

ORIGINAL ARTICLE

M. F. Wei · B. Q. Qi · G. L. Xia · J. Y. Yuan
G. Wang · Y. Z. Weng · Z. Y. Xu · X. J. Yang
X. F. Zhou · E. C. Tong

Use of the appendix to replace the choledochus

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Abstract Ten cases of choledochal cyst (CC) were treated by biliary-appendicoduodenostomy. The follow-up comprised a patient interview, ultrasonography (US), and single-proton ejected computerized tomography (SPECT) scanning. In all cases an anti-reflux submucosal tunnel was added to the distal appendico-duodenostomy; all showed an uneventful postoperative course. All the dilated intrahepatic bile ducts had normalized on B-US postoperatively. Four children underwent SPECT examination; all of them had patent neo-bile ducts. In the authors' opinion: (1) Anastomosing the cecal end of the appendix to the common hepatic duct seemed more favorable than the other way around, because the cecal end could be easily trimmed to the size of the common hepatic duct, which was more or less dilated in the presence of a CC; (2) It is necessary to add a submucosal tunnel to the distal appendicoduodenostomy to achieve a more reliable anti-reflux effect; and (3) Transposing the vascularized appendix through the retro-transverse colon simplified the procedure and might reduce the risk of retroperitoneal complications if bile leakage should occur.

Key words Choledochal cyst · Appendix · Biliary-appendicoduodenostomy

Introduction

Total excision of the cyst and Roux-en-Y hepatic or choledochoenterostomy is the treatment of choice for the common type of choledochal cyst (CC). Ascending cholangitis after surgery, as in biliary atresia (BA), occurs

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M.F. Wei (✉) · B.Q. Qi · G.L. Xia · J.Y. Yuan · G. Wang · Y.Z. Weng · Z.Y. Xu · X.J. Yang · X.F. Zhou · E.C. Tong
Department of Pediatric Surgery, Tongji Hospital,
Tongji Medical University, Wuhan 430030,
People's Republic of China

in about 50% of patients [1, 2], and many accessory procedures have been added to the intestinal conduit to avoid this complication, although none can completely eradicate reflux [3–5]. Grosfeld et al. first reported the use of a vascularized appendiceal graft to reconstruct the biliary system [6]. Thereafter, two additional papers reported good anti-reflux results in treating BA and CC [7, 8].

In the period from October 1992 to October 1996, ten children with CC cyst were operated upon in our department using a biliary-appendicoduodenostomy (BAD). The follow-up examinations showed a satisfactory anti-reflux effect.

Materials and methods

The patients' ages ranged from 1 to 6 years (mean 3 years 10 months; the male-to-female ratio 4:6). The diagnosis was based on the clinical findings, the upper gastrointestinal (GI) X-ray series, single proton ejected computerized tomography (SPECT) scanning, and B-ultrasonography (US). The type of CC was classified according to US and/or operative cholangiography. In three patients the lesions were located in the choledochus; two were cystic and one cylindrical. In the remaining seven, both extra- and intrahepatic ducts were involved. The mean follow-up duration was 36 months (range 12–48 months). No episode of ascending cholangitis occurred postoperatively. The follow-up comprised an interview, abdominal US, and SPECT scanning.

Results

All ten patients recovered completely. The mean hospitalization was 20 days. The children are growing and developing well without any symptoms of ascending cholangitis, i.e., abdominal pain, fever, jaundice, etc. One child developed hepatitis C due to a transfusion. All the dilated intrahepatic bile ducts had become normal on postoperative B-US. Four children underwent SPECT examinations all of them had patent neo-bile ducts (Figs 1 and 2).

Operative technique

The CC was removed together with the gallbladder. The common hepatic duct (CHD) was left open, and the duodenal end of the

