

Endoscopic and retrograde cholangiographic appearance of hepaticojejunostomy strictures: A practical classification

Klaus Mönkemüller, Ivan Jovanovic

Klaus Mönkemüller, Department of Internal Medicine, Gastroenterology and Infectious Diseases, Marienhospital Bottrop, Bottrop 46236, Germany

Klaus Mönkemüller, Department of Gastroenterology, Hepatology and Infectious Diseases and Department of Pathology, Otto-von-Guericke University of Magdeburg, Magdeburg 39120, Germany

Ivan Jovanovic, Department of Internal Medicine, Gastroenterology and Infectious Diseases, Marienhospital Bottrop, Bottrop 46236, Germany

Ivan Jovanovic, Clinic for Gastroenterology and Hepatology, Clinical Center of Serbia, Belgrade, Faculty of Medicine, University of Belgrade, Belgrade 11000, Serbia

Author contributions: Mönkemüller K contributed to the conception and design of the study, collected, analyzed and interpreted the data, revised the article critically for important intellectual content and did the final approval of the version to be published; Jovanovic I contributed to the design of the study, collected, analyzed and interpreted the data, drafted the article and figures and did the final approval of the version to be published.

Correspondence to: Klaus Mönkemüller, MD, PhD, FASGE, Department of Internal Medicine, Gastroenterology and Infectious Diseases, Marienhospital Bottrop, Josef-Albers-Str. 70, Bottrop 46236, Germany. moenkemueller@yahoo.com

Telephone: +49-204-11061001 Fax: +49-204-11061019

Received: January 18, 2011 Revised: September 4, 2011

Accepted: September 11, 2011

Published online: November 16, 2011

Abstract

AIM: To study the endoscopic and radiological characteristics of patients with hepaticojejunostomy (HJ) and propose a practical HJ stricture classification.

METHODS: In a retrospective observational study, a balloon-assisted enteroscopy (BAE)-endoscopic retrograde cholangiography was performed 44 times in 32 patients with surgically-altered gastrointestinal (GI) anatomy. BAE-endoscopic retrograde cholangio pancreatography (ERCP) was performed 23 times in 18 patients with HJ. The HJ was carefully studied with the

endoscope and using cholangiography.

RESULTS: The authors observed that the hepaticojejunostomies have characteristics that may allow these to be classified based on endoscopic and cholangiographic appearances: the HJ orifice aspect may appear as small (type A) or large (type B) and the stricture may be short (type 1), long (type 2) and type 3, intrahepatic biliary strictures not associated with anastomotic stenosis. In total, 7 patients had type A1, 4 patients A2, one patient had B1, one patient had B (large orifice without stenosis) and one patient had type B3.

CONCLUSION: This practical classification allows for an accurate initial assessment of the HJ, thus potentially allowing for adequate therapeutic planning, as the shape, length and complexity of the HJ and biliary tree choice may mandate the type of diagnostic and therapeutic accessories to be used. Of additional importance, a standardized classification may allow for better comparison of studies of patients undergoing BAE-ERCP in the setting of altered upper GI anatomy.

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Key words: Endoscopic retrograde cholangio pancreatography; Roux en Y anastomosis; Hepaticojejunostomy; Biliary strictures; Bile duct strictures; Double balloon enteroscopy

Peer reviewers: C Mel Wilcox, MD, Professor, Director, UAB Division of Gastroenterology and Hepatology, 703 19th Street South, ZRB 633, Birmingham, AL 35294-0007, United States; Tom G Moreels, MD, PhD, Professor, Division of Gastroenterology and Hepatology, Antwerp University Hospital, Wilrijkstraat 10, B-2650 Antwerp, Belgium

Mönkemüller K, Jovanovic I. Endoscopic and retrograde cholangiographic appearance of hepaticojejunostomy strictures: A practical classification. *World J Gastrointest Endosc* 2011; 3(11): 213-219 Available from: URL: <http://www.wjgnet.com/1948-5190/full/v3/i11/213.htm> DOI: <http://dx.doi.org/10.4253/wjge.v3.i11.213>

INTRODUCTION

Occasionally, patients with previous complex upper gastrointestinal (GI) surgery and hepaticojejunostomy (HJ) present with pancreatobiliary problems^[1-3]. HJ is a common curative and palliative procedure performed for benign and malignant biliary obstruction. The incidence of anastomotic stricture following HJ in experienced centers is 4%-10%^[1-3]. Because re-operation carries a significant morbidity, endoscopic or radiological approaches to treat these strictures are now preferred^[1-3]. Nevertheless, performing an endoscopic retrograde cholangio pancreatography (ERCP) in these patients is technically very challenging or impossible, frequently mandating an operative intervention. However, the advent of balloon-assisted enteroscopy (BAE)^[4] has increased our ability to reach the HJ located in the excluded limb and perform diagnostic and therapeutic endoscopic retrograde cholangiography (ERC)^[3-18]. During BAE-ERC, we have observed that the HJ and biliary tree have specific appearances (i.e., patterns).

