

A Study on the Factors that Influence the Surgical Outcomes of Choledochal Cyst in Children*

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INTRODUCTION

Cystic dilatation of the biliary duct, also known as choledochal cyst is an uncommon disease entity. In case of serious condition, it requires surgical treatment. It is more frequent in East Asians, females and children rather than Westerners, males and adults¹⁻³.

In patients with choledochal cyst, an anomalous pancreatic duct-biliary duct junction (APBDJ) is often seen in both pediatric and adult patients⁴⁻⁶. The anomalous junction causes pressure gradient and results in a reflux of pancreatic juice into the bile duct, where

the activated pancreatic enzymes damage the bile duct wall and result in cyst formation. Other etiologies include sphincter dysfunction, innervations deficit and obstruction of distal choledochus of either congenital or acquired in nature⁷⁻¹¹. Choledochal cysts are currently classified into five major subtypes based on anatomical findings¹². The most common subtype in both children and adult is dilatation of extrahepatic biliary tree, representing 50-80% of all cases¹³. Classic symptom triads of choledochal cyst are abdominal pain, jaundice and palpable abdominal mass. According to the recent reports, abdominal pain is the most frequent symptom, especially in adult patients¹⁴. Meanwhile, adult patients less likely present jaundice and rarely abdominal mass¹⁵. Unlike the adult patients, jaundice is most frequent symptom and the appearance of all symptom triad is

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more common in children¹⁶. If left untreated, choledochal cysts can cause morbidity and mortality from recurrent cholangitis, pancreatitis, sepsis, liver abscesses and cholangiocarcinoma. Therefore, early diagnosis via ultrasonography and cholangiography is considered essential and most of surgeons currently agree that all patients require complete cyst excision and hepaticoenterostomy¹⁷. However, there are many reported cases of continued problems for long period following surgery¹⁸.

In this study, we reviewed clinical findings and results of treatment in pediatric patient undergone surgical management of choledochal cyst to investigate the factors affecting the surgical outcomes and determine optimal timing for surgery.

MATERIALS and METHODS

From 1995 to 2009, 32 patients under the age of 18 diagnosed as choledochal cyst were enrolled in this study. All patients included in this study were undergone surgical treatment at our hospital and their medical records were reviewed and analyzed retrospectively. Patients' sex, age at the time of surgery, preoperative clinical symptoms, laboratory findings and anatomical type of the cyst were recorded. The diagnosis was

confirmed by radiological methods of abdominal ultrasonography (US), computed tomography (CT), or magnetic resonance cholangiopancreatography (MRCP). The surgical method was cyst excision with cholecystectomy and Roux-en-Y hepaticojejunostomy. To evaluate the surgical outcomes, we analyzed mean operation time, incidence of postoperative complications, duration of hospital stay and re-hospitalization rate.

The analysis of results was conducted by SPSS 12.0 (Statistical Package for Social Sciences) while methods of t-test, chi-square test, Fisher's exact test, multiple linear regression analysis and binary logistic regression analysis. Statistical significance was determined based on a *P*-value of 0.05.

RESULTS

Of 32 patients with choledochal cyst, 10 patients were male and 22 patients were female. The mean age at operation is 5.4 ± 5.2 (range: 2 weeks~17 years) years. Among the enrolled patients, 8 patients (25.0%) undergone surgery under two years old, 11 (34.4%) were preschool age (2~5 years), 7 (21.9%) were school age (6~10 years) and 6 patients (18.8%) were adolescence (above 10 years). Of the 8 patients undergone surgery under two years old, 1 patient had been diagnosed as

choledochal cyst during prenatal period and performed surgery at age of 2 month.

According to Todani's classification of choledochal cyst, all of the patients showed extrahepatic cyst, type I, II and IVb. Of 32 patients, 28 patients (87.5%) exhibited type I and 3 patients (9.4%) showed type IVb. There was only 1 patient (3.1%) as type II. Type III, IVa and V not exhibited in any patient. In our study, APBDJ was seen in 9 patients

(28.1%). The most common preoperative imaging tool in this study was MRCP (21 patients, 65.6%), and abdominal US (18 patients, 56.3%) and abdominal CT (11 patients, 34.4%) were in order. And 28 patients (87.5%) were taken operative cholangiogram. The mean follow-up period after operation is 34.6 ± 35.4 (range: 2 weeks~123 month) months. All patients came to hospital at least 1 month after operation except one patient (Table 1).

