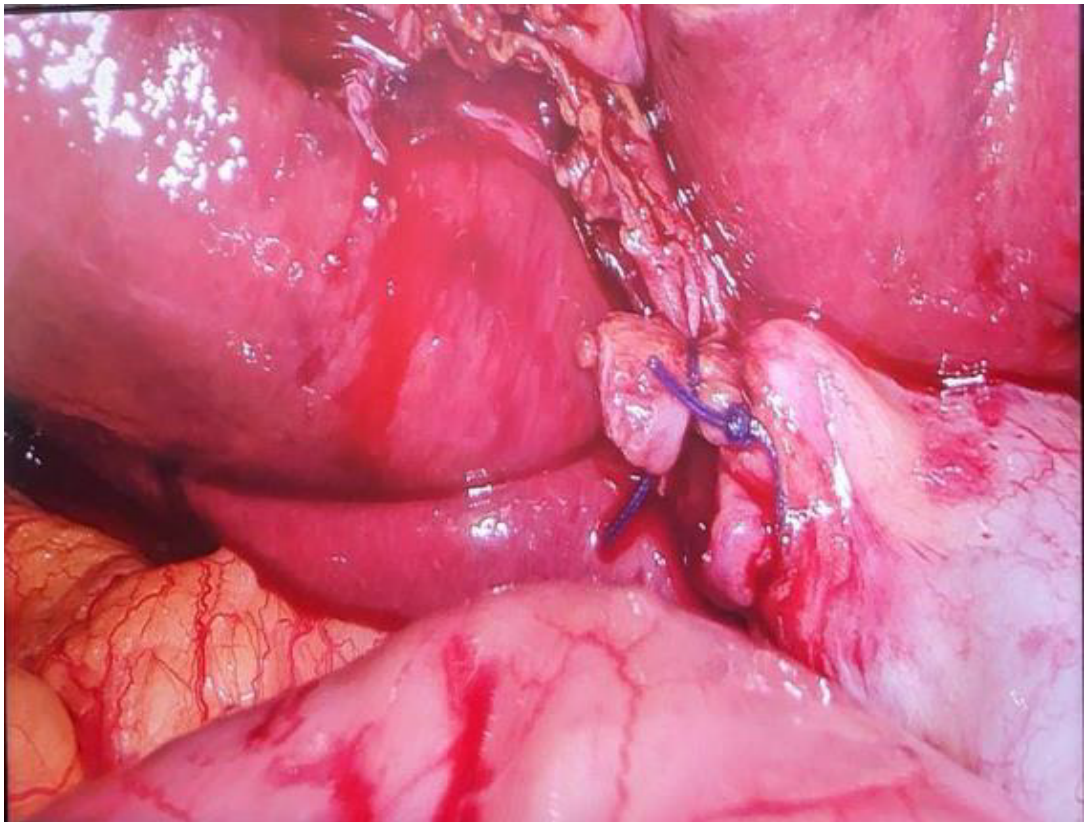

Figure: Cystic duct ligation

Outcome Measures

The primary outcome measures included the incidence of bile leakage, intraoperative hemorrhage, and postoperative complications such as clip or knot slippage, clip migration, and bile duct stricture. Secondary outcome measures comprised operative time (measured in minutes), postoperative pain assessed using the Visual Analogue Scale (VAS) on postoperative Day 1 and at the time of discharge, duration of postoperative hospital stay, and cost-effectiveness of the ligation technique. Additionally, patients were followed up with ultrasonography (USG) to assess common bile duct diameter and liver function tests (LFTs) at 1, 3, and 6 months postoperatively to evaluate late biliary complications.

Data Collection and Statistical Analysis

Data were collected using a structured proforma that recorded demographic details (age and sex), clinical diagnosis and indication for surgery, operative parameters including duration and intraoperative events, postoperative recovery variables, pain scores assessed using the Visual Analogue Scale (VAS), and follow-up findings such as ultrasonography (USG) results and liver function tests (LFTs). All collected data were anonymized and securely stored with restricted access to maintain patient confidentiality. Following data entry into Microsoft Excel, statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software. Continuous variables were summarized as mean ± standard deviation (SD) and compared using the independent t-test or Mann–Whitney U test based on the distribution of data. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test, as appropriate. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 86 patients were enrolled in the study and randomized equally into the study group (intracorporeal knotting, n = 43) and the control group (titanium clips, n = 43). All patients completed the intended follow-up period.