The aims of this study were to assess the endoscopic and radiological characteristics of the HJ of patients with Roux-en-Y anastomosis presenting with biliary problems undergoing BAE-ERC and propose a practical HJ stricture classification.

MATERIALS AND METHODS

Patients

Over a period of 4 years, we performed 44 BAE-ERCPs in 32 patients with various types of complex post-surgical upper GI anatomy and pancreatobiliary problems. In the present study, we focused on the endoscopic and radiological findings of hepaticojejunostomies. Patients without HJ or with intact papilla were excluded. The procedures were performed at the University of Magdeburg Medical Center and Marienhospital, Bottrop, Germany. All patients provided written informed consent before the endoscopy. The study was approved by the institutional review board and conducted according to the guidelines of Helsinki.

Procedure description

The patients were placed in the prone position and the endoscopy was performed using conscious sedation with midazolam and propofol with constant monitoring of vital signs. ERC was performed with the therapeutic DBE (DBE-EN-450T5, Fujinon, Saitama, Japan) with a working channel of 2.8 mm diameter and a 140 cm long, 13.5 mm diameter overtube (TS Fujinon, 13.5 mm, Saitama, Japan). The ERC was performed either with balloons mounted on both the enteroscope and overtube or only on the overtube. The details of the procedure have been described in detail elsewhere^[6-10]. BAE-ERC was performed under fluoroscopic control using a C-arm (Philips, Holland). Cannulation of the biliary tract was achieved with a tapered tip biliary catheter (F3CTPK1810250M, Fujinon, Japan) and two types of guidewires: Jagwire (Boston Scientific, Miami, United States) or the FTE-Wildcat nitinol exchange guide wire (650 cm long, F3LQPK0850650X-S)

Fujinon Europe, GmbH). The following stents were used: 7 Fr 5 cm long (Wilson Cook, Ireland). These stents were pushed with the biliary catheter or the customized pusher tube for the DBE system (Fujinon FPU7270: this pusher pushes 7 Fr stents and has a length of 270 cm). These additional accessories were used to accomplish the various interventional procedures: balloon dilation of the anastomosis was performed using a constant radial expansion (CRE) wire-guided balloon dilatation catheter (Wire-guided 240 cm, CRE™ Balloon Dilator, Boston Scientific Medizintechnik GmbH, Ratingen, Germany).

Descriptive statistics were employed to describe the patient's demographics and clinical characteristics, presenting means and ranges.

RESULTS

ERCP using the DBE was performed on 44 occasions in 32 patients (10 female and 22 male, mean age 62.5, range 25 to 78) with altered upper GI anatomy. Twenty three BAE-ERCPs were performed in 18 patients with Roux-en-Y type of reconstruction with HJ and represent the study group. In fourteen patients (3 female, and 11 male), the HJ could be clearly visualized and cannulated. In five patients, multiple procedures (2 to 3) were performed (e.g., follow-up to remove or place new stents). Thus, a total of 19 out of 23 (82%) procedures were successful (Table 1). The mean follow-up has been 18 mo (range 6 to 40 mo). Table 1 summarizes the demographic, clinical, endoscopic findings, procedures and interventions of the study group. Indications for ERC included biliary obstruction and cholestasis in all patients. The procedure lasted a mean time of 70 min (range 35 to 240 min).

We observed that the HJ does not have a uniform appearance but rather a few key characteristics that may allow the stenosis to be stratified based on endoscopic (letter classification, i.e., A, B, C and D) and cholangiographic appearance (numbers, i.e. 0, 1, 2 and 3) (Table 2). Endoscopically, the HJ orifice can appear as small (type A) (Figure 1), large (type B) (Figure 2), normal (C) and double (i.e., separate anastomosis for the left and right hepatic ducts) (D)^[17]. Of note, the endoscopic appearance allows classification of the HJ-orifice at the level of the lumen or above it. In Figure 2, a case of a suprastenotic stricture is seen, i.e. the anastomosis at the luminal level is wide open or normal, whereas there is a clear stricture a few millimeters above it (i.e., proximal) (Figure 2). This is a supra-anastomotic stricture (S) (Table 2).

