Development of Intrahepatic Biliary Stones After Excision of Choledochal Cysts

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Background: The incidence of intrahepatic cholelithiasis and cholangitis has not yet been well studied postoperatively in patients with choledochal cysts.

Methods: One hundred three patients with choledochal cysts had operative cholangiography, underwent standard excision of a choledochal cyst with Roux-en-Y hepatico-jejunal anastomosis, and were at a mean follow-up of 12½ years. The incidence of intrahepatic bile duct stones was analyzed according to the 3 morphologic types of intrahepatic bile duct observed at initial operative cholangiography: type 1, no dilatation of the intrahepatic bile ducts; type 2, dilatation of the intrahepatic bile ducts but without any downstream stenosis; and type 3, dilatation of the intrahepatic bile ducts associated with downstream stenosis. Initially, there was no evidence of intrahepatic bile duct stones in any of the 103 patients.

Results: Among 50 type 1 patients, intrahepatic cholelithiasis developed in only 1 patient (2%). Among 43 type 2 patients, 1 patient (2%) had intrahepatic cholelithiasis, and 2 (5%) had postoperative cholangitis. Among 10 type 3 patients, 4 (40%) had intrahepatic cholelithiasis ($P < .01$), and 3 (30%) had postoperative cholangitis. Time intervals between the initial surgery and the first identification of intrahepatic stones ranged from 3 to 22 years.

Conclusions: One of the major causes of formation of intrahepatic cholelithiasis has been clarified; patients with intrahepatic biliary dilatation with downstream stenosis can get intrahepatic bile duct stones long after excision of a choledochal cyst.

INDEX WORDS: Intrahepatic cholelithiasis, choledochal cyst, postoperative cholangitis.

INTRAHEPATIC BILE DUCT STONES are more frequently encountered in East Asian countries than in Europe and the United States.[1] Nevertheless, their diagnosis and treatment are important worldwide. Biliary stricture, either idiopathic or caused by underlying anomalies, has been suggested as a cause of the formation of intrahepatic bile duct stones.[2] However, this hypothesis has never been proven.

In 1971 we reported that dilatation of the intrahepatic bile ducts occurred in 9 of 16 patients with choledochal cyst, drawing attention to the high incidence of intrahepatic involvement of this lesion.[3] Similar observations followed by Todani et al[4] and by other investigators. Intrahepatic cholelithiasis, suppurative cholangitis, and carcinogenesis were considered to be potentially serious postoperative complications of such intrahepatic involvement of choledochal cyst. However, the actual incidence of postoperative intrahepatic cholelithiasis, cholangitis, and carcinogenesis has not yet been well studied in patients with choledochal cysts, and an extensive follow-up study was undertaken to clarify these points of debate.

MATERIALS AND METHODS

The main purpose of the current study was to investigate whether preexisting intrahepatic dilatation with downstream stenosis can predispose to the formation of intrahepatic biliary stones over the long term. Infants and children with choledochal cyst who underwent surgery from 1953 to 1999 at the Department of Surgery, Gunma Children's Medical Center, Gunma; Department of Pediatric Surgery, University of Tokyo; and Department of Surgery, National Children's Hospital, Tokyo, were reviewed at our follow-up clinics. Among all the patients who had been under the direct supervision of the current authors, only 103 patients in whom intraoperative cholangiography was performed, who underwent excision of the dilated common and hepatic ducts followed by Roux-en-Y hepatico-jejunostomy, and who were followed up for at least 2½ years were analyzed to rule out other factors that might have influenced the clinical outcome. Therefore, 12 patients who underwent choledochal cyst-jejunostomy (Roux-en-Y), choledochal cyst-duodenostomy, or excision of a choledochal cyst simultaneously with prophylactic hepatic lateral segmentectomy[5] were excluded from the current study.

Patients were reviewed at our follow-up clinics. In addition to routine examinations such as peripheral blood count and blood chem-

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istry, ultrasonography, computed tomography, and/or magnetic resonance tomography were used to screen for intrahepatic cholelithiasis. Postoperative cholangitis was diagnosed when the patient had jaundice and abnormally elevated serum transaminase levels accompanied by leukocytosis.

The incidence of postoperative complications such as intrahepatic bile duct stones and cholangitis was analyzed according to the 3 major anatomic types of the intrahepatic biliary system recorded at the initial surgery with operative cholangiography. As we reported previously,[6] type 1 denotes no dilatation of the intrahepatic bile ducts; type 2, dilatation of the intrahepatic bile ducts but without any downstream stenosis; and type 3, dilatation of the intrahepatic bile ducts associated with downstream stenosis (Fig 1). The first author of this article carefully reviewed all of the operative cholangiograms, and only a definitive, abrupt narrowing was classified as downstream stenosis; the definition of intrahepatic biliary dilatation was based on an unequivocal dilatation.

