

Comparison of Flush Clipping / Ligation Versus High Clipping / Ligation of Cystic Duct in Laproscopic Cholecystectomy

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Abstract: Introduction: Laparoscopic cholecystectomy (LC) has become the gold standard for treating symptomatic cholelithiasis. The optimal site for cystic duct ligation is critical to prevent postoperative complications like bile leaks or "remnant cystic duct" syndrome. High ligation leaves a longer cystic duct stump >0.5 cm, while flush ligation aims for a minimal remnant. Flush clipping of the cystic duct in laparoscopic cholecystectomy (LC) refers to the precise application of surgical clips close at the junction of the cystic duct and the common bile duct (CBD) with cystic duct stump <0.5 cm. Aim: To Compare the Flush clipping/ ligation of cystic duct versus High clipping/ligation in laproscopic cholecystectomy in terms of outcome. Methods: This hospital-based retrospective comparative study was based on 30 cases of Laproscopic cholecystectomy done for various causes conducted over a period of 2.5 years from 2024 to 2026. A total of 30 patients undergoing LC were randomized into two groups Group A (flush clipping/ligation) and Group B (High clipping/ligation). The outcomes are measured for intraoperative and postoperative complications like infection, bleeding, post cholecystectomy syndrome, bile duct injury, bile leak, residual CBD stones/sludge, clip migration, retained gall bladder, chronic inflammation, cystic duct carcinoma and mortality. Out of the 30 cases, flush clipping is done in 23 cases and High clipping is done in 7 cases with severe inflammation, not able to achieve critical view of safety. 2 cases of bleeding is encountered in flush clipping group, 3 cases of bleeding, 1 case of clip migration & bile leak, 3 cases of post cholecystectomy syndrome, 2 cases of residual stone/sludge, 1 case of retained gall bladder, 1 case of chronic inflammation in high clipping group. There is no case of bile duct injury, cystic duct carcinoma and mortality in both groups. Results: In this comparative study there is no statistical difference between the two groups in terms of bile leak, bile duct injury, retained gall bladder, clip migration, chronic inflammation, cystic duct carcinoma. There is significant association between post cholecystectomy syndrome, residual bile stones/sludge and High clipping group, suggesting more incidence in high clipping group compared to flush clipping group. Conclusion: This study suggests that flush clipping/ligation of cystic duct in laproscopic cholecystectomy is more effective than high clipping/ligation in prevention of complications like post cholecystectomy syndrome, residual stones/sludge in CBD. Hence flush clipping/ligation should be performed whenever possible and able to achieve the critical view of safety.

Abbreviations: LC (Laparoscopic Cholecystectomy), CBD – Common bile duct

1. Introduction

Laparoscopic cholecystectomy (LC) is the minimally invasive surgical removal of the gallbladder. It is the gold standard treatment for gallstone disease, a common condition that affects around 10-15% of adults in Western countries [1]. This high frequency is due to gallstones' prevalence, often requiring surgical intervention when symptomatic, or when complications like cholecystitis, biliary colic, or pancreatitis arise. Flush clipping/ligation is the application of clip or ligation close to the cystic duct and common bile duct junction. High ligation/clipping is done away from the cystic duct CBD junction leaving a cystic duct stump of at least 0.5 cm. While laparoscopic cholecystectomy is generally considered safe, it is associated with several complications. The most significant are bile leakage, bile duct injury (BDI), retained/recurrent stones, residual gall bladder, post cholecystectomy syndrome, clip migration, chronic inflammation and carcinoma of cystic duct stump, bleeding, infection, and, in rare cases, mortality. The incidence of BDI is estimated at 0.3-0.6% of cases, a higher rate than in traditional open cholecystectomy. While most patients recover uneventfully, around 1-2% experience significant postoperative complications, some of which require additional surgeries or hospitalizations. Flush ligation/clipping after proper dissection helps in minimizing the complications compared to high ligation. This study aims to show the

effectiveness of flush ligation of cystic duct in reducing these complications.

2. Materials and Methods

This study is based on the retrospective analysis of 30 cases of laproscopic cholecystectomy done over a period of 2 years from 2024-2026 for multiple causes consisting of Gall stones, Calculus and Acalculis cholecystitis, symptomatic cholelithiasis, Gall bladder perforation, Empyema of gall bladder, gangrenous cholecystitis, gall bladder polyp and Adenomyomatosis. In all the cases careful dissection of the calot's triangle to obtain the CRITICAL VIEW OF SAFETY and flush ligation/clipping of cystic duct was done if critical view is obtained and less inflammation and High ligation of cystic duct is done if critical view is not obtained/there is heavy inflammation. Fischer test is used for analyzing the above complications between the two groups and obtaining the p value and odd's ratio for knowing the significance

3. Background and Data

In this study a total of 30 cases of laproscopic cholecystectomy is done over a period of two and half years from 2024 to 2026. out of 30 cases 15 cases are for gall stone disease single stone measuring > 1.5 cm. multiple stones with or without symptoms, 2 cases of Acalculis cholecystitis, 3 cases of Calculus cholecystitis based on image findings, 3

