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Original Article

Surgical management of benign biliary strictures: a 20-year experience

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Abstract: Objective: To summarize the causes, types, and surgical outcomes of benign biliary strictures. Methods: Data on consecutive patients with benign biliary strictures who were treated at three centers from 1990 to 2010 were retrospectively reviewed. Benign biliary strictures were classified according to the Bismuth's classification with a small modification. Results: A total of 868 patients with benign biliary strictures were included in this study. Among them, 538 patients were women and the mean age was 49.5 years. According to the modified classification, patients were divided into 6 types. The types of benign biliary strictures were I in 108 patients, II in 144 patients, III in 150 patients, IV in 156 patients, V in 66 patients, and VI in 244 patients. The major causes of benign biliary strictures were lithiasis (52.4%), operative strictures (45.1%), and postoperatively inflammatory strictures (2.5%). All of the patients underwent various operations, in which 421 patients (48.5%) underwent biliary-enteric anastomoses. The overall mortality was 1.6% (14 patients). The incidence of postoperative complications was 13.7% (119 patients). A total of 424 patients were followed up, and excellent results were obtained in 320 patients (75.5%). Multivariable regression analysis confirmed that types of benign biliary strictures and postoperative complications were two independent factors affecting the long-term outcomes. Conclusion: The lithiasis, operative and postoperative inflammatory strictures are three major causes of benign biliary strictures. Different procedures should be performed by experienced surgeons according to the different types of benign biliary strictures, and biliary-enteric anastomosis is the most common used treatment.

Keywords: Benign biliary stricture, classification, surgery

Introduction

The management of benign biliary stricture has been a major challenge for hepatobiliary surgeons. Benign biliary stricture usually results from iatrogenic injuries (e.g., cholecystectomy, orthotopic liver transplantation), chronic pancreatitis, congenital, posttraumatic, postradiotherapy, inflammatory strictures, and other factors [1]. Iatrogenic stricture is one of the major causes of benign biliary strictures [2]. Benign biliary stricture is regarded as a main factor influencing the efficacy of biliary surgery [1, 2]. Therapeutic endoscopic retrograde cholangiopancreatography (ERCP) has become the mainstay of therapy for benign biliary strictures [3]. Recently, the endoscopic insertion of the self-expandable metal stent (SEMS) has been reported better than plastic stent [4]. Despite this, surgery is reserved for selected patients if endoscopic treatment fails or is not feasible [1-4]. The data of surgical management of benign biliary strictures from China remain sparse. So we summarized the causes, types, and surgical outcomes of benign biliary strictures in three tertiary hospitals.

Patients and methods

Patients' selection

All patients, who were diagnosed as benign biliary strictures and underwent surgical treatments at three tertiary hospitals from 1990 to 2010, were subjected to this study. The study protocol was approved by the Institutional Review Boards of three hospitals. Benign biliary strictures were classified into 6 types according

Table 1. Classification for benign biliary stricture

Classification	Location
I	Papillary stricture
II	> 2 cm distal to hepatic confluence
III	< 2 cm distal to hepatic confluence
IV	Hilar stricture with intact confluence
V	Stricture of the confluence, the main ducts are separated
VI	Stricture of left or right main intrahepatic duct

Table 2. Demographic and clinical data of patients with benign biliary strictures

Characteristics	N	Percentage (%)
Female	538	61.98
Pain or fever	342	39.40
Complicated with lithiasis	455	52.42
Operations before	391	45.05
Classification		
I	108	12.44
II	144	16.59
III	150	17.28
IV	156	17.97
V	66	7.60
VI	244	28.11
Lithiasis		
Intrahepatic bile duct stone	313	36.09
Extrahepatic bile duct stone	142	16.37
Postoperative		
Cholecystectomy or LC	129	14.96
Cholecystectomy plus T tube	110	12.67
Biliary-enteric anastomosis	103	11.97
Papillotomy	35	4.03
Gastrectomy	10	1.15
Other operation	4	0.52
Post-inflammatory		
Subhepatic abscess	12	1.4
Biliary leakage	7	0.88
Other diseases	3	0.35

LC: laparoscopic cholecystectomy.

to the Bismuth's classification with a slight modification [5]. They were as follows: type I, papillary stricture; type II, stricture of common bile or hepatic duct, and common hepatic duct was longer than 2 cm; type III, stricture of common hepatic duct, and common hepatic duct was shorter than 2 cm; type IV, absence of common hepatic duct with intact confluence; type V, stricture of the confluence with separation of the main ducts; type VI, stricture of left or right main intrahepatic duct (**Table 1**). Bismuth's classification did not include papillary stricture (type I). Follow-up outcomes were graded as follows: excellent, no biliary symptoms; medium, transitory symptoms requiring medical therapies; poor, serious symptoms or restrictures needing reoperations [6].