Patients with incomplete data from operative cholangiography, who underwent other types of surgical procedure or who had follow-up shorter than 2½ years, were excluded from the current analysis. Initially, operative cholangiography did not show any evidence of intrahepatic bile duct stones in any of the 103 patients. The conditions of the patients were evaluated based on whether intrahepatic cholelithiasis, cholangitis, or cholangiocarcinoma was present. Statistical analysis was performed using Fisher's Exact test.

RESULTS

The mean follow-up time in the 103 patients was 12 years, 6 months. In 50 type 1 patients who did not show any dilatation of the intrahepatic bile ducts, intrahepatic cholelithiasis developed in only 1 (2%). None of the patients experienced postoperative cholangitis. Among 43 type 2 patients whose intrahepatic bile ducts were dilated but not associated with any downstream stenosis, 1 patient (2%) experienced intrahepatic cholelithiasis, and 2 (5%) had postoperative cholangitis. Among 10 type 3 patients with intrahepatic bile duct dilatation and downstream stenosis, 4 patients (40%) had intrahepatic cholelithiasis ($P < .01$), and 3 (30%) had postoperative cholangitis (Table 1). Time intervals between the initial surgery for choledochal cyst and the first identification of intrahepatic stones ranged from 3 to 22 years. Biliary carcinoma did not develop in any of the 103 patients postoperatively.

The stones were identified proximal to the stenosis in all 4 type 3 patients (Fig 2), and the stones were found in the initially confirmed dilated portions in 5 of the 6 patients (1 in type 2 patients and 4 in type 3 patients). An intrahepatic bile duct stone that developed in 1 type 1 patient was found just proximal to the site of hepaticojejunal anastomosis.

Table 1. Postoperative Complications According to Morphologic Types of Intrahepatic Bile Ducts at Initial Surgery

	Type 1	Type 2	Type 3
Intrahepatic bile duct stones	1	1	4
Postoperative cholangitis	0	2	3
Carcinogenesis	0	0	0
Total no. of patients	50	43	10

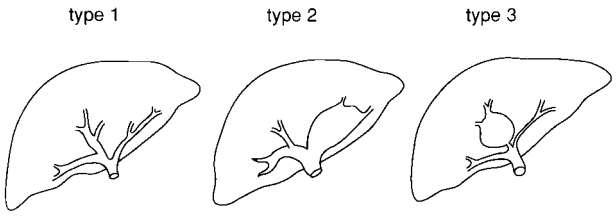

Fig 1. Types of intrahepatic bile ducts observed with intraoperative cholangiography in infants and children with choledochal cysts. Type 1 denotes no dilatation of intrahepatic bile ducts; type 2, dilatation of the intrahepatic bile ducts but without downstream stenosis; and type 3, dilatation of the intrahepatic bile ducts with downstream stenosis.

DISCUSSION

The current analysis appears to have clarified one of the major causes of the formation of intrahepatic cholelithiasis. It is concluded that patients with intrahepatic biliary dilatation with a downstream stenosis are most likely to develop bile duct stones long after excision of a choledochal cyst. It also was verified that hepaticojejunal anastomotic stenosis may play a minor role in the formation of intrahepatic cholelithiasis.

It has long been unclear whether dilatation with or without downstream stenosis, frequently observed together with intrahepatic cholelithiasis, is a cause of stone formation or the result of it. Such intrahepatic dilatation generally has been considered a secondary change caused by stones,[1,2] but some Western authors attributed these strictures to congenital dysplasia of the biliary system.[7-9] There have been very few reports that clarify these points of debate. Recently, Fujii et al[10] conjectured,

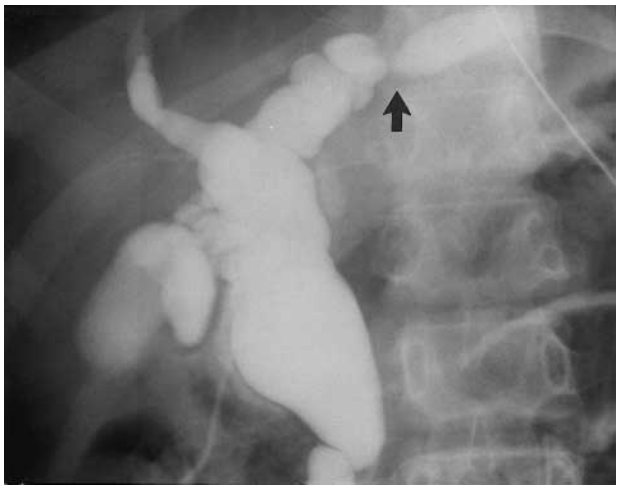

Fig 2. Operative cholangiogram of an 11-year-old girl with choledochal cyst showed dilatation of the left intrahepatic bile ducts with stenosis (type 3). Intrahepatic cholelithiasis developed in the dilated portion, proximal to the stenosis (arrow), of the left intrahepatic bile ducts 3 years postoperatively.