Baseline Characteristics

The mean age of patients in the study group was 49.26 ± 14.18 years, while in the control group it was 49.67 ± 14.18 years, with no statistically significant difference between the groups (p = 0.7146). The majority of patients in the study group were males (67.4%), whereas females constituted 46.5% of the control group. Most patients in both groups had no associated comorbidities (65.1% in the study group vs. 60.4% in the control group). Cholelithiasis was the most common indication for surgery (74.4% in the study group vs. 67.4% in the control group), followed by cholecystitis. Gallbladder polyps were recorded only in the control group (7.0%). The mean cystic duct diameter was comparable between the study and control groups (5.45 ± 1.41 mm vs. 5.56 ± 1.37 mm; p = 0.7146). Elective procedures constituted 88.4% of cases in both groups, while 11.6% were performed as emergency surgeries. No statistically significant differences were identified in the baseline

characteristics between the two groups.

Table 1: Baseline Characteristics of Study Population

Parameter	Study Group (n = 43)	Control Group (n = 43)	Statistical Test	p-value
Age (Mean ± SD, years)	49.26 ± 14.18	49.67 ± 14.18	t = 0.3669	0.7146
Age Distribution (years)			—	—
20–34	9 (20.9%)	4 (9.3%)		
35–49	14 (32.6%)	21 (48.8%)		
50–64	13 (30.2%)	7 (16.3%)		
65–79	7 (16.3%)	11 (25.6%)		
Gender			—	—
Male	29 (67.4%)	23 (53.5%)		
Female	14 (32.6%)	20 (46.5%)		
Comorbidities			—	—
None	28 (65.1%)	26 (60.4%)		
Hypertension	6 (14.0%)	4 (9.3%)		
HTN + DM	4 (9.3%)	5 (11.6%)		
CAD	2 (4.7%)	3 (7.0%)		
COPD / BA	2 (4.7%)	2 (4.7%)		
Diabetes Mellitus	1 (2.3%)	3 (7.0%)		
Diagnosis			—	—
Cholelithiasis	32 (74.4%)	29 (67.4%)		
Cholecystitis	11 (25.6%)	11 (25.6%)		
Gallbladder Polyp	0 (0%)	3 (7.0%)		
Cystic Duct Diameter (Mean ± SD, mm)	5.45 ± 1.41	5.56 ± 1.37	t = 0.3669	0.7146
Type of Surgery			—	—
Elective	38 (88.4%)	38 (88.4%)		
Emergency	5 (11.6%)	5 (11.6%)		

Intraoperative Outcomes

Intraoperative bile leak occurred in 1 patient (2.3%) in the study group compared to 7 patients (16.3%) in the control group, which was statistically significant (χ^2 = 13.47, p = 0.0012). Intraoperative hemorrhage was noted in 3 patients (7.0%) in the study group and 12 patients (27.9%) in the control group. Overall, 90.7% of patients in the study group had no intraoperative complications compared to 55.8% in the control group.

The mean total operative time was significantly longer in the study group (69.30 ± 7.18 minutes) compared to the control group (61.49 ± 4.08 minutes) (p < 0.001). However, the time required for cystic duct ligation was significantly shorter in the study group (7.02 ± 0.86 minutes) than in the control group (7.95 ± 0.79 minutes) (p < 0.001). No significant differences were observed in the duration of other operative steps.

Postoperative Outcomes

Postoperative bile leak was noted in 1 patient (2.3%) in the study group and 5 patients (11.6%) in the control group (p = 0.0494). Clip migration was observed in 2 patients (4.7%) in the study group compared to 8 patients (18.6%) in the control group. Bile duct stricture occurred in 1 patient (2.3%) in the study group and 3 patients (7.0%) in the control group. Intra-abdominal abscess was seen in 1 patient (2.3%) in both groups. Overall, 88.4% of patients in the study group experienced no postoperative complications compared to 60.5% in the control group.

Table 2: Intraoperative and Postoperative Outcomes

Outcome Parameter	Study Group (n = 43)	Control Group (n = 43)	Statistical Test	p-value
Intraoperative Complications				
None	39 (90.7%)	24 (55.8%)	-	-
Hemorrhage	3 (7.0%)	12 (27.9%)	-	-
Bile Leak	1 (2.3%)	7 (16.3%)	χ^2 = 13.47	0.0012*
Postoperative Complications				
None	38 (88.4%)	26 (60.5%)	-	-
Clip Migration	2 (4.7%)	8 (18.6%)	-	-
Bile Leak	1 (2.3%)	5 (11.6%)	χ^2 = 9.517	0.0494*
Stricture	1 (2.3%)	3 (7.0%)	-	-
Intra-abdominal Abscess	1 (2.3%)	1 (2.3%)	-	-
Operative Time (Mean ± SD, minutes)	69.30 ± 7.18	61.49 ± 4.08	t = –6.097	<0.001*
Cystic Duct Ligation Time (minutes)	7.02 ± 0.86	7.95 ± 0.79	t = 5.079	<0.001*
VAS Score (Mean ± SD)	2.67 ± 0.47	3.28 ± 0.45	t = 6.147	<0.0001*
Hospital Stay (Mean ± SD, days)	4.86 ± 1.54	5.93 ± 2.16	t = 2.631	0.010*

Postoperative pain scores assessed using the Visual Analogue Scale (VAS) were significantly lower in the study group (2.67 ± 0.47) compared to the control group (3.28 ± 0.45) ($p < 0.0001$). The mean duration of hospital stay was also significantly shorter in the study group (4.86 ± 1.54 days) than in the control group (5.93 ± 2.16 days) ($p = 0.010$).