Statistical analysis

All data were presented as means (M) ± standard deviations (SD). Univariate comparisons were performed using chi-square tests or analyses of variance. Multinomial logistic regression analysis or multiple linear regression analysis was performed to determine predictive factors using SPSS software (SPSS Inc., Chicago, IL, USA). A result was considered as statistically significant if the *P* value was less than 0.05.

Results

A total of 1194 patients with benign biliary strictures were encountered in three hospitals from 1990 to 2010. Among them, 868 patients underwent surgical treatments, 302 patients were treated by endoscopic stents, and 24 patients underwent endoscopic dilatations with balloons. Patients who underwent surgical treatments (n = 868) were included in the study. The clinical characteristics of the enrolled patients are summarized in **Table 2**. There were 538 females with a mean age of 49.5 years, ranging from 13 years to 85 years.

A total of 455 patients (52.4%) were complicated with lithiasis, and 391 patients (45.1%) underwent operations before. The causes of benign biliary strictures are also shown in **Table 2**. Patients with benign biliary strictures were divided into 6 types: type I, 108 cases; type II, 144 cases; type III, 150 cases; type IV, 156 cases; type V, 66 cases; and type VI, 244 cases. All patients received various procedures, including 421 biliary-enteric anastomoses (e.g., hepaticojejunostomy, choledochojejunostomy, and choledochoduodenostomy), 220 hepatic lobectomies plus biliary-enteric anastomoses, 105 papillotomies, and 32 cholangioplasties or repairs of the bile ducts. The types of operations according to the types of benign biliary strictures are listed in **Table 3**.

Table 3. The types of operations for benign biliary strictures (n = 868)

Procedures	N	Types of benign biliary strictures	Percentage (%)
Hepaticojejunostomy	288	Type III (n = 132); Type IV (n = 156)	33.2
Choledochojejunostomy	117	Type I (n = 3); Type II (n = 114)	13.5
Choledochoduodenostomy	16	Type II (n = 16)	1.8
Hepatic lobectomy plus hepaticojejunostomy	220	Type V (n = 52); Type VI (n = 168)	25.3
Hepatic lobectomy	39	Type VI (n = 39)	4.5
Cholangioplasty or repair of the bile duct	32	Type II (n = 14); Type III (n = 18)	3.7
Papillotomy	105	Type I (n = 105)	12.1
Portal vein decompression plus bilioenterostomy	38	Type V (n = 10); Type VI (n = 28)	4.4
Other procedures	13	Type V (n = 4); Type VI (n = 9)	1.5

Table 4. The postoperative complications of surgical management of benign biliary stricture (n = 119)

Postoperative complications	N	Percentage (%)
Short-term complications		
Biliary fistula	17	14.3
Subphrenic abscess	14	11.8
Wound infection	15	12.6
Pneumonia	9	7.6
Gastrointestinal bleeding	6	5.0
Others	10	8.4
Long-term complications		
Recurrent cholangitis	25	21.0
Residual stones or stone formation	12	10.1
Restricture of anastomosis	5	4.2
Biliary cirrhosis or portal hypertension	6	5.0

The postoperative mortality was 1.6% (14 patients). The causes of death included septic shock (4 cases), hepatorenal syndrome (3 cases), pulmonary infection (3 cases), gastrointestinal bleeding (2 cases), and myocardial infarction (2 cases). The overall postoperative complication rate was 13.7% (119 patients). Major short-term complications included biliary fistula, subphrenic abscess, wound infection, pneumonia, etc. Main long-term complications included recurrent cholangitis, restricture of biliary-enteric anastomosis, biliary cirrhosis, etc. The details of postoperative complications are shown in **Table 4**.

A total of 424 patients were followed up until August, 2015, with an interval of 8.5 years. Excellent results were achieved in 320 patients (75.5%); medium results were achieved in 61 patients (14.4%); and poor results were achieved in 43 patients (10.1%). In univariate analysis, factors influencing the long-term outcomes were types of benign biliary strictures, types of operations, and postoperative complications (**Table 5**). Multivariable regression analysis comfirmed that types of benign biliary strictures and postoperative complications are two independent factors affecting the long-term outcomes (P = 0.03, P = 0.04, respectively) (**Table 6**).

Discussion

It is useful to classify benign biliary strictures according to the sites. Papillary stricture (type I) was not included in Bismuth's classification. However, this type of benign biliary stricture is common in clinical practice. So we added this type of benign biliary stricture into Bismuth's classification in order to make it more helpful in clinical practice.

