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REVIEW ARTICLE

Laparoscopic Repair for Choledochal Cyst in Children: Current Status

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ABSTRACT

Objectives: To determine feasibility and outcome of laparoscopic repair of choledochal cyst in pediatric age.

Materials and methods: A literature search was performed on choledochal cyst and laparoscopic repair in children using PubMed database to extract data related to age, gender, technical details, operative time, conversion rate, intraoperative complications, hospital stay, early and mid-term complications and outcome.

Results: There were 710 patients with a median follow-up of 29.1 months; the median age was 4.3 years and 73.4% were women. The choledochal cysts were classified as type I of Todani´s classification in 74% of cases and in all of them a laparoscopic excision and hepaticoenterostomy was carried out. The mean operative time was 265 minutes and the conversion rate to open surgery was 2.4%. The mean postoperative hospital stay was 6.5 days and the early and late complications were 6.9 and 4% respectively.

Conclusion: The laparoscopic repair of choledochal cyst is safe and feasible in children with early- and mid-term complication rates similar to open surgery.

Keywords: Choledochal cyst, Laparoscopic repair of choledochal cyst.

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INTRODUCTION

Choledochal cyst is a congenital cystic dilatation of the biliary tree that typically affects the pediatric population with a higher prevalence in Asia and girls. If left untreated, they can cause recurrent cholangitis, pancreatitis, sepsis, liver abscesses and cholangiocarcinoma. Therefore, recognition and proper management of choledochal cyst disease are important.[1,2] Complete cyst excision and hepaticoenterostomy have become a standard procedure in open surgery for choledochal cyst, but in the last decade, there has been tremendous development in laparoscopic surgery in children, with a great majority of operations accomplished using the minimally invasive technique. Although most reported series described a small number of patients and an intermediate-term follow-up, the laparoscopic approach seems to be safe and feasible for choledochal cyst repair.[3,4]

MATERIALS AND METHODS

A literature search was performed on choledochal cyst and laparoscopic repair in children using PubMed database to extract data related to age, gender, technical details, operative time, conversion rate, intraoperative complications, hospital stay, early- and mid-term complications and outcome.

RESULTS

We have selected 17 articles and use data only of pediatric age patients. There were 710 patients with a median age of 4.3 years and 73.4% of girls. According to Todani´s classification, 74% of the cases were type I cyst and in all of them a laparoscopic excision plus hepaticoenterostomy was carried out. Both, hepaticojejunostomy (HJ) and hepaticoduodenostomy (HD) were constructed (54.2 and 45.8%). The mean operative time was 265 minutes and the mean conversion rate to open surgery was 7.6%. The mean postoperative hospital stay was 6.5 days and the early and late complications were 11.3 and 6.1% respectively with a median follow-up of 29.1 months.

DISCUSSION

Choledochal cyst is a congenital anomaly usually found in pediatric population. It is estimated to occur in 1 of 5,000 live births, with a higher frequency in Asians. The classic triad of symptoms is jaundice, abdominal pain and vomiting but it is not always present.[1]

Todani et al[5] classified choledochal cysts based on the location of the cyst. Type I or cystic dilatation of the common duct constitutes over 85% of the cases in all reported series. Type II choledochal cyst is very rare and commonly described as a diverticular malformation of the common duct. Type III choledochal cyst or choledochocele usually is intraduodenal and is slightly more common than type II. Type IV choledochal cysts occur in approximately 10% of cases and are multicystic structures with both intra- and extrahepatic components. Finally, type V forms are single or multiple intrahepatic cysts. When these intrahepatic cysts are associated with hepatic fibrosis, they are referred to as Caroli's disease.[6]

The standard investigations include abdominal ultrasound and magnetic resonant cholangiogram, and they

try to clarify the type of bile duct dilatation and to rule out pancreatobiliary malunion.[7] As the antenatal ultrasonography is getting more popular and easily available, more diagnoses are made antenatally. This enables a better communication with parents and an earlier surgery with less disease-related complications and an easier dissection during the surgical procedure as a result of decreased periductal inflammation.[1]

The treatments of these cysts consist on medical management of complications, surgery and long-term follow-up. Choledochal cysts were initially treated by providing external or internal drainage. Although these procedures were easy to perform, they did not decrease the incidence of malignancy because there was continuous reflux of pancreatic juice into the bile duct. If left *in situ*, the risk of cancer in the retained cyst is as high as 50%.[2] At present, total excision of choledochal cysts (types I, II and IV) with hepaticoenterostomy has been widely accepted as the procedure of choice.[8] The principle of laparoscopic surgery for choledochal cyst is similar to that of open surgery, although it is much more technically demanding especially in small children in whom the peritoneal space is very limited.[4]

