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Study on Surgical Outcomes of Choledochoduodenostomy & Roux-en-Y Hepaticojejunostomy in Cases of Intraoperative Common Bile Duct Injury - A Comparative Study

Richa Jaiman[1], Shivli Srivastava[1*], Bhavana Verma[1] & Punit Srivastava[1]

[1]Department of General Surgery, Sarojini Naidu Medical College, Agra, India

HIGHLIGHTS

- Roux-en-Y showed superiority
- Fewer postoperative complications
- Lower stricture rates
- Shorter hospital stay
- Better long-term outcomes

Key Words:
Common bile duct injury
Choledochoduodenostomy
Roux-en-Y hepaticojejunostomy
Biliary stricture
Surgical outcome

ABSTRACT

Introduction: Intraoperative common bile duct injury is a serious complication of hepatobiliary surgery and often requires definitive biliary reconstruction. Choledochoduodenostomy and Roux-en-Y hepaticojejunostomy are commonly used procedures, but their comparative postoperative outcomes remain clinically important. **Aim & Objective:** To compare the surgical outcomes of choledochoduodenostomy and Roux-en-Y hepaticojejunostomy in patients with intraoperative common bile duct injury, with respect to morbidity, recovery, biliary complications, and outcome. **Materials & Methods:** This prospective comparative study was conducted in the Department of General Surgery, S.N. Medical College, Agra, among 60 patients with intraoperative common bile duct injury. Patients were equally divided into Group A undergoing choledochoduodenostomy and Group B undergoing Roux-en-Y hepaticojejunostomy. Demographic profile, intraoperative details, ICU requirement, hospital stay, postoperative complications, biliary stricture, recurrent jaundice, readmission, mortality, satisfaction, and quality-of-life outcomes were recorded and compared. **Results:** Both groups were comparable for age and sex distribution. ICU requirement was significantly higher after choledochoduodenostomy than Roux-en-Y hepaticojejunostomy (6/30 vs 2/30; $p=0.025$). Mean hospital stay was longer in the choledochoduodenostomy group (8.80 ± 2.882 days) than the Roux-en-Y group (6.10 ± 1.882 days; $p=0.016$). Bile leak, wound infection, postoperative fever, pain burden, biliary stricture at 6 months (12/30 vs 5/30; $p=0.015$), readmission, and long-term recurrent jaundice (14/30 vs 3/30; $p=0.039$) were higher after choledochoduodenostomy. Final excellent outcome was more frequent after Roux-en-Y hepaticojejunostomy (18/30 vs 9/30; $p=0.049$). **Conclusion:** Roux-en-Y hepaticojejunostomy demonstrated better early recovery, fewer complications, lower stricture and recurrent jaundice rates, and superior outcome than choledochoduodenostomy, helping define the preferable reconstructive option in selected biliary injury patients.

* **Corresponding Author:** Shivli Srivastava, e-mail: shivliisrivastava@gmail.com
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INTRODUCTION

Bile duct injury is one of the most serious complications encountered during hepatobiliary surgery, particularly during cholecystectomy. Although cholecystectomy is among the most commonly performed abdominal operations, injury to the extrahepatic biliary tree remains a major surgical concern because it can convert a routine procedure into a complex reconstructive problem [1]. The World Society of Emergency Surgery guidelines describe bile duct injury as a dangerous complication of cholecystectomy, associated with significant morbidity, mortality, and long-term impairment of quality of life. The reported incidence of bile duct injury during cholecystectomy is approximately 0.4% to 1.5%, and most injuries are identified either during the operation or in the early postoperative period [2]. Intraoperative common bile duct injury may occur due to difficult anatomy, severe inflammation, dense adhesions, distorted Calot's triangle, bleeding, previous surgery, acute cholecystitis, Mirizzi syndrome, or misidentification of the common bile duct as the cystic duct [3]. The injury may range from a small lateral tear to partial transection, complete transection, segmental loss, thermal injury, or associated vascular injury [4]. Its clinical importance lies not only in the immediate bile leak or peritonitis but also in delayed complications such as biliary stricture, recurrent cholangitis, secondary biliary cirrhosis, hepatic dysfunction, and repeated hospital admissions. Long-term studies have shown that bile duct injury can result in biliary strictures, anastomotic strictures, recurrent cholangitis, and impaired quality of life even years after the initial operation [5].

