Hypothesis: Choledochal cyst is rarely diagnosed in adulthood. When complicated by biliary tract malignancy, the disease has a distinct presentation and carries a dismal prognosis despite radical surgical resection.

Design: Retrospective study.

Setting: Tertiary referral center.

Patients: A retrospective study was performed on 30 adult patients who presented with choledochal cyst from January 1, 1989, to December 31, 2000.

Main Outcome Measures: The clinical presentation, management, and outcome of patients with and without biliary tract malignancy.

Results: Nine patients (30%) had biliary tract malignancy complicating choledochal cyst (group A). Compared with 21 patients without malignancy (group B), group A patients had a significantly higher incidence of previous internal drainage operations for choledochal cyst ($P = .049$) and presentation with cholangitis ($P = .03$). Four patients in group A underwent pancreaticoduodenectomy and 3 received a palliative biliary drainage operation. The overall median survival of patients in group A was 12 months. Complete excision of choledochal cyst and Roux-en-Y hepaticojejunostomy were performed for all patients in group B, among whom 2 underwent concomitant hemihepatectomy. The operative morbidity and mortality were 14% and 0%, respectively, and there were no long-term complications with a median follow-up of 66 months.

Conclusions: Biliary tract malignancy complicating choledochal cyst in adults should be suspected in patients with a history of internal drainage of choledochal cyst and presentation with cholangitis. Complete excision of choledochal cyst with Roux-en-Y hepaticojejunostomy is the treatment of choice for patients without malignancy and can be performed with low operative morbidity and absence of long-term complications in adult patients.

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The diagnosis of choledochal cyst is usually made in the first few years of life, and more than 60% of all cases are diagnosed in the first decade.\textsuperscript{1,2} Presentation in adulthood is uncommon and is often associated with complication of the cyst. Early reports suggested that drainage operations including cystoduodenostomy or cystojejunostomy without excision of the cyst resulted in satisfactory outcome in the treatment of choledochal cysts.\textsuperscript{3,4} However, late complications occur on long-term follow-up. These include anastomotic stricture, cholangitis, biliary calculi, and biliary tract malignancy.\textsuperscript{5,6} The aim of the present study was to review the clinical presentation, treatment, and outcome of adult patients who had choledochal cyst with and without the complication of biliary tract malignancy.

See Invited Critique at end of article

The study comprised 30 adult patients presenting with choledochal cysts during the study period. There were 9 men (30%) and 21 women (70%), with a median age of 39 years (range, 18-64 years). The choledochal cysts were classified as Todani and coworkers’ type I in 20 patients, type II in 2 patients, and type IV in 8 patients.\textsuperscript{7} Nine patients (30%) were diagnosed as having biliary tract malignancy complicating choledochal cyst (group A), including adenocarcinoma arising from the cyst wall (7 patients) and gallbladder (2 patients). Choledochal cyst was not complicated by biliary tract malignancy in the remaining
PATIENTS AND METHODS

A retrospective study was conducted on patients older than 18 years presenting with choledochal cyst during a 12-year period from January 1, 1989, to December 31, 2000. Clinical data were derived from patients' records, and radiologic examination films were reviewed. Cysts were grouped according to the classification of Todani and coworkers.7 Preoperative investigations included blood biochemistry, ultrasonography of the hepatobiliary system, computed tomography, endoscopic retrograde cholangiopancreatography, and magnetic resonance imaging in selected patients. In patients who presented with acute pancreatitis or acute cholangitis, conservative management, including intravenous fluid administration, intravenous antibiotics, and analgesics, was provided. Preoperative investigations were completed after the acute attack subsided. When biliary tract malignancy was diagnosed on preoperative investigations (group A), complete evaluation was performed aiming at radical curative resection. Complete excision of choledochal cyst with Roux-en-Y hepaticojejunostomy was performed in all patients without biliary tract malignancy (group B). In selected patients with intrahepatic extension of choledochal cyst (type IV disease), hemihepatectomy was performed.

Statistical analysis was performed with the χ² test or Fisher exact test, when appropriate, to compare discrete variables. The Mann-Whitney test was used to compare continuous variables. Survival analysis of patients with biliary tract malignancy was estimated by the Kaplan-Meier survival method. All P values <.05 were considered to indicate statistical significance. Statistical analyses were made with the help of SPSS for Windows computer software (SPSS Inc, Chicago, Ill).

21 patients (70%) (group B). The clinical data of both groups of patients are listed in Table 1. Five patients (56%) in group A presented with acute cholangitis, and the incidence was significantly higher than that of 14% (3 patients) in group B (P = .03). Four patients (44%) in group A and 2 patients (10%) in group B had previous internal drainage operations for choledochal cyst 5 to 21 years before presentation (P = .049) (Table 2).

After evaluation, 8 patients with biliary tract malignancy (group A) underwent laparotomy. The disease was found to be too advanced for curative resection in 4 patients, and 3 of them underwent palliative biliary drainage operation (Table 3). Four patients with adenocarcinoma arising from the cyst wall underwent pancreaticoduodenectomy, but all of them died of recurrent disease 5 to 38 months after the operation. The overall median survival of patients in group A was 12 months.