based on their observations of 38 cases of intrahepatic cholelithiasis associated with choledochal cyst, that biliary strictures must have been formed congenitally. Cetta et al[11,12] reported that a stricture preceded intrahepatic stone formation in their study of 8 patients with hepatolithiasis not associated with Caroli's disease. Their report on preexisting strictures before stone formation may be one of the first 2 reports[6] that confirmed the theory of the congenital origin of intrahepatic cholelithiasis. They treated 2 other patients who had Caroli's disease and formed intrahepatic biliary stones.[11,12] Cases of intrahepatic cholelithiasis associated not only with Caroli's disease[12,13] but also with biliary atresia[14,15] have been reported. It should be remembered that irregular cystic dilatation of the intrahepatic biliary system is frequently encountered in biliary atresia postoperatively.[16]

In addition to this series, a 4-year-old girl with a choledochal cyst with type 3 intrahepatic involvement underwent excision of the choledochal cyst together with prophylactic left hepatic lateral segmentectomy in 1996,[5] because the cystically dilated left intrahepatic bile duct was almost totally separated from the common hepatic duct by severe stenosis and because we were convinced by our early experiences[6] that it would be impossible to avoid stone formation in the hugely dilated left intrahepatic bile duct of this patient if conventional excision of the extrahepatic bile ducts alone was performed. This patient did well 7 years postoperatively.

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REFERENCES

1. Fan ST, Choi TK: Intrahepatic lithiasis and benign intrahepatic strictures, in Lygidakis NJ, Makuuchi M (eds): Pitfalls and Complications in the Diagnosis and Management of Hepatobiliary and Pancreatic Diseases. Stuttgart, Germany, Georg Thieme, 1993, pp 261-265

2. Matsumoto Y, Fujii H, Yoshioka M, et al: Biliary stricture as a cause of primary intrahepatic bile duct stones. World J Surg 10:867-875, 1986

3. Tsuchida Y, Ishida M: Dilatation of the intrahepatic bile ducts in congenital cystic dilatation of the common bile duct. Surgery 69:776-781, 1971

4. Todani T, Naruse M, Watanabe Y, et al: Management of congenital choledochal cyst with intrahepatic involvement. Ann Surg 187:272-280, 1978

5. Tsuchida Y, Taniguchi F, Nakahara S, et al: Excision of a choledochal cyst and simultaneous hepatic lateral segmentectomy. Pediatr Surg Int 11:496-497, 1996

6. Uno K, Tsuchida Y, Kawarasaki H, et al: Development of intrahepatic cholelithiasis long after primary excision of choledochal cysts. J Am Coll Surg 183:583-588, 1996

7. Norman O: Studies on hepatic ducts in cholangiography. Acta Radiol Suppl 84:5-77, 1951

8. Glenn F, Moody FG: Intrahepatic calculi. Ann Surg 153:711-716, 1961

9. Balasegaram M: Hepatic calculi. Ann Surg 175:149-154, 1972

10. Fujii H, Yang Y, Matsumoto Y, et al: Current problems with intrahepatic bile duct stones in Japan: Congenital biliary malformations as a cause. Hepatogastroenterology 44:328-341, 1997

11. Cetta F, Montalto G, Nuzzo G: Recurrent hepatolithiasis after primary excision of choledochal cysts. J Am Coll Surg 185:197-201, 1997

12. Cetta F: Bile stasis due to bile duct stricture precedes, not follows, the formation of primary intrahepatic stones and plays a basic role in their pathogenesis. Am J Gastroenterol 91:2451-2452, 1996

13. Takei M, Yoda H, Kamijo N, et al: A case of Caroli's disease with hepatolithiasis, choledocholithiasis, and cholangiocarcinoma. Gastroenterol Jpn 26:224-229, 1991

14. Enriquez G, Lucaya J, Allende E, et al: Intrahepatic biliary stones in children. Pediatr Radiol 22:283-286, 1992

15. Matsui A, Nakamura M, Aihara T, et al: Hepatic calcification in an anicteric patient with biliary atresia after hepatic portoenterostomy. Acta Paediatr Jpn 36:294-296, 1994

16. Tsuchida Y, Honna T, Kawarasaki H: Cystic dilatation of the intrahepatic biliary system in biliary atresia after hepatic portoenterostomy. J Pediatr Surg 29:630-634, 1994