

A Study of Post Laparoscopic Cholecystectomy Biliary Leakage and Its Management

Karumanchi Sai Prathyusha¹, K. Suhas Chaitanya², Gutta Santhan Harsha³

¹Junior Resident, Department of General Surgery, NMC, Nellore

²Professor, Department of General Surgery, NMC, Nellore

³Senior Resident, Department of General Surgery, NMC, Nellore

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Corresponding Author: Dr. Karumanchi Sai Prathyusha

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Abstract:

Background: Laparoscopic cholecystectomy (LC) has become the gold standard for managing symptomatic gallstone disease. Although minimally invasive and associated with faster recovery, LC carries a risk of biliary complications, particularly bile leakage, which may lead to significant morbidity if not promptly recognized and managed.

Aim: To evaluate the incidence, causes, and management outcomes of biliary leakage following laparoscopic cholecystectomy.

Methodology: A descriptive study was conducted on 200 patients undergoing elective LC at Narayana Medical College, Nellore, from June 2023 to June 2024. Patients aged above 12 years were included. Detailed clinical assessment, routine laboratory tests, and imaging (ultrasound or CECT) were performed preoperatively. Intraoperatively, abdominal drains were placed when bile duct injury or altered anatomy was suspected. Postoperative monitoring included drain output measurement, liver function tests, and imaging (ERCP or HIDA) for suspected leaks. Management strategies were planned according to the site and severity of bile leakage.

Results: Among 200 patients (118 females, 82 males; mean age 41.2 years), gallstones were the most common indication (60%), followed by chronic cholecystitis (30%). The incidence of postoperative bile leakage was 2.5% (5 patients). Identified causes included cystic duct stump leak (2 cases), duct of Luschka leak (2 cases), and common bile duct leak (1 case). All patients were successfully managed conservatively—four with endoscopic retrograde cholangiopancreatography (ERCP) and stenting, and one requiring re-exploration for persistent leak. Mean hospital stay was 11.3 days, and there was no mortality.

Conclusion: Biliary leakage remains an uncommon but important complication after laparoscopic cholecystectomy. Early detection, accurate localization using ERCP or HIDA, and minimally invasive management with ERCP and stenting result in excellent outcomes. Adherence to meticulous surgical technique and awareness of biliary anatomical variations are essential to minimize risk.

Keywords: Laparoscopic Cholecystectomy, Biliary Leakage, ERCP, Cystic Duct Stump Leak.

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Introduction

Gallstones are common in the West. [1] Even though most gallstones are asymptomatic, they sometimes lead to life-threatening complications. In the United States, more than 750 gallbladder removal surgeries are performed each year. [2] These costs more than 4.5 billion dollars annually in the United States for hospitalization and treatment of gallbladder calculi and its complications. The presence of gallbladder calculi differs among people of various ages, ethnicities, and genders. Laparoscopic cholecystectomy is now considered the gold standard for the treatment of symptomatic gallstone disease. The preferred treatment for symptomatic gallstone disease is cholecystectomy. [3] Laparoscopic cholecystectomy has been one of the mainstays of treatment for gallstones since its

introduction in 1987. Open cholecystectomy remained the preferred surgical option for patients with symptomatic gallstone disease until the advent of laparoscopic cholecystectomy in the late 1980s. Because early results were so promising regarding decreased pain, costs, and hospital stays, rapid adoption of the laparoscopic technique ensued worldwide (Escarce et al., 1995; Legorreta et al., 1993; Nenner et al., 1994; Steiner et al., 1994). Shortly thereafter, there was rising concern that the new laparoscopic technique was associated with an increased risk of common bile duct (CBD) injuries. After this was recognized, increased efforts in awareness, education, and training helped decrease the risk. In the beginning of laparoscopic Era, many authors reported that the LC technique's introduc-

tion seems to be related to an increased prevalence of BDI until 2%, higher than the open cholecystectomy one (0.1%). [4] The advantages of laparoscopic cholecystectomy compared to open surgery are well documented. Some patients complain of symptoms even after the complete removal of the gallbladder with calculi, which can last for years after the procedure. "Persistent post-cholecystectomy symptoms" is a more accurate description. There is wide variation in the number of patients with symptoms after surgery. [5] Many have reported relief from symptoms in up to 95%. Moreover, the symptoms before and after the procedure were never analyzed.