The management of intraoperative common bile duct injury depends on the timing of recognition, level and extent of injury, duct diameter, tissue condition, vascularity, availability of expertise, and general condition of the patient [6]. Early recognition during surgery provides an opportunity for immediate controlled repair, but inappropriate repair by an inexperienced surgeon may increase the risk of failure [7]. Therefore, definitive reconstruction should ideally be performed by surgeons familiar with hepatobiliary anatomy and biliary-enteric anastomosis. The WSES guidelines emphasize proper classification, staging, reporting, and structured management of bile duct injury once detected [8].

Several options restore biliary continuity after common bile duct injury. Minor lateral injuries may be treated by primary repair over a T-tube or endoscopic stenting when duct continuity is preserved. Major transections, segmental loss, devascularized ducts, or high strictures usually need biliary-enteric reconstruction [9]. Choledochoduodenostomy and Roux-en-Y hepaticojejunostomy provide internal biliary drainage, while choledochoduodenostomy is a simpler, shorter procedure suitable for selected cases with a dilated duct and healthy mobile duodenum [10]. Literature on benign biliary obstruction has reported that choledochoduodenostomy can be safe and can provide good long-term results when a permanent biliary drainage procedure is required. However, concerns remain regarding postoperative bile reflux, ascending cholangitis, sump syndrome, anastomotic narrowing, and its suitability in cases where the injury is high or the duct is small [11].

