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Comparative Analysis of Conventional Single-Incision Laparoscopic Cyst Excision and Roux-En-Y Hepaticojejunostomy for Children with Choledochal Cysts: An Institutional Based Study

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ABSTRACT

Introduction: Choledochal cysts (CDCs) are reported to be a rare congenital biliary malformation. The incidence of CDCs that were in Western countries ranges from 1/50,000 to 1/200,000, while in case of Japan it is approximately 1/13,000, having a male-to-female ratio of 1:4.

Materials and Methods: Present study was planned with 20 children with choledochal cysts 12 of which were cystic type and the other 8 were fusiform type. Single-incision laparoscopic Roux-en-Y hepaticojejunostomies were performed. Twenty conventional laparoscopic hepaticojejunostomies of consecutive children with choledochal cysts were employed as control. Data was collected and statistical analyses were done using SPSS 19.0 software (SPSS, Inc., Chicago, IL).

Results: The mean operative time in the single-incision laparoscopic group was comparable with that in the conventional laparoscopic group (207.1±6.4 (145–251) vs 208.2±6.5 (148–245) min, P=0.957, t test). Results revealed lower Estimated blood loss in the single-incision laparoscopic group than the conventional laparoscopic group but failed to notice a significant difference (10.3±1.3 (7–18) vs 13.7±1.5 (5-30) ml, P=0.103, t test).

Conclusion: To summarize, total laparoscopic CDC resection and Roux-en-Y hepaticojejunostomy are safe and feasible. Based on our practice with radical laparoscopic CDC excision and intestinal anastomosis with a stapler, proper cooperation and accurate operations can enhance the safety and efficacy of the surgical procedure. Additionally, the hospitalization cost in the TLH group was relatively expensive, hence surgical plans should be customised individually for each patient considering their family's socio-economic condition.

Keywords: Laparoscopy, Choledochal, Cyst, Jejunostomy.

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INTRODUCTION

Choledochal cysts (CDCs) are reported to be a rare congenital biliary malformation. The incidence of CDCs that were in Western countries ranges from 1/50,000 to 1/200,000, while in case of Japan it is approximately 1/13,000, having a male-to-female ratio of 1:4.[1-3] Cyst excision in toto with Roux-en-Y hepaticoenterostomy has increasingly becoming the standard procedure.[4] In the year 1995, Farello et al[5] reported for that the laparoscopic-assisted treatment of CDCs for the first time. Currently, the laparoscopic treatment of CDCs has been accepted predominantly by surgeons and children due to its advantages of its small incision, less trauma, less pain postoperatively and a quick recovery.[6] The gradual improvement of laparoscopic instruments and surgical techniques has made CDC to be treated in children by using total laparoscopy. However, considering the limited space inside the abdominal cavity, the operation handling manoeuvre and the high cost of hospitalization has made it less widely performed.[7] So, in this study, we compared the effectiveness of total laparoscopic hepaticojejunostomy (TLH) and conventional laparoscopic hepaticojejunostomy (CLH) in children with CDCs.

The advantages of laparoscopic surgery are well documented in the literature starting with less surgical trauma, less bleeding, smaller scars and rapid recovery. Laparoscopic hepaticojejunostomy for children with choledochal cysts has been gaining popularity nowadays.[7,8] Single-incision laparoscopic surgery has become popular in paediatric surgeons to achieve minimal surgical trauma to the children.[9] It is considered as the next step in the evolution of standard laparoscopic surgery, it is performed through a single small skin incision, often partially concealed at the umbilicus and patients may feel less

postoperative pain and fewer port site-related complications. Single-incision laparoscopic Roux-en-Y hepaticojejunostomy was introduced by Diao et al where they achieved comparable short-term results with conventional laparoscopic hepaticojejunostomy.[10]

MATERIALS AND METHODS

Present study was planned with 20 children with choledochal cysts admitted in the Department of General Surgery, L. N. Medical College & Research Centre, Bhopal, Madhya Pradesh (India) and 12 of which were cystic type and the other 8 were fusiform type. Single-incision laparoscopic Roux-en-Y hepaticojejunostomies were performed. Twenty conventional laparoscopic hepaticojejunostomies of consecutive children with choledochal cysts were employed as control. Written informed consent was obtained from all the parents and the conventional and single-incision laparoscopic procedures were performed after seeking approval from the Institutional Review Board and Ethical committee. Demographic and perioperative information was identified. The clinical parameters analysed in this study were total operating time—time from operative field skin preparation to skin closure, estimated blood loss (EBL)—as recorded in the operative records, time elapsed to oral intake—time from the end of the operation to food intake, drainage removal time— time from the end of the procedure to drainage removal, post-operative complications—an unexpected event related to the operation within hospitalization, and duration of postoperative hospital stay—time from the end of the procedure to discharge. Abdominal ultrasonography and laboratory tests were advised to study the postoperative complications. Postoperative complications were classified using the modified classification of Clavien-Dindo system.[9] Grades I and II complications are regarded as minor complications which requires non-invasive interventions; grade III complications are defined as patients required surgical, endoscopic or radiological intervention; life-threatening complication (including central nervous system complications) requiring intermediate care or intensive care unit management are grouped into grade IV complications.

