Strategy of Management for Congenital Biliary Dilatation in Early Infancy

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Purpose: The aim of this study was to establish the optimal management strategy of congenital biliary dilatation (CBD) in early infancy.

Methods: Over the last 15 years, 14 patients with CBD in early infancy (within 5 months), including 3 antenatally diagnosed patients, were treated in the authors' department. Of the 14 patients, 7 (50%) underwent early definitive surgery (E group), and the other 7 (50%) underwent delayed primary definitive surgery after percutaneous transhepatic cholangiodrainage (PTCD; D group). Both groups were compared retrospectively using clinical data.

Results: Pretreatment status and backgrounds of the patients were clinically homogeneous between the 2 groups. The total length of hospital stay was significantly longer in the D group. As short-term complications, 1 patient in the E group was compromised with hepatolithiasis, and 3 patients in the D group were compromised with catheter-related complications. Other clinical data, such as age at definitive surgery, blood loss, pathologic fibrosis of the liver, jaundice-free day, and long-term complications were not significantly different between the 2 groups.

Conclusions: The authors propose that the standard of management should be early definitive surgery with wide anastomosis before 2 months of age. However, PTCD might be used under strict consideration of indication and careful management for patients with extremely poor surgical risk.

INDEX WORDS: Congenital biliary dilatation, infancy, antenatal diagnosis, percutaneous transhepatic cholangiodrainage.

BECAUSE of the advance and widespread use of ultrasonography (US), congenital biliary dilatation (CBD) has been diagnosed frequently in early infancy, especially in the antenatal period with maternal US. However, the optimal strategy of management for CBD in early infancy has not yet been established. We have treated 14 early infants with CBD during the last 15 years in our department with 2 different strategies: early definitive surgery and delayed primary definitive surgery after percutaneous transhepatic cholangiodrainage (PTCD). Based on the findings in these patients, we evaluated the 2 strategies, especially the role of PTCD, to establish the optimal strategy of management for CBD in early infancy.

MATERIALS AND METHODS

Between 1986 and 2000, 55 children with CBD were referred to our department. There were 13 boys and 42 girls, ranging in age from 0 to 15 (3.3 ± 3.7, mean ± SD) years. The types of CBD were classified as 41 cystic and 14 fusiform. Of the 55 patients, 14 (26%) were referred to us in early infancy (within 5 months of birth, including 3 antenatally diagnosed patients), and these 14 were examined retrospectively. We regard infants within 5 months of birth who have not yet started on solid foods as in the "early infancy" period, and we use the term *choledochal cyst* for the dilated extrahepatic biliary tract of patients with CBD in this report. Of the 14 patients, 7 (50%) underwent early definitive surgery for CBD with choledochal cyst excision and Roux-en-Y hepaticojejunostomy as early as possible after admission; they were classified as the E group. The other 7 (50%) initially underwent PTCD and then underwent delayed primary definitive surgery for CBD; they were classified as the D group.

Our indications of PTCD for CBD in early infancy were as follows: severe obstructive jaundice with a serum total bilirubin (TB) level of more than 7.0 mg/dL, ascending cholangitis resistant to antibiotics, or malnutrition caused by difficulty in feeding and vomiting because of a huge choledochal cyst. Our procedure of PTCD for CBD in early infancy is as follows: under general anesthesia and fluoroscopic control, US guided percutaneous transhepatic puncture of the dilated biliary tract is performed using a 22-gauge exclusive needle. In patients whose intrahepatic bile duct is dilated, standard transhepatic puncture of the intrahepatic bile duct is performed; however, in patients whose intrahepatic bile duct is not dilated, transhepatic puncture of the choledochal cyst is performed (Fig 1). After bile sampling for bacterial examination, cholangiography through the needle is performed to confirm the anomalous form of the biliary tract. A 5F pigtail-shaped PTCD catheter (DUAN-5.0-20-15-PIG; Cook, Bloomington, IN) then is inserted using a standard guidewire and dilator technique. Finally, the catheter is fixed tightly to the chest wall with an exclusive device and is dressed heavily with gauze and elastic tape. The catheter is always managed under sterilization. The drained bile is collected and measured every 8 hours, and injected into the stomach via a nasogastric tube. Antibiotic cover is applied according to the results of bacterial

