

## Appendix as a Biliary Conduit for Choledochal Cysts in Children

A. A. Shah

A. V. Shah

### Abstract

Biliary conduits are constructed in operations for choledochal cysts. A wide variety of options are available for biliary tract reconstruction. We present our experience of treating six children with choledochal cysts by using the appendix as a biliary conduit. After mobilizing the appendix on its vascular pedicle, non-refluxing, tunneled anastomosis was made with the 2nd part of the duodenum and the appendix. The operative procedure was simple and less time-consuming. Postoperative evaluation was done with the help of HIDA scan and ultrasound examination. Postoperative cholangitis was conspicuously absent in the two years of follow-up. One child has been lost to follow-up. From our preliminary experience, the operation seems simple and satisfying. Though the long-term efficacy still remains to be proven, the appendix should prove durable as a functional conduit.

### Key words

Choledochal cyst · appendix

### Résumé

Des néo-conduits biliaires sont réalisés pour traiter les kystes du cholédoque. Une large variété de possibilités sont disponibles pour la reconstruction de l'arbre bilaire. Nous présentons notre expérience du traitement de six enfants avec des kystes du cholédoque en utilisant l'appendice comme néo-canal bilaire. Après avoir mobilisé l'appendice sur son pédicule vasculaire, une anastomose tunnélisée non refluxante était réalisée entre la deuxième partie du duodénum et l'appendice. Le procédé opératoire est

simple et peu consommateur de temps. L'évaluation post-opératoire était faite avec l'aide d'une scintigraphie à HIDA et une échographie. Une cholangite post-opératoire n'était jamais observée dans les deux ans de suivi. Un enfant a été perdu de vue. De cette expérience préliminaire, cette opération paraît simple et satisfaisante. Quoiqu'une efficacité à plus long terme reste à prouver, l'appendice pourrait être un néo-canal bilaire valable.

### Mots-clés

Kyste du cholédoque · appendice

### Resumen

En las operaciones por quiste del coléodo es necesario reconstruir la vía biliar para lo que hay varias opciones disponibles. Presentamos nuestra experiencia en el uso del apéndice como conducto biliar en 6 niños con quiste del coléodo. Tras movilizar el apéndice con su pedículo vascular se realizó una anastomosis tunelizada entre la segunda porción del duodeno y el apéndice. El procedimiento operatorio fue fácil y breve. La evaluación postoperatoria se hizo con ayuda de HIDA y estudio ecográfico. No hubo colangitis postoperatoria en los 2 años de seguimiento. Hemos perdido de vista uno de los niños. De esta experiencia preliminar deducimos que esta operación parece simple y satisfactoria aunque la eficacia a largo plazo no ha sido aún probada. El apéndice parece ser un conducto biliar funcional.

### Palabras clave

Quiste del coléodo · apéndice

#### Affiliation

Department of Pediatric Surgery, K. M. School of Postgraduate Medicine and Research, N. H. L. Municipal Medical College, V. S. Hospital, Ahmedabad, India

#### Correspondence

Dr. Anirudh V. Shah · "Anicare", 13, Shantisadan Society · Nr. Parimal Garden, Nr. Doctor House · Ellisbridge, Ahmedabad, 380006 · India · E-mail: anirudhshah@icenet.net, amarshah\_22@hotmail.com

Received: January 8, 2004 · Accepted after Revision: March 14, 2004

#### Bibliography

Eur J Pediatr Surg 2005; 15: 128–131 · © Georg Thieme Verlag KG Stuttgart · New York · DOI 10.1055/s-2004-821220 · ISSN 0939-7248

## Zusammenfassung

Bei der Operation von Choledochuszysten muss eine biliäre Ableitung mit Zwischenschaltung anderer Organe durchgeführt werden. Zur Rekonstruktion der Gallenwege werden vielfältige Techniken angegeben. In der vorliegenden Arbeit werden 6 Kinder mit einer Choledochuszyste vorgestellt, bei denen die Appendix zur Gallenableitung verwandt wurde. Nach Mobilisierung der Appendix mit ihrer vaskulären Versorgung wurde ein nicht refluxiver Tunnel mit dem zweiten Teil des Duodenums angelegt und die Appendix mit dem Choledochus verbunden. Das operative Verfahren war einfach und wenig zeitaufwändig. Postoperativ wurden mithilfe des HIDA-Scans und des Ultra-

schalls die Kinder nachuntersucht. Bei allen war, zumindest zwei Jahre nach dem Eingriff, keine postoperative Cholangitis zu beobachten. Ein Kind konnte nicht weiter nachuntersucht werden.

