



Outcomes of Hepaticoduodenostomy over T-tube against Roux-en-Y Hepaticojejunostomy to Restore Bilio-enteric Continuity after Choledochal Cyst Excision in Children

Vinit Kumar Thakur¹ , Ramdhani Yadav¹, Digamber Chaubey¹, Rupesh Keshri¹, Zaheer Hasan¹, Vijayendra Kumar¹, Ramjee Prasad¹, Rakesh Kumar¹, Sandip Kumar Rahul^{1*} 

¹Department of Paediatric Surgery, Indira Gandhi Institute of Medical Sciences, Patna

***Address for Corresponder:** Dr. Sandip Kumar Rahul, Department of Paediatric Surgery, Indira Gandhi Institute of Medical Sciences, Patna (email: sandeep.rahul65@gmail.com)

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Abstract

Introduction: Any surgical procedure which would restore the bilio-enteric continuity after excision of the choledochal cyst with minimal complications would be a feasible alternative to Hepaticojejunostomy using a Roux loop of jejunum. To determine the outcomes of Hepaticoduodenostomy done over T-Tube against Roux-en-Y Hepaticojejunostomy for bilio-enteric reconstruction after excision of choledochal cyst.

Materials and Methods: This study was retrospectively done on all patients of choledochal cysts (Types 1 and 4) operated between January, 2014 and December, 2019. The clinical details, intra-operative and post-operative results of patients who underwent Roux-en-Y Hepatico-Jejunostomy (Group-1) and Hepatico-duodenostomy over T-Tube (Group -2) for establishing bilio-enteric continuity after excision of choledochal cyst were compared and analyzed statistically.

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Keywords

- Choledochal cyst
- Hepaticoduodenostomy
- T-Tub

Results: 78 patients of choledochal cysts were operated during this period with 31 patients in Group-1 and 47 in Group-2; there was no difference in the mean age or size of the cysts in the two groups; Type 1 cysts were the most common with female preponderance in both groups.

Group-2 patients had lesser intra-operative time and fewer numbers of sutures were used during surgery. There was no difference in the incidence of anastomotic leaks, strictures, cholangitis or adhesive obstruction and reoperation rates between the two groups. Group 2 showed increased nasogastric bilious aspirates in 19.15% of cases which improved on conservative management.

Conclusion: Bilio-enteric reconstruction using Hepaticoduodenostomy over T-Tube is a simpler, lower pressure and less time taking anastomotic technique with comparable complication rates when compared to Roux-en-Y Hepaticojejunostomy in the management of choledochal cysts.

Introduction

Surgical management of Choledochal cyst (CDC) is complex and determined by the type of CDC. The most common types of CDC – type 1 and 4 are managed by excision of CDC and re-establishing bilio-enteric continuity by anastomosing the healthy biliary channel to a bowel loop. This can be variously done by using either a Roux loop of Jejunum or the duodenum (open or laparoscopic methods). Several investigators have compared the two approaches and most of them have favored Hepatico- jejunostomy using Roux loop of jejunum (HJ).^{1- 3} At our center, two different units practice two different procedures; one of the two units does open HJ, while the other does open hepaticoduodenostomy (HD) to restore

bilio-enteric continuity after CDC excision. In the unit performing HD, two patients had anastomotic leak which was very difficult to manage and increased the morbidity and hospital stay of those patients. So, this unit now practices a modified HD technique where a low-pressure anastomosis is fashioned over a T-tube ensuring its further protection. We present a comparative study between all our patients who had this modified HD over T- tube and those who had a Roux-en-Y HJ.

Materials and Methods

This was a retrospective study that was conducted on all patients of type 1 and type 4 choledochal cysts operated in the

department of Pediatric Surgery at a tertiary care center from January, 2014 to December, 2019 after taking clearance from the institutional ethics committee. All other types of choledochal cysts (Types 2, 3 and 5) and cases which presented with perforation of the choledochal cysts were excluded from the study.

