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Comparative Outcomes of Roux-en-Y Hepaticojejunostomy and Hepaticoduodenostomy Following Choledochal Cyst Resection

Dr. Prashant Lavania[1], Dr. Punit Shrivastva[2], Dr. Shyam Prakash Sahu[3]

[1]Professor, S. N. Medical College Agra Uttar Pradesh

[2]Professor, S. N. Medical College Agra Uttar Pradesh

[3]Senior Resident, S. N. Medical College Agra Uttar Pradesh

Abstract: ***Introduction: The two commonly practiced reconstruction methods post-excision are Roux-en-Y hepaticojejunostomy and hepaticoduodenostomy. This study aims to compare the outcomes of RYHJ and HD following choledochal cyst resection in terms of operative time, hospital stay, morbidity, and mortality. Material and Methods: A total of 60 patients diagnosed with choledochal cysts were enrolled and randomly assigned to undergo either RYHJ (Group A) or HD (Group B). Operative time, blood loss, postoperative pain, duration of hospital stay, total drain output, and complications such as bile leak, cholangitis and ileus. Statistical analysis was conducted to determine the significance of differences between the groups. Results: The mean operative time and intraoperative blood loss were significantly lower in the HD group (112 ± 10.64 minutes and 91.67 ± 9.13 ml) compared to the RYHJ group (171.67 ± 17.83 minutes and 175.33 ± 27.51 ml), p<0.001. Hospital stay was shorter in the HD group (8.37 ± 1 days) versus RYHJ (12.3 ± 0.88 days), p<0.001. Both groups exhibited comparable postoperative morbidity and no significant difference in mortality (p=0.093). Complication rates were similar, although the RYHJ group had fewer cases of ileus and obstruction. Conclusion: Both RYHJ and HD are effective reconstruction techniques post-choledochal cyst excision. HD offers advantages of shorter operative time, less intraoperative blood loss, and reduced hospital stay, while RYHJ demonstrates a slightly lower trend of postoperative obstruction-related complications.***

Keywords: hepaticoduodenostomy, Roux-en-Y-hepaticojejunostomy, Choledochal Cyst, biliary reconstruction, surgical outcomes.

1. Introduction

It is recommended that a Roux-en-Y anastomosis be used for the restoration of biliary enteric continuity following choledochal cyst excision. This is because it is associated with fewer complications, such as cholangitis and anastomotic leaks1. Excision of the cyst is often the treatment of choice for choledochal cysts; however, the biliary enteric continuity can be achieved by a variety of restoration procedures.2. The hepaticojejunostomy (HJ) anastomosis with a Roux-en-Y limb is the method of choice for some surgeons, while others choose for the hepaticoduodenostomy (HD) reconstructive method whenever possible. Advocates of the use of HJ anastomosis assert that it has less consequences of bile leak, which is made possible by reduced stress on the suture line by the Roux limb. Additionally, it allows for enteric diversion away from the biliary tree, which helps to prevent cholangitis once the procedure has been completed.3 One of the advantages of HD is that it requires less intestinal manipulation, which results in a quicker recovery of bowel function. Additionally, HD has a shorter operational duration since it only requires one anastomosis, in contrast to a jejunal reconstruction, which requires three.4. It is believed that the use of the duodenum as a conduit for anastomosis results in a higher incidence of reflux, which in turn leads to a higher incidence of postoperative cholangitis, anastomotic stricture, and in some cases, the development of cancer5. There is a significant correlation between the ascending transit of enteric bacteria to the biliary system and the occurrence of cholangitis during biliary reconstruction. Enteric diversion from the biliary tree is made possible by a Roux-en-Y HJ, which makes advantage of a lengthy limb that has been defunctionalized. There is a direct passage of enteric bacteria from the duodenum to the biliary system, which is the reason why a duodenal conduit for HD is thought to have a greater incidence of cholangitis. In order to give an explanation for ascending cholangitis in rat models, Hsieh et al6 used Escherichia coli bacteria that were introduced using gel electrophoresis into the biliary enteric conduits.

In the process of biliary reconstruction, the utilisation of the duodenum offers a number of benefits, including reduced surgical timeframes and a reduced risk of leaks due to the utilisation of a single anastomosis process. One of the conditions for a safe HD is that the duodenum must be adequately mobilised in order to be able to reach the stump of the common bile duct in order to perform an anastomosis that does not involve any stress. In the event that there is tension in the anastomosis, the procedure should be modified to HJ7 since it is very contraindicated.

Patients who underwent HJ anastomosis had a complication rate of 25%, according to a 15-year analysis conducted by Silva-Baez et al2 in 2015. This is in comparison to patients who had HD anastomosis, which had a rate of 16.6%. Cholangitis, leak, and surgical reflux are instances of complications that may arise. In the course of their research, they have not discovered any fatalities, and they advocate for the utilisation of the duodenum as a more secure option that presents less difficulties than the Roux limb reconstruction technique.2.