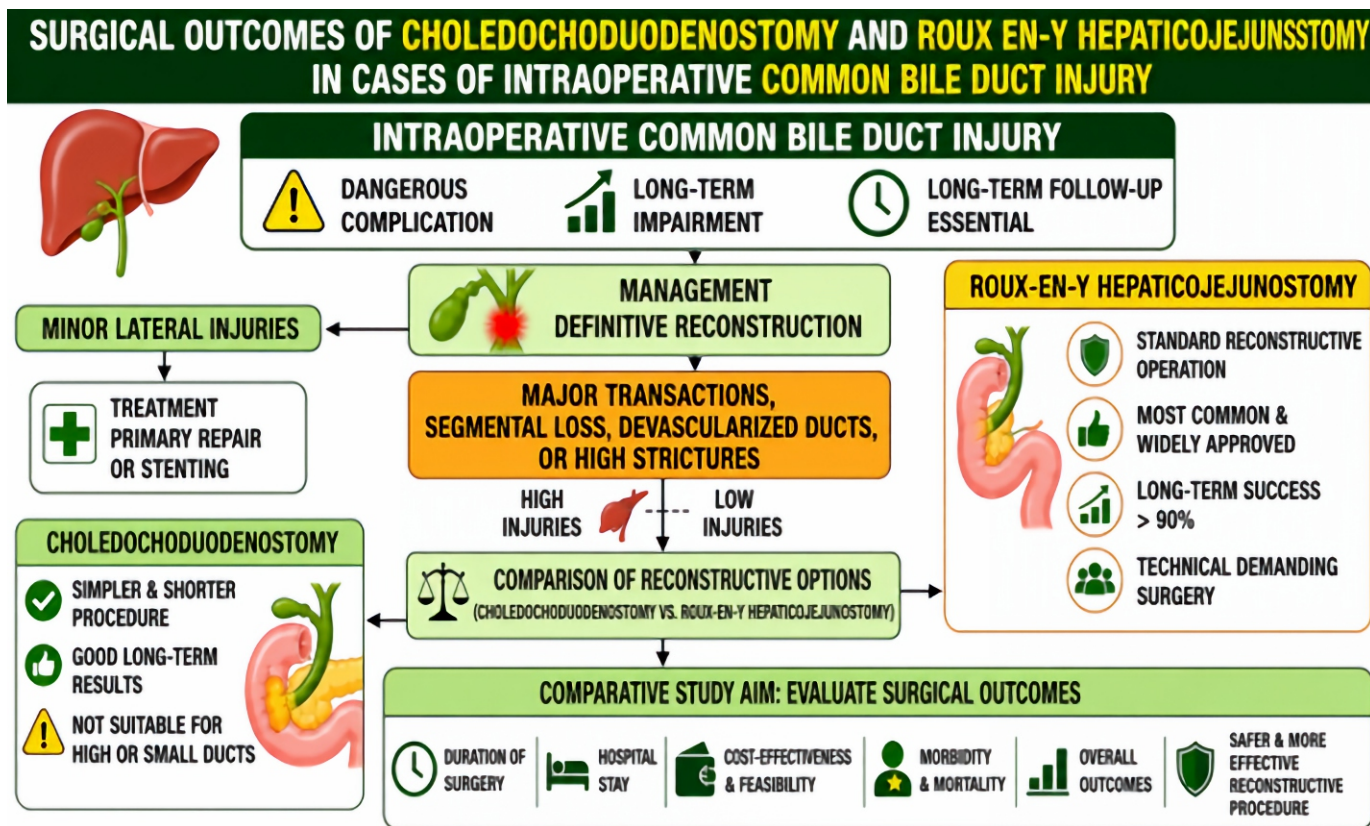

Figure 1. Comparative overview of choledochoduodenostomy and Roux-en-Y hepaticojejunostomy for reconstruction after intraoperative common bile duct injury and the surgical outcomes assessed.

Roux-en-Y hepaticojejunostomy is widely regarded as the standard reconstructive operation for major post-cholecystectomy bile duct injuries. In this procedure, the hepatic duct or common hepatic duct is anastomosed to a defunctionalized Roux limb of jejunum, providing a tension-free, well-vascularized biliary drainage pathway away from duodenal reflux [12]. It is especially useful in complete transaction, proximal bile duct injury, tissue loss, or cases where the distal common bile duct cannot be safely used. StatPearls notes that Roux-en-Y hepaticojejunostomy is the most common technique used for the repair of major bile duct injuries [13]. Other reports also describe Roux-en-Y hepaticojejunostomy as the most widely approved management for most post-cholecystectomy bile duct injuries, with long-term success commonly reported around 90% in experienced settings [14].

Despite its accepted role, Roux-en-Y hepaticojejunostomy is technically demanding, and its outcome is strongly influenced by surgical expertise, site of anastomosis, duct diameter, blood supply, presence of sepsis, timing of repair, and associated vascular injury. Complications may include bile leak, intra-abdominal collection, wound infection, anastomotic stricture, recurrent cholangitis, and need for radiological, endoscopic, or surgical revision. Long-term follow-up after hepaticojejunostomy is therefore essential because an initially successful repair may later develop stricture or recurrent cholangitis [15]. A long-term follow-up study of 120 patients after hepaticojejunostomy for post-cholecystectomy bile duct injury reported a successful long-term outcome in 88.3% of patients, while long-term complications occurred in 29% [16].

The choice between choledochoduodenostomy and Roux-en-Y hepaticojejunostomy is clinically important in intraoperative common bile duct injury. Choledochoduodenostomy is simpler and suitable for selected low injuries with dilated ducts, while Roux-en-Y hepaticojejunostomy is preferred for high, complex, transected, or devascularized injuries. Comparing bile leak, cholangitis, stricture, reintervention, hospital stay, recovery, and long-term drainage helps guide appropriate reconstruction [17]. **Figure 1.** Schematic overview of the management and reconstructive options for intraoperative common bile duct injury, comparing choledochoduodenostomy and Roux-en-Y hepaticojejunostomy.

This comparative study aims to evaluate the surgical outcomes of choledochoduodenostomy and Roux-en-Y hepaticojejunostomy in intraoperative common bile duct injury. The study will compare the duration of surgery, postoperative pain, infection, hospital stay, cost-effectiveness, feasibility, morbidity, mortality, and overall postoperative outcomes to determine the safer and more effective reconstructive procedure in selected patients.