**Schlussfolgerungen:** Von unseren begrenzten Erfahrungen her kann die Operation mit Interposition einer Appendix zwischen Choledochus und unterem Duodenum bei Vorliegen einer Choledochuszyste empfohlen werden. Allerdings muss noch geprüft werden, ob die Appendix selbst als ein brauchbares, funktionelles und vor allem dauerhaftes Ersatzrohr geeignet ist.

## Schlüsselwörter

Choledochuszyste · Appendix · Galleableitung

## Introduction

The use of intestinal segments to reconstruct the biliary system after surgery for biliary atresia or choledochal cyst is not new. Kasai et al. [9] first described hepaticoportoenterostomy, which involved the use of a Roux-en-Y jejunal loop. Later, many modifications were made to the technique by Kasai and others [4, 5, 10, 11, 17], but a major problem of these techniques has been ascending cholangitis. Ascending cholangitis has been noted in up to 50–90% of cases with a high incidence of morbidity [12]. The authors describe here their experience with the use of the appendix as a biliary conduit for biliary reconstruction following excision of choledochal cysts in six children. The operation is easier and it achieves an anatomic reconstruction that is close to normal.

## Materials and Methods

Six patients between 4 and 9 months of age with choledochal cysts type I were studied from March 2000 to September 2001. Three patients presented with conjugated hyperbilirubinemia, while one presented with a perforated choledochal cyst with biliary peritonitis. Two were diagnosed incidentally on abdominal ultrasound.

In addition to clinical examination, hematological tests for a full blood count, renal function tests, liver function tests, and a coagulation profile were carried out. An ultrasound examination was done in all cases for the evaluation of the extra- and intrahepatic ducts. Magnetic resonance cholangiopancreatography was done preoperatively in all cases to rule out biliopancreatic duct anomalies.

The abdomen was opened through a supraumbilical right transverse incision. The right colon and hepatic flexure was mobilized to bring the cecum under the liver. The appendix was then detached, preserving the vascular pedicle. The stump was ligated and buried, using purse string sutures. The tip of the appendix was cut open so as to form a tube from the appendix. This was irrigated with a solution of providone iodine and saline. The cecal end of the appendix was anastomosed with the common hepatic duct with interrupted 5–0 dexon or vicryl sutures. The distal end of the appendix was anastomosed to the duodenum

with interrupted 5–0 dexon or vicryl sutures after forming a tunnel between the mucosa and the muscularis. The seromuscular layers were closed over it using interrupted 5–0 dexon sutures (Figs. 1 and 2). A drain was placed in the sub-hepatic space. Postoperatively it has been our practice to give prophylactic antibiotics for a period of six weeks. We used a combination of trimethoprim and sulphamethoxazole (cotrimoxazole 12 mg/kg once daily in all our patients. Hematological and biochemical investigations were repeated two weeks after surgery and subsequently at six weeks during the first follow-up. An ultrasound was done at 3 months and supplemented with a Tc HIDA scan in three patients. Repeat ultrasound scans were done on a yearly basis for the first two years. Hematological and biochemical investigations were repeated every 6 months for the first two years. Follow-up was done every 6 months up to a period of two years, following which the children will be reviewed on a yearly basis (Table 1).

## Results

All children did well in the postoperative period. There was no evidence of cirrhosis in any of the patients. One child was lost to follow-up after two weeks. All hematological and biochemical investigations were normal at the two-week check-up. Jaundice had resolved in all three children who had initially presented with hyperbilirubinemia. A Tc HIDA scan was done in three patients operated for choledochal cyst excision with interposition of the appendix three months after surgery which showed a normal length and caliber of the duct with free flow of the contrast into the duodenum and no evidence of reflux. Follow-up HIDA scans could not be carried out in all patients because of economic restraints, but the lack of clinical evidence of cholangitis or jaundice eliminated the possibility of reflux or strictures and ensured a free flow of bile. Repeat ultrasound scans done on a yearly basis showed no dilatation of the intrahepatic biliary tree or changes of portal vasculature.