Table 1. Demographic Characteristics of Patients

Characteristics	Number of cases (%)
Sex	
Male	10 (31.3)
Female	22 (68.8)
Age (years)	
≤ 2	8 (25.0)
2~5	11 (34.4)
6~10	7 (21.9)
> 10	6 (18.8)
Todani modification of Alonso-Lej classification	
Type I	28 (87.5)
Type II	1 (3.1)
Type IVb	3 (9.4)
Anormalous pancreatic duct - biliary duct junction	
Presence	9 (28.1)
Absence	23 (71.9)
Imaging tool	
Magnetic resonance cholangiopancreatogram	21 (65.6)
Ultrasonogram	18 (56.3)
Computed tomogram	11 (34.4)
Operative cholangiogram	28 (87.5)
Postoperative follow up period (months)*	
≤ 12	10 (31.3)
13~24	2 (6.3)
>24	20 (62.5)

* mean: 34.6 ± 35.4 (range : 1/2 ~ 123) months

Table 2. Preoperative Symptoms

Symptoms	Number of cases (%)
Symptomatic Group	30 (93.8)
Abdominal pain	19 (63.3)
Jaundice	12 (40.0)
Vomiting	7 (23.3)
Abdominal mass	5 (16.7)
Fever	5 (16.7)
Pruritus	2 (6.7)
Diarrhea	2 (6.7)
Asymptomatic Group	2 (6.3)

Table 3. Preoperative Laboratory Findings

Abnormal Laboratory Findings	Number of cases (%)
Increased AST* and ALT†	18 (56.3)
Hyperbilirubinemia	8 (25.0)
Leukocytosis	7 (21.9)

* AST: aspartate aminotransferase

† ALT: alanine aminotransferase

+ normal range: AST; 0~40 IU/L ALT; 0~40 IU/L

Bilirubin; 0.2~1.2 mg/dl

WBC; 5000~17500/L (<1 year)

6000~17000/L (1~2 years)

5000~14500/L (2~5 years)

4500~13500/L (6~11 years)

4000~10000/L (>12 years)

Of 32 patients, 30 patients (93.8%) presented symptoms preoperatively but 2 patients (6.3%) did not show any symptoms. Among the presented symptoms, abdominal pain was the most frequent (63.3%), followed by jaundice (40.0%), vomiting (23.3%), abdominal mass (16.7%) and fever (16.7%). There were no patients with symptom triad such as abdominal pain, jaundice and palpable abdominal mass, while

9 patients exhibited two symptoms among symptom triad (Table 2).

Investigating preoperative laboratory findings, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were elevated in 18 patients (56.3%). Hyperbilirubinemia was exhibited in 8 patients (25.0%) and 7 patients (21.9%) showed leukocytosis (Table 3).

All patients underwent surgical treatment

Table 4. Postoperative Complications and Hospital Stay

Course	Number of cases (%)
Postoperative complication	5 (15.6)
Cholangitis	2
Anastomosis site stricture	1
Postoperative bleeding	1
Intestinal obstruction	1
Postoperative hospital stay (weeks)*	
≤ 1	4
1~2	21
> 2	7
Re-admission during follow up period	3 (9.0)

* Mean hospital stay : 12.2 ± 5.8 (range ; 5~30) days

of cyst excision, cholecystectomy and Roux-en-Y hepaticojejunostomy. Mean operation time was 246.5 ± 55.7 (range: 185 ~450) minutes, and mean blood loss was 122 ± 172 (range: 10~700) ml. Postoperative complications were noted in 5 patients (15.6 %). Two patients were cholangitis and 1 patient was anastomotic site stricture. Another 2 patients showed postoperative bleeding and intestinal obstruction. Mean postoperative hospital stay was 12.2 ± 5.8 (range: 5~30) days. The 3 patients were re-hospitalized during follow-up period. Two patients were owing to cholangitis and another patient was owing to intestinal obstruction. The above 3 patients were improved with conservative treatment (Table 4).

In order to search for the factors that could influence the surgical outcomes such

as operation time, complication, postoperative hospital stay and re-admission, we performed the univariate analysis. As a result, the presence of symptoms prolonged the duration of postoperative hospital stay with statistically significant value ($p = 0.010$). Also, the presence of APBDJ increased re-admission rate significantly, too ($p = 0.005$). Another analyzing the factors by multivariate analysis, increased age at the time of operation prolonged the mean operation time and the duration of hospital stay ($p = 0.004, 0.028$). Symptomatic patients had longer postoperative hospital stay than asymptomatic patients ($p = 0.001$). The presence of APBDJ increased readmission rate, too ($p = 0.005$). Gender, type of cyst and preoperative laboratory findings did not affected the outcomes (Table 5).