At our center, patients of CDC are randomly allocated to one of the two units for surgical management. One unit performs open HJ after CDC excision and all these patients constituted Group 1. The other unit does open HD over a T-Tube after CDC excision and all patients operated by this technique constituted Group 2. While allocation of patients, a simple rule was followed that patients presenting to a particular unit's outpatients' care would be operated by the same unit. This also was the reason for the different number of patients in the two groups.

To calculate the sample size, search was done for similar comparative study in literature. In one such study, Liem et al., reported operative time of 220 ± 60 minutes and 164 ± 51 minutes for HJ and HD groups, respectively.³ Considering an alpha error of 0.05 and power of 80% and using the values of mean, standard deviation and percentage of decrease in operative time (25.45%) from this data, we got a sample size of 36 (18 for each group). Considering a 10% loss to follow-up, we calculated a sample size of 20 for each group. So, we planned to compare at least 20 patients in each group.

Operative records of patients were recovered from the monthly operative census and hospital medical records. A total of 78 patients were included in the study. The patient characteristics (including age at the time of surgery, sex, type of choledochal cyst on Magnetic Resonance Cholangiopancreatogram (MRCP), size of choledochal cyst); intraoperative parameters (like size of the cyst during surgery, operative time, blood loss, any significant intraoperative complication; number of sutures used); Postoperative findings (including number of days for drain removal, number of days for start of oral feeding, wound infection, anastomotic leak, number of days of hospital stay, postoperative adhesion, cholangitis, any anastomotic stricture in long term follow-up, cosmetic aspects, evidence of malabsorptive symptoms, diarrhea, malnutrition) and overall cost of surgery were compared between the two groups. Patients were followed up in the outpatient's department (three-monthly in the first year, six-monthly for next two years and yearly thereafter for five years). In case of any symptoms, they were advised to follow-up any time. Abdominal ultrasound at six months and liver function tests (LFT) at three months were routinely done in all patients; any symptomatic patients (fever, abdominal pain, altered LFT, raised total leukocyte counts) were subjected to Hepatobiliary Iminodiacetic Acid (HIDA) scan to confirm anastomotic patency.

Data thus collected was analyzed.

Protocol for management of Choledochal cyst at our Institute

All patients who presented with a diagnosis of CDC on abdominal sonogram for the evaluation of symptoms like abdominal pain, jaundice, fever or lump abdomen were further evaluated by MRCP to elucidate the CDC type and guide further surgical management. Simultaneously, all routine laboratory tests like complete blood counts, LFT and renal function tests were done. After

pre-anesthetic evaluation and proper counseling, patients were taken up for surgery which included excision of CDC and restoration of bilio-enteric continuity by either a Roux-en-Y HJ or HD over a No. 10 Fr T-Tube, depending on the concerned unit in which they were admitted. While performing HD over T-Tube, complete Kocherization of the duodenum was done after cyst excision. Site of anastomosis was chosen distal to the normal location of ampulla in the second part of duodenum **Figure1**.