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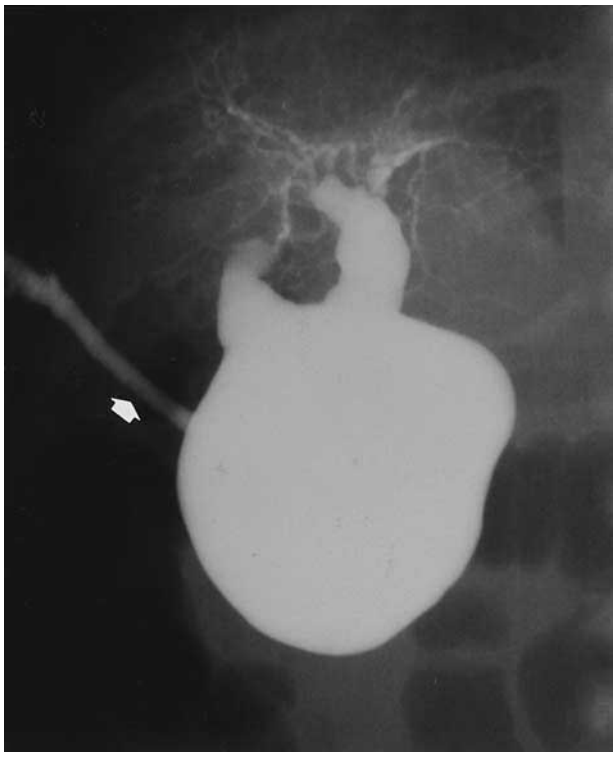

Fig 1. A 5-day-old girl who had CBD diagnosed at 29 weeks' gestation with maternal US. After birth, difficulty in feeding gradually developed after enlargement of the choledochal cyst. PTCD was applied 16 days after birth, and delayed primary definitive surgery for CBD was performed 53 days later (arrow, PTCD catheter).

examination of the bile, not routinely. The appropriate timing of delayed primary definitive surgery is decided according to sufficient improvement of the individual symptoms indicated for PTCD.

Both groups were compared using the following clinical data: age and body weight at admission; choledochal cyst diameter measured with US; laboratory data of serum TB, direct bilirubin (DB), asparate aminotransferase (AST), alanine aminotransferase (ALT) and C-reactive protein (CRP) levels at admission; age at definitive surgery for CBD; blood loss during definitive surgery; the presence of pathologic fibrosis of the liver, which was defined by a single pathologist as an increase in the amount of fibrous tissue in the portal area; jaundice-free day, which means the day after admission at which the serum TB level fell to less than 1.0 mg/dL; short-term complications that occurred during the hospital stay; long-term complications that occurred after discharge; length of hospital stay after definitive surgery; total length of hospital stay; and follow-up period.

Data are expressed as median (range) for each group. Statistical differences between the 2 groups were analyzed using the Mann-Whitney U test. The frequencies of the presence of pathologic fibrosis of the liver, short-term complications, and long-term complications were analyzed using the χ^2 test. A P value less than .05 was considered statistically significant. These analyses were carried out with Stat View for Macintosh microcomputer (Abacus Concepts, Berkeley, CA).

RESULTS

In the E group, the 7 patients consisted of 7 girls and 7 cystic types, and the chief complaints were jaundice (3 patients), antenatal diagnosis of CBD (2; gestational age at diagnosis were 22 and 30 weeks, respectively), abdominal distension (n = 1), and light-colored stools (n = 1). Definitive surgery was performed at a median of 8 (range, 4 to 17) days after admission. In the D group, the 7 patients consisted of 7 girls and 7 cystic types, and the chief complaints were jaundice (4 patients), antenatal diagnosis of CBD (1; gestational age at diagnosis was 29 weeks), abdominal distension (n = 1), and vomiting (n = 1). PTCD was performed at a median of 6 (range, 3 to 42) days after admission. One patient was indicated initially for elective definitive surgery; however, sepsis caused by resistant ascending cholangitis occurred during the waiting period for definitive surgery, and PTCD was applied as late as 42 days after admission. Indications for PTCD were severe obstructive jaundice (3 patients), ascending cholangitis (n = 2), and difficulty in feeding (n = 2), and definitive surgery was performed at a median of 33 (range, 23 to 53) days after PTCD. The intervals between admission and initial surgical intervention (E group, definitive surgery; D group, PTCD) were not significantly different between the 2 groups (P = .37). Clinical data for both groups are shown in Table 1. The age at admission was higher in the E group but was not significant. The body weight was nearly equal in both groups. The cyst diameter was larger in the D group but was not significant. All of the laboratory data were higher in the D group but not significantly. The age at definitive surgery was higher in the D group but was not significant. Blood loss was nearly equal in both groups. Pathologic fibrosis was present in 57% (4 of 7) of the E group and 43% (3 of 7) of the D group, but the frequency was not significant. The jaundice-free day was nearly equal in both groups. Although it was not significant, the 57% (4 of 7) frequency of short-term complications in