MATERIALS & METHODS

This prospective comparative study was conducted in the Department of General Surgery, S.N. Medical College, Agra, among 60 patients with intraoperative common bile duct injury. Patients were divided into two equal groups: Group A underwent choledochoduodenostomy and Group B underwent Roux-en-Y hepaticojejunostomy. After informed consent and ethical approval, demographic details, intraoperative findings, duration of surgery, postoperative pain, ICU requirement, bile leak, hemorrhage, wound infection, fever, jaundice, biliary stricture, readmission, mortality, hospital stay, biochemical parameters, patient satisfaction, and quality-of-life outcomes were recorded. Data were analyzed to compare feasibility, complications, morbidity, mortality, and overall surgical outcomes between both procedures.

RESULTS

Most patients in both surgical groups were aged 51–60 years, followed by 41–50 years, showing a similar age pattern between choledochoduodenostomy & Roux-en-Y hepaticojejunostomy groups. Age distribution was statistically comparable ($p= 0.943$). Female predominance was observed in both groups, with 60.0% females in the choledochoduodenostomy group and 53.3% in the Roux-en-Y hepaticojejunostomy group. Sex distribution was also comparable ($p=0.602$), indicating balanced baseline characteristics. ICU requirement was higher in the choledochoduodenostomy group, where 6 patients required ICU care compared with only 2 patients in the Roux-en-Y hepaticojejunostomy group. Most patients in both groups did not require ICU admission, but the proportion was better in the Roux-en-Y group. The association was statistically significant ($p = 0.025$), indicating a meaningful difference in postoperative critical care requirement. Scientifically, this suggests that Roux-en-Y hepaticojejunostomy was associated with lower ICU need and comparatively smoother immediate postoperative recovery **(Table 1)**. Mean hospital stay was longer in the choledochoduodenostomy group (8.80 ± 2.882 days) compared with the Roux-en-Y hepaticojejunostomy group (6.10 ± 1.882 days). This difference was statistically significant ($p = 0.016$), showing that the type of surgical reconstruction significantly influenced postoperative hospital stay. The shorter stay in the Roux-en-Y group suggests faster postoperative stabilization and recovery. Scientifically, Roux-en-Y hepaticojejunostomy appeared to be associated with better early postoperative outcomes in terms of reduced hospitalization duration **(Table 2)**. Bile leak was more frequent in the choledochoduodenostomy group, where 6 patients developed bile leak compared with only 1 patient in the Roux-en-Y hepaticojejunostomy group. Most patients in both groups had no bile leak, but the Roux-en-Y group showed a clearly lower postoperative leak burden. This indicates that Roux-en-Y hepaticojejunostomy provided a more secure biliary reconstruction in terms of anastomotic leakage. Scientifically, lower bile leak frequency suggests better early postoperative safety and more favorable surgical outcome with Roux-en-Y hepaticojejunostomy **(Figure 2)**. Wound infection was higher in the choledochoduodenostomy group, where 9 patients developed infection compared with only 2 patients in the Roux-en-Y hepaticojejunostomy group.