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cases of symptomatic cholelithiasis with stones less than 1.5 cm and symptoms like dyspepsia, right upper quadrant pain, colic, 1 case of gall bladder perforation, 2 cases of Empyema gall bladder, 1 case of gangrenous cholecystitis, 2 cases of gall bladder polyp and 1 case of Adenomyomatosis. All cases are evaluated preoperatively with all routine blood investigation, lipid profile, respiratory and cardiac fitness,

Magnetic resonance cholangiography to rule out bile duct involvement. Upper gastrointestinal endoscopy is done in all cases before laproscopic cholecystectomy except 1 case of gangrenous cholecystitis which is done postoperatively. All 30 cases underwent laproscopic cholecystectomy after careful dissection of calot's triangle to obtain the critical view of safety starting the dissection above the Rouvier's sulcus.



Figure 1: Critical View of Safety showing only cystic duct and cystic artery entering the Gall bladder

After obtaining the critical view of safety flush clipping of the cystic duct was performed on 21 cases, flush ligation of the cystic duct was done using 2-0 vicryl sutures for thin cystic duct. In flush ligation /clipping cases the stump length was less than 0.5cm.

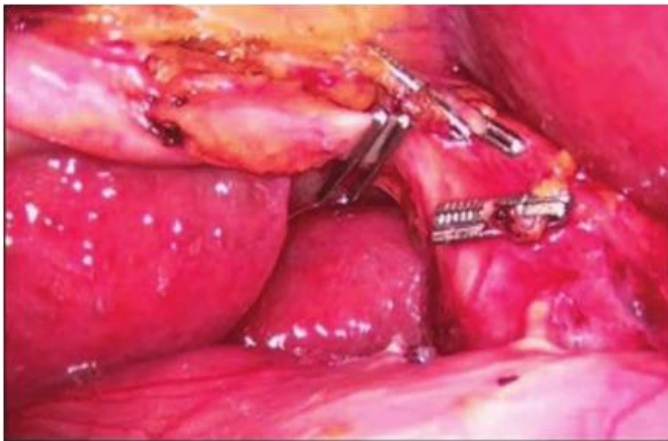


Figure 2.1 and 2.2: Showing flush clipping of cystic duct with stump less than 0.5 cm



Figure 3: Showing flush ligation of cystic duct with 2-0 vicryl sutures

High ligation of cystic duct was carried out in 7 cases, 3 cases of cholecystitis 1 case of gall bladder perforation, 1 case of Empyema, 1 case of gangrenous gallbladder and 1 case with features of chronic cholecystitis. In all cases the cystic duct ligation was done after milking the cystic duct and partial opening of the cystic duct in case of wide cystic duct. All the 30 cases were given antibiotics postoperatively depending of the level of infection, abscess and gangrenous changes.



Figure 4: Showing the high ligation of cystic duct with stump more than 0.5cm

All the 30 cases are evaluated for the postoperative complications of bile leakage, bile duct injury (BDI), retained/residual stones, residual gall bladder, post cholecystectomy syndrome, clip migration, chronic inflammation and carcinoma of cystic duct stump, bleeding, infection. In all the 30 cases there is no mortality and both groups are compared using Fischer test for calculating the p value and odd's ratio.

Out of 23 cases of flush ligation/clipping no cases of bile leakage, bile duct injury, post cholecystectomy syndrome, carcinoma of cystic duct, residual stones or infections. 2 cases had bleeding during surgery which is managed intraoperatively or conservatively using gel foam.

Of the 7 cases of High ligation of cystic duct, there is 1 case of Bile leakage from cystic duct stump with migration of clip which is managed by ultrasound guided drainage, 3 cases of post cholecystectomy syndrome managed conservatively and ERCP, 2 cases residual stones / sludge formation in common bile duct/ stump managed by ERCP clearance and stenting, 1 case of residual gall bladder in a case of gangrenous cholecystitis managed conservatively, 1 case of chronic inflammation and 3 cases of intraoperative bleeding managed by drain and Gel foam. There are no cases of Bile duct injury, infection and carcinoma of the cystic duct in both the groups. Fischer 's exact t test is used as the test of significance in comparing the two groups and the results with interpretation for the comparison of complications between the 2 groups is as follows. The cut off value is taken as 0.1 below which the association is considered significant and above which is not considered significant.

4. Analysis

1) Bile Leak

	Bile leak +	Bile leak -
Flush clipping/ligation	0	27
High clipping	1	6

The two-tailed P value equals 0.2333

The association between rows (groups) and columns (outcomes) is considered to be not quite statistically significant.

2) Clip Migration

	Clip Migration+	Clip Migration -
Flush clipping/ ligation	0	23
High ligation	1	6

The two-tailed P value equals 0.2333

The association between rows (groups) and columns (outcomes) considered to be not quite statistically significant.

3) Post Cholecystectomy Syndrome

Post-cholecystectomy syndrome (PCS) refers to the persistence or recurrence of abdominal symptoms- like upper right quadrant pain, bloating, and indigestion—following cholecystectomy. can occur in upto 15% of cases.