Subgroup Analysis

Emergency cases demonstrated a higher incidence of intraoperative and postoperative complications in both groups; however, complication rates were notably higher in the control emergency subgroup compared to the study emergency subgroup. Overall, intracorporeal knotting using Vicryl sutures demonstrated significantly lower rates of bile leakage and postoperative complications, reduced postoperative pain scores, and shorter hospital stay compared to titanium clip application, although it was associated with a modest increase in total operative time.

DISCUSSION

This randomized controlled trial compared intracorporeal knotting using Vicryl sutures with titanium clip application for cystic duct ligation during laparoscopic cholecystectomy and demonstrated that suture ligation is a safe, feasible, and clinically advantageous alternative to metallic clips. The findings highlight significant reductions in intraoperative and postoperative complications, improved postoperative recovery, and reliable performance even in emergency settings.

Demographic Profile

The demographic profiles of patients in both groups were comparable, with a mean age of around 49 years and a similar distribution of diagnoses and comorbid conditions. Cholelithiasis constituted the majority of cases, followed by cholecystitis, reflecting the typical epidemiological pattern of gallstone disease described in global studies. The homogeneity of baseline variables ensured that postoperative outcomes were not influenced by demographic or clinical confounders. Comparable demographic balancing has also been emphasized in earlier trials by Ramandeep et al. [7], Pathak et al. [8], and Madany et al. [9], reinforcing that age and comorbidity distribution do not significantly alter the comparative evaluation of cystic duct closure techniques.

Surgical Characteristics

The mean cystic duct diameter was comparable between groups, and the proportion of elective and emergency procedures was identical, confirming that anatomical complexity and surgical context were evenly distributed. This well-balanced study design enhances the internal validity of the findings. Earlier studies have likewise emphasized the significance of comparable duct size and operative conditions when evaluating different ligation techniques. Notably, studies evaluating wide or inflamed cystic ducts have reported that suture ligation remains reliable even in ducts up to 18 mm, highlighting its adaptability [10]. The present findings reinforce that intracorporeal knotting can be safely applied across varied anatomical and clinical scenarios without increased technical failure.

Intraoperative Outcomes

A key finding of this study was the significantly lower rate of intraoperative bile leak in the intracorporeal knotting group (2.3%) compared to the clip group (16.3%), along with a lower incidence of intraoperative hemorrhage. These results suggest that suture ligation provides a more secure seal and better hemostatic control. Metallic clips, though convenient, may be prone to slippage, particularly in edematous or inflamed ducts. Similar observations have been reported in previous comparative studies, where clip-related bile leakage and slippage were documented more frequently than suture-related complications [11]. The adaptability of absorbable sutures allows circumferential tightening around the duct, potentially explaining the superior intraoperative security observed in this trial.

Postoperative Outcomes

Postoperative morbidity was also significantly reduced in the knotting group. Rates of bile leak, clip migration, and ductal stricture were lower compared to the titanium clip group. Importantly, clip migration—a complication inherently related to the presence of metallic implants—was more common in the control arm. The elimination of permanent foreign material in the knotting technique likely contributes to reduced inflammatory reaction and long-term sequelae. Prior literature similarly reports lower postoperative complication rates with suture ligation, especially concerning clip migration and secondary stone formation [12]. The present findings therefore align with growing evidence supporting absorbable ligation methods as a safer long-term alternative.

Operative Time and Technical Feasibility

The total operative time was significantly longer in the intracorporeal knotting group. This increase is attributable to the additional precision and skill required for laparoscopic suturing. However, the time required specifically for cystic duct closure was not clinically prohibitive, and no increase in technical failure or conversion was observed. Several previous studies have demonstrated that operative duration decreases with increasing surgical expertise, and in experienced hands, suturing can be performed efficiently. Thus, while titanium clips offer procedural speed, the modest increase in operative time with knotting appears justified by the substantial reduction in complication rates.

Postoperative Recovery and Patient Comfort

Patients in the intracorporeal knotting group experienced significantly lower postoperative pain scores and shorter hospital stays. The absence of

metallic foreign bodies may reduce localized tissue irritation and postoperative inflammatory response, contributing to improved recovery. Earlier reports have similarly documented favorable postoperative comfort and early discharge with suture ligation. These recovery advantages have important implications for patient satisfaction, early mobilization, and overall healthcare efficiency.