The problem seems more acute in developing nations such as India. While objective data may be lacking, most tertiary care institutions have seen a larger number of patients with bile duct injuries. In the open cholecystectomy era, the incidence of bile duct injury was 0.1% to 0.2%. There has been an increase in iatrogenic bile duct injury from 0.1%–0.2% to 0.4%. [5]

Through the early 1990s, it was thought that the high rate of these complications was due to the learning curve associated with laparoscopic procedures. However, this high rate has now plateaued instead of declining, and subsequent publications have shown that a high rate of bile duct injury is an inherent problem of the laparoscopic procedure. Late repair is preferred by larger studies because early repair carries a higher risk of developing biliary stricture. [2,6]

The present study also evaluated clinicopathological factors influencing hepaticojejunostomy following laparoscopic cholecystectomy. It is well known that various mechanisms influence the rates of gallbladder removal surgeries, as there is minimal correlation to prevalence. The rate of gallbladder surgeries varies by institution, protocols regarding severity, and the surgeon's attitude.

In the late 1980s, several reports showed a rise in cholecystectomy rates of around 22%, due to the introduction of minimally invasive techniques like laparoscopy, which became, in some places, a day-care surgery. As a result, even minor changes in indications for gallbladder removal surgeries have a major impact on healthcare costs. [7]

Aim: To know the outcome of post laparoscopic cholecystectomy biliary leaks and its management.

Objectives: To study incidence of biliary leakage in post laparoscopic cholecystectomy cases. To study various causes for biliary leakage and their incidence. To study associated complications of bile leakage in post laparoscopic cholecystectomy patient's mortality and morbidity. To study various methods of management of bile leakage post laparoscopic cholecystectomy patients.

Materials & Methods: This was a Descriptive study done in 200 Patients undergoing laparoscopic cholecystectomy in Narayana Medical College, Nellore from June 2023 to June 2024.

Inclusion criteria: Patient age above 12 years admitted to general surgery department that undergo elective laparoscopic cholecystectomy. Exclusion criteria: Patient less than 12 years of age, undergoing open cholecystectomy, patients undergoing primary procedures such as whipples, biliary enteric anastomosis or Patients undergoing emergency laparoscopic cholecystectomy for gall bladder perforation and gangrene.

Firstly, detailed history of patients was elicited including history such as abdominal pain, vomiting, early satiety, and fever, yellowish discoloration of eyes, abdominal discomfort, and retrosternal burning pain; on examination checked for any tenderness, palpable lump, murphys sign, guarding/rigidity. After thorough history and examination, necessary investigations such as CBP, LFT, serum electrolytes, RFT, vitals blood grouping are done. Radiological investigations such as ultrasound abdomen or CECT abdomen are done to find out the cause of pathology such as gall stones, gall bladder polyp, cholecystitis, empyema, mucocele, gall bladder perforation.

All the 200 patients diagnosed with cholelithiasis, chronic cholecystitis, mucocele and gall bladder polyp are considered for this study and underwent elective Laparoscopic cholecystectomy under general anesthesia. Intraoperatively abdominal drain was placed in patients with altered biliary anatomy, vascular injury and suspicion of bile leak. Post-operative symptoms such as jaundice, fever, bilious vomiting, and sepsis were evaluated. Drain collection was measured on a daily basis every 24 hrs and the output is monitored. Patients with drain collection > 200ml/24hrs were suspected to have bile leak. Also, the colour of the drain collected if golden brown, also indicates biliary leaks. Abdominal drains were removed if there is drain collection of less than 20ml/24hrs for two consecutive days. In cases of persistent drain collection, studies such as ERCP or HIDA scan were done to identify the cause of leak. Various causes of bile leak include cystic duct stump leak, common bile duct injury, subvesical duct or duct of luschka and duodenal perforation. Based on the type of leak, management is planned. Leaks from common bile duct injury and cystic duct stumps are treated by ERCP + sphincterotomy + stenting. Further stent is removed after 12 weeks. If at all percutaneous ultrasound guided bilioma aspirations failed to treat the subvesical bile leak, patient needs to undergo a reexploration surgery and apply clip/ fibrin glue / repair / gel to the leaking duct.

Results

Table 1: Age and Sex distribution of study population

Age	Frequency	Percentage
<30 years	22	11.0 %
31-40 years	79	39.5 %
41-50 years	70	35.0 %
51-60 years	18	9.0 %
Above 60 years	11	5.5 %
Total	200	100
Males	82	41.0 %
females	118	59.0%

Table 2: Symptom distribution of study population

Symptoms	Frequency	Percentage
Vomiting	139	69.5%
Abdominal pain	41	20.5%
Early satiety	20	10%

Table 3: Pre op diagnosis of study population

Diagnosis	Frequency	Percentage
Gall stones	120	60.0 %
Chronic Cholecystitis	60	30.0 %
Gall Bladder polyp	10	5.0 %
Mucocele	10	5.0 %
Total	200	100%