Statistical analyses were done using SPSS 19.0 software (SPSS, Inc., Chicago, IL). Data are reported as mean and standard deviation (SD). The t-test and chi-square test (or Fisher's exact test) were used to evaluate the differences between the groups. Two-tailed P values of less than 0.05 were considered as significant statistically.

Table 1: Comparison of demographic parameters, perioperative variables for patients undergoing cyst excision and Roux-en-Con-Y hepaticojejunostomy either by single-incision and conventional laparoscopic approach

Parameters	Conventional laparoscopy (n=20)	Single-incision laparoscopic (n=20)	P - value
Gender			
Male (%)	15	17	1.000
Female (%)	5	3	
Age (years)			
Median	4.9±0.9 (0.8–13)	3.7±0.8 (0.5–14)	0.698
Total operating time (min)			
Median (range)	207.1±6.4 (145–251)	208.2±6.5 (148–245)	0.957
Blood loss (mL)			
Median (range)	13.7±1.5 (5-30)	10.3±1.3 (7–18)	0.113
Time to oral intake (days)			
Median (range)	3.82±0.26 (3–6)	3.71±0.23 (3–5)	0.894
Drainage (days)			
Median (range)	4.12±0.26 (2–4)	4.28±0.51 (3–11)	0.068
Postoperative hospital stay			
Median (range)	7.45±0.23 (6–11)	7.62±0.27 (6–10)	0.632
Post-operative complications			
Grade I and II	2	1	1.001
Grade – III	0	0	
Grade IV	0	0	

RESULTS

20 patients were treated with single-incision laparoscopic Roux-en-Y hepaticojejunostomies were considered as the study group and 20 patients treated with conventional laparoscopic Roux-en-Y hepaticojejunostomies were employed as the control group. Patient demographic data and peri-operative outcomes are depicted in Table 1. There were no significant differences between the conventional laparoscopic group and the single-incision laparoscopic group with regard to preoperative variables including age (P=0.698, t test) and sex distribution (P=1.003, chi-square test). The mean operative time in the single-incision laparoscopic group was comparable with that in the conventional laparoscopic group (207.1±6.4 (145–251) vs 208.2±6.5 (148–245) min, P=0.957, t test). However, we showed lower Estimated blood loss in the single-incision laparoscopic group than the conventional laparoscopic group, but failed to notice a significant difference (10.3±1.3 (7–18) vs 13.7±1.5 (5-30) ml, P=0.103, t test). No blood transfusion was required during the procedure in both groups. For evaluating the time to oral intake (3.71±0.23 (3–5) vs 3.82±0.26 (3–6) days, P=0.894, t test), drainage removal time (4.28±0.51 (3–11) vs 4.12±0.26 (2–4) days, P=0.068, t test) and postoperative hospital stay (7.62±0.27 (6–10) vs 7.45±0.23 (6–11) days, P=0.632, t test), these differences were also non-significant.

The mean follow-up time for the single-incision laparoscopic group was estimated to be 16.3 days and the mean follow-up time for the conventional laparoscopic group was 15.7 days. There were no differences regarding postoperative complications between the two groups according to the modified classification of *Clavien-Dindo* system (1/15 vs 1/17, P=1.000, chi-square test) No pancreatic leak, anastomotic stenosis, cholangitis, pancreatitis, intestinal obstruction and wound infection were reported in the single-incision laparoscopic group. One child in the single-incision laparoscopic group developed bile leak post-operatively and spontaneous healing was actively achieved after 10 days of conservative treatment. Wound infection occurred in a kid who had undergone conventional laparoscopic group and achieved secondary healing after the change of dressing. Similarly, serum liver enzymes after the surgeries in both groups also demonstrated significant improvements without any complications. No hepatic hilar effusions and pneumobilia were encountered with postoperative abdominal ultrasonography in both groups.