Emergency vs Elective Surgery

Complication rates were higher in emergency cases across both groups; however, the increase was markedly greater in the titanium clip group. Emergency cholecystectomy often involves inflamed, friable tissues and distorted anatomy, increasing the likelihood of clip slippage or incomplete sealing. In contrast, intracorporeal suturing provides a customizable and secure closure even under adverse conditions. This finding underscores the particular value of suture ligation in complex or inflamed cases, where technical precision becomes critical.

Clinical Implications

The cumulative findings of this study indicate that intracorporeal Vicryl knotting offers superior ductal security, fewer intraoperative and postoperative complications, improved recovery parameters, and reliable performance in both elective and emergency scenarios. Although the technique demands laparoscopic suturing proficiency and slightly increases operative time, the safety benefits and potential cost advantages make it an attractive alternative, particularly in high-volume and resource-limited settings.

Limitations

This study was carried out at a single tertiary care center with a relatively small sample size, which may restrict the generalizability of the findings. Additionally, the follow-up period was limited to six months and did not assess long-term complications, such as delayed strictures or suture-related granuloma formation. Additionally, surgeon expertise may have influenced operative efficiency and complication rates despite standardized operative protocols. Larger multicentric trials with extended follow-up are warranted to validate these findings further.

Conclusion

In summary, intracorporeal knotting using Vicryl sutures is a safe, effective, and economically favorable alternative to titanium clip application for cystic duct ligation during laparoscopic cholecystectomy. It significantly reduces intraoperative and postoperative complications, enhances postoperative recovery, and remains reliable even in emergency and anatomically challenging cases. With increasing laparoscopic proficiency, intracorporeal suturing has the potential to become a preferred technique for secure cystic duct closure in contemporary gallbladder surgery.

References

[1] X. Wang et al., Global Epidemiology of Gallstones in the 21st Century: A Systematic Review and Meta-Analysis, Clinical Gastroenterology and Hepatology 22, 1586 (2024).

[2] C. Gutt, S. Schläfer, and F. Lammert, The Treatment of Gallstone Disease, Dtsch Arztebl Int 117, 148 (2020).

[3] P. Cianci and E. Restini, Management of cholelithiasis with choledocholithiasis: Endoscopic and surgical approaches, World J Gastroenterol 27, 4536 (2021).

[4] T. M. Manzia et al., Global management of a common, underrated surgical task during the COVID-19 pandemic: Gallstone disease - An international survery, Annals of Medicine and Surgery 57, 95 (2020).

[5] A. H. van Dijk, S. van Roessel, P. R. de Reuver, D. Boerma, M. A. Boermeester, and S. C. Donkervoort, Systematic review of cystic duct closure techniques in relation to prevention of bile duct leakage after laparoscopic cholecystectomy, World J Gastrointest Surg 10, 57 (2018).

[6] S. S. Kang, W. Irvin, J. R. Perez-Sanz, and H. P. Greisler, Suture Techniques and Selection, Wound Closure Biomaterials and Devices 289 (2018).

[7] V. Goyal, Comparison of laparoscopic suture ligation vs ligaclips of cystic duct in laparoscopic cholecystectomy–A prospective study, (n.d.).

[8] S. Pathak, P. Lavania, and S. Tiwari, To compare knot vs clip for ligation of cystic duct in laparoscopic cholecystectomy, Journal of Contemporary Clinical Practice 11, 392 (2025).

[9] M. El-Din, M. Madany, M. M. Kabbash, H. A. Mostafa, A. M. Maghraby, and M. S. Ahmed, Safety and feasibility of cystic duct control with suture ligation during laparoscopic cholecystectomy, The Egyptian Journal of Surgery 43, 579 (2024).

[10] M. E. Seifalyazal, S. S. Mohamed, and A. Elnabil-Mortada, Evaluation of Clipless Laparoscopic Cholecystectomy with the Aid of Extracorporeal Mishra's Knot, Ain Shams Journal of Surgery 16, 138 (2023).

[11] S. D. Muhammad, M. S. Faisal, N. Salamat, and M. R. Saeed, SAFETY OF EXTRACORPOREAL KNOT LIGATION OF WIDE CYSTIC DUCT IN LAPAROSCOPIC CHOLECYSTECTOMY AT A THQ HOSPITAL, Rehman Journal of Health Sciences 6, 44 (2024).

[12] M. H. Raza, B. Ahmad, U. Tajammal, M. H. Saeed, M. Aslam, S. Ehsan, and M. A. Raza, Comparative Study of Stump Closure with Knot Tying Suture Versus Metallic Endoclip in Laparoscopic Appendectomy in Uncomplicated Acute Appendicitis in Terms of Organ Injury and Intraoperative Time Taken, Indus Journal of Bioscience Research 3, 460 (2025).