Table 5. Factors that Influence on Surgical Outcomes

Prognostic Factors (n=number of cases)	Mean Op Times (mins)	p - value	Complica- tion Cases (%)	p - value	Mean Postop Hospital Stay (days)	p - value	Re-admis- sion Cases (%)	p - value
Sex								
Male (n=10)	231.7 ± 44.2	0.833	1 (10.0)	0.484	11.6 ± 5.4	0.322	0 (0.0)	0.194
Female (n=22)	253.9 ± 60.5		4 (18.2)		12.5 ± 6.1		3 (13.6)	
Age								
<2 years (n=8)	215.0 ± 23.8	0.004	1 (12.5)	0.785	13.5 ± 8.0	0.028	0 (0.0)	0.868
2~5 years (n=11)	230.0 ± 28.4		2 (18.2)		11.4 ± 4.2		2 (18.2)	
6~10 years (n=7)	225.8 ± 11.1		1 (14.3)		9.7 ± 2.4		1 (14.3)	
Over 10 years (n=6)	325.8 ± 65.8		1 (16.7)		14.8 ± 7.7		0 (0.0)	
Clinical Finding								
Symptomatic (n=30)	247.8 ± 57.5	0.665	4 (13.3)	0.234	11.3 ± 4.8	0.001	3 (10.0)	0.603
Asymptomatic (n=2)	230.0 ± 28.3		1 (50.0)		25.0 ± 7.1		0 (0.0)	
Types of Cyst								
Type I (n=28)	246.1 ± 57.4	0.665	4 (14.3)	0.484	12.2 ± 6.1	0.642	2 (7.1)	0.194
Type II (n=1)	240.0 ± 0.0		0 (0.0)		8.0 ± 0.0		0 (0.0)	
Type IVb (n=3)	250.0 ± 50.7		1 (33.3)		13.3 ± 4.9		1 (33.3)	
APBDJ*								
Presence (n=9)	236.3 ± 29.2	0.637	3 (33.3)	0.099	11.3 ± 3.7	0.642	3 (33.3)	0.005
Absence (n=23)	250.8 ± 64.0		2 (8.7)		12.5 ± 6.5		0 (0.0)	
Laboratory Data (n=27)								
Increased AST [†] , ALT [†] (n=18)	239.2 ± 60.7	0.774	2 (11.1)	0.161	11.1 ± 5.0	0.899	2 (11.1)	1.000
Normal AST [†] , ALT [†] (n=9)	261.1 ± 43.6		3 (33.3)		13.7 ± 8.2		1 (11.1)	
Hyperbilirubinemia (n=8)	256.9 ± 83.6	0.596	2 (25.0)	0.574	13.5 ± 6.6	0.935	2 (25.0)	0.136
Normal Bilirubin (n=19)	242.1 ± 41.2		3 (15.8)		11.3 ± 6.1		1 (5.3)	
Leukocytosis (n=7)	264.3 ± 87.4		2 (28.6)		13.9 ± 7.0		2 (28.6)	
Normal WBC [‡] (n=20)	240.3 ± 41.0	0.278	3 (15.0)	0.426	11.3 ± 5.9	0.612	1 (5.0)	0.088

* APBDJ : anomalous pancreatic duct-biliary duct junction

† AST : aspartate aminotransferase

‡ ALT : alanine aminotransferase

‡ WBC : white blood cell

DISCUSSION

The prevalence of choledochal cyst is higher in Asia than in western countries and most cases are reported in Japan, where they occur in one of every 1,000 live births^{1,7}. The incidence of choledochal cyst in Republic of Korea is on the increase due to the recent development in the diagnostic technology and a rapid growth in the subclinical patient through health examinations by means of abdominal US, abdominal CT, and MRCP etc. Choledochal cyst is characterized by its remarkable higher incidence in female patients together with the regional preference. In this study, we also found more cases of female patients (68.8%). Though the distribution of occurrence according to the age varies to a great extent, it is reported that most of the patients are infants or children below 10 year-old¹⁹⁻²¹. In this study investigating patients under age of 18 year-old, 26 patients (81.3%) were under the age of 10, too.

The classifying method of choledochal cyst in this study was Todani modification of Alonso-Lej classification that is currently used by most surgeons. According to this classification, Yamaguchi¹ reported that Type I occupy 77.7% of all choledochal cysts and Type II, III constitute only 2.0% and 1.4%. And, Type IV occupies 22.9%

while reported cases of Type V are very rare. In this study, the result was similar with this report that type I was most frequent with the fraction of 87.5% followed by 9.4% of type IV and 3.1% of type II.

As an etiology and pathophysiology, APBDJ theory is commonly accepted and explains the further complications such as cholangitis, biliary malignancy, pancreatitis and pancreatic cancer^{4,22,23}. In our study, there were only 28.1% of patients with APBDJ confirmed by operative cholangiogram with more than 15mm of common channel length. This result suggested that choledochal cyst in pediatric patients can arise without APBDJ and congenital anomaly can be suspected as the cause of choledochal cyst.