Complete excision of choledochal cyst with Roux-en-Y hepaticojejunostomy was performed for all patients in group A. One patient underwent concomitant left hemihepatectomy and another patient had a right hemihepatectomy for intrahepatic extension of the choledochal cyst (type IV). Operative morbidity in group B was 14%, and there were no operative mortalities. Postoperative complications included leakage from hepaticojejunostomy anastomosis that required laparotomy (1 patient), subhepatic collection that required percutaneous drainage (1 patient), and wound infection (1 patient). Median postoperative hospital stay was 11 days (range, 6-49 days). With a median follow-up of 66 months, all patients in group B were well and none of them developed symptoms suggestive of hepatobiliary disease, such as anastomotic stenosis, acute cholangitis, acute pancreatitis, and biliary tract malignancy.

### Table 1. Clinical Data of 30 Adult Patients Who Had Choledochal Cyst With (Group A) and Without (Group B) Biliary Tract Malignancy

<table>
<thead>
<tr>
<th>Clinical Variable</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>3 (33)</td>
<td>6 (29)</td>
</tr>
<tr>
<td>Age, y*</td>
<td>43 (29-64)</td>
<td>38 (18-64)</td>
</tr>
<tr>
<td>Serum albumin, g/dL*</td>
<td>3.7 (2.9-4.6)</td>
<td>4.0 (3.5-4.9)</td>
</tr>
<tr>
<td>Serum total bilirubin, mg/dL†</td>
<td>1.9 (0.3-14.7)</td>
<td>0.7 (0.4-2.0)</td>
</tr>
<tr>
<td>Alkaline phosphatase, U/L</td>
<td>197 (66-498)</td>
<td>73 (37-199)</td>
</tr>
<tr>
<td>Aspartate aminotransferase, U/L*</td>
<td>44 (10-164)</td>
<td>23 (12-66)</td>
</tr>
<tr>
<td>Hemoglobin, g/dL*</td>
<td>12.1 (10.6-13.8)</td>
<td>12.4 (10.2-15.4)</td>
</tr>
<tr>
<td>Presentation, No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute cholangitis</td>
<td>5 (56)‡</td>
<td>3 (14)‡</td>
</tr>
<tr>
<td>Acute pancreatitis</td>
<td>1 (11)</td>
<td>3 (14)</td>
</tr>
<tr>
<td>Jaundice or impaired liver function</td>
<td>2 (22)</td>
<td>2 (10)</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>1 (11)</td>
<td>8 (38)</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>0</td>
<td>1 (5)</td>
</tr>
<tr>
<td>No symptoms</td>
<td>0</td>
<td>4 (19)</td>
</tr>
</tbody>
</table>

*Values are expressed as median (range).
†To convert to micromoles per liter, multiply by 17.1.
‡P < .05.

### Table 2. Previous Surgery for Choledochal Cyst in Patients With (Group A) and Without (Group B) Biliary Tract Malignancy

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Previous surgery</td>
<td>4*</td>
<td>2*</td>
</tr>
<tr>
<td>Cystoduodenostomy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cystojejunostomy</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>No previous surgery</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>21</td>
</tr>
</tbody>
</table>

*P = .049.

Choledochal cyst is an uncommon anomaly and is estimated to occur in 1 in 13000 to 1 in 2 million live births.8,9 It is reported to be more common in Asian populations and in females.10,11 In neonates or children, it usually presents with an abdominal mass or abdominal pain.12 Initial manifestation in adulthood is rare, and the presentation is usually nonspecific right-upper-quadrant abdominal pain, jaundice, acute pancreatitis, or acute cholangitis.13 A palpable mass is rare.14,15 It was the chief pre-
The cyst has been reported to be enhanced by cystenterostomy, which was the chief presenting symptom in only 1 of the 30 patients in the present series. While presentation with acute cholangitis is rare in the pediatric age group, it is more common in adult patients with choledochal cysts. Acute cholangitis was the chief presenting symptom in 27% of our patients and was found to be significantly more common in patients with biliary tract malignancy.

The etiology of choledochal cyst is still controversial. The "common channel theory" proposed by Babitt et al is the most commonly accepted theory. The presence of an abnormally long common channel and ineffective sphincter of Oddi around the union of the common bile duct and the pancreatic duct has been demonstrated by a number of investigators in many patients with choledochal cysts. However, this theory cannot satisfactorily explain the cause of diverticular choledochal cyst, choledochocele, or intrahepatic cyst formation.

It was once thought that internal drainage of choledochal cysts was an appropriate and adequate treatment. However, it has become evident that 30% to 50% of patients with cystoduodenostomy have late complications, such as acute cholangitis, secondary biliary cirrhosis, and development of cholangiocarcinoma. Alkalization of the cystic contents and reflux of the duodenal contents into the biliary tree, acute cholangitis and other problems still commonly occur. While cystenterostomy is technically easier, cyst excision with Roux-en-Y hepaticojejunostomy can be performed with low morbidity and mortality, being 14% and 0%, respectively, in the present study.