Proper case selection is mandatory to avoid complications, especially in the first cases at the beginning of the learning curve of the laparoscopic repair. Difficulty may arise in older patients where the size of the cyst may be very large and pericyst inflammation very important due to prior episodes of cholangitis or pancreatitis. Also, we should be cautious in childrens with liver cirrhosis and portal hypertension.[9]

TECHNICAL CONSIDERATIONS

Patient position: The patient is placed in a 30º head-up supine position and the surgeon stands at the lower end of the operating table in small children and at the left side of the table in older ones.

Port position: One 10 mm trocar is inserted through the umbilicus for the telescope and three 5 mm trocars (3 mm trocar for small infants) for instruments: Right flank, left flank and left hypochondrium. And extra port is sometimes used for hepatic retraction.[3,4,8,10]

Cyst dissection: To obtain a good exposure, the liver is either secured to the abdominal wall by a stay-suture placed at the round ligament or separated with a liver retractor. The gallbladder is retracted cranially and the transverse colon and duodenum caudally.[3,4]

The first step in patients without a good preoperative imaging study is to perfom an intraoperative cholangiogram (IOC) through the gallbladder. It is essential to delineate the exact pancreatobiliary anatomy to guide the level of the cyst excision in order to minimize the chance of damaging the pancreatic duct.[4,9]

The cystic artery and duct are identified, clipped and divided; but the gallbladder is left in place to facilitate displacement of the liver upward during dissection and suturing. The mid-portion of the cyst is dissected circumferentially, divided and irrigated to wash out biliary debris. Then, it is opened longitudinally both on the anterior and posterior walls to inspect the orifice of the common biliopancreatic duct distally and the common hepatic duct (CHD) proximally. The cyst is then divided and totally excised. The monopolar electrocautery device was used to ensure the hemostasis of the epicholedochal venous plexus. At the end, a cholecystectomy is carried out.[3,4,9,10]

When extensive pericystic adhesions are present due to recurrent cholangitis, to avoid injury to the portal vein there are two methods:

1. The front wall of the cyst is first opened so separation of the back wall of the cyst from the portal vein is carried out while viewing the cyst internally and externally.
2. The anterolateral part of the cyst is resected first followed by resection or fulguration of the mucosal lining, leaving a narrow rim of the posterior cyst wall on the portal vein and hepatic artery. Injection of saline between the mucosa and the posterior cyst wall helps in the excision by raising a plane of dissection.[3,4]

   Hepaticoenterostomy is then constructed either with duodenum or jejunum. In the HD, the duodenum is mobilized and an anastomosis is constructed 2.0 cm away from the pylorous. In the HJ, a 5/0 silk stay-suture is placed 20 to 40 cm distal to the ligament of Treitz and a second one is placed below the first suture to mark the jejunal limb, which will be anastomosed to the hepatic duct.
3. It is still debated if HD or HJ is the best type of biliodigestive reconstruction after cyst excision. HD is preferred by some surgeons because it is a more simple procedure that can be completely carried out laparoscopically, with less chance of postoperative adhesions, better cosmetic results and shorter operative time. On the other hand, cholangitis and gastritis owing to bilious reflux are major concerns after HD and they are absent in the HJ group.[2,3]

When an HJ is selected as the anastomosis of choice, the Roux-en-Y loop can also be made extracorporeally or totally intracorporeally. In the first one, the jejunal segment with two sutures is exteriorized through the enlarged umbilical wound and the jejunojejunostomy is carried out extracorporeally and then reintroduced to the abdominal cavity. The Roux limb is brought retrocolic to the porta

hepatis and an HJ is performed.[3,4,9,11-13] For the totally intracorporeal approach, the Roux-en-Y loop is carried out by a side-to-side jejunojejunostomy with endostaplers. To reduce the duration of performing this procedure, before making the enterostomy for applying an endoscopic stapler, the two limbs can be approximated side by side, to place two stay sutures on the antimesenteric border of the limbs. Upward traction facilitates Endo-GIA firing and intracorporeal suturing for closure of the enterotomy. The authors that support the extracorporeal jejunojejunostomy argue that this enables meticulous bowel anastomosis just like the open surgery and also avoids intra-abdominal contamination. Even the surgeons familiar with laparoscopic surgery for choledochal cyst prefer the intracorporeal approach due to less technical difficulties, less operative time and less cost (no endostaplers). Nevertheless, in the early part of their learning curve, surgeons can adopt the extracorporeally method before embarking on a totally laparoscopic approach.[7,8,10,14]