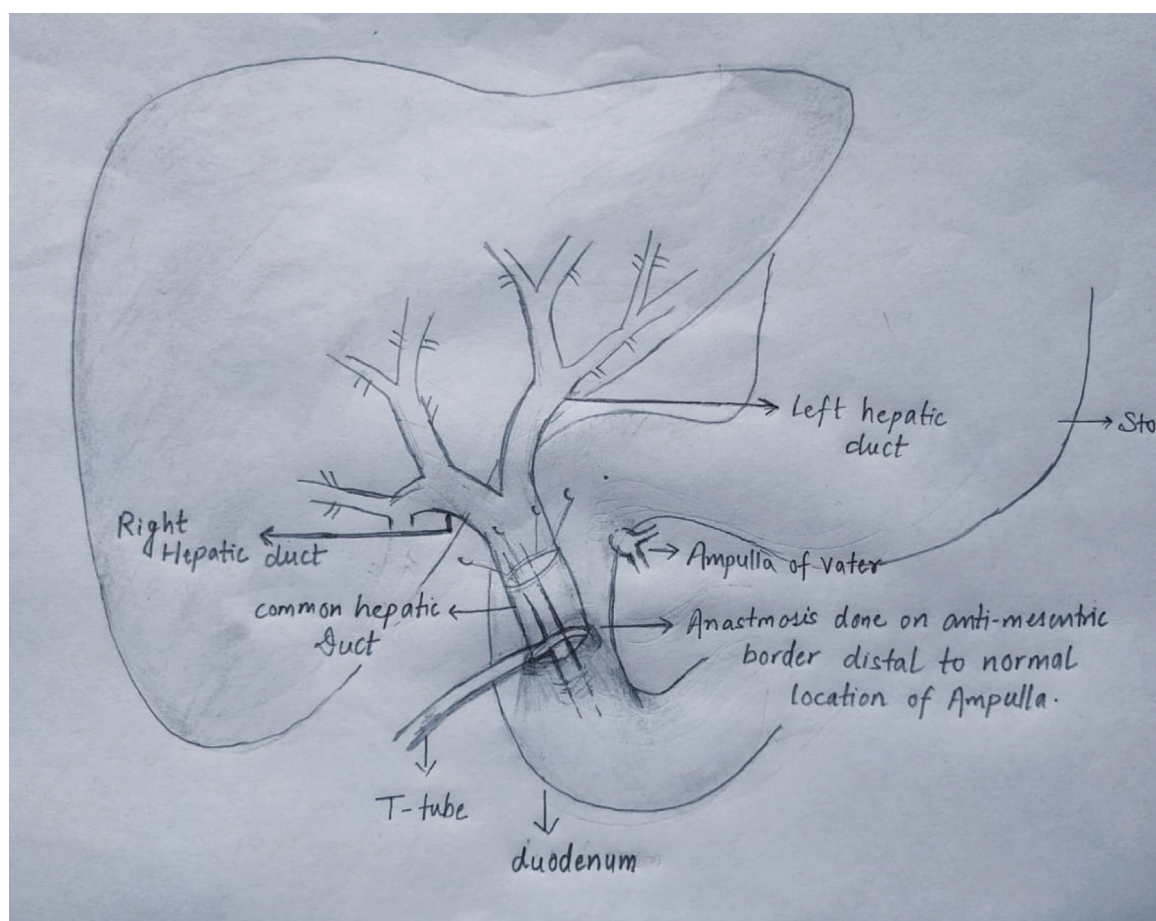


Figure 1: Sketch showing site and method used to fashion HD over T-Tube after excision of CDC

While dissection of the distal portion of the CDC, a small caliber cannula or feeding tube was inserted to flush the distal end and also to have an idea of the location of the ampulla in the duodenum. After taking the posterior sutures, T-tube was inserted with one limb in biliary

channel and the other in the duodenum. Then, anterior layer was completed keeping T-Tube in dependent position **Figure 2**. Kocherization of the duodenum made this anastomosis easy and tension-free without any kink. A subhepatic drain and wide caliber nasogastric tube was introduced before closure of wound.

