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Preliminary Experience on the Safety and Efficacy of Laparoscopic Choledochojejunostomy Reconstruction for Anastomotic Stenosis After Choledochojejunostomy

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Abstract: *Objective*: To evaluate the safety, feasibility, and key surgical techniques of laparoscopic choledochojejunostomy reconstruction for anastomotic stenosis following biliary-enteric internal drainage surgery. *Methods*: The clinical data of 5 patients with anastomotic stenosis after biliary-enteric internal drainage surgery, admitted to The First Affiliated Hospital of Hunan Normal University between March 2025 and August 2025, were retrospectively reviewed and analyzed. All patients provided written informed consent, and the study was conducted in compliance with medical ethics standards. There were 3 males and 2 females, with an age range of 10–45 years and a median age of 17 years. Outcome measures included operation time, intraoperative blood loss, postoperative anal exhaust time, postoperative hospital stay, and perioperative complications. *Results*: All 5 patients successfully underwent laparoscopic choledochojejunostomy reconstruction without conversion to open surgery. The operation time ranged from 220 to 380 minutes (median, 235 minutes), and the intraoperative blood loss was 20–80 mL (median, 50 mL), with no blood transfusion required in any case. T-tube drainage was performed in 2 patients. The postoperative anal exhaust time was 1–2 days (median, 2 days), and the postoperative hospital stay was 5–7 days (median, 6 days). No perioperative complications occurred in any patient. *Conclusion*: Laparoscopic choledochojejunostomy reconstruction is a safe and feasible surgical approach for anastomotic stenosis after biliary-enteric internal drainage surgery, offering advantages of minimal invasiveness and a low incidence of perioperative complications.

Keywords: Laparoscope; Biliary-enteric anastomotic stricture; Biliary-enteric anastomotic reconstruction

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1. Introduction

As a commonly used clinical procedure, biliary-enteric drainage plays a key role in the treatment of diseases such

as liver and bile duct stones, common bile duct cysts, bile duct injuries, and reflux cholangitis [1]. It can effectively improve bile drainage and prolong patient survival. However, anastomotic stenosis is a common complication after surgery, which not only leads to recurrent biliary obstruction, but also can cause cholangitis, biliary cirrhosis, and even liver failure, seriously affecting the quality of life and long-term prognosis of patients [2]. The existing treatment methods include endoscopic or percutaneous dilation and stent placement, open anastomosis reconstruction, etc [3,4]. Although endoscopic and interventional procedures have minimal trauma, the recurrence rate is relatively high and the duration of patency maintenance is limited [5]. Although open surgery can achieve long-lasting patency, the surgical trauma is large, postoperative recovery is slow, and the difficulty of reoperation often increases due to abdominal adhesions. How to reduce surgical trauma while ensuring therapeutic efficacy remains a clinical challenge.

With the development and popularization of minimally invasive techniques, the application of laparoscopic surgery in biliary reconstruction has gradually attracted attention. It has the advantages of enlarging the field of view, clear anatomy, and minimal trauma, which can improve surgical safety and reduce patient recovery time while ensuring surgical effectiveness [6]. At present, there are several large clinical diagnosis and treatment centers in China that have accumulated rich experience and are proficient in using laparoscopic technology to perform anastomotic reconstruction surgery for patients with biliary-enteric anastomotic stenosis who have undergone two or more surgeries [7]. In this study, laparoscopic cholestochojejunostomy reconstruction was performed on 5 cases of bile intestinal anastomosis stenosis, achieving good clinical efficacy. The summary report is as follows.

2. Data and methods

2.1. General information

Retrospective analysis of clinical data of 5 patients admitted to the Hepatobiliary Surgery Department of the First Affiliated Hospital of Hunan Normal University (Hunan Provincial People's Hospital) from March 2025 to August 2025 who underwent laparoscopic cholestochojejunostomy reconstruction due to bile intestinal anastomosis stenosis. Among them, there were 3 males and 2 females; The age range is 10–45 years old, with a median age of 17 years old. The cause and surgery of the first biliary-enteric anastomosis: 2 cases of liver and bile duct stones, underwent biliary exploration and stone removal combined with biliary-enteric drainage surgery; Three cases of congenital choledochal cyst were treated with choledochal cystectomy combined with biliary-enteric drainage. The time interval between the first anastomosis and narrow reconstruction was 16–126 months, with a median time of 61 months. General information is detailed in **Table 1**. Diagnostic criteria for biliary-enteric anastomotic stenosis: A history of biliary-enteric drainage surgery and the following conditions:

(1) The patient has recurrent symptoms such as abdominal pain, chills, fever, jaundice, and imaging examinations such as CT, magnetic resonance cholangiopancreatography (MRCP), and percutaneous transhepatic cholangiography (PTC) suggest anastomotic stenosis [8].