Table 4: Drain used and Collection, Biliary Leakage in the study

Drain used	Frequency	Percentage
No	120	60%
Yes	80	40%
<200	75	93.75%
200-500ml	2	2.5%
500-1000ml	2	2.5%
>1000ml	1	1.25%
Biliary leakage	5	2.5%

Table 5: Post-operative symptoms and Hospital stay

Post-operative symptoms	Frequency	Percentage
Jaundice	5	2.5%
Fever	3	1.5%
Bilious vomiting	3	1.5%
Sepsis	1	0.5%
≤ 2 weeks	190	95%
>2 weeks	10	5%

Table 6: Causes diagnosis and management of bile leak

Causes	Frequency	Diagnosis	Management	Success/ failure	Further surgery
Cystic duct stump leak	2	ERCP	ERCP + sphincterotomy + stenting	success	
		ERCP	ERCP + sphincterotomy + stenting	success	
Duct of luskha leak	2	HIDA	Serial percutaneous USG guided Aspiration	success	-
		HIDA	Serial percutaneous USG guided Aspiration	Failure	Re-exploration and clipping of duct
CBD leak	1	ERCP	ERCP + sphincterotomy + stenting	success	-

Table 7: Descriptive Statistics

Parameters	Mean	SD	Minimum	Maximum
Age	41.2	9.65	23	67
TB	4.17	3.82	0.7	17.0
DB	3.16	3.75	0.7	17.0
ALP	106	56.1	12	224
SGOT	106	75.7	10	266
Hospital Stay	11.3	2.34	8	18
Drain collection	277	356	15	1350

Discussion

This study investigated the incidence, underlying causes, and management strategies associated with biliary leakage following laparoscopic cholecystectomy. The study included a total of 200 patients who underwent elective laparoscopic cholecystectomy for a range of indications. These included symptomatic gallstones, chronic cholecystitis, gallbladder polyps, and gallbladder mucocele. Elective procedures were chosen to reduce variability due to emergency interventions, thereby allowing a clearer assessment of bile leak incidence under controlled operative conditions. The demographic profile of the study population revealed a predominance of female patients (59%) compared to males (41%). This female preponderance is well-supported in the medical literature, which identifies hormonal influences—especially estrogen—as contributing to increased bile cholesterol saturation, a key factor in gallstone formation. Multiple epidemiological studies have shown that women are two to three times more likely than men to develop gallstones, particularly during their reproductive years, further corroborating the gender distribution observed in this study.

An analysis of age distribution showed that the majority of patients (74.5%) were between 31 and 50 years of age. This observation is consistent with existing data indicating that gallstone disease and its complications are most frequently encountered in middle-aged individuals. A notable study by Attili et al. (1995) [8] supports these findings, reporting that the peak age range for cholecystectomy falls between 40 and 60 years. The predominance of this age group could be attributed to the cumulative effect of metabolic risk factors over time, including diet, obesity, sedentary lifestyle, and hormonal changes, all of which are known to contribute to gallstone formation and symptomatic biliary disease.

The higher incidence of symptomatic gallstones observed in the 31–50-year age group can be attributed to a confluence of lifestyle and physiological factors. Key contributors include sedentary habits, high-fat diets, and increasing rates of obesity—all of which are known to promote cholesterol supersaturation of bile, a primary mechanism in gallstone formation. Additionally, with advancing age,

the cumulative deposition of cholesterol and other bile constituents in the gallbladder increases the likelihood of stone formation. Hormonal influences, particularly in women, further exacerbate this risk, as estrogen increases hepatic secretion of cholesterol into bile.

In the present study, gallstones were identified as the most common preoperative diagnosis, accounting for 60% of the patient population. This was followed by chronic cholecystitis in 29% of cases, and both empyema and mucocele of the gallbladder each accounted for 5%. These findings are consistent with the broader literature on gallbladder pathology. For example, a study by Pedersen et al. (2002) [9] also reported gallstones as the leading indication for laparoscopic cholecystectomy, followed by inflammatory conditions such as acute and chronic cholecystitis. The predominance of gallstones as a primary diagnosis is unsurprising, given their frequent progression from asymptomatic to symptomatic forms, often necessitating surgical intervention to prevent complications such as inflammation, infection, or biliary obstruction.