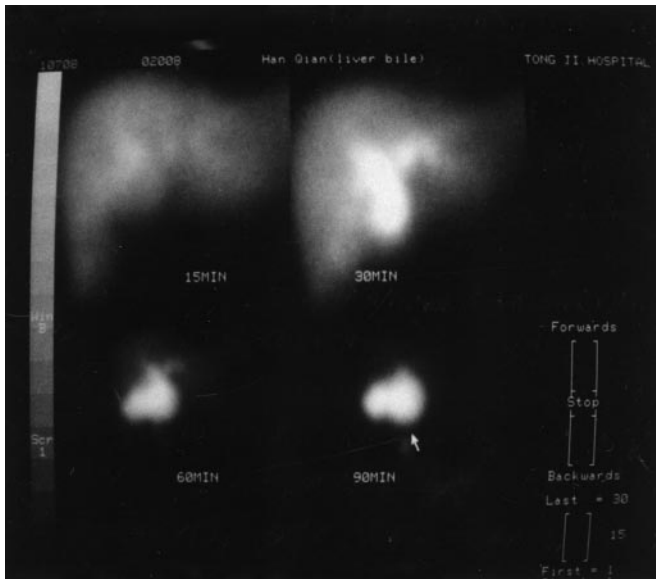


Fig. 1 Preoperative SPECT scan showing large developing cyst

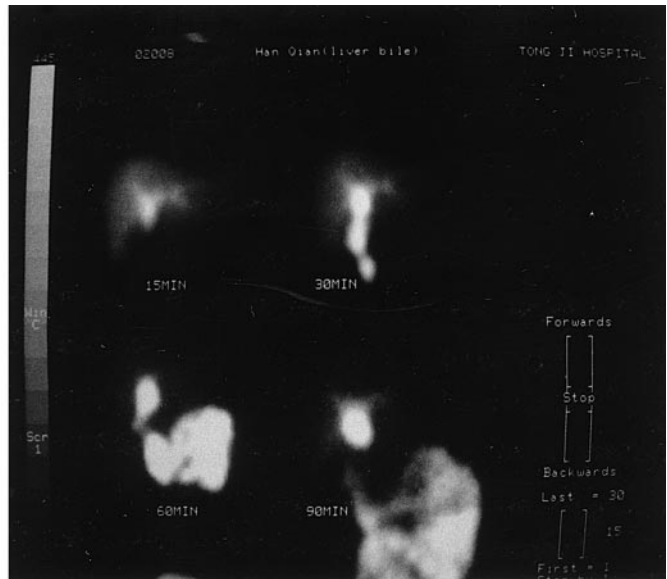


Fig. 2 SPECT scan reveals good developing intestine and reconstructed biliary duct 6 months after operation

choledochus was ligated and sealed. The free appendix with an intact vascular pedicle was then prepared, leaving the cecal end with a trumpet-shaped opening corresponding to the size of the CHD in order to facilitate the subsequent anastomosis. The appendiceal vessel was mobilized and traced to its origin from the ileocolic artery in order to bring the appendix up to the subhepatic area without tension. The appendix and its lumen were repeatedly flushed through its open tip with a mixture of saline, gentamycin, and metronidazole. We did not mobilize the paracolic peritoneal reflection of the right colon and bring the appendix through the retro-ascending colon; instead, the appendix was transposed to the subhepatic area by the left side of the ascending colon and retro-transverse colon.

The final step was to reconstruct the biliary tract by two different types of end-to-end anastomoses. The upper one was between the cecal end of the appendix and the CHD (T-H), the lower one between the cecal end of the appendix and the duodenum. In all cases a submucosal tunnel was established at the distal anastomosis, as described by Lich et al. [9], to increase the anti-reflux effect.

A fine, soft silastic tube was placed into the new extrahepatic duct with its tip above the upper anastomosis and the abdomen was closed. The tube allowed bile drainage and cholangiography. After demonstrating no leakage and good bile drainage to the duodenum on cholangiography, the tube was removed 12 days postoperatively.

Discussion

The appendix was chosen to replace the extrahepatic duct because it can offer a vascularized, epithelized, small-caliber conduit that is quite similar to a normal choledochus. An anti-reflux submucosal tunnel at the distal anastomosis can easily be made for the purpose of reducing the risk of ascending cholangitis. There are two ways to bridge the appendix between the hepatic duct and duodenum: isoperistaltically anastomosing the

tip of the appendix to the hepatic duct (T-H), or, conversely, the cecal end of the appendix to the hepatic duct (C-H) [7, 8]. The advantage of the T-H anastomosis is that isoperistalsis of the appendix can presumably facilitate bile drainage, the drawback being that there is always a curve at the T-H junction due to the discrepancy in diameter between the appendiceal tip and the CHD or the raw surface of the hepatic hilum, as shown in our case 1 as well as Crombleholme et al.'s two cases [7]. In the C-H anastomosis, the size of the cone-shaped cecal end of the appendix in young children can be easily trimmed to fit to the dilated CHD. In our experience with eight cases, we found the C-H anastomosis more convenient than the T-H, especially in type IV disease.

All the children with accessory submucosal tunnels were symptom-free, and their previous intrahepatic duct dilation had resolved on B-US and SPECT scanning. It appears that the fine caliber of the appendix did not absolutely guarantee an anti-reflux function, and adding a submucosal tunnel to the distal anastomosis is necessary to achieve a more reliable effect.

In the present series, we did not dissect the paracolic peritoneal reflection of the ascending colon, but instead brought the appendix up through the retro-transverse colon. This maneuver made the procedure more simple and would prevent the potential risk of retroperitoneal complications if bile leakage should occur. Being a functional conduit, the transposed appendix should keep its vitality permanently. Weinberg and Martin used the appendix to replace the ureter, and follow-up 3 and 11 years after operation revealed that the appendiceal tubes still showed patency and excellent peristalsis [10, 11]. Another advantage of BAD over the procedures using an intestinal conduit is that it does not interrupt the continuity of the GI tract and the bile is directly introduced into the duodenum, which would not disturb the digestive mechanism.

Considering the small number of cases and the relatively short follow-up duration, we believe larger series and longer observation is needed to ascertain whether BAD is more advantageous than the other procedures using intestinal conduits for reducing the incidence of ascending cholangitis. It also should be noted that the prerequisites for performing a BAD are a healthy appendix with enough length and an adequate vascular pedicle that allows the appendix to be transposed to the hepatic hilum without tension. Obviously, not every child's appendix can satisfy these conditions.

In conclusion, our results showed that BAD is a promising procedure for the treatment of CC, with the advantageous effect of reducing ascending cholangitis. Of the two methods of reconstructing the extrahepatic duct, the C-H anastomosis seems more favorable than the T-H because the cecal end of the appendix can easily be trimmed to the size of the CHD, facilitating the anastomosis. It is necessary to add an anti-reflux submucosal tunnel to the appendicoduodenostomy to achieve a more reliable anti-reflux effect. We transposed the appendix through the retro-transverse colon, further simplifying the procedure and reducing the risk of retroperitoneal complications in case bile leakage should occur. However, more cases and longer durations of follow-up are needed to determine whether BAD is more advantageous than other procedures.

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