We had no febrile episodes to suggest cholangitis in the two years of follow-up of our patients. Currently all five patients in follow-up are free of jaundice.

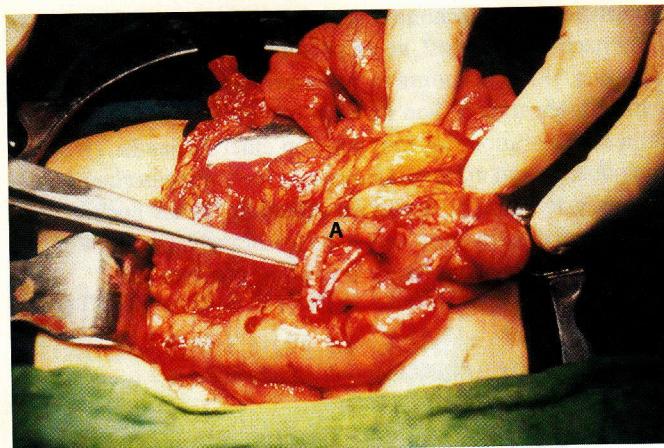


Fig. 1 Picture showing the mobilized appendix preserving the vascular pedicle (A).

## Discussion

An ideal biliary conduit is one that should allow a free flow of bile from the liver to the duodenum, without allowing reflux of any intestinal contents back into the biliary tree. Though the jejunal loop is well known and effective, it has its own drawbacks.

Cholangitis is one of the main problems that the surgeons have to face in these patients. As many as 50% of patients who have been operated for Biliary Atresia, and about 46% of patients operated for biliary reconstruction after resection of choledochal cysts have episodes of cholangitis. This high incidence has prompted various modifications of the jejunal grafts to prevent reflux, e.g. using interposition grafts, intussuscepted ileocolic interposition graft [1,4,10], jejunal nipple valve [3,10,15], mucosal flap valve [16], and sphincter of Oddi valve [13], but in spite of all these modifications the incidence of cholangitis remains significant. Jejunal loop has its own disadvantages, i.e. the use of a wide loop that may necessitate tailoring, strictures at the site of anastomosis, and loss of a long jejunal loop out of the intestinal circuit.

The use of the appendix, on the other hand, is well suited as a biliary conduit. The procurement of the appendix is simple and direct. The conical base and the tapering tip are well suited for biliary replacement. The small caliber, well-vascularized tube can be anastomosed to the duodenum using a nonrefluxing tun-

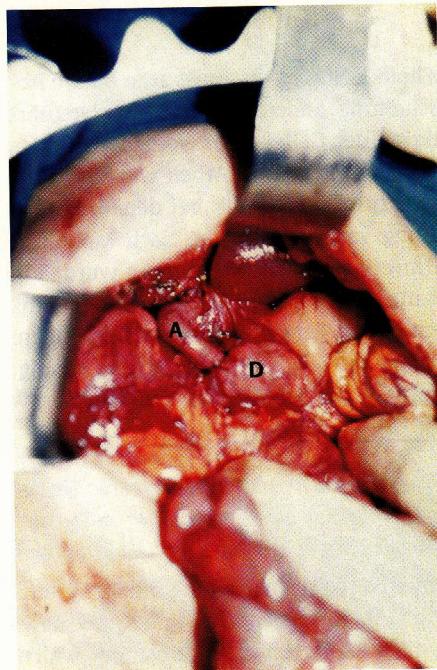


Fig. 2 Picture showing the appendix (A) placed between the common bile duct and the 2nd part of the duodenum (D).

nel. The bile is directed into the duodenum, which is a physiological area for the intestinal and biliary contents to be mixed.

We used prophylactic antibiotics for up to six weeks after surgery. O'Neill [14] suggests that the chances of postoperative cholangitis diminish six weeks after surgery. Decreased incidence of postoperative cholangitis as suggested by Gupta et al. [8] where the appendix was used as a biliary conduit was possibly due to the role played by the presence of lymphoid follicles in the wall of the appendix.