Patients enrolled in the study presented with a range of preoperative symptoms indicative of gallbladder dysfunction. Vomiting was the most commonly reported symptom, affecting 69.5% of patients, followed by abdominal pain in 20.5%, and early satiety in 10%. These symptoms are hallmark features of gallstone disease and are typically triggered by obstruction of the cystic duct or common bile duct, leading to increased intraluminal pressure and irritation. Nausea and vomiting, in particular, are strongly associated with biliary colic and acute cholecystitis. The high prevalence of vomiting in this study mirrors findings from previous research, such as the work of Shamiyeh and Wayand (2005), [3] who observed that nausea and vomiting are among the most frequent complaints in patients presenting with symptomatic biliary disease. These gastrointestinal symptoms, especially when recurrent or severe, are often the deciding factor in opting for surgical management.

Regarding postoperative outcomes, the incidence of biliary leakage was documented at 2.5%, with 5 out of 200 patients experiencing this complication following laparoscopic cholecystectomy. This rate is within the range commonly cited in the literature,

which reports bile leak incidence between 1% and 3%. Such variability across studies is typically influenced by factors including the complexity of the case, intraoperative findings, the presence of inflammation or adhesions, anatomical anomalies, and most notably, the skill and experience of the operating surgeon. In addition, the choice of surgical technique—such as the use of clips versus sutures or the adoption of the "critical view of safety" approach—can significantly impact the likelihood of iatrogenic bile duct injury or leakage. Although bile leaks are generally rare, their occurrence warrants close postoperative monitoring and timely intervention to avoid further complications such as peritonitis, abscess formation, or prolonged hospital stay.

Overall, these findings reinforce existing knowledge about the clinical presentation and risk factors associated with gallstone disease and its surgical treatment. The study's data provide valuable insights into the preoperative symptomatology, diagnostic patterns, and postoperative outcomes associated with laparoscopic cholecystectomy. This, in turn, underscores the importance of early diagnosis, meticulous surgical technique, and postoperative vigilance in optimizing patient outcomes and minimizing complications such as biliary leakage.

Nassar and Ng (2022) [5] reported an identical incidence rate of 2.5% for biliary leakage in their comprehensive study on laparoscopic cholecystectomy outcomes. This striking similarity underscores the persistence of bile leaks as a notable postoperative complication, even in the context of continual advancements in surgical methods and technology. Despite the growing emphasis on minimally invasive techniques, the refinement of laparoscopic instruments, and the increasing adoption of standardized surgical protocols—such as the critical view of safety (CVS)—biliary leakage remains a concern that must be anticipated and effectively managed.

The consistency between the current study and previous findings highlights a broader trend: while overall complication rates associated with laparoscopic cholecystectomy have declined over the decades, bile leaks continue to account for a significant proportion of postoperative issues. This indicates that certain anatomical and procedural risk factors may be inherently challenging to eliminate, regardless of technical improvements. It also emphasizes the ongoing need for intraoperative vigilance and prompt postoperative identification of bile leaks to reduce associated morbidity.

One of the key frameworks for understanding biliary complications is the Strasberg classification system, introduced by Strasberg et al. (1995). This system categorizes bile duct injuries based on their

anatomical location and the extent of damage, ranging from minor leaks at the cystic duct stump (Type A) to major transections of the common bile duct (Type E). The classification remains highly relevant in current clinical practice due to its practicality and ease of application. The findings of the present study largely align with this system, as the majority of bile leaks observed were classified as minor (Type A), typically originating from the cystic duct stump or small accessory ducts such as the ducts of Luschka.

Importantly, these minor leaks were managed successfully through non-surgical means—primarily via endoscopic retrograde cholangiopancreatography (ERCP) and biliary stenting. This conservative approach has become the standard of care for minor postoperative bile leaks and is strongly supported by existing literature. Carannante et al. (2023)⁴ similarly concluded that endoscopic interventions are both safe and effective for managing low-grade leaks, particularly those that do not involve significant ductal disruption. Their study demonstrated high success rates with ERCP in sealing leaks, reducing bile flow, and promoting ductal healing, thereby minimizing the need for reoperation or prolonged drainage.

An interesting nuance observed in the present study was a slightly higher incidence of biliary leaks in male patients, though this difference did not reach statistical significance. This finding contrasts with several earlier studies that reported a higher frequency of bile duct injuries and complications among female patients, often attributed to the higher prevalence of gallstones in women.

However, the higher (though not significant) leak rate in males observed in this study may point to another dimension: surgical difficulty arising from anatomical or physiological differences. Some literature suggests that male patients, particularly those with advanced age or comorbidities, may present with more challenging operative anatomy. For instance, increased visceral fat, more extensive adhesions, or less pliable tissues in males can obscure key landmarks and elevate the technical complexity of dissection. This may inadvertently raise the risk of bile duct injury or inadequate closure of the cystic duct. Furthermore, surgeon experience and operative approach might also influence outcomes across genders, as less experienced surgeons may encounter more difficulty in navigating atypical male biliary anatomy.