(2) During the operation, it was found that the bile duct anastomotic site was narrow, resembling a needle tip, and the bile duct was dilated at or above [9].

Table 1. General information of five patients

Sequence	Gender	Age (Year)	BM (kg/m^2)	Basic disease	Preoperative CT/MR	First surgery	Time interval between two surgeries (Month)
1	Male	37	25.3	None	Anastomotic stenosis	Intrahepatic bile duct stone extraction, Choledochojejunostomy	38
2	Male	45	23.6	None	Anastomotic stenosis, Bile duct stones	Intrahepatic bile duct stone extraction, Choledochojejunostomy	16
3	Male	12	19.4	None	Anastomotic stenosis, Bile duct stones	Congenital Dilated Bile Duct Resection Choledochojejunostomy	126
4	Female	17	22.6	None	Anastomotic stenosis, Bile duct stones	Congenital Dilated Bile Duct Resection Choledochojejunostomy	118
5	Female	10	18.2	None	Anastomotic stenosis	Congenital Dilated Bile Duct Resection Choledochojejunostomy	61

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

(1) Diagnosed with biliary anastomotic stenosis and laparoscopic choledochojeunostomy reconstruction;
(2) Previously underwent biliary-enteric drainage surgery;
(3) The general condition is good and the patient can tolerate surgery;
(4) Clinical and follow-up data are complete.

2.2.2. Exclusion criteria

(1) Choledochojejunostomy reconstruction under laparoscopy due to other factors such as intestinal obstruction and perforation;
(2) The general condition is good and the patient cannot tolerate surgery;
(3) Lost to follow-up or incomplete clinical data.

2.3. Surgical methods

Under general anesthesia, adopt a supine split leg position, with the head high and feet low, and a five hole layout (see **Figure 1** for details). Place a 12 mm puncture sheath on the navel. After the construction of pneumoperitoneum is completed, the principle is to first place a puncture sheath in the left non adhesive area (in this case, a 12 mm puncture sheath is placed under the rib margin of the left clavicle midline); Place a 12 mm puncture sheath above the navel on the midline of the left clavicle, and use an ultrasonic knife combined with scissors to release the adhesion between the abdominal wall, omentum, and intestinal tract. After the separation of abdominal wall adhesion, a right puncture sheath is inserted (in this case, a 5 mm puncture sheath is placed below the rib margin of the right clavicle midline); Place a 5 mm puncture sheath above the navel on the right axillary line. Adhering from the right edge of the liver towards the hepatic hilum (**Figure 2a**), residual hepatic circular ligament is exposed, and the hepatic hilum is exposed along the hepatic circular ligament approach. Finally, the enlarged biliary-enteric anastomosis and dilated bile duct are revealed (**Figure 2b**); Open the biliary-enteric anastomosis, use an 11Fr cholangioscopy to explore the bile duct, take stones from the stone basket and

exclude intrahepatic bile duct stenosis (**Figure 2c**, **d**), further free the extrahepatic bile duct, cut off scar bile duct tissue with scissors (**Figure 2e**), extend the incision along the longitudinal axis of the anterior wall of the common hepatic duct, and expose the left and right hepatic duct openings as much as possible in the lumen; Free the input loop and check the intestinal anastomosis to ensure that the length of the input loop intestinal tube is sufficient and the tension is appropriate. Then, use a 4-0PDS suture to reconstruct the biliary intestinal anastomosis (**Figure 2f**). For patients who may have residual stones, the diameter of the reconstructed anastomosis is still relatively small, and the inflammation of the tube wall is severe, which increases the possibility of anastomotic leakage after surgery. Place a T tube at the anastomosis site. Finally, fix the end of the intestinal ring onto the circular ligament of the liver to reduce anastomotic tension.