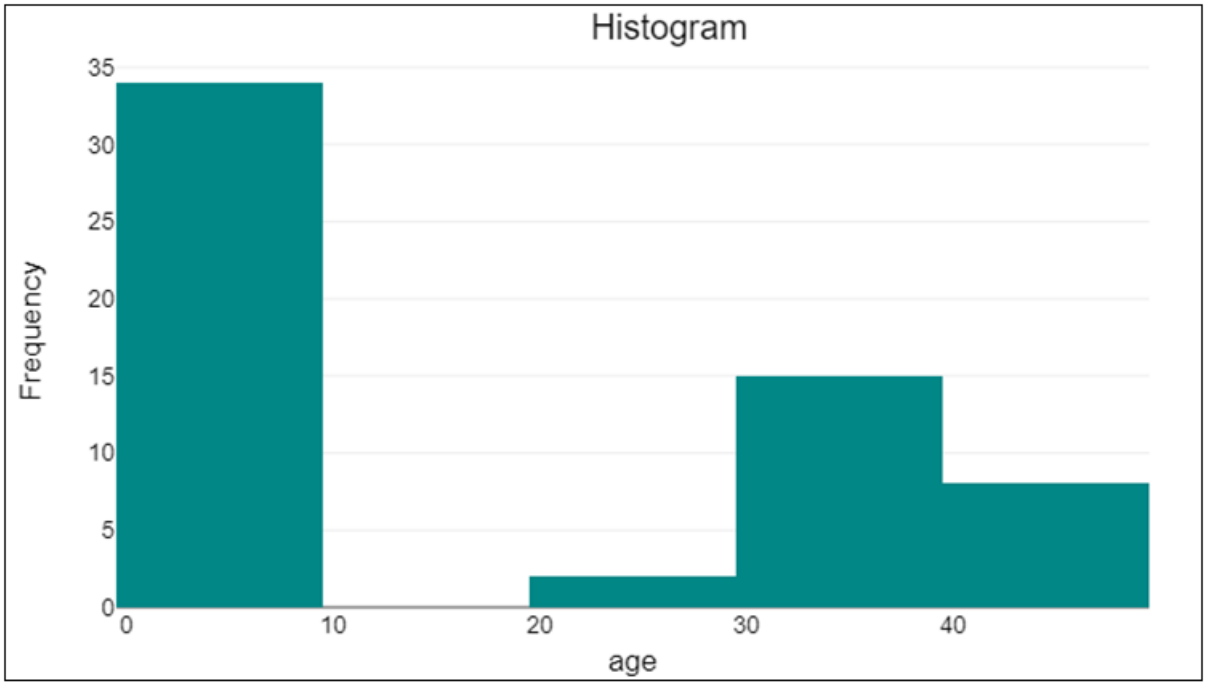
2. Methodology

- Design: Prospective comparative study
- Duration: Study was Conducted from September 2022 – June 2024
- Setting: Department of Surgery, SN Medical College, Agra
- Sample: 60 patients (randomized into two groups: 30 RYHJ, 30 HD)
- Inclusion Criteria: Patients aged 3 months–50 years with types I/II/IV choledochal cysts
- Exclusion Criteria: Type III/Caroli's disease, associated anomalies, or unfit for surgery

3. Results

	age
Mean	17.29
Std. Deviation	17.38
Minimum	4 months
Maximum	49 years
95% Confidence interval for mean	12.76 - 21.82

The mean age in the present study was 17.29 +/- 17.38 years

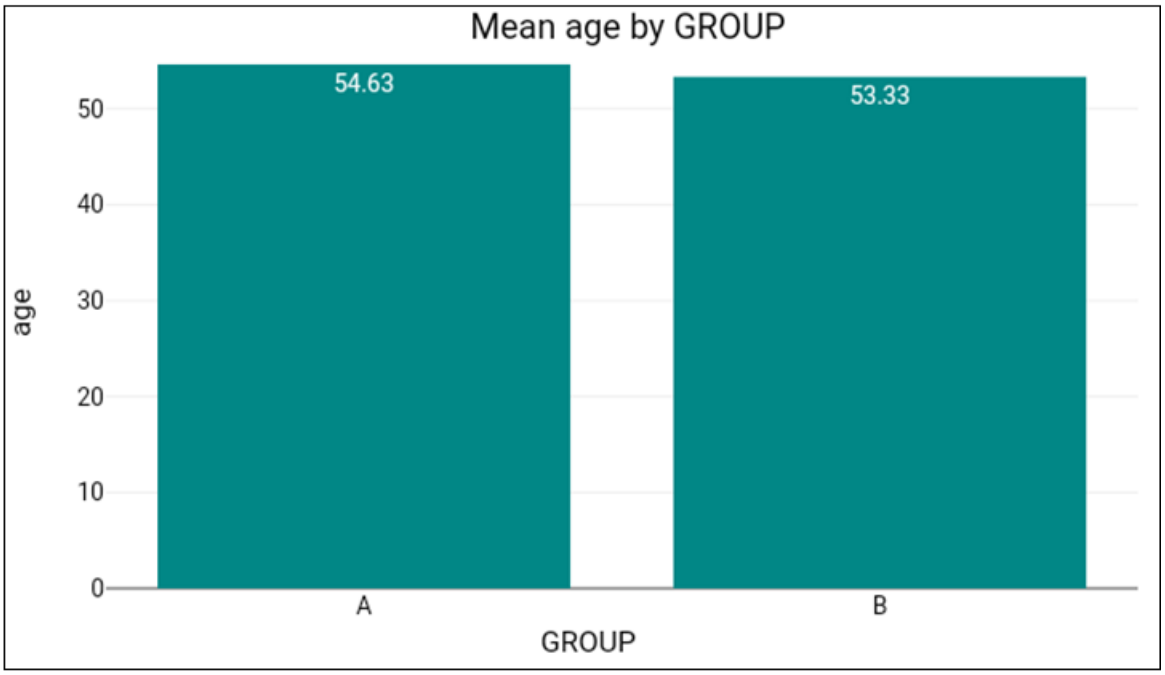


There was no difference in the mean ages between the two groups.