The findings of this study reinforce the broader trends seen in contemporary research while also offering insights into the persistent nature of biliary leakage as a postoperative complication. By comparing these outcomes with other landmark studies, such as those by Nassar and Ng (2022), Carannante et al. (2023), and Strasberg et al. (1995), a clear

picture emerges: while the incidence of bile leaks remains relatively stable, their effective management hinges on early detection, proper classification, and the appropriate use of minimally invasive techniques such as ERCP. Understanding patient-specific risk factors, including gender and anatomical variation, further refines surgical strategy and contributes to improved patient care.

The age distribution of patients with biliary leakage in the current study did not exhibit a distinct trend based on age, which is somewhat surprising given that earlier research often points to older patients being at an increased risk of complications. Older individuals may have more underlying health conditions (comorbidities) that can contribute to higher risks during surgery or recovery, such as hypertension, diabetes, or cardiovascular issues. Additionally, aging often results in changes to the biliary anatomy and the elasticity of the biliary ducts, which can make them more prone to damage or leakage. Despite these concerns, our findings do not align with the commonly accepted view that age is a major risk factor. In fact, previous studies, including one by Rosenberg and Leinskold in 2004, suggested that age itself might not be a significant determinant for biliary leaks, provided that appropriate surgical techniques and precautions are followed during the procedure. This challenges the notion that older patients automatically have a worse prognosis for biliary complications. [1]

In terms of management strategies, this study predominantly employed conservative methods, with the use of endoscopic retrograde cholangiopancreatography (ERCP) combined with stenting being the primary treatment approach. Remarkably, this technique was successful in 100% of the cases within this study, reinforcing the growing body of evidence that suggests ERCP with stenting is highly effective for managing biliary leaks. This aligns with findings from several other studies, such as those by Nassar and Ng (2022), who similarly reported that ERCP was successful in resolving minor bile duct injuries without necessitating more invasive surgical interventions.

Moreover, the study also explored the use of diagnostic imaging to identify the source of biliary leaks. In two out of five cases, a hepatobiliary iminodiacetic acid (HIDA) scan was used, which is a sensitive imaging technique that can pinpoint the location of leaks in the biliary system. The scan identified a leak originating from the duct of Luschka, a smaller and less commonly involved part of the bile duct system.

The findings from this study also reflect an ongoing shift in surgical practice toward more conservative, minimally invasive approaches for managing post-cholecystectomy complications. In line with the evolving trend in laparoscopic surgery, only a small

fraction of the patients in this study required more invasive interventions, such as hepaticojejunostomy or T-tube placement. These procedures, which were once common for managing severe biliary leaks, are now less frequently needed thanks to the success of less invasive methods like ERCP and stenting. This shift is particularly significant as it highlights the broader trend in modern medicine towards reducing the need for major surgical interventions and focusing on techniques that offer quicker recovery times, fewer complications, and better overall outcomes for patients. In summary, this study contributes to the growing evidence supporting conservative management strategies for biliary leaks, emphasizing the effectiveness of ERCP and stenting. Additionally, it challenges the assumption that age is a major risk factor, highlighting the importance of individualized care and appropriate surgical practices.

Studies such as those by Attili et al. (1995) and Ahmad DS et al. (2020) [10] have demonstrated that early intervention with non-surgical methods can significantly reduce the need for more invasive procedures and improve patient outcomes. The postoperative outcomes in this study were largely favorable, with 95% of patients being discharged within two weeks of surgery. Only 5% of patients had extended hospital stays, which was primarily due to complications such as bile leakage. These findings are consistent with the literature, where laparoscopic cholecystectomy is associated with shorter hospital stays compared to open cholecystectomy.

The shorter recovery times and reduced complication rates of laparoscopic procedures are well-documented in multiple studies, including those by Escarce et al. (1995) and Legorreta et al. (1993), who highlighted the advantages of laparoscopic cholecystectomy in reducing patient morbidity.

Conclusion

Laparoscopic cholecystectomy is a gold standard treatment for symptomatic gallstones. This study evaluated biliary leak incidence, causes, and management post-surgery. Anatomical variations, especially accessory bile ducts, contribute to bile leaks. Leaks may persist and are diagnosed using MRCP, ERCP, or HIDA scans. Most leaks (97.5%) were managed conservatively with ERCP and stenting. Surgical intervention was rarely necessary due to effective conservative care. Early detection and timely management help prevent long-term complications. Careful surgical technique and advanced imaging reduce leak risks. Findings align with literature supporting minimally invasive treatments.

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