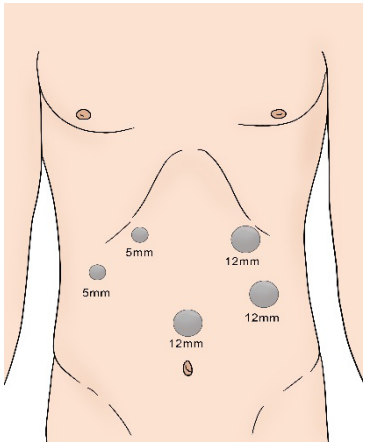
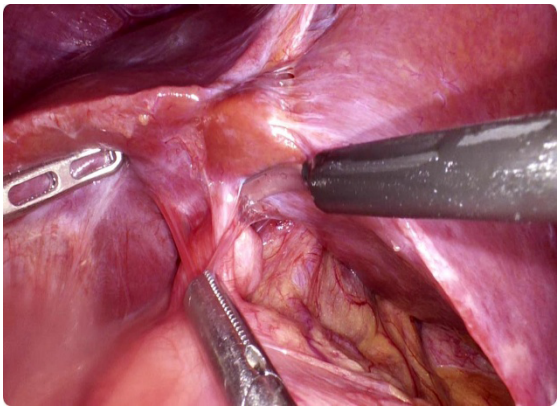


Figure 1. Distribution of surgical puncture sheaths in sequence two patients.



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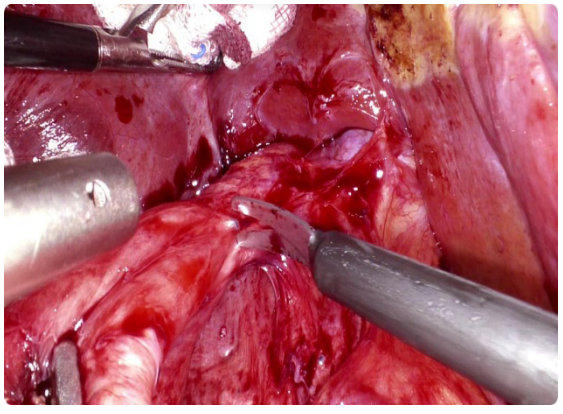

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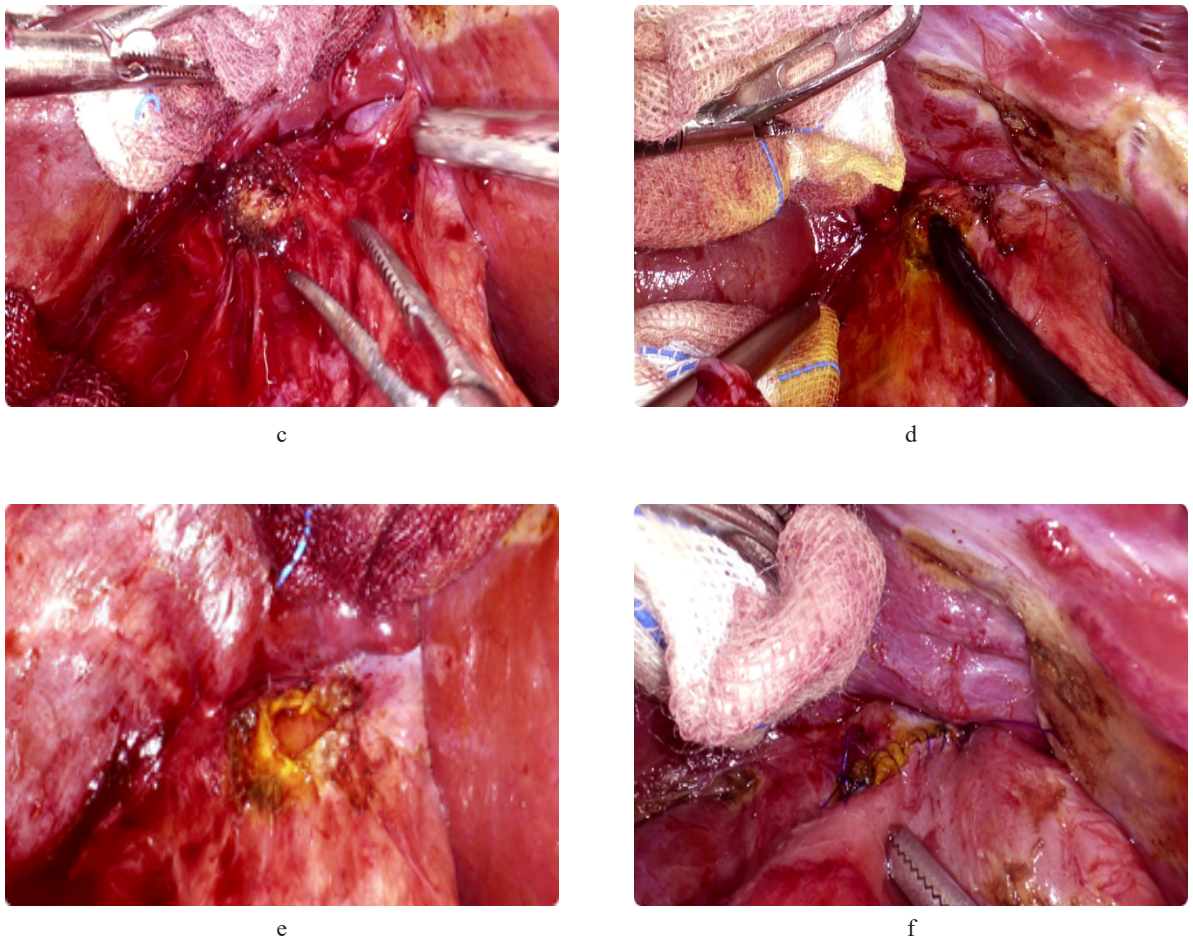