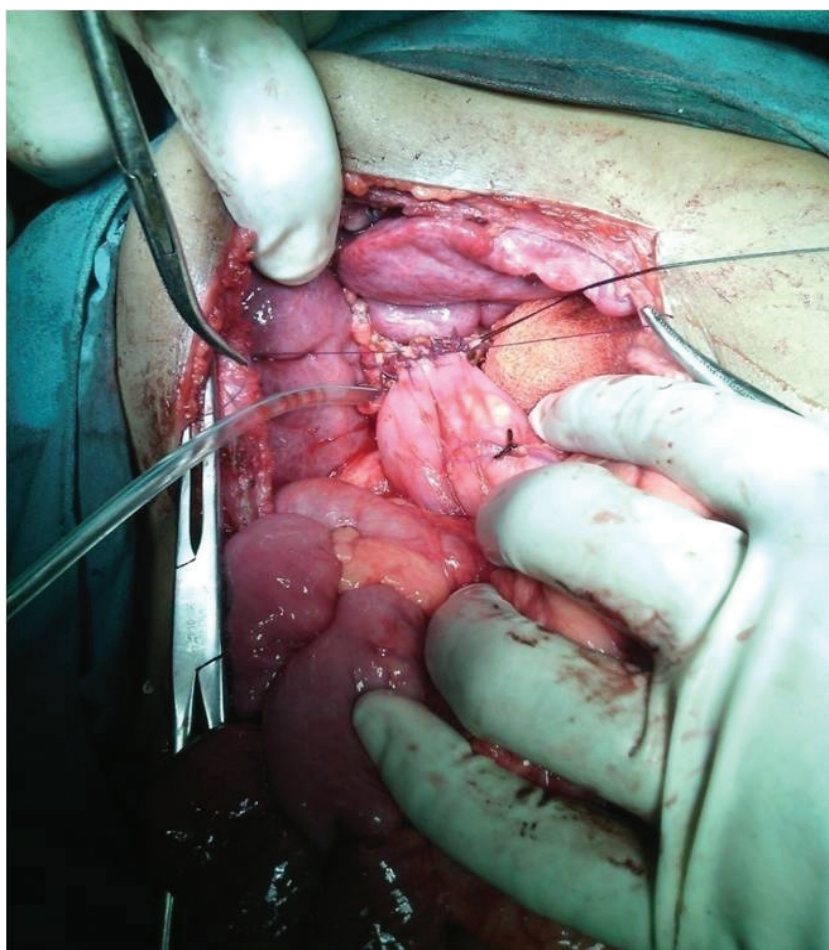


Figure 2: Intra-operative picture of completed HD over a T-Tube after excision of CDC

In the peri-operative period, patients were transfused blood products as per need and managed on intravenous (I.V.) fluids, antibiotics and analgesics. Patients were allowed oral intake when nasogastric tube

output lessened and bowel movements normalized.

Patients with HD over T-tube needed clamping of the T-tube once bowel movements were normal and they

tolerated oral feeds. These patients were discharged with a clamped T-Tube coiled neatly underneath a strap dressing and on oral medications. T- Tube was removed after three weeks of surgery at the time of first follow-up. Thereafter, follow-up of these patients was done at three months interval during first year and six monthly thereafter for 2 years and yearly after that. Liver function tests were done after three months and hepato-biliary sonogram after six months of surgery. HIDA scans were done in selected patients who either had some abnormality in sonogram or liver function tests or had suspicion of cholangitis.

Summary statistics were presented in the table as mean quantitative variable and as

n% for categorical outcome. Check for homogeneity of sample population and normality assumption was performed. Chi square test was used to compare proportions and t-test to compare the difference in averages. Statistical significance was based on $p\text{-value} \leq 0.05$.

Results

A total of 78 patients of CDC were operated during this period. Among these 31 belonged to Group 1 and had Roux-en-Y HJ after cyst excision; 47 belonged to Group 2 and had HD over T-Tube. **Table 1** gives the details of the patients presenting in these two groups.

Table 1: Demographic characteristics and clinical presentation of 78 patients who underwent excision of choledochal cyst and reconstruction.