Regarding the type of suturing at the time of the hepaticoenterostomy, it can be done by running[4,12] or interrupted sutures.[7,9-11] The latest are used when the diameter of the CHD is less than 1 or 1.5 cm while others do so in all cases to avoid late anastomosis strictures. Endostich device may help to simplify this complex intracorporeal procedure.[15]

The mean operative time in this review is 265 minutes. The relatively longer operative time in the minimally invasive approach *vs* open surgery is due to different factors: Type of cyst, previous recurrent and/or severe inflammation, previous endoscopic retrograde cholangiopancreatogram (ERCP), extraprecautions taken during surgery and time required for instruction of the trainees.[4] As surgeons gain experience with the laparoscopic procedure, the times are decreasing significantly.[13]

The conversion rate to open surgery is variable among different series, in this review, the mean rate is 7.6% (0-50%). The different causes are: Continuation of the cyst either to the liver or to the pancreas, big sized cyst, difficult dissection due to adhesions, oozing, CHD tearing or high section, suspicion of malignancy or prolonged surgery.[1,3,4,8,11,12]

The laparoscopic repair of choledochal cyst can be performed safely with a low intraoperative complication rate. The major complications described are right hepatic duct injury and right hepatic artery injury. Dissection as close as possible to the cyst wall is mandatory to prevent both complication and they could be avoided with increased experience.[3,4,12,16]

The overall short-term complication rate is 11.3%: Bleeding at the HJ junction, anastomotic leakage, intra-abdominal collection, wound infection, prolonged ileus, small bowel obstruction and respiratory tract infection. Anastomotic leakage is the most frequent early complications and in the majority of cases they are treated conservatively with good outcome.[1,3,4,7,9,12-14,16]

The mid-term complications rate is 6.1% with a median follow-up of 29.1 months: Recurrent anastomotic strictures, residual cyst, cholangitis, bilious reflux (only in cases of HD), pancreatitis, small bowel obstruction and ventral hernia.[1,3,4,11-14] Intrahepatic stones and biliary carcinoma are potential complications that were not seen in the series reviewed. Anastomotic stricture is a main concern an there are some methods to avoid it: Ductoplasty in cases of ductal strictures at the moment of surgery, to leave a small cuff of the cyst to facilitate the anastomosis and to make a wide HJ.[3,7,8,12]

Liem et al[16] have compared laparoscopic *vs* open choledochal cyst repair, in the laparoscopic procedure the operative time was significantly longer; the need of blood transfusion was lower (3.2 *vs* 11.1%, p = 0.001); the postoperative evolution was more favorable with less complications (3.9 *vs* 5.5%) and the reintervention rate was also lower (0.3 *vs* 3.6%). The intraoperative complications were similar in both groups (0.6 *vs* 0.3%). The mean postoperative stay was significantly lower is laparoscopic group (7 *vs* 9 days, p = 0.001). Liuming et al,[13] comparing laparoscopic *vs* open surgery, found the same results except for a slightly more early complications (15 *vs* 10%) due to respiratory tract infections although the overall complication rates were similar. In their opinion, this complication is more frequent in the laparoscopic group due to the more operative time and therefore more anesthetic time.

The overall advantages of the laparoscopic approach over the classic open surgery in choledochal cyst is superior visualization of the structures around the cyst and hepatic hilum and in turn meticulous mobilization of the cyst, less blood loss, improved immediate postoperative recovery, less hospital stay and excellent cosmetics.[2,4,7,8,10,13,17]

CONCLUSION

Laparoscopic surgery is feasible for choledochal cyst in experienced hands but is technically demanding with a considerably long-learning curve. The procedure can be performed according to the currently accepted standards of the conventional approach with minimum conversion and acceptable morbidity. The principal advantage is that it allows a very clear visualization and meticulous mobilization of the cyst. Further studies with long-term follow-up are necessary to identify those cases that are at risk of having complications and to determine, if it could became an accepted alternative to conventional laparotomy for choledochal cyst in pediatric population.

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