Grosfeld et al. [7] first reported the use of an appendiceal graft for biliary reconstruction in mongrel dogs. Greenholz et al. [1] performed an ancillary appendiceal conduit to provide biliary drainage of an independent bile duct. Crombleholme et al. [17] used this technique successfully in patients with biliary atresia and choledochal cyst [2]. The appendix has also been used as a ureteral conduit and long-term patency and function has been documented for as long as 11 years postoperatively [18]. Our initial experiences with the use of the appendix as a bilioenteric

Table 1 Patient details

Patient no.	Age in months	Sex	Presentation	Postoperative course	LFT at 6 weeks post op.	Follow-up
1	6	Male	Incidental	Uneventful	Normal	HIDA – Normal
2	5	Male	Biliary peritonitis	Fever for two days	Normal	HIDA – Normal
3	7	Male	Jaundice	Uneventful	Normal	USG – Normal
4	4	Male	Jaundice	Uneventful	N/A	Lost to follow-up
5	9	Female	Jaundice	Uneventful	Normal	HIDA – Normal
6	71/2	Male	Incidental	Uneventful	Normal	USG – Normal

conduit in children with choledochal cyst seem to be promising and long-term follow-up of these children would be interesting.

## References

- <sup>1</sup> Chiba T. Bile duct reconstruction with an ileocaecal intestinal graft to prevent postoperative ascending cholangitis. *Jpn J Soc Pediatr Surg* 1974; 10: 611–618
- <sup>2</sup> Crombleholme TM, Harrison MR, Langer JC et al. Biliary appendico-duodenostomy: A nonrefluxing conduit for biliary reconstruction. *J Pediatr Surg* 1989; 24: 665–667
- <sup>3</sup> Donahoe PK, Hendren WH. Roux-en-Y on line intussusception to void ascending cholangitis in biliary atresia. *Arch Surg* 1983; 118: 1091–1094
- <sup>4</sup> Endo M, Katsumata K, Yokoyama J et al. Extended dissection of the portahepatis and creation of an intussuscepted ileo-colic conduit for biliary atresia. *J Pediatr Surg* 1983; 18: 784–793
- <sup>5</sup> Freund H, Berlotzky Y, Schiller M. The ileocaecal segment: An anti-reflux conduit for hepatic portoenterostomy. *J Pediatr Surg* 1979; 14: 169–171
- <sup>6</sup> Greenholz SK, Lilly JR, Shikes RH et al. Biliary atresia in the newborn. *J Pediatr Surg* 1986; 21: 1147–1148
- <sup>7</sup> Grosfeld JL, Weinberger M, Clatworthy HW. Vascularized appendiceal transplants in biliary and urinary tract replacement. *J Pediatr Surg* 1971; 6: 630–638
- <sup>8</sup> Gupta DK, Rohatgi M. Use of appendix in biliary atresia. *Indian J Pediatr* 1989; 56: 479–482
- <sup>9</sup> Kasai M, Kimura S, Asakura Y et al. Surgical treatment of biliary atresia. *J Pediatr Surg* 1968; 3: 665–675
- <sup>10</sup> Kaufman BH, Luck SR, Raffensperger JG. The evolution of a valved hepato-duodenal-intestinal conduit. *J Pediatr Surg* 1981; 16: 279–283
- <sup>11</sup> Lilly JR, Altman RP. Hepatic portoenterostomy (the Kasai operation) for biliary atresia. *Surgery* 1975; 78: 76–86
- <sup>12</sup> Lilly JR, Karrer FM. Contemporary surgery for biliary atresia. *Pediatr Clin North Am* 1985; 32: 1233–1246
- <sup>13</sup> Lilly JR, Stenlin G. Catheter decompression of hepatic portocholecystostomy. *J Pediatr Surg* 1982; 17: 904–950
- <sup>14</sup> O'Neill JA. Choledochal cyst. *Curr Probl Surg* 1992; 29: 361–410
- <sup>15</sup> Reynolds M, Luck SR, Raffensperger JG. The valved conduit prevents ascending cholangitis: A follow-up. *J Pediatr Surg* 1985; 20: 696–702
- <sup>16</sup> Shin WKT, Zhang JZ. Antirefluxing Roux-en-Y biliary drainage for hepatic portoenterostomy: Animal experiments and clinical experience. *J Pediatr Surg* 1985; 20: 689–692
- <sup>17</sup> Suruga K, Komo S, Miyano T et al. Treatment of biliary atresia: Microsurgery for hepatic porto-enterostomy. *Surgery* 1976; 80: 558–562
- <sup>18</sup> Weinberg RW. Appendix ureteroplasty. *Br J Urol* 1976; 48: 234