Parameter	Group 1 (Roux-en-Y HJ) 31	Group 2 (HD over T-Tube) 47	P value	Mean Difference ±SE (95% CI)
No. of patients (78)	31	47		
Age (months)	33	38		
Gender				
Male	12	16	0.6741	Not applicable
Female	19	31		
Type of Cyst				
1	27	43	.3916	Not applicable
4	4	4		
Size of cyst in mm (Mean)	62.71 (range 36-124)	63.95 (range -32-122)	0.8013	-1.25 ± 4.95 (-11.11-8.61)
Operative time in min (Mean)	161.65 (range 129-190)	113.21 (range 96-131)	P<.0001*	48.44± 3.130 (45.2056-54.675)
No. of sutures used for anastomosis(Mean)	Vicryl sutures - 5(range 4-6)	Vicryl -3(range 3-4)	<.0001*	1.66±0.147 (1.36-1.95)
Hospital Stay in days	9.26	11.87	<0.0001*	-2.61±0.349

(Mean)				(-3.306 to -1.91)
No. Of Post op. Days when i.v. fluids were given (mean)	7.41	7.49	0.7313*	-0.07±0.203 (-0.474to 0.33)

*t -Test significant at 5% level

Patients in the two groups were comparable in age at the time of surgery and females outnumbered males in both these groups. Type 1 variety of CDC was the commonest CDC type operated upon during the period of the study. However, there was a great variability in the range of the age of the patients at presentation. Some of them presented as infants, while some presented as late as 12years. Youngest patient in Group 2 was

3.5months old; anastomosis (HD) over 10 Fr T-Tube could be easily done because we cut a linear segment of the T-Tube opposite to the long limb to ensure its easy insertion. Mean follow-up time of patients was 31months in our study.

Table 2 compares the intra-operative and post-operative results of 78 patients who underwent excision of CDC and reconstruction

Table 2: Intra-operative and Post-operative complications

Parameter	Group 1 (Roux-en-Y HJ) 31	Group 2 (HD over T-Tube) 47
Mortality	0	0
Morbidity		
Intra-operative major complication	Nil	Nil
Anastomotic leak	Nil	Nil
Post operative bilious nasogastric output	Nil	Significant in 9 (19.15%)
Post operative adhesion/obstruction	1	Nil
cholangitis	2(6.4%)	1 (2.1%)
Anastomotic stricture	Nil	Nil
Malnutrition (Anthropometric measurement & Serum Protein)	6 (All improved at one year after surgery)	8 (All improved at one year after surgery)

There was no significant difference in the postoperative complications like anastomotic leak, anastomotic stricture, adhesive obstruction or cholangitis. A significant incidence of increased nasogastric bilious output was seen in 9/47 (19.15%) of patients in HD over T-Tube group. These aspirates settled conservatively and on follow-up none of these nine patients have experienced any other symptoms suggestive of reflux gastritis. In 41/47 of these, anastomosis was distal to location of ampulla in distal second part of duodenum.

No T-Tube specific complication was observed in the HD over T-Tube group. T-Tubes could be easily pulled out after three weeks of surgery in all patients.

HIDA scan was not done in all patients due to cost constraints and was done only in selected patients (total seven in number), who had either suspicion of cholangitis (two in HJ group and one in HD group); altered LFT (raised alkaline phosphatase in three HD patients and in one HJ patient). In all seven patients, patency was confirmed on HIDA scan. On Ultrasound – abdomen, only two of these seven patients showed dilatation of intrahepatic biliary radicles with evidence of sludge in one patient and pneumobilia in another patient.

14/78 (17.95%) patients were malnourished at presentation (six in Group 1 and eight in Group 2) represented by weight below two standard deviations on WHO growth chart; all of these patients gained weight at one year follow-up after surgery.