After the cholangiogram was performed, the biliary tract was depicted and a stricture was verified, which was short (type 1) (Figure 3), long (type 2) (Figure 4) and type 3, intrahepatic biliary strictures not associated with anastomosis, i.e., non-anastomotic, e.g., sclerosing cholangitis) (Figure 5). In the theoretical case of absence of cholangiographic stricture, the classification would be type 0. In total, 7 patients had type A1 (Figure 6A-D), 4 patients A2 (Figure 7A and B), one patient had B1 (Figure 8A-C), one patient had B3 and one patient had large orifice HJ without stenosis (type B0, Figure 9A and B). The types of HJ

Table 1 Demographic, clinical and endoscopic data in patients undergoing endoscopic retrograde cholangio pancreatography with the double balloon enteroscopy

No	Sex	Age (yr)	Indication	Post surgical anatomy	Findings	Intervention
1	Male	55	Jaundice	s/p Whipple with Roux-en-Y HJ	A1	Stenting Stent extraction and new stent (× 2) Balloon dilation
2	Male	55	Cholestasis, jaundice	s/p Whipple with Roux-en-Y HJ	A1	Cannulation with Jagwire Cholangiogram Stenting
3	Female	78	Upper GI-bleeding, melena, suspicious bleeding from the afferent loop	s/p Roux-en-Y HJ after complicated CCE	B	Direct endoscopic cholangiogram APC-therapy of angiodysplasias at the HJ
4	Male	36	Cholestasis, recurrent cholangitis	s/p Whipple with Roux-en-Y HJ	A2	Cholangiogram Stent placement Stone extraction
5	Male	69	Jaundice, suspicious relapse of Klatskin-Tumor	s/p partial CBD resection with hepaticojejunostomy	NA	Tumor biopsies at the HJ Cannulation failed => PTCD
6	Male	70	Cholestasis	s/p Whipple's operation, Roux-en-Y HJ	A1	Cholangiogram Stent insertion
7	Male	77	Cholestasis	s/p partial gastric resection with Roux-en-Y HJ s/p PTCD	A2	Cannulation with Jagwire Cholangiogram DHC-stenosis No stent
8	Male	72	Cholangitis	s/p Roux-en-Y HJ	NA	Failed (adhesions)
9	F	36	Cholestasis, chronic abdominal pain	s/p Roux-en-Y HJ	A1	Cholangiogram Balloon dilatation Perforation
10	Male	36	Cholestasis	s/p at age of 17 with Roux-en-Y HJ Late onset ulcerative colitis	B3	Referred for OLT
11	Male	65	Choledocolithiasis, abdominal pain, cholestasis	s/p Whipple's operation, Roux-en-Y HJ	A1	Balloon dilation and stenting Stent and stone extraction
12	Female	25	Cholangitis	s/p at age of 3 resection of a choledococele with Roux-en-Y HJ	A1	Bougienage of CBD stenosis and stent (× 2) insertion Stent retrieval and balloon dilation of CBD stenosis
13	Female	75	Choledocolithiasis	s/p Roux-en-Y HJ after complicated CCE (iatrogenic bile duct injury)	NA	Failed, adhesions, afferent limb intubated but proximal end not reached and HJ not found
14	Male	70	Cholestasis	s/p Whipple's operation, Roux-en-Y HJ	B1	Failed, oxygen desaturation Cholangiogram, biliary stent insertion
15	Male	72	Cholangitis	s/p Roux-en-Y with HJ after a complicated CCE (gangrenous cholecystitis)	A2	Dilation of CBD stenosis Biliary stent insertion
16	Male	54	Choledocolithiasis	s/p partial gastric resection with Roux-en-Y HJ	A2	Dilation of CBD stenosis, stent insertion Stone extraction
17	Female	58	Choledocolithiasis	s/p Whipple's operation, Roux-en Y HJ	NA	Failed, adhesions, afferent limb intubated but proximal end not reached and HJ not found
18	Male		Jaundice	s/p Whipple's operation, Roux-en Y HJ	A1	Dilatation Stenting

HJ: Hepaticojejunostomy; GI: Gastrointestinal; CBD: Common bile duct; CCE: cholecystectomy; PTCD: Percutaneous transhepatic cholangiography drainage; DHC: ductus hepaticus communis; OLT: Orthotopic liver transplantation; s/p: Status post; NA: Not applicable.

found in each patient are depicted in Table 1. Interestingly, when observing a large opening of the HJ, a stenosis cannot be completely excluded as this can be located in the supra-anastomotic segment of the bile duct (type B, Figure 8A). In these cases, the stricture may be either short (type 1) or long (type 2). In other cases of type B or D HJ orifice (wide opening), a direct cholangiography using the thin enteroscope can be accomplished (Figures 9A and B). In occasional cases, unexpectedly, strictures may not be directly related to the HJ operation at all and affect the bili-

ary tract diffusely, such as in a case of primary sclerosing cholangitis (type 3, Figure 5). The proposed classification and various types of HJ strictures are depicted in Figure 10. In addition, the proposed classification is summarized in Table 2.