DISCUSSION

CDCs are a group of rare disorders affecting the bile duct producing dilation that was first briefed by *Vater* and *Ezler* in the year 1723.[11] Though these cysts are benign in origins, they are closely associated with many serious complications such as malignant bile duct tumours, cholangitis, pancreatitis and intrahepatic biliary ductal stones.[12] Therefore, surgery should be performed soon after the diagnosis is made clear.[13,14] Compared with traditional open surgery, laparoscopic CDC surgery has the following advantages[15,16]: They are Laparoscopy can magnify the tissue 4–8 times which allows precise separation of the cyst from the surrounding vital tissues, such as the hepatic artery, portal vein, pancreas and capillary network around the cyst, and thus avoiding adverse complications. Laparoscopy has the ability to penetrate deep into the hepatic hilum for a more precise operation; meanwhile, bile duct abnormalities such as labyrinthine bile duct and hepatic stenosis, can be visually detected when used properly. Laparoscopic surgery is responsible for less intestinal disturbance and allows faster post-operative recovery of intestinal peristalsis. The incision made in this surgery is small and aesthetically appealing and the pain is also mild. The incidence of wound infection and development of incisional hernia is reduced after this operation. Total laparoscopic surgery, in addition to the above advantages, has an added advantage in which the umbilical incision is smaller and more aesthetic, which is more satisfactory according to the needs of the children and their families.

In the CLH group, the bowel was pulled out through an umbilical incision is made to complete the jejunal end-to-side anastomosis. Intestinal traction and exposure might increase the risk of intestinal injury and adhesions in general. But we successfully performed total laparoscopic CDC excision and Roux-en-Y hepaticojejunostomy in 40 children. Compared with those in the CLH group, the postoperative fasting time and hospitalization duration were significantly shorter in the TLH group. These findings show that the total laparoscopic approach disturbs the bowel less and allows faster recovery of gastrointestinal function. But, it is also worth noting that the hospitalization cost in the TLH group was significantly higher than that in the CLH group which may be due to the high cost of laparoscopic instruments. Owing to the gradual development in the surgical instruments, we believe that in the near future, the cost of laparoscopic instruments will promptly decrease. The main difference between TLH and CLH is jejunum-to-jejunum anastomosis is that one must need to pay extra attention to the following points: When the jejunum is incised using an endoscopic stapler, the intestinal tube should be fully fattened to avoid overlap, which could result in insufficient & improper cutting and a development of intestinal fistula. A side-hole jejunotomy was created on the antimesenteric border just 0.5 cms from the end of the proximal jejunum, which is done to minimize the occurrence of a "blind pouch" post-operatively.

When endoscopic cutter stapler is used for jejunal side-to-side anastomosis, the puncture hole in the intestinal wall does not need to be large. The size should be large enough to be suitable for placement at the end of the stapler to minimize the residual stoma and reduce the operative duration. Moreover, side-to-side anastomosis of the jejunum should be arranged alongside with the mesentery to ensure full contact with the stapler. In the early stages of implementing total laparoscopic surgery, there was one case in which a child underwent jejunal side-to-side anastomosis with an uneven arrangement, resulting in excessive residual anastomosis, increased suture difficulties and a prolonged operation. In this study, the time taken for jejunal side-to-side anastomosis in the TLH group was longer than the time for jejunal end-to-side anastomosis in the CLH group but there was no significant difference between them. We consider that this finding may be related to the learning curve for mastering total laparoscopic surgery.

The major reported postoperative complications of laparoscopic CDC excision include pancreatitis[17], pancreatic fistula[18], cholangitis[1], biliary fistula and intestinal obstruction.[19]. The transverse mesocolon and gastrocolic ligament are often thicker in older children with CDCs being complicated with recurrent infections; thus, we advise that after establishing a retrocolic tunnel to cross the transverse mesocolon, the gastrocolic ligament should be completely separated at the same time so that the intestinal tube can pass through smoothly. Additionally, the hepatic limb of jejunal and transverse mesocolon should be sutured intermittently with 3 to 4 needles to avoid obstruction caused by intestinal hernia. We considered the pancreatic fistula to have been caused by deep operating position when the distal end of the cyst was separated, resulting in damage to the pancreatic duct. *Li* et al[20] believed that in children with cystic dilatation, not ligating the distal stump is a feasible approach and hence minimizing the pancreatic duct injury. The limitations of this study are that the number of cases is relatively small and that the follow-up time period is also relatively short. The long-term effect in the two groups should further be evaluated for the betterment.

CONCLUSION

To summarize, total laparoscopic CDC resection and Roux-en-Y hepaticojejunostomy are safe and feasible. Moreover, the TLH operation was cumbersome because of the limited space in the abdominal cavity capacity of children which results in a narrow operation space within delicate tissue, recovery was relatively faster and the stay in hospital was shorter in the TLH group than in the CLH group. Based on our practice with radical laparoscopic CDC excision and intestinal anastomosis with a stapler, proper cooperation and accurate operations can enhance the safety and

efficacy of the surgical procedure. Additionally, the hospitalization cost in the TLH group was relatively expensive, hence surgical plans should be customised individually for each patient considering their family's socio-economic condition.

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