Discussion

The choice between HJ and HD to restore bilio-enteric continuity after excision of CDC has been a matter of debate since a very long time.^{1,2} Several investigators have argued against HD claiming it to be associated with increased incidence of cholangitis and biliary gastritis and that such complication with traditional HJ is rare.^{3,4} On the other hand, HD appears to be more physiologic as the site of bilio-enteric anastomosis is the duodenum itself; unlike HJ, where a significant length of jejunum is lost in fashioning a Roux loop of adequate length to lessen the chances of cholangitis. Sufficient evidence now exists against the unnecessary anxiety about risks of cholangitis in HD patients.^{1,5 &6} Lesser operative time, fewer sutures and accessibility of the anastomotic site to endoscopy are a few other straightforward advantages of HD.⁷ The performance of HD saw a significant rise after the advent of laparoscopic surgery for choledochal cysts.^{7,8} This was because of the obvious reasons of ease of performance in lesser time and with fewer expenses towards the fewer number of sutures needed and fewer chances of postoperative adhesions.^{1,8} However, two very important risks particularly possible in the cases of HD needed to be addressed to. First one is the remote but possible risk of anastomotic leak in the cases of HD, and the second is the matter of biliary reflux and associated gastritis in these cases. Our modification of technique of doing HD over a T-tube

makes the anastomotic site a low-pressure zone, reduces edema at the anastomotic site, and promotes healing thereby lessening further the chances of leak.^{9, 10} This study is a comparison between HJ and HD over a T-tube done to achieve bilioenteric continuity after excision of CDC.

T-Tubes have been used for a long time in adult cases of surgery for stone in the common bile duct (CBD), and in those limited injuries of the common bile duct, where closure of the defect in CBD is done over a T-Tube.¹¹ While the clinical use of former has lessened after the advent of Endoscopic Retrograde Cholangiopancreatography (ERCP) with stenting and primary closure of the CBD after laparoscopic CBD exploration, the use of T-Tube in latter is still indicated as it has been a simple and effective option.^{11, 12} In a study by Xiao et al., stented closure of CBD after laparoscopic CBD exploration was better than primary closure or closure over a T-Tube, when comparing the operative time, biliary complications and return of liver function tests to normal.¹³ But, introducing a stent would subject the patient to another endoscopic procedure in the future. Although T-Tube has to be kept longer and as per our protocol is removed after 3 weeks of surgery, it has no other disadvantages and can be removed without any invasive procedure. Patients go home on full oral diet in the meantime. These advantages of T-tube in making the anastomotic region a low-pressure system by forming a controlled fistula ensures a complication-free healing process and can

be used in HD after CDC excision depending on this principle.

In a study by Sharma et al., correlation between Cyst size, intra-cystic pressure, backpressure changes on hepatic histology, levels of amylase and lipase in intra-cystic fluid, and cyst wall histology was reported.¹⁴ High pressure cysts tended to be smaller in size with comparatively more significant liver parenchymal changes on histology. By contrast, cysts with low intracystic pressures were comparatively larger and had higher levels of amylase and lipase to cause more damage to the cyst wall on histology.¹⁴ Keeping this important observation in consideration, we emphasize on the importance of keeping low intra-cystic pressure in not only lessening the pressure on the anastomosis in HD but also in maintaining the physiological flow of bile from liver towards the bowel, thereby lessening the backpressure changes on the liver parenchyma. A simple T-Tube insertion at the anastomotic site ensures such pressure characteristics in the lumen and in the liver.

In this study, out of a total of 78 patients, 31 underwent HJ while 47 had HD over a T-Tube. This difference is only due to the fact that more patients presented to the outpatient's department of the unit practicing HD over a T-tube. Similar trends in the choice of surgery have been observed in a meta-analysis of pediatric patients of CDC who have undergone either HJ or HD; the number of patients with HD outnumbered those who had HJ.¹ Patients belonging to the two groups

were of comparable age. In both the groups, Type 1 was the commonest type of CDC followed by type 4 which were only a few in numbers. The mean size of the lesion in both the groups did not show any statistical difference and were therefore comparable. Size and anatomy of CDC has an important role in determining the duration of dissection (surgery). On comparing the overall time required to complete the surgery, HD took shorter time than HJ to be completed and this difference was found to be statistically significant. This finding can be explained by the extra time needed for jejuno-jejunostomy during Roux loop construction. This also is the reason for extra sutures and increased cost of surgery in HJ. These findings are in line with the observation of several other investigators.^{2, 3 & 7}