Common Symptoms

Abdominal pain: Sharp or cramping pain in the upper right abdomen. Dyspepsia: Indigestion, nausea, or vomiting. Digestive changes: Bloating, flatulence, and frequent, watery diarrhea

Other: Mild jaundice, heartburn, and fatty food intolerance.

Causes: Retained stones Bile duct injury/ leak, sphincter of oddi dysfunction, cystic duct remnant, irritable bowel syndrome, Acid reflux

	Post cholecystectomy syn +	Post cholecystectomy syn -
Flush clipping/ ligation	0	23
High ligation	3	4

The two-tailed P value equals 0.0086

The association between rows (groups) and columns (outcomes) considered to be statistically significant.

4) Residual Stones/Sludge Formation

	Residual stones/Sludge +	Residual stones/Sludge -
Flush clipping/ligation	0	23
High clipping	2	5

The two-tailed P value equals 0.043

The association between rows (groups) and columns (outcomes) considered to be statistically significant.

5) Residual Gall Bladder

	Residual gall bladder +	Residual gall bladder -
Flush clipping/ligation	0	23
High clipping	1	5

The two-tailed P value equals 0.2333

The association between rows (groups) and columns (outcomes) considered to be not quite statistically significant.

6) Chronic Inflammation

	Chronic inflammation+	Chronic inflammation -
Flush clipping/ ligation	0	23
High clipping	1	6

The two-tailed P value equals 0.2333

The association between rows (groups) and columns (outcomes) considered to be not quite statistically significant.

7) Bleeding

	Bleeding +	Bleeding -
Flush clipping/ligation	2	21
High clipping	3	

The two-tailed P value equals 0.069

The association between rows (groups) and columns (outcomes) considered to be not quite statistically significant.

There are no cases of bile duct injury and infection in both the groups.

5. Results

Of the 30 cases of Laproscopic cholecystectomy flush ligation/clipping was done in 23 cases and High clipping/ligation was done in 7 cases. The interpretation of the results of outcome by Fischer exact test shows that there is significant association of high clipping/ligation group with post cholecystectomy syndrome and residual stones/ sludge compared to flush clipping/ ligation group. There is no significant association between the two groups in terms of infection, bleeding, bile leak, clip migration, residual gall bladder, chronic inflammation, cystic duct carcinoma and mortality. However this is a smaller study and requires a large sample size for more specific and accurate information.

6. Discussion

Flush clipping/ligation of the cystic duct- placing the clip immediately adjacent to the common bile duct (CBD) junction—during laparoscopic cholecystectomy (LC) is a critical technical maneuver aimed at reducing postoperative complications. The main advantages of this technique are to prevent the formation of a long stump, which is associated with complications like retained or recurrent stones and bile leakage.

Advantages of Flush Clipping of the Cystic duct

- **Prevention of Post-Cholecystectomy Syndrome:** Leaving a long cystic duct stump acts as a "second gallbladder," which can develop bile stasis, causing the formation of new stones (cystic duct stump calculi) or retention of existing ones, resulting in recurrent pain (post-cholecystectomy syndrome).
- **Reduced Risk of Bile Leakage:** While close, meticulous clipping minimizes the likelihood of a 0.4%–0.6% incidence of bile leak from the cystic stump, which is the most common site of leakage after LC.
- **Minimization of Residual Gallbladder:** Ensuring the clipping is flush with the CBD reduces the risk of incomplete removal of the gallbladder, particularly in cases with a short or wide cystic duct.
- **Improved Long-Term Outcomes:** By eliminating a "dead space" stump, the risk of late-onset complications, such as cystic duct stump cholangiocarcinoma or chronic inflammation, is lowered.

Critical Technical Considerations

- **Avoid Excessive Tension:** While a close cut is ideal, the clip must not be so tight that it causes traction or "tenting" of the common bile duct, which could lead to inadvertent clipping or occlusion of the main bile duct, resulting in severe biliary injury.
- **Optimal Clip Selection:** Although metallic (titanium) clips are commonly used for this, they have a increased risk of slippage compared to other methods (e.g., polymer clips, suture ligation), especially on a wide duct. Cystic duct ligation by energy devices and staplers are other methods.
- **"Semicut" Method:** Recent studies recommend placing a clip, performing a partial cut ("semiccut") to check for stones within the duct stump, and then applying a final, flush clip for maximum safety.

7. Conclusion

This comparative study shows that both techniques demonstrate similar efficacy for immediate closure of cystic duct. The choice of the method is typically based on the ability to achieve the "Critical View of Safety" in the Calot's triangle depending on the Gall bladder conditions for which laparoscopic cholecystectomy is performed. Flush ligation is recommended whenever it is safe to perform to avoid long-term remnant complications like bile leak, post cholecystectomy syndrome, clip migration, chronic inflammation, retained/recurrent stones, residual gall bladder, bleeding and infections. Whereas high ligation is used in difficult cases where flush dissection risks Common bile duct injury. Thus emphasizing flush clipping/ligation of cystic duct has better outcome than high clipping/ligation in terms of long

term complications and should be performed whenever possible and able to achieve critical view of safety in laparoscopic cholecystectomy.

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