Previous studies showed that the classic triad of jaundice, abdominal pain and abdominal mass was often seen in pediatric patients than in adults^{1,7}. More specifically, adult patients were prone to have the symptom of abdominal pain, while pediatric patients tended to have jaundice²⁴. In this study, there was no patient with all classic symptom triad and abdominal pain was the most common symptom with the incidence of 63.3% that is more frequent than jaundice (40.0%). The reason of no patients with all symptom triad can be suggested that earlier visits to hospital and early detection through advanced diagnostic

tools possible with improved levels of national medical consciousness. And in this study, the leading symptom was abdominal pain in pediatric patients paradoxically. This result is probably owing to the small number of enrolled patients and the wide range of age distribution, from birth to the 18 year-old. Several studies suggested that intermittent jaundice is mostly noticed in neonates or infants, whereas abdominal pain is common in children and adults^{25,26}. Further investigation with additional pediatric patients would be needed for the age specific data.

The treatment modality of choledochal cyst had been debated and selection of surgical method was different depending on the age, general conditions of patients, and location and type of choledochal cyst²⁷. Since 1980, total resection of choledochal cyst has been regarded as the basic treatment method²⁸. But, the optimal time of surgery for asymptomatic pediatric patients diagnosed before birth or on health examinations is still controversial^{29,30}.

In this study, all the patients underwent total excision of choledochal cyst with cholecystectomy and hepaticojejunostomy. The recent study reported that short-term and long-term postoperative complications for choledochal cyst in children had decreased²⁶, and in this study, there were

postoperative complications in 15.6% of cases, among which cholangitis was most frequent with 2 cases. There were also 3 cases of re-admission during following period. And, with the results of multivariate analysis, we could identify the factors that have affected treatment outcomes. The younger the patients were at the time at surgery, the shorter the operation time and postoperative hospital stay. Additionally, patients with symptoms and APBDJ showed longer duration of postoperative hospital stay and re-admission rate after. These results suggest that as the time goes on with choledochal cyst especially associated with APBDJ, the progression of pathological change of pancreato-biliary system would worsen the prognosis of patients.

Conclusively, gender, type of cyst and preoperative laboratory findings did not affect the outcomes. But the presence of APBDJ can increase readmission rate. If choledochal cyst is resected as soon as possible, operation time and length of hospital stay would be shortened.

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소아에서 담관 낭종의 수술 성적에 영향을 주는 요인에 대한 연구

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담관 낭종은 흔하지는 않지만, 외과적 절제가 필요한 주요 질환이다. 절제하지 않고 남겨두면 다른 질환으로의 이환이나 다양한 합병증에 의한 사망까지도 야기할 수 있기 때문에 적절한 수술적 치료가 필수적이다. 최근 수술에 따른 다양한 문제들이 계속 보고되고 있으며, 출생 전이나 건강 검진 시 발견되는 무증상의 담관 낭종의 수술 시기에 대해서도 아직 논란이 되고 있다. 저자들은 1995년부터 2009년까지 담관 낭종으로 수술 받은 환자 중 수술 받을 당시의 연령이 18세 이하인 32명 환자의 임상 양상과 수술 기록을 후향적으로 분석하여, 수술 성적에 영향을 주는 요인들을 알아보려고 하였다. 전체 32명 중 남자 10명, 여자 22명이었으며, 수술 당시의 평균 연령은 5.4세였다. 췌담관 합류이상은 9명(28.1%)이었으며, 평균 추적 관찰 기간은 34.6개월이었다. 술 전 증상을 호소한 환자는 30명(93.8%)이었으며, 복통(63.3%), 황달(40.0%), 구토(23.3%), 복부종물(16.7%), 발열(16.7%) 등의 순서였다. 술 전 혈액 검사에서 AST/ALT의 상승이 18명(56.3%), 고빌리루빈혈증이 8명, 백혈구 증가증이 7명(21.9%)이었다. 술 후 합병증은 5명(15.6%)에서 나타났는데, 2명은 담관염이었고, 나머지 3명은 문합부 협착, 술 후 출혈, 장 폐쇄가 각각 1명 있었다. 술 후 평균 재원 기간은 12.2일이었으며, 추적 관찰 기간 중 3명(9.0%)이 재입원 하였다. 수술 성적에 영향을 미치는 요인으로, 수술 당시의 나이가 많을수록 평균 수술 시간과 재원 기간이 증가하였다($p=0.004$, $p=0.028$). 증상이 있었던 환자군에서 무증상 환자군보다 재원 기간이 더 길었다($p=0.001$). 또한 췌담관 합류이상이 있었던 환자군에서 재입원율이 유의하게 높았다($p=0.005$). 소아의 담관 낭종은 진단이 되면 증상 발현 전이라도 조기에 수술하는 것이 수술 시간 및 재원 기간을 단축시킬 수 있으며, 췌담관 합류이상이 동반된 경우에는 술 후에 재입원할 가능성이 높으므로 주의깊게 추적 관찰하는 것이 바람직할 것이다.

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