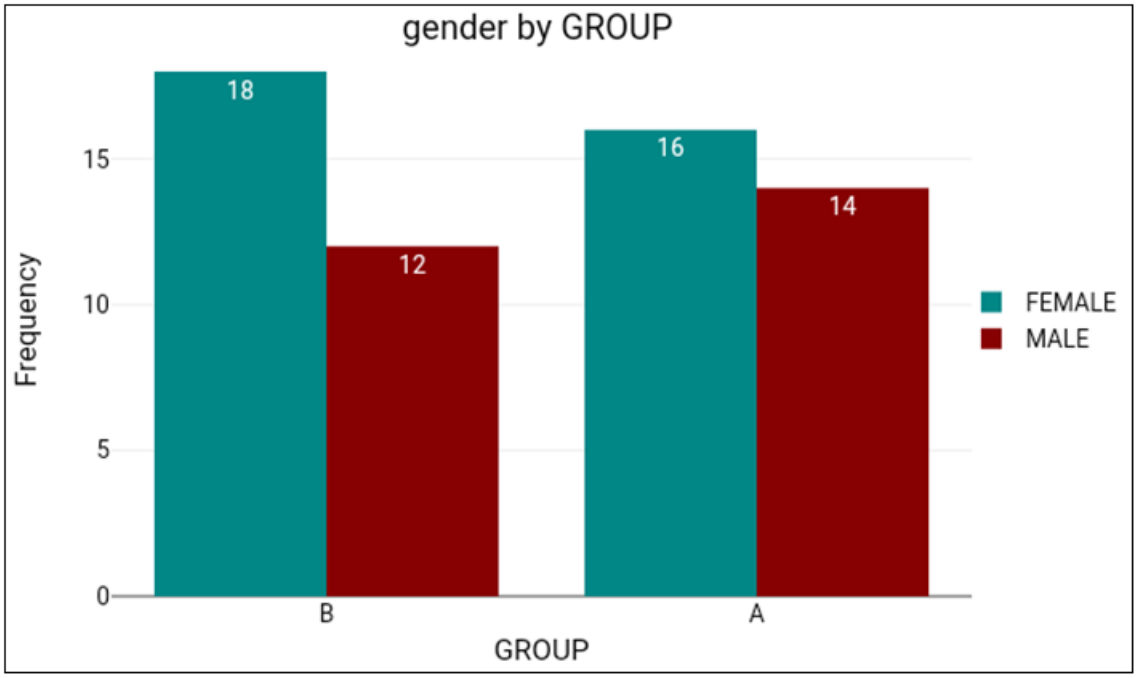
		Frequency	%	Mean ± Std.
Age	B	30	50%	53.33 ± 13.35
	A	30	50%	54.63 ± 10.53

t-test comparison of means

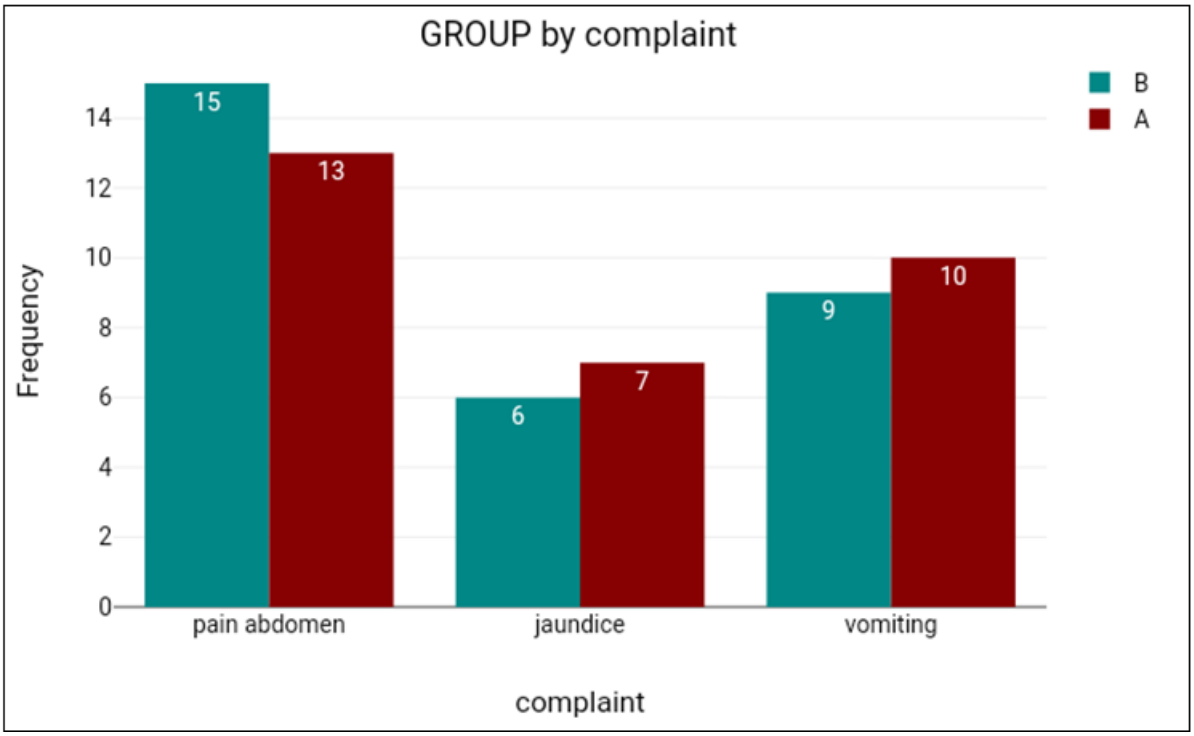
		t	df	p	Cohen's d
age	Equal variances	-0.42	58	0.677	0.11
	Unequal variances	-0.42	55.01	0.677	0.11