Mo st patients in the Roux-en-Y group had no wound infection, indicating a comparatively better postoperative wound outcome. This difference suggests that choledochoduodenostomy was associated with greater postoperative infectious morbidity. Scientifically, Roux-en-Y hepaticojejunostomy showed a more favorable recovery pattern with lower wound infection burden **(Figure 3)**. Postoperative fever was higher in the choledochoduodenostomy group, where 10 patients developed fever compared with only 3 patients in the Roux-en-Y hepaticojejunostomy group. Most patients in both groups remained afebrile, but the Roux-en-Y group showed a lower postoperative febrile response. The association was statistically significant (p = 0.021), indicating a meaningful difference between the procedures. Scientifically, Roux-en-Y hepaticojejunostomy was associated with lower postoperative inflammatory or infective morbidity and better early recovery **(Table 3)**. Postoperative pain score distribution showed comparatively higher pain intensity in the choledochoduodenostomy group, with more patients scoring in the higher VAS range of 8–10. In contrast, the Roux-en-Y hepaticojejunostomy group had more patients clustered around lower to moderate VAS scores, especially 0, 4, and 5. This indicates that postoperative pain burden was greater after choledochoduodenostomy. Scientifically, Roux-en-Y hepaticojejunostomy appeared to provide a more favorable early postoperative recovery profile in terms of pain severity **(Figure 4)**. Biliary stricture at 6 months was higher in the choledochoduodenostomy group, where 12 patients developed stricture compared with 5 patients in the Roux-en-Y hepaticojejunostomy group. A larger proportion of Roux-en-Y patients remained stricture-free, indicating better medium-term biliary drainage outcome. The association was statistically significant (p = 0.015), showing a meaningful difference between both procedures. Scientifically, Roux-en-Y hepaticojejunostomy appeared to provide more durable biliary reconstruction with lower risk of postoperative stricture formation **(Table 4)**. Readmission within 3 months was slightly higher in the choledochoduodenostomy group, where 5 patients were readmitted compared with 3 patients in the Roux-en-Y hepaticojejunostomy group. Most patients in both groups did not require readmission, indicating generally acceptable postoperative recovery in both procedures. However, the lower readmission frequency in the Roux-en-Y group suggests comparatively better short-term follow-up outcome. Scientifically, Roux-en-Y hepaticojejuno-stomy appeared to be associated with fewer postoperative events requiring hospital readmission **(Figure 5)**. Long-term recurrent jaundice was higher in the choledochoduodenostomy group, where 14 patients developed recurrence compared with only 3 patients in the Roux-en-Y hepaticojejunostomy group. Most Roux-en-Y patients remained free from recurrent jaundice, indicating better long-term biliary drainage. The association was statistically significant (p = 0.039), showing a meaningful difference between both procedures. Scientifically, Roux-en-Y hepaticojejunostomy appeared to provide superior long-term outcome with lower recurrence of jaundice **(Table 5)**. Final outcome distribution showed better results in the Roux-en-Y hepaticojejunostomy group, with 18 patients having excellent outcomes compared with 9 patients in the choledochoduodenostomy group. Poor outcome was more frequent in the choledochoduodenostomy group, where 7 patients had poor results compared with only 1 patient in the Roux-en-Y group. The association was statistically significant (p = 0.049), indicating that final outcome differed meaningfully between both surgical procedures. Scientifically, Roux-en-Y hepaticojejunostomy demonstrated a more favorable overall surgical outcome profile than choledochoduodenostomy **(Table 6)**.

Table 1. Association between ICU Requirement and Surgical Group (n = 60)

ICU Requirement	Choledochoduodenostomy	Roux-en-Y Hepaticojejunostomy	Total	p-value
No	24	28	52	0.025
Yes	6	2	8	
Total	30	30	60	

Table 2. Comparison of Mean Hospital Stay between Surgical Groups (n = 60)

Variable	Group	N	Mean	Std. Deviation	P value
Hospital Stay (days)	Choledochoduodenostomy	30	8.80	2.882	0.016
	Roux-en-Y Hepaticojejunostomy	30	6.10	1.882	

Table 3. Association between Post-operative Fever and Surgical Group (n = 60)

Fever	Choledochoduodenostomy	Roux-en-Y Hepaticojejunostomy	Total	p-value
No	20	27	47	0.021
Yes	10	3	13	
Total	30	30	60	