Figure 2. Schematic diagram of laparoscopic choledochojejunostomy reconstruction surgery performed on patient 2 in sequence.

Note: a represents the separation of intestinal tract and liver adhesions; B is to expose the original biliary-enteric anastomosis; C shows a narrow biliary-enteric anastomosis when the anastomotic site is opened; D is for cholangioscopy exploration and stone extraction; E is to dilate the mouth and open it for intestinal anastomosis; F is for reconstruction of biliary intestinal anastomosis.

2.4. Observation indicators

Intraoperative conditions include surgical time and intraoperative bleeding volume. Postoperative conditions include postoperative anal exhaust time, postoperative hospital stay, and postoperative complications (bleeding, bile leakage, intestinal leakage, infection, secondary surgery). Recent therapeutic effects include clinical recurrence of cholangitis, antibiotic use, and re intervention rate during postoperative follow-up; Biochemical changes: alkaline phosphatase (ALP), glutamine transferase (GGT), total bilirubin, and trend of direct bilirubin ratio (TB/DB); All patients received follow-up after surgery, with a follow-up period of 4–9 months.

3. Results

3.1. Surgery and recovery

All 5 patients underwent laparoscopic reconstruction of the biliary-enteric anastomosis and none were converted

to open surgery. The operation time was 220–380 minutes, with a median time of 235 minutes; The intraoperative bleeding volume was 20–80 mL, with a median bleeding volume of 50 mL, and no blood transfusion was administered. Among them, 2 patients were placed with a T-tube, and the postoperative anal exhaust time was 1–2 days, with a median time of 2 days. The postoperative hospitalization time was 5–7 days, with a median time of 6 days. All 5 patients did not experience perioperative complications, Including readmission within 30 days, bile leakage, infection, intestinal fistula, intra-abdominal abscess, bleeding re intervention, etc. The specific patient information is shown in **Table 2,3,4**.

Table 2. Perioperative situation of five patients

Sequence	Operation time (min)	Intraoperative blood loss (mL)	Retain T tube	Postoperative anal exhaust time (d)	Complication	Postoperative hospitalization time (d)
1	235	50	No	2	None	5
2	380	80	No	2	None	6
3	230	50	Yes	1	None	7
4	220	20	Yes	1	None	6
5	260	20	No	2	None	7

Table 3. Biochemical indicators during the perioperative period and follow-up of five patients

Sequence / Indicator	Alkaline phosphatase (ALP)			Glutamine transferase (GGT)			Total bilirubin/Direct bilirubin (TB/DB)		
	Preoperative value (U/L)	Postoperative value (U/L)	After follow-up (U/L)	Preoperative value (U/L)	Postoperative value (U/L)	After follow-up (U/L)	Preoperative value	Postoperative value	After follow-up
1	246	182	106	120	96	72	2.63	2.65	2.62
2	136	140	98	66	74	50	3.74	2.51	2.47
3	375	328	100	180	172	58	1.27	1.42	2.03
4	184	190	76	112	106	42	3.14	4.12	3.84
5	120	134	86	68	82	32	2.16	1.83	1.96