		GROUP		
		B	A	Total
Gender	Female	18	16	34
	Male	12	14	26
	Total	30	30	60



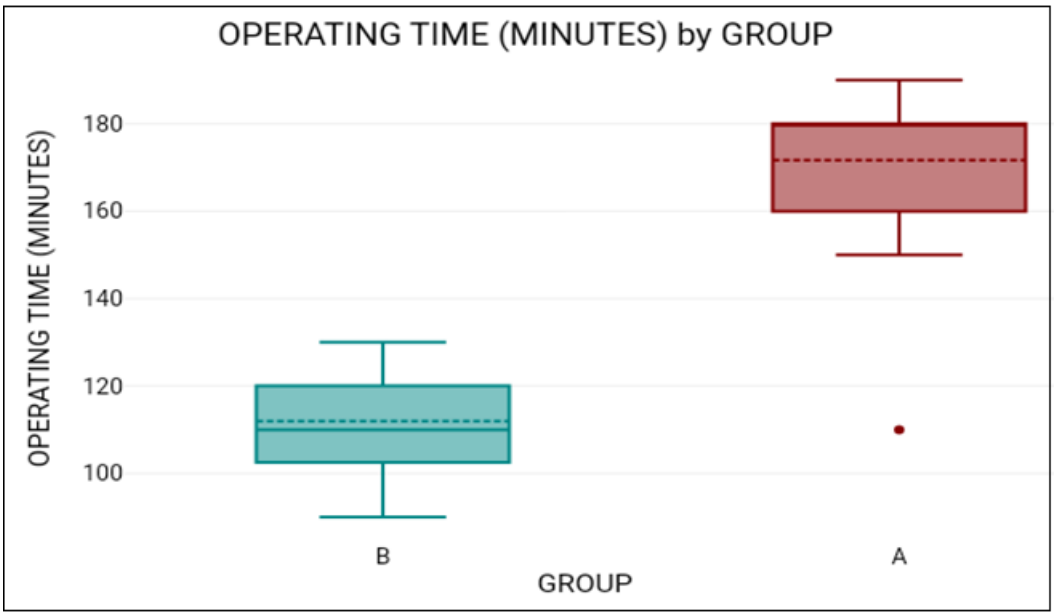
		Complaint			
		Pain Abdomen	Jaundice	Vomiting	Total
Group	B	15	6	9	30
	A	13	7	10	30
	Total	28	13	19	60



		n	Mean	Std. Deviation	Std. Error Mean
Volume of Blood Lost in Surgery (ML)	B	30	91.67	9.13	1.67
	A	30	175.33	27.51	5.02

		t	df	p	Cohen's d
Volume of Blood Lost in Surgery (ML)	Equal variances	-15.81	58	<.001	4.08
	Unequal variances	-15.81	35.31	<.001	4.08

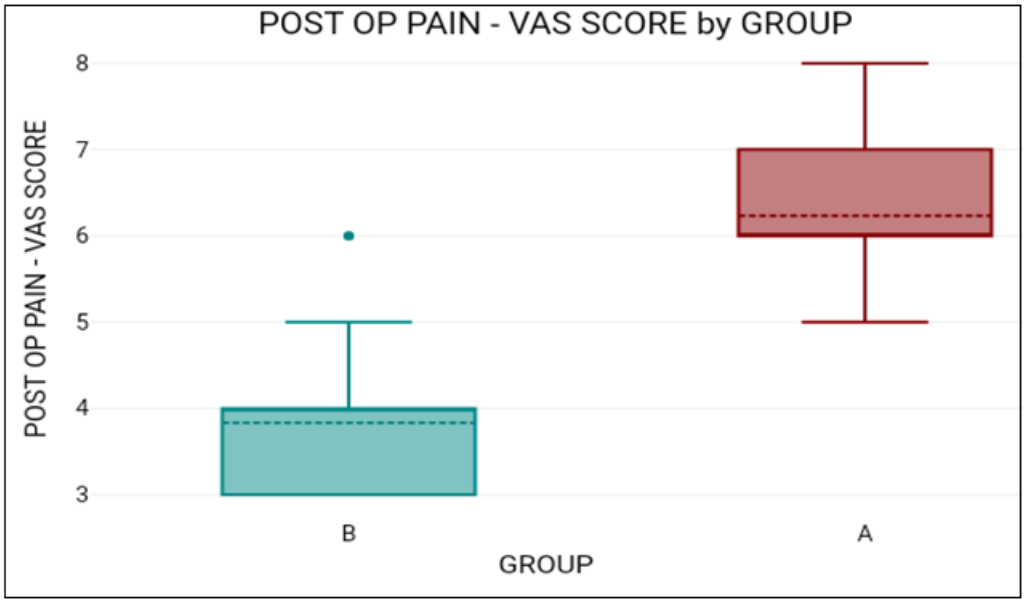
		n	Mean	Std. Deviation	Std. Error Mean
Operating Time (Minutes)	B	30	112	10.64	1.94
	A	30	171.67	17.83	3.25



		t	df	p	Cohen's d
Operating Time (Minutes)	Equal variances	-15.74	58	<.001	4.06
	Unequal variances	-15.74	47.32	<.001	4.06

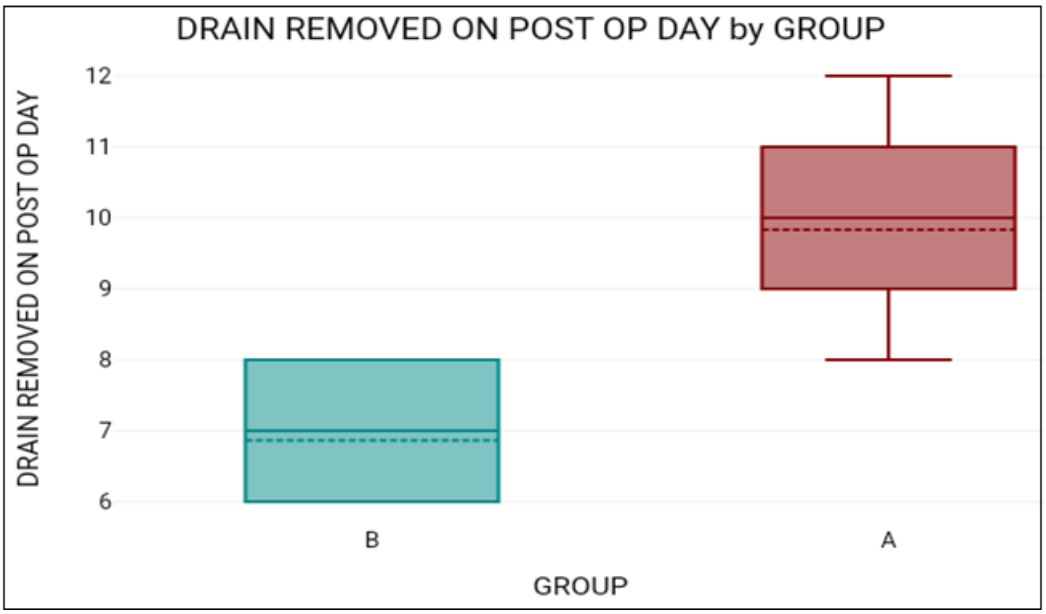
		n	Mean	Std. Deviation	Std. Error Mean
Post OP Pain - VAS Score	B	30	3.83	0.83	0.15
	A	30	6.23	0.9	0.16