The basic principles to treat benign biliary stricture include correction of the stricture, elimination of the lesion, and drainage of the bile [2, 7]. The main goal for surgical treatment of benign biliary stricture is to establish bile flow in a manner that prevents cholestasis, cholangitis, stone formation, and restricture [2, 6, 7]. As the type of benign biliary stricture was an independent factor affecting the long-term outcomes, we considered that the surgical treatment of benign biliary strictures should be performed according to the types of benign biliary strictures and statuses of patients. For type I stricture, papillotomy was chose for young patients and endoscopic sphincterotomy (ES) for the elderly [8]. For patients with postoperative papillary stricture, a repeat papillotomy or EST was performed if the common bile duct was less than 1.5 cm in diameter [8]. In type II stricture, a biliary-enteric anastomosis was considered. Because of the risk of duodenobiliary reflux,

Table 5. Univariate analysis of predictors of long-term outcomes

Variable	Long-term outcomes			*P* value
	Excellent	Medium	Poor	
Sex, F/M	145/175	33/28	21/22	0.43
Age	50.1 ± 10.4	48.5 ± 12.4	48.3 ± 13.1	0.39
Bilirubin, umol/L	40.4 ± 9.6	40.6 ± 13.4	42.8 ± 11.4	0.36
Alkaline phosphatase, U/L	298.4 ± 56.6	288.2 ± 64.8	282.5 ± 57.3	0.15
Albumin, g/L	35.7 ± 8.4	33.4 ± 6.4	36.3 ± 8.8	0.19
Gamma-glutamyl transpeptidase, IU/L	254.4 ± 52.2	261.3 ± 53.4	243.7 ± 45.4	0.23
Pain or fever, No. of patients	256	50	36	0.81
Types of benign biliary strictures, No. of patients				
I	30	18	4	0.02
II	42	24	4	
III	43	22	9	
IV	41	18	17	
V	10	12	10	
VI	60	40	20	
Types of operations, No. of patients				
Hepaticojejunostomy	186	22	16	0.04
Choledochojejunostomy	56	19	13	
Choledochoduodenostomy	7	2	1	
Cholangioplasty or repair	13	4	2	
Papillotomy	58	14	11	
Postoperative complications, No. of patients	54	10	15	0.02

Table 6. Multivariable regression analysis of predictors of long-term outcomes

Parameter	Regression parameter estimation (B)	Standard errors (BE)	Wald	Degree of freedom	*P*-value (Sig)	Relative risk (B)	95% CI for Exp (B)
Types of benign biliary strictures	0.31	0.12	6.9	1	0.03	1.36	1.08~1.70
Types of operations	0.34	0.17	3.82	1	0.07	1.41	1.07~1.89
Complications	0.41	0.14	7.71	1	0.04	1.49	1.12~1.98

choledochoduodenostomy was only performed in patients older than 70 years or patients underwent Billroth II before [9]. Biliary-enteric anastomosis with a Roux-en-Y jejunal loop was recommended for patients with type II stricture [9]. In types III and IV strictures, hepaticojejunostomy was the most suitable procedure to ensure successful management [10]. Mucosal to mucosal anastomosis was mandatory in order to prevent restricture [10]. In types V and VI strictures, the essential way was to perform cholangioplasty and hepaticojejunostomy with a Roux-en-Y jejunal loop. Sometimes, a small hilar parenchymal resection at the base of segments IV and V was required prior to biliary-enteric anastomosis [9]. Adopting the strategies above, the mortality, morbidity, and success rates in this study appeared to be better than a previous report [6].

In our opinion, biliary-enteric anastomosis is a gold standard and essential procedure for the treatment of benign biliary strictures. Endoscopic stenting using a retrievable covered stent is also a clinically effective method [11]. In order to correct the stricture and remove the hepatic lesion completely in some cases, both cholanioplasty and hepatic lobectomy were performed simultaneously (also known as combined surgery). If scar tissues could be completely cleared in patients with mild hilar duct strictures, pediculate tissues were selectively used to repair the biliary defects. Substitutes included serosal patches of stomach, gallbladder wall, jejunum, and round ligament with blood supply. This type of repair obtained good results in the early stage, owing to the preservation of Oddi's sphincter function and prevention of retrograde biliary infection.

Biliary-enteric anastomosis could be performed using the common bile duct, common hepatic duct, and intrahepatic duct. The major principles to perform a satisfactory biliary-enteric anastomosis were summarized as follows: all scar tissues should be resected; the anastomosis should be performed using normal bile duct without tension; choledochodenostomy should be only used for highly selected patients due to its risk of retrograde biliary infection; and the anastomosis between intestinal seromuscular layer and normal bile duct should apply a single layer of absorbable suture to prevent minimal bile leakage.

Conclusion

The lithiasis, operative and postoperative inflammatory strictures are three major causes of benign biliary strictures. Different procedures should be performed by experienced surgeons according to the different types of benign biliary strictures, and biliary-enteric anastomosis is the most common used treatment.

Disclosure of conflict of interest

None.

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