Table 4. Postoperative complications and recent efficacy of five patients

Sequence	Recurrence of cholangitis	Application of antibiotics	reintervention rate	Narrowing again	Smooth anastomosis	30-day readmission
1	None	None	None	None	Yes	No
2	None	None	None	None	Yes	No
3	None	None	None	None	Yes	No
4	None	None	None	None	Yes	No
5	None	None	None	None	Yes	No

4. Discussion

Bile intestinal anastomosis stenosis is one of the most challenging complications after biliary reconstruction surgery. Previous treatments include endoscopic dilation, stent placement, interventional therapy, and open

surgery, but these methods have limitations such as high recurrence rates, decreased quality of life, or significant surgical trauma. In contrast, laparoscopy not only has curative effects, but also has minimally invasive advantages, which can reduce patient pain and recovery time while ensuring therapeutic efficacy. The results of this study are consistent with previous reports, further verifying the feasibility of laparoscopy in clinical applications [10]. This study combines case data and surgical experience to explore the causes of anastomotic stenosis and precautions for laparoscopic surgery.

4.1. Analysis of the causes of stenosis at the biliary-enteric anastomosis site

Technical defects in anastomosis:

(1) Excessive tension at the anastomotic site

Insufficient free length of bile duct or jejunum can lead to sustained local tension after anastomosis, resulting in tissue ischemia, poor healing, and ultimately causing fibrosis.

(2) Improper stitching

Suture that is too tight (causing ischemic necrosis due to tissue compression), too sparse (inflammation induced by bile leakage), or misaligned bile duct and jejunal mucosa (compensatory hypertrophy of scar tissue during healing).

(3) The initial diameter of the anastomotic site is too small

Excessive trimming of bile duct and jejunal stump (such as short bile duct stump or narrow jejunal opening) can further narrow the lumen during postoperative healing.

(4) Suture selection

When using non absorbable sutures, the sutures remain at the anastomotic site for a long time, continuously stimulating local tissues and causing chronic inflammation, ultimately leading to fibrous wrapping and narrowing.

(5) Insufficient blood supply

The main source of blood supply to the bile duct comes from the branches of the hepatic artery (especially in the 3 and 9 o'clock directions of the bile duct). If the outer membrane is excessively peeled off during the separation of the bile duct during surgery, or if the nourishing blood vessels are damaged during suturing, it can lead to blood supply disorders in the anastomotic area, a decrease in tissue repair ability, and a higher risk of scar hyperplasia and anastomotic leakage.

Anastomotic inflammation and infection factors:

(1) Early postoperative biliary fistula or infection

Leakage at the bile intestinal anastomosis can cause continuous stimulation of the abdominal cavity and surrounding tissues by bile. If combined with bacterial infection, it can further aggravate tissue damage and fill the lumen with a large amount of fibrous tissue during healing.

(2) Anti reflux mechanism

If an effective anti reflux structure is not constructed during surgery and the input loop is too short, it can lead to reflux cholangitis. Long term repeated stimulation of the anastomotic site can form a vicious cycle of "inflammation repair scar", ultimately resulting in stenosis.

4.2. Surgical experience summary

Laparoscopic feasibility: Currently, it is believed that the separation of abdominal adhesions is one of the main

difficulties in laparoscopic biliary-enteric drainage reconstruction surgery. For patients who undergo surgery again, extensive adhesions in the abdominal cavity and adhesions in the hepatic portal area are often more severe. In addition, due to the limited operating space and large angle of laparoscopic surgery, if the adhesion situation is severe and the anatomical structure is unclear, a backup plan of "conversion to open surgery" must be developed in advance to prevent intestinal and vascular damage during forced separation.