				t	df	p	Cohen's d
Post OP Pain - VAS Score	Equal variances			-10.73	58	<.001	2.77
Unequal variances	-10.73	57.69	<.001	2.77			



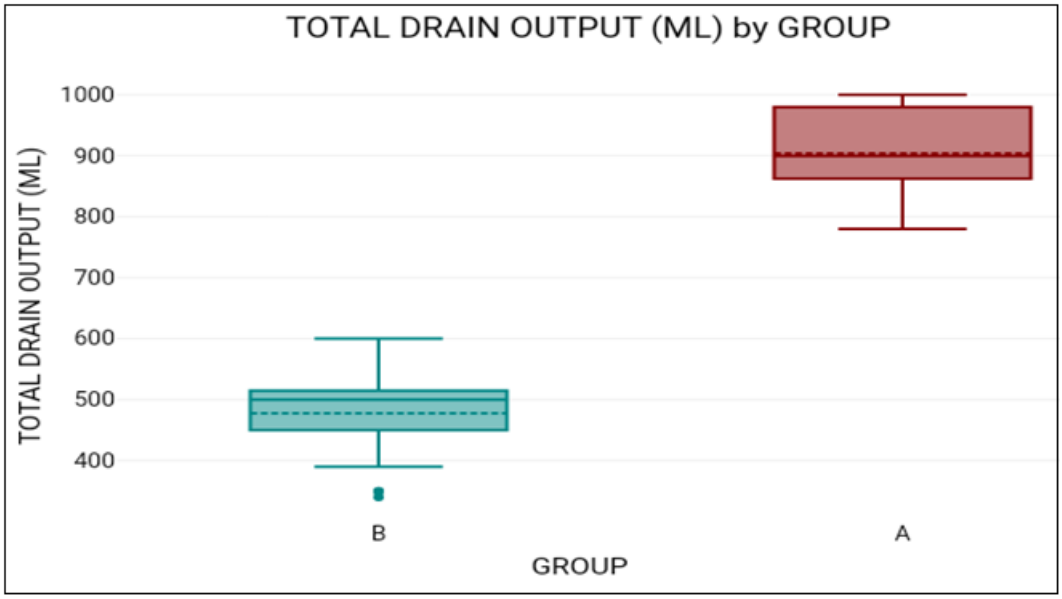
		n	Mean	Std. Deviation	Std. Error Mean
Drain Removed on Post OP Day	B	30	6.87	0.86	0.16
	A	30	9.83	1.02	0.19

		t	df	p	Cohen's d
Drain Removed on Post OP Day	Equal variances	-12.18	58	<.001	3.14
	Unequal variances	-12.18	56.4	<.001	3.14



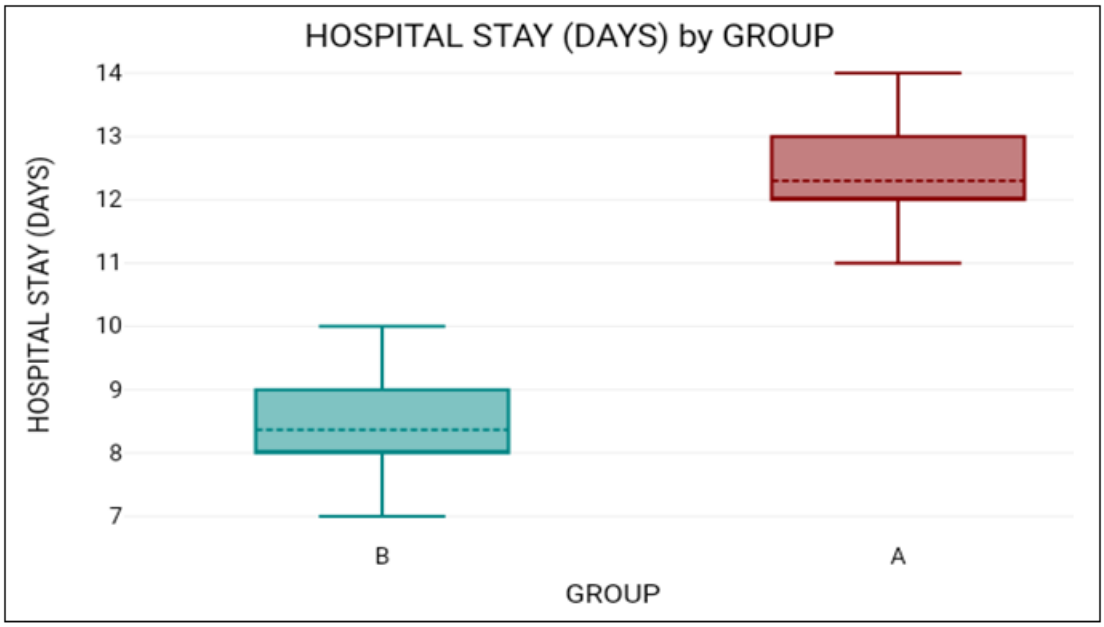
		n	Mean	Std. Deviation	Std. Error Mean
Total Drain Output (ML)	B	30	477.33	67.31	12.29
	A	30	903.67	78.85	14.4

		t	df	p	Cohen's d
Total Drain Output (ML)	Equal variances	-22.52	58	<.001	5.82
	Unequal variances	-22.52	56.61	<.001	5.82