Biliary tract malignancy has been reported to occur in 2.5% to 28% of patients with choledochal cyst, representing a risk at least 20 times greater than that of the normal population. The risk is age related and has been reported to be 14.5% in patients older than 20 years. Possible factors for carcinogenesis in choledochal cysts include chronic inflammation, bile stagnation with possible development of carcinogens, and a sporadic distribution of the protective mucin-secreting glands of the bile duct. The incidence of biliary tract malignancy complicating choledochal cyst in the present series was 30%, which was the highest among the reported series. This could be explained by the pattern of referral to the tertiary surgical center. Patients with previous bile duct surgery and evidence suggestive of biliary tract malignancy were more likely to be referred for care to this center.

Biliary tract malignancy complicating choledochal cyst has been reported to be enhanced by cystenterostomy. It is postulated that pancreatic juice easily regurgitates into the bile duct through an anomalous junction of the pancreaticobiliary ductal system in patients with choledochal cyst, and enteric drainage causes pancreatic juice in the cyst to become activated because of the influx of enteric content. Therefore, inflammatory changes of the cysts are accelerated and result in carcinoma. In the present study, 4 of the 9 patients with biliary tract malignancy had history of a previous drainage operation for choledochal cyst. The incidence was significantly higher than for patients without malignancy (P = .049). The mean age at detection of malignancy complicating choledochal cyst is influenced by previous internal drainage operations. The age at detection of biliary tract malignancy in patients with internal drainage was found to be 15 years less than the age in those without a previous drainage procedure, and most cases of malignant degeneration were detected, on average, 10 years after an internal drainage procedure. Since carcinoma developed from choledochal cyst has a very dismal prognosis even after radical surgical excision, and most patients die within 2 years of diagnosis, excision and biliary reconstruction rather than internal drainage is recommended as the treatment of choice for choledochal cyst.

The operative morbidity of patients without biliary tract malignancy in the present series was 14% and appeared to be higher than that of patients in the pediatric age group. Complete excision of choledochal cyst in adults can be technically difficult, since pericystic inflammatory adhesion is common with repeated attacks of cholangitis and pancreatitis. Some researchers recommended leaving part or all of the cystic wall behind and performing cystenterostomy. With substantial risk of biliary tract malignancy after cystenterostomy, this should not be taken as an alternative to complete excision of choledochal cyst and hepaticojejunostomy. With a median follow-up of 66 months, no long-term complications were detected in our patients after complete excision of choledochal cyst and hepaticojejunostomy. However, there is evidence that patients who have undergone complete excision of choledochal cyst have an increased risk of developing carcinoma of the intrahepatic bile duct. Long-term close follow-up of these patients for early detection of malignancy is required.

In summary, biliary tract malignancy complicating choledochal cyst in adults occurred in 30% of the patients in our study. The condition should be suspected in patients who have a history of internal drainage of choledochal cysts and present with cholangitis. The prognosis is still dismal, even after radical resection with pancreaticoduodenectomy. Complete excision of choledochal cyst with Roux-en-Y hepaticojejunostomy is the treatment of choice for patients without malignancy and can be performed with low operative morbidity and absence of long-term complications in adult patients.

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Table 3. Operations Performed for 9 Adult Patients With Biliary Tract Malignancy Complicating Choledochal Cyst (Group A)

<table>
<thead>
<tr>
<th>Operation</th>
<th>No. (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatoduodenectomy</td>
<td>4 (44)</td>
</tr>
<tr>
<td>Palliative cystenterostomy</td>
<td>2 (22)</td>
</tr>
<tr>
<td>T-tube drainage</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Laparotomy only</td>
<td>1 (11)</td>
</tr>
<tr>
<td>No surgery</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Total</td>
<td>9 (100)</td>
</tr>
</tbody>
</table>

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REFERENCES


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he series of 30 adult patients with choledochal cysts by Dr Liu and his coauthors is an important contribution to the literature regarding the natural course of this disease. At their referral center, they identified biliary malignancy in 9 (30%) of 30 patients. Most important, none of these 9 patients was cured. Five were not candidates for potentially curative resection at the time of presentation, and the 4 patients treated by pancreaticoduodenectomy died 5 to 38 months after operation.

The development of malignancy in a larger proportion of patients with choledochal cysts is beyond dispute. This high incidence of cancer is compelling evidence for surgical resection at the time a choledochal cyst is diagnosed, even in the absence of symptoms. It equally apparent that, once cancer has developed within the biliary tree, cure is unlikely, even despite indicated aggressive surgical resection. It has been recognized for more than 2 decades that the incidence of malignant degeneration within choledochal cysts is not reduced by cystenterostomy. The authors’ recommendation that patients previously treated by cystenterostomy should have elective cyst excision may not go far enough. Referral centers that have previously performed cystenterostomy have an obligation to identify such patients and offer them elective cyst excision before the development of cancer.

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