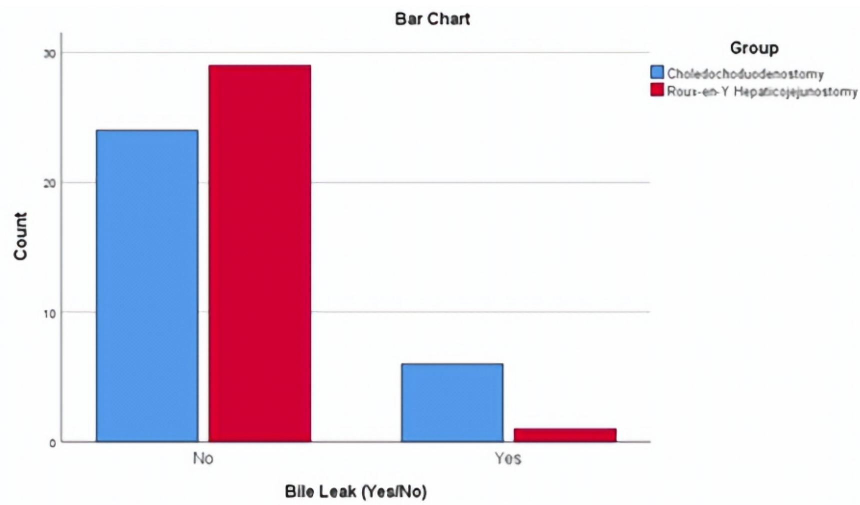

Figure 2: Association of Bile Leak with Surgical Group

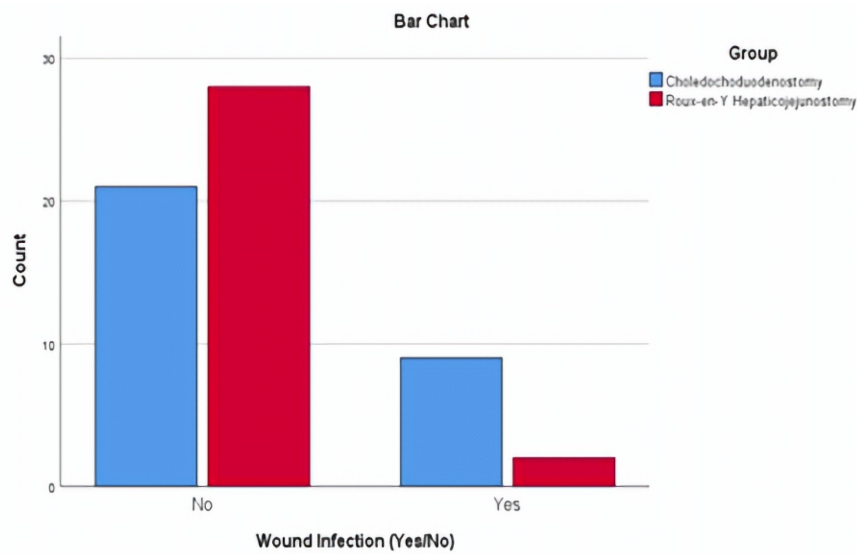

Figure 3: Association of Wound Infection with Surgical Group

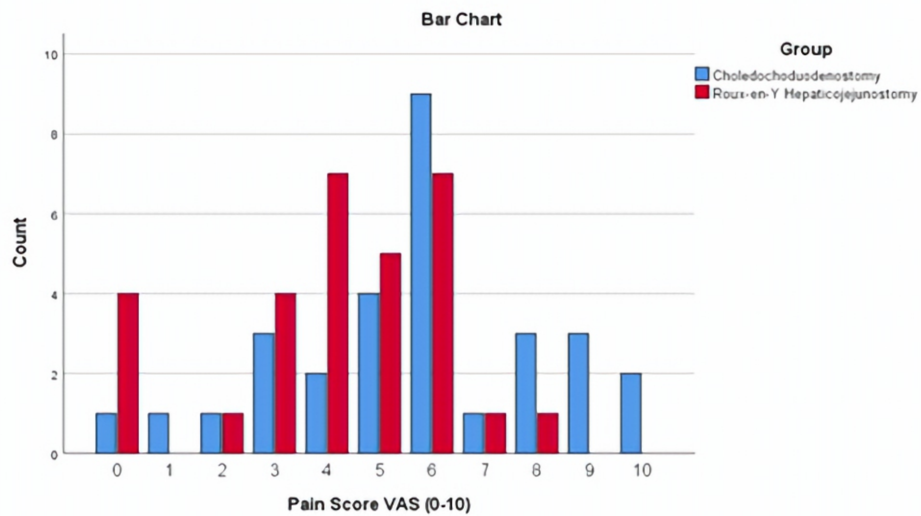

Figure 4: Association of Postoperative Pain Score with Surgical Group

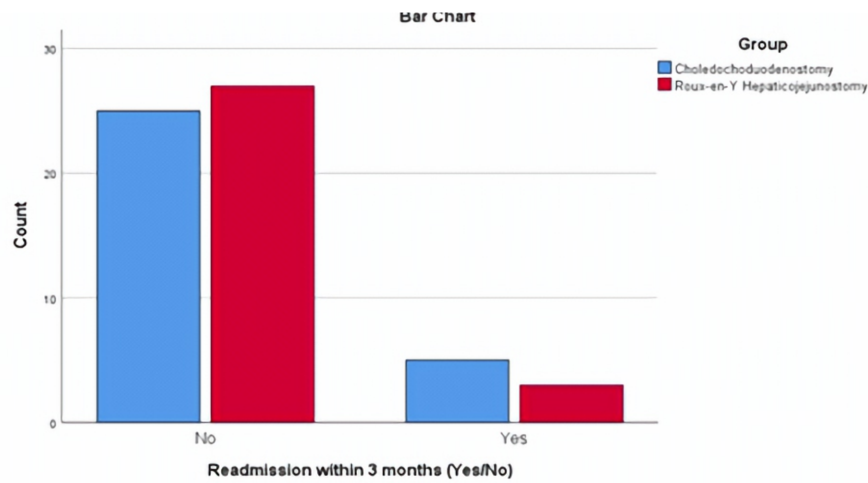

Figure 5: Association of Readmission within 3 Months with Surgical Group

Table 4. Association between Biliary Stricture at 6 Months and Surgical Group (n = 60)

Biliary Stricture	Choledochoduodenostomy	Roux-en-Y Hepaticojejunostomy	Total	p-value
No	18	25	43	0.015
Yes	12	5	17	
Total	30	30	60	

Table 5. Association between Long-term Recurrent Jaundice and Surgical Group (n = 60)

Recurrent Jaundice (Long -term)	Choledochoduodenostomy	Roux-en-Y Hepaticojejunostomy	Total	p-value
No	16	27	43	0.039
Yes	14	3	17	
Total	30	30	60	

Table 6. Association between Final Outcome and Surgical Group (n = 60)

Final Outcome	Choledochoduodenostomy	Roux-en-Y Hepaticojejunostomy	Total	p-value
Excellent	9	18	25	0.049
Good	4	3	20	
Fair	10	8	9	
Poor	7	1	6	
Total	30	30	60	

DISCUSSION

In our study, baseline comparison showed that both surgical groups were demographically comparable, as most patients belonged to the 51–60-year age group in both choledochoduodenostomy (CDD) & Roux-en-Y hepaticojejunostomy (RYHJ) groups (30.0% vs 33.3%), with no significant association between age and procedure type (p=0.943). Female predomina-nce was also comparable between CDD and RYHJ groups (60.0% vs 53.3%), and sex distribution was statistically non-significant (p=0.602), indicating that