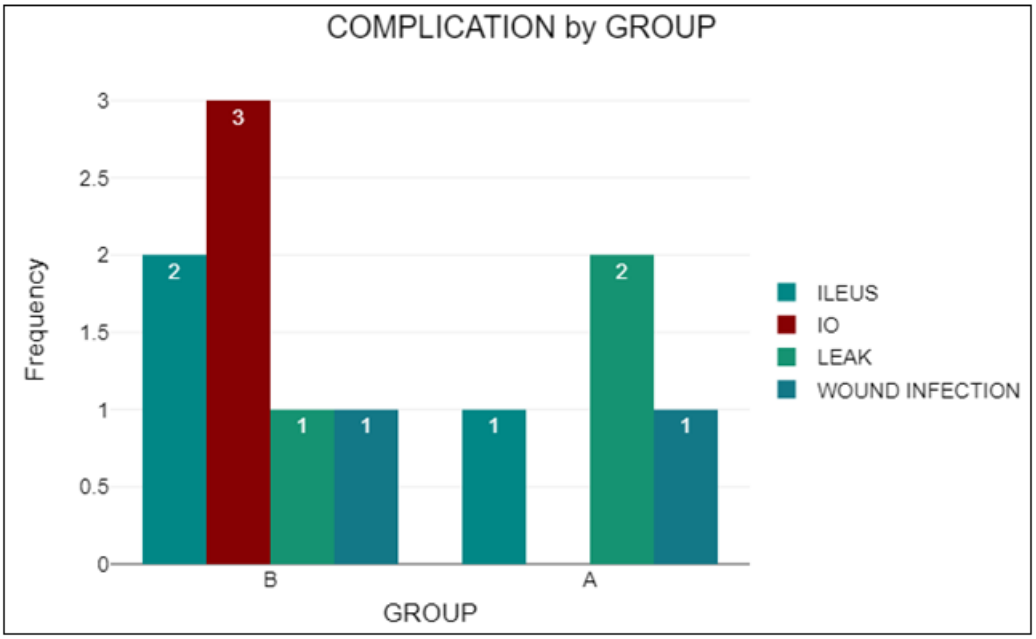


		n	Mean	Std. Deviation	Std. Error Mean
Hospital Stay (Days)	B	30	8.37	1	0.18
	A	30	12.3	0.88	0.16

		t	df	p	Cohen's d
Hospital Stay (Days)	Equal variances	-16.2	58	<.001	4.18
	Unequal variances	-16.2	57.04	<.001	4.18



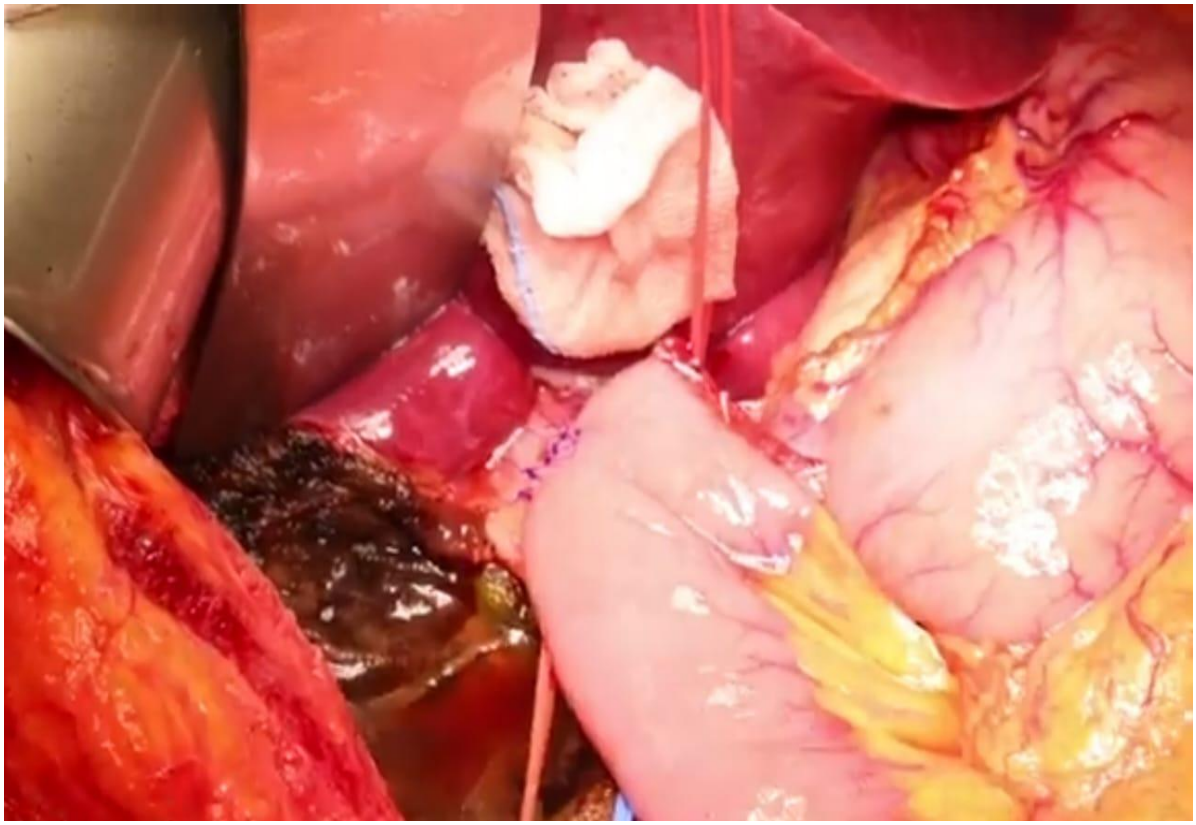
		Group		
		B	A	Total
Complication	ILEUS	2	1	3
	IO	3	0	3
	Leak	1	2	3
	Wound Infection	1	1	2
	Total	7	4	11