Table 1. Clinical Data

	E Group (n = 7)	D Group (n = 7)	*P* Value
Age at admission (d)	59 (2-141)	55 (5-105)	.65
Body weight (kg)	4.6 (3.0-7.0)	4.5 (2.9-6.2)	.66
Cyst diameter (mm)	50 (31-103)	58 (35-100)	.44
TB (mg/dL)	5.6 (0.5-8.9)	7.9 (3.2-24.7)	.08
DB (mg/dL)	3.4 (0.2-6.6)	5.4 (1.0-6.9)	.14
AST (IU/L)	97 (38-318)	140 (33-258)	.48
ALT (IU/L)	51 (7-315)	102 (11-199)	.57
CRP (mg/dL)	0.1 (0-0.3)	0.5 (0.1-6.6)	.05
Age at definitive surgery (d)	76 (31-149)	98 (69-134)	.75
Blood loss (g)	106 (30-205)	101 (68-147)	.80
Pathologic fibrosis	4/7	3/7	.59
Jaundice-free day (d)	48 (28-79)	50 (11-79)	.35
Complications			
Short-term	1/7	4/7	.09
Long-term	2/7	1/7	.51
Length of hospital stay (d)			
After definitive surgery	15 (12-59)	16 (11-26)	.65
Total	36 (17-71)	60 (43-94)	.02
Follow-up period (yr)	2 (1-15)	5 (2-11)	.30

the D group was higher than that of 14% (1 of 7) in the E group. In the E group, postoperative recurrent cholangitis requiring a long period of total parenteral nutrition and antibiotic cover was seen in 1 patient. In the D group, PTCD catheters slipped out of the liver during the drainage period in 2 patients; however, they did not result in episodes of bile peritonitis. Other short-term complications in the D group were 1 each of catheter-related retrograde cholangitis and postoperative wound infection. In both groups, the treatments were completed successfully with no mortality. The length of hospital stay after definitive surgery was nearly equal in both groups; however, the total length of hospital stay was significantly longer in the D group. As long-term complications, postoperative adhesive ileus occurred in 1 patient in each group, and 1 patient in the E group is complicated with hepatolithiasis and is indicated for percutaneous transhepatic cholangioscopic lithotomy. All 14 patients are alive at a median of 2 (E group) and 5 (D group) years' follow-up.

DISCUSSION

Owing to the advance and widespread use of US, CBD has been diagnosed frequently in early infancy, especially in the antenatal period with maternal US.[1-11] As a result, about half of patients with antenatally diagnosed CBD are asymptomatic at the time of admission when referred to pediatric surgeons.[1,2] However, once the patients start feeding, bile production increases, which may lead to enlargement of a choledochal cyst with stenosis of the distal part of the cyst[1,3]; this stenosis has been reported to be present in approximately 80% of cystic CBD cases.[4,5] These pathophysiologic changes in the choledochal cyst may lead to clinical symptoms such as obstructive jaundice, liver dysfunction, ascending cholangitis, rupture of the cyst, or difficulty in feeding and vomiting caused by compression and outlet obstruction of the stomach, which result in malnutrition. Moreover, a long period of cholestasis from early infancy may result in biliary cirrhosis and portal hypertension; histologically confirmed varying degrees of fibrosis of the liver have been reported in newborns with cystic CBD.[4-6] In addition, type I cystic biliary atresia (BA), of which the prognosis is greatly dependent on definitive surgery as early as possible, and cystic CBD may share the same pattern with US,[7,8] making prompt differential diagnosis of these 2 entities necessary.[5,7,8,12] For these reasons, an early decision on the strategy for surgical treatment is essential for CBD in early infancy, even when the patients are asymptomatic. However, an optimal strategy of management for CBD in early infancy has not yet been established. For these patients, 2 different strategies may be considered: early definitive surgery and delayed primary definitive surgery after PTCD. To the best of our knowledge, there is no report comparing these 2 strategies from a series collected from a single institution.

Choledochal cyst excision and hepaticoenterostomy is the optimal definitive surgery for CBD. Regarding this, deciding the appropriate transectional level of the intrapancreatic terminal choledochus and the common hepatic duct to achieve complete excision of the choledochal cyst is essential to prevent any remnant of the cyst, which may result in recurrent pancreatitis or carcinoma as late postoperative complications.[13] In addition, a wide anastomosis allowing free bile drainage also is essential to prevent late postoperative complications such as recurrent cholangitis and hepatolithiasis, which are induced by anastomotic stricture.[13] Neonatal surgery on a thin-walled choledochal cyst and a narrow common hepatic duct may be technically difficult and may injure surrounding structures such as the hepatic artery, portal vein, or pancreatic duct, and cause further anastomotic complications such as leakage and stricture.[4] In our series, 1 patient in the E group has hepatolithiasis, which could have been a complication induced by anastomotic stricture. However, several recent investigators[3-6,10] have reported that definitive surgery for CBD in early infancy is safe and effective and may prevent serious complications later in life. In addition, it offers the chance of differential diagnosis with type I cystic BA and improves its outcome.[4] Therefore, when the patient's clinical status permits, early definitive surgery, generally before 2 months of age, is one of the optimal strategies.