postoperative differences were unlikely to be due to baseline demographic imbalance. This strengthens the internal validity of outcome comparison, as emphasized by Wang X et al. [18], who highlighted that timing, referral pattern, and appropriate surgical selection influence bile duct injury repair outcomes more than demographic variation. Early postoperative recovery favored RYHJ, as ICU requirement was significantly lower in RYHJ than CDD (2/30 vs 6/30; p=0.025), and mean hospital stay was shorter in RYHJ (6.10 ± 1.88 days) compared with CDD (8.80 ± 2.88 days), suggesting reduced postoperative morbidity and faster stabilization. Similar findings were supported by Fong ZV et al. [19], who reported that bile leak and ductal injury significantly influence postoperative morbidity and management outcomes. Procedure-related complications also showed clear superiority of RYHJ. Bile leak was lower after RYHJ, while wound infection was significantly higher in CDD (9/30 vs 2/30; p=0.020), and postoperative fever was also more frequent after CDD (10/30 vs 3/30; p=0.021), indicating greater infective and inflammatory burden after CDD. Sahajpal AK et al. [20] reported better long-term outcomes when bile duct injuries were managed with durable reconstruction. Pain score distribution also favored RYHJ (p=0.001), with severe pain observed only in CDD and absence of pain more frequent after RYHJ, reflecting better post-operative comfort and smoother recovery. Intermediate biliary patency further supported RYHJ, as biliary stricture at 6 months was significantly higher in CDD than RYHJ (12/30 vs 5/30; p= 0.015).