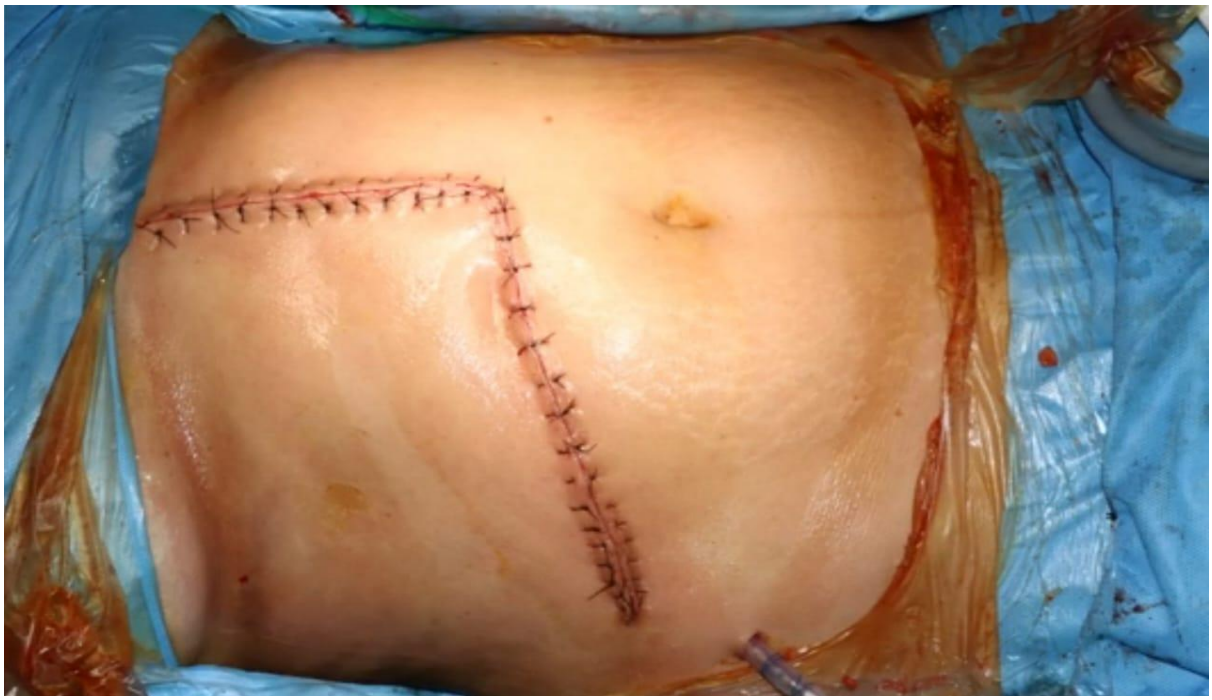
		Mortality		
		No	Yes	Total
GROUP	B	27	3	30
	A	28	2	30
	Total	55	5	60

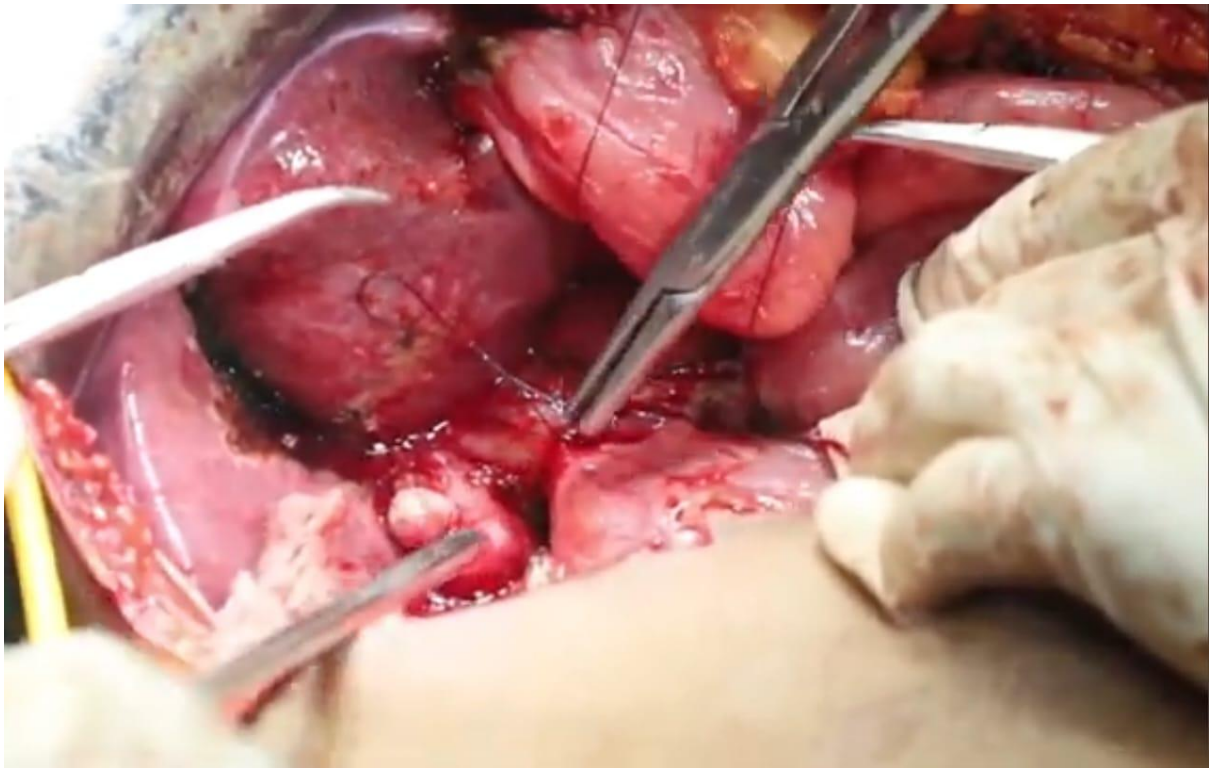
	Chi^2	df	p
Group - Mortality	2.82	1	0.093