However, because of the technical difficulty of neonatal surgery, several investigators[2,4,10] suggested that patients who are antenatally diagnosed and yet asymptomatic should be monitored closely with US and biochemical liver function tests and should undergo elective definitive surgery at 3 months of age. While waiting for the patient's physical development before definitive surgery, it is very important to prevent cholestasis, and thus stop the progression of liver damage. For this purpose, especially when early definitive surgery seems to be hazardous because of severe obstructive jaundice, ascending cholangitis, or malnutrition, PTCD may be useful to manage and stabilize the patient until the clinical status improves. In addition, decreasing the size of the enlarged choledochal cyst can be achieved easily with PTCD, which may lead to an improvement in the feeding and physical development of the patient. Therefore, initial PTCD followed by delayed primary definitive surgery would be a wise alternative procedure in CBD in early infancy with poor surgical risk.[1,13] However, there are theoretical objections to converting a sterile biliary system into a colonized one via the percutaneous catheter. In addition, the technical difficulty and catheter-related complications such as failure of insertion, infection, or slipping out are considered to be disadvantages

of PTCD in early infancy. In our series, the frequency of short-term complications in the D group, most of which were catheter-related, was higher than that in the E group. Moreover, once PTCD is used, the total length of hospital stay may be increased, as seen in our series; therefore, the cost implications of PTCD also are a major problem. For these reasons, the role of PTCD should be limited to a short-term solution for patients with extremely poor surgical risk who need rapid and less invasive surgical intervention such as severe obstructive jaundice associated with bleeding tendency or sepsis caused by resistant ascending cholangitis. Therefore, the strict evaluation of indication, skillful technique of PTCD, and careful management of the catheter are needed to use this strategy. The appropriate timing of delayed primary definitive surgery is reported to be 1 or 2 months later when the patient's clinical status has improved[1]; however, the shorter the catheter placing period, the less the risk of catheter-related complications. In our series, the catheters were placed for a median of as long as 33 days because we intended to obtain an excess efficacy from PTCD, but it was too long. Therefore, delayed primary definitive surgery should be performed as early as possible when the patient's clinical status has begun to improve.

In our series, 14 early infants with cystic CBD collected over 15 years from our institution were divided into 2 groups according to the strategy of management and compared. The pretreatment status and backgrounds of the patients were clinically homogeneous between the 2 groups. Of the clinical data examined, the total length of hospital stay was significantly longer in the D group, which was the result of the waiting period with PTCD until delayed primary definitive surgery, and, although it was not significant, the frequency of short-term complications was higher in the D group. However, no marked differences regarding other clinical courses and outcomes, such as age at definitive surgery, blood loss during definitive surgery, the presence of pathologic fibrosis of the liver, jaundice-free day, and long-term complications were revealed between the 2 groups. Therefore, we regard the 2 strategies as having different indications and risks, but equal efficacy for management of CBD in early infancy.

The natural history of antenatally diagnosed CBD is worthy of attention, and a critical analysis would be timely; however, there were only 3 cases in our series. In addition, the recent increasing proportion of CBD in early infancy is reported to be the fusiform type detected after an episode of transient neonatal jaundice or complicated by inspissated bile; therefore, the natural history and optimal strategy of management for incidentally diagnosed fusiform CBD also are worthy of attention and are controversial; however, there were none in our series. For these points, studies with a larger number of patients are necessary.

We propose the optimal strategy of management for CBD in early infancy to be as follows: for asymptomatic patients, choledochal cyst diameter, jaundice, and liver function should be monitored closely with US and blood sampling until 3 months of age, and then elective definitive surgery should be performed. For symptomatic patients, especially when a differential diagnosis with type I cystic BA is doubtful, early definitive surgery with careful dissection and wide anastomosis is the standard management and must be performed before 2 months of age. However, when the diagnosis of CBD is confirmed, for patients with extremely poor surgical risk who need rapid and less invasive surgical intervention, PTCD might be used under strict consideration of indication and careful management, and delayed primary definitive surgery should be performed as early as possible. Whatever the strategy chosen, an early decision on the strategy for the surgical treatment is essential for CBD in early infancy to avoid the risk of cholestasis, which may result in biliary cirrhosis and portal hypertension.

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