This agrees with Giger U et al. [21], who reported better long-term patency with RYHJ, and Mishra et al. [22], who found lower stricture recurrence after RYHJ. Readmission within 3 months was significantly associated with surgical procedure, indicating greater early postoperative instability after CDD. Long-term recurrent jaundice was markedly higher after CDD than RYHJ (14/30 vs 3/30; p=0.039), supporting better sustained biliary drainage after RYHJ. Luu C et al. [23] also observed fewer recurrent biliary symptoms with RYHJ compared with CDD. Final outcome distribution confirmed this trend, with excellent outcomes more frequent in RYHJ (18/30 vs 9/30) and poor outcomes lower in RYHJ (1/30 vs 7/30; p=0.049). Overall, our findings indicate that RYHJ provided superior early recovery, fewer complications, better intermediate patency, lower long-term recurrent jaundice, and better final surgical outcome than CDD.

CONCLUSION

The present study concluded that Roux-en-Y hepaticojejunostomy showed better surgical outcomes than choledochoduodenostomy in patients with intraoperative common bile duct injury. Both groups were comparable in age and sex distribution, allowing fair comparison of outcomes. RYHJ was associated with lower ICU requirement, shorter hospital stay, reduced bile leak, wound infection, postoperative fever, pain, biliary stricture, readmission, recurrent jaundice, and better final outcome. These findings suggest that RYHJ provides more durable biliary drainage, fewer postoperative complications, and better long-term recovery. Therefore, RYHJ may be preferred over CDD, especially in complex bile duct injuries.

LIMITATIONS & FUTURE PERSPECTIVES

The study's limitations include a single-centre setting, a relatively small sample size, and a short study duration, which may limit the broader applicability of the results. Future studies should incor-porate multicentre designs with larger populations to enhance validity, assess long-term outcomes, and investigate advanced diagnostic & management approaches. Such efforts will improve overall patient care and help minimize complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical healthcare applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient care, diagnosis, and treatment outcomes. By highlighting real-world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

CBDI: Common Bile Duct Injury
CDD: Choledochoduodenostomy
RYHJ: Roux-en-Y Hepaticojejunostomy
ICU: Intensive Care Unit
QOL: Quality of Life
LOS: Length of Stay
POD: Postoperative Day

AUTHOR INFORMATION

Dr. (Prof.) Richa Jaiman: M.S, FIAGES, Professor
Dr. Shivli Srivastava: MBBS, MS, Junior Resident 3
Dr. Bhavana Verma: M.S. FIAGES, Associate Professor
Dr. Prof. Punit Srivastava: M.S., M.Ch. (Pediatric Surgery), Professor

AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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None

ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a re-asonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research diretions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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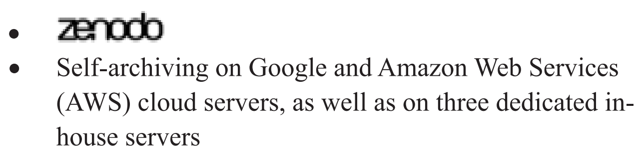
- 
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[2]CSIR-National Botanical Research Institute, Lucknow, India

HANDLING EDITOR

Dr. Dinesh Kumar Verma
Research Assistant Professor, School of Allied Health Sciences, Boise State University, Boise, Indiana, USA
e-mail: dineshkumarverma@boisestate.edu

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