No Difference in Post-Operative Mortality



Intraoperative picture of Roux- en- Y hepaticojejunostomy showing anastomosis between hepatic duct and jejunal limb





Intraoperative picture of hepaticodudenostomy showing anastomosis between hepatic duct and duodenum

4. Discussion

The incidence of CC in the western population is estimated to be 1 in 100/150,000 live births [6], and it is additionally more commonly reported in Asian nations, notably in Japan [7,8,9,]. Various hypotheses have been proposed to elucidate the aetiology of CC. The notion of common pathways proposed by Babbitt is well recognised [10]. The concurrent presence of biliary and pancreatic juice initiates the activation of pancreatic enzymes, resulting in the inflammation and enlargement of the biliary duct wall. Within this particular setting, the long common channel is established in a subjective way, with the authors defining it as varying between 10 mm and 45 mm [11,12]. Forme Fruste CC offers empirical support for the APBJ hypothesis about the formation and issues of CC. Nevertheless, APBJ is present in 50-80% of those diagnosed with CC. The number 18 is enclosed in square brackets. Singham et al. ascribed the expansion of the central canal (CC) to the overproduction of epithelial cells during the cannulation phase of embryogenesis [11]. Davenport and Basu observed a notable insufficiency of neurones and ganglions in the CC . Their concept posits that spherical cysts are congenital and that the blockage induced by aganglionosis is comparable to Hirschsprung's disease. Authors also suggest that fusiform dilations occur due to acquired arterial posterior cerebral blood flow. Komi et al. have classified three types of ABPJ according to their pathophysiology: (i) A right-angled union, which is connected to the cystic dilatation of the common bile duct (CBD), (ii) An acute-angled union, which is related to the fusiform dilatation of the CBD, and (iii) A right/acute-angled union with an auxiliary pancreatic duct.

The mean age of the study population was 17.29 +/- 17.38 years, with no difference between both groups. Ray et al observed that the average age at presentation in group A was 5.4 years, while in group B it was 4.8 years, which was lower than the results of the current study.

The prevalence of this disease is commonly shown to be higher in females, with a female to male ratio of 3-4:1 [1,4,8]. However, the current study shows that the sex ratio is equal, with a ratio of 1.4:1. The likely reason for the decline in female enrollments can be ascribed to the diminished significance placed on female children.

Two procedures of hepaticoenterostomy that have become popular are RYHJ and HD. Despite attempts to implement appendix interpositioned hepaticoenterostomy in several medical facilities, it did not gain widespread acceptance. The appendix experienced stenosis, resulting in biliary obstruction and the formation of hepatic fibrosis . RYHD is often regarded as the top procedure in numerous centres, whereas HD remains a straightforward and uncomplicated technique. We conducted a comparative analysis of the benefits and drawbacks of both techniques in order to select the most suitable strategy for biliary regeneration following the removal of CC. The duration of surgery and the length of time under anaesthesia have a significant impact on the occurrence of complications and death after surgery, particularly in infants and young children.

The average bleeding was less in the HD group, with a mean of 91.67 +/- 9.13 ml, compared to the RYHJ group, which had an average bleeding of 175.33 +/-27.51 ml. The observed difference is statistically significant ($p < 0.001$) and represents the primary advantage in the HD group.

The average duration of operative was 112 +/- 10.64 minutes in HD vs 171.67 +/-17.83 minutes. The difference between was groups was significant (<0.001) Ray et al. observed that the HD group had a shorter average operating time of 1 hour

and 25 minutes, compared to the RYHJ group, which had an average working time of 2 hours and 10 minutes. The observed difference is statistically significant (p=0.006) and represents the primary benefit in the HD group.

The occurrence of postoperative complications is contingent upon factors such as the medical facility, the patient's age, and the nature of the surgical intervention. Anastomotic stricture is observed in 4.1% of cases following bilioenteric anastomosis for CC, however, none of our patients encountered anastomotic stricture. A wide connection was created between the colon and the hilum of the liver. The present investigation found that ileus was more prominent in the HD group compared to the RYHJ group, however this disparity did not achieve statistical significance. Shimotakahara et al. found that 33.3% of HD patients experienced duodenogastric bile reflux, and they suggested using RYHJ for bilioenteric anastomosis.

Our study revealed a greater occurrence of anastomotic leak in the group that had Roux-en-Y hepaticojejunostomy (RYHJ) compared to the group that underwent hepaticojejunostomy with a hepatic duct (HD). During the patient's follow-up in the RYHJ group, one instance of adhesion bowel obstruction was discovered, compared to one case observed in the HD group. Shimotakahara et al. detected this issue in 7.1% of the patients in the RYHJ group, but none of the patients in the HD group encountered it.

5. Conclusion

Choledochal cyst is a rare anomaly of the biliary tree, first described by Todani et al. Since then, extensive research has been performed. We observed that hepaticoduodenostomy has lesser operative time, lesser bleeding and overall hospital stay. While RYHJ has a longer hospital stay, the complications of ileus and obstruction were lesser in prevalence**.**

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APPENDIX-5

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