An obvious advantage of HJ was reflected by the earlier discharge of these patients compared to the HD group. But we found that this was more due to the reluctance on the part of the surgeons in starting oral feeds early due to the presence of T-Tube in duodenum. We now routinely start oral feeds on 7th postoperative day in case of HD and discharge the patient as soon as they accept full oral diet after clamping T-Tube without any complications. None of our patients have had any problems after clamping the T-Tube and they go home with a clamped T-Tube neatly dressed and covered over the abdominal wall. There is no restriction in patient's mobility and none of the patients have pulled it accidentally. T-Tube is removed after 3 weeks of surgery as a day care procedure

when the patient turns up in the outpatient clinic.

No anastomotic leak or any significant intra-operative complication was noted in either of the groups. In long term follow-up, two patients in the HJ group had cholangitis while this complication was found in only one patient of HD. So, we did not find any significant difference in the incidence of post-operative cholangitis in the follow-up period. All these patients were managed conservatively.

One patient in HJ group developed adhesive obstruction around three months after surgery. He had to be re-operated for adhesiolysis. Extensive bowel handling and an additional anastomosis increase the chances of such complications in HJ group. However, Shimotakahara et al. did not report any significant difference in the incidence of postoperative adhesive intestinal obstruction in the two groups.⁶

An important observation regarding post-operative nasogastric bilious output was made exclusively in the HD group. 19.15% of patients with HD had significant bilious output in the post-operative period which took time to settle down. In all these patients, there was a delay in starting oral feeds. This can be explained by the direct anastomosis of biliary channel with relatively straightened duodenum which has been Kocherized during surgery and is not guarded by any sphincter, like the naturally present sphincter of Oddi. We analyzed the reason behind not finding increased bilious output in other patients and inferred that an anastomosis distal to the normal biliary opening in a fully Kocherized duodenum

has lesser chances of such reflux. So, the anastomosis is never done proximal to the normal location of Ampulla of Vater and preferably done distal to it in the second part of the duodenum. Several other investigators have found the exclusive occurrence of reflux gastritis in HD patients and have therefore, favored Roux-en-Y HJ on this ground.^{6, 15} In a meta-analysis by Narayanan et al., the incidence of reflux gastritis was the only difference between the HD and HJ group of patients; there was no difference in the incidence of post-operative cholangitis, bile leak, anastomotic stricture, bleeding, operative time, reoperation rate, and adhesive intestinal obstruction.^{1, 5}

Chances of biliary reflux and associated gastritis in future have a strong correlation and such patients need to be counselled about the need for periodic endoscopy if patients show any symptoms. None of the nine patients with increased nasogastric bilious aspirates in our study have had any other symptoms in the follow-up period. However, they have been told about the need for endoscopic evaluation if such symptoms are noted.

We concluded that although Roux-en-Y HJ is a time-tested gold standard for bilio-enteric reconstruction and no definite advantage of HD is seen in our study with respect to complication rates; still HD is a

prompt, feasible and cheap alternative with similar postoperative outcomes.

Conclusion

HD over T-Tube is as good a procedure as Roux-en-Y HJ to restore the bilio-enteric continuity. Being a more physiologic and prompter procedure, anastomosis over T-Tube lessens the intraluminal pressure and edema to further decrease the risks of post-operative leak. Although hazards of possible biliary gastritis in the long term with HD may need endoscopic evaluation, its incidence can definitely lessen by an anastomosis distal to the normal ampulla. A randomized study with more patients may further bring out stronger and conclusive evidence regarding this issue.

Ethical Consideration

This study was approved by Institute Ethics Committee of Indira Gandhi Institute of Medical Science Indira Gandhi Institute of Medical Sciences, Patna s:Sheikhpura: Patna-14

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Conflict of interests

There is no conflict of interest

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