Anastomotic positioning: In the process of exploring the biliary-enteric anastomosis, the surface of the liver is first separated and exposed, and then gradually separated to the left along the right edge of the liver until reaching the first porta hepatis area. At this point, the common hepatic duct is usually exposed, and the specific location of the biliary-enteric anastomosis can be easily determined. Using this separation method can effectively reduce the risk of hepatic artery damage. Alternatively, one can first search for the bridge loop of the biliary-enteric anastomosis, and then search for the anastomosis along the intestinal tract. Patients with anastomotic stenosis and stones often have severe anastomotic dilation and bile duct dilation, which can also be used to help locate the narrowed anastomotic site during surgery; In addition, if the location of the biliary-enteric anastomosis cannot be determined, fine needle puncture can be used in suspicious areas to clarify the position of the biliary-enteric anastomosis. All cases in this group were separated from the right edge of the liver towards the hepatic hilum, revealing the anastomotic site. Among them, case 5 determined the position of the anastomotic site by puncturing bile from a suspicious area. Cases 3 and 4 had large stones embedded in the anastomotic site, causing swelling at the upper end of the anastomotic site, which helped to locate the anastomotic site.

Biliary duct plastic surgery: Inflammation, hyperplasia, and scar formation at the anastomotic site are important pathological mechanisms of anastomotic stenosis, and can even induce cancer under repeated chronic inflammation stimulation; During surgery, scar bile ducts should be removed as much as possible, and attention should be paid to protecting the arteries that run longitudinally in the 3 and 9 o'clock directions of the bile duct to ensure blood supply to the bile duct. Generally, the incision should be extended along the longitudinal axis of the anterior wall of the common hepatic duct, and the incision should not exceed the confluence of the left and right hepatic ducts, fully exposing the openings of the left and right hepatic ducts in the lumen. In order to facilitate the reconstruction of the anastomotic site and reduce the occurrence of anastomotic stenosis.

Intestinal anastomosis examination: The reconstruction of the biliary intestinal anastomosis requires ensuring a suitable length of the input loop intestinal tube, preferably 40–60 cm. A reasonable length of the input loop jejunum is one of the key strategies to prevent biliary intestinal reflux, and excessive length can cause poor bile drainage and lead to bile stasis.

Reconstruction of biliary-enteric anastomosis: Based on our experience, the margin of suture during biliary-enteric anastomosis is approximately 2 mm on the bile duct side and 3 mm on the jejunum side, with a needle spacing of about 2–3 mm. Attention should be paid to uniform needle insertion and ensuring the closure of the entire bile duct and jejunum layer. Currently, the selection of sutures mostly uses 4-0 or 5-0 PDS absorbable sutures. For larger bile duct diameters, continuous suturing of the anterior and posterior walls can effectively reduce anastomosis time and avoid knot retention in the anastomotic cavity; For small bile duct diameters, continuous suturing of the posterior wall and intermittent suturing of the anterior wall are often used for anastomosis. The reason is that laparoscopic surgery is limited by space, such as when the diameter of the bile duct is small, in the last few stitches of continuous suturing of the anterior wall, the suturing space is greatly reduced due to the tightening and completion of the anterior knot, making it difficult to identify the lumen and resulting in suturing errors. After confirming the absence of bile leakage and ischemia at the anastomotic site, the end of the intestinal

ring can be fixed on the circular ligament of the liver to reduce anastomotic tension. In addition, for patients with stones that cannot be completely removed, small anastomotic diameter, severe inflammation of the tube wall, and a high possibility of anastomotic leakage after surgery, it is recommended to place a T-tube. In this group of cases 1, 2, and 5, the anastomotic site was sutured continuously with 4-0PDS absorbable suture to the anterior and posterior walls. Cases 3 and 4 were sutured continuously with 4-0PDS absorbable suture to the posterior wall, intermittently suturing the anterior wall, and placing a T-tube.

5. Conclusion

In summary, for mature surgical teams, laparoscopic reconstruction of the biliary-enteric anastomosis is safe and effective in treating biliary-enteric anastomotic stenosis after biliary-enteric drainage surgery. Laparoscopy has a natural magnifying effect, which can further reduce surgical risks, accelerate postoperative recovery, and reduce the occurrence of postoperative complications through fine adhesion separation, proper bile duct shaping, and appropriate anastomosis strategies. It should be pointed out that laparoscopic reconstruction of the bile intestinal anastomosis is difficult, and there are relatively few such patients, so the sample size is small. Our center will expand the number of patients participating in the study and increase follow-up time to further confirm the safety and effectiveness of laparoscopic reconstruction of the biliary-enteric anastomosis for patients with anastomotic stenosis after biliary-enteric drainage surgery.

Disclosure statement

The authors declare no conflict of interest.

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