In three patients, we were unable to deeply intubate the afferent limb. In another patient, the HJ was infiltrated with a recurrent Klatskin tumor impeding cannulation of the bile duct (Patient No. 5). The overall diagnostic success was 93% (13/14) and the endoscopic therapeutic

Table 2 Endoscopic-cholangiographic classification of hepaticojejunostomies

Type	Endoscopic findings
A	Small opening
B	Large opening
C	Normal opening
D	Double opening (i.e., double anastomosis)
S	Supra-anastomotic stricture ¹
	Cholangiographic findings
0	No stricture
1	Short stricture
2	Long stricture
3	Intrahepatic strictures

Letters refer to endoscopic appearance and numerals refer to cholangiographic characteristics. ¹In cases of normal (B) or large opening (C) a supra-anastomotic stricture can be present. This is separately indicated by S.

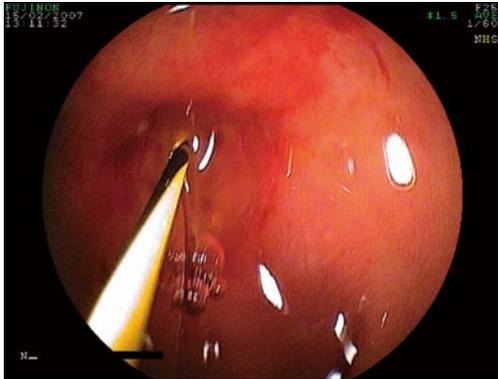


Figure 1 Small hepaticojejunostomy opening. A guidewire barely traverses it. This is a type A hepaticojejunostomy.

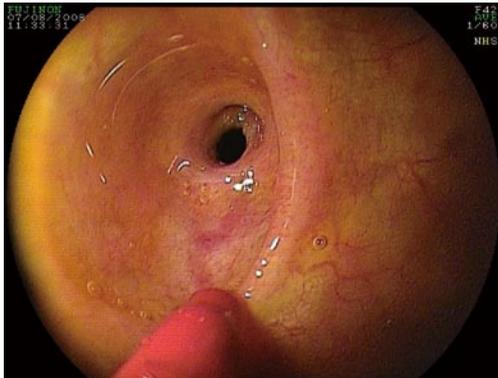


Figure 2 Wide opening hepaticojejunostomy (type B). The tip of the catheter shows the lower rim of the large hepaticojejunostomy opening. Above the hepaticojejunostomy there is a visible stenosis, which is clearly supra-anastomotic (type S). The length of the stenosis will be determined with a cholangiography (e.g., type 1 short or type 2 long).

success was 75% (9/13, in one patient no therapeutic intervention was attempted as he had sclerosing cholangitis and was referred for liver transplantation). Therapeutic interventions included biliary stent insertion ($n = 8$), dilation of common bile duct stenosis with a balloon ($n = 5$), stone removal with Dormia basket ($n = 3$) and stent

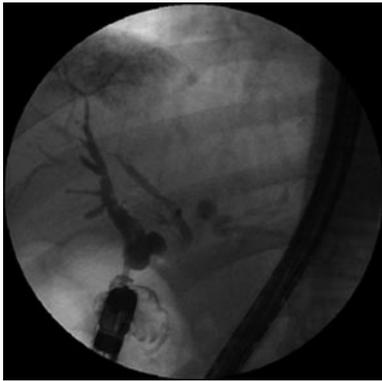


Figure 3 Short stricture of the distal bile duct at the level of the hepaticojejunostomy (type 1).

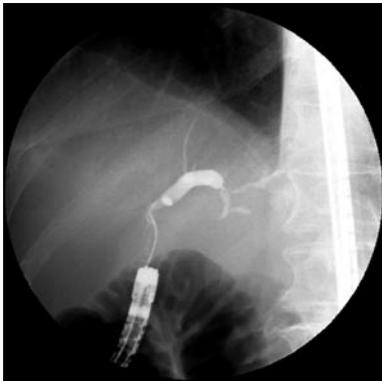


Figure 4 Long stricture of the hepaticojejunostomy (type 2).



Figure 5 Intrahepatic bile duct strictures not affecting the hepaticojejunostomy in a patient with primary sclerosing cholangitis (type 3).

retrieval ($n = 5$) (therapeutic interventions exceeds the number of patients as in some patients more than one procedure was done). One complication occurred. This was a perforation of a HJ during balloon dilation (Table 1, Case No. 9). The patient was taken to the operating room immediately and a new surgical HJ was performed after extracting multiple stones from the biliary tract.

DISCUSSION

We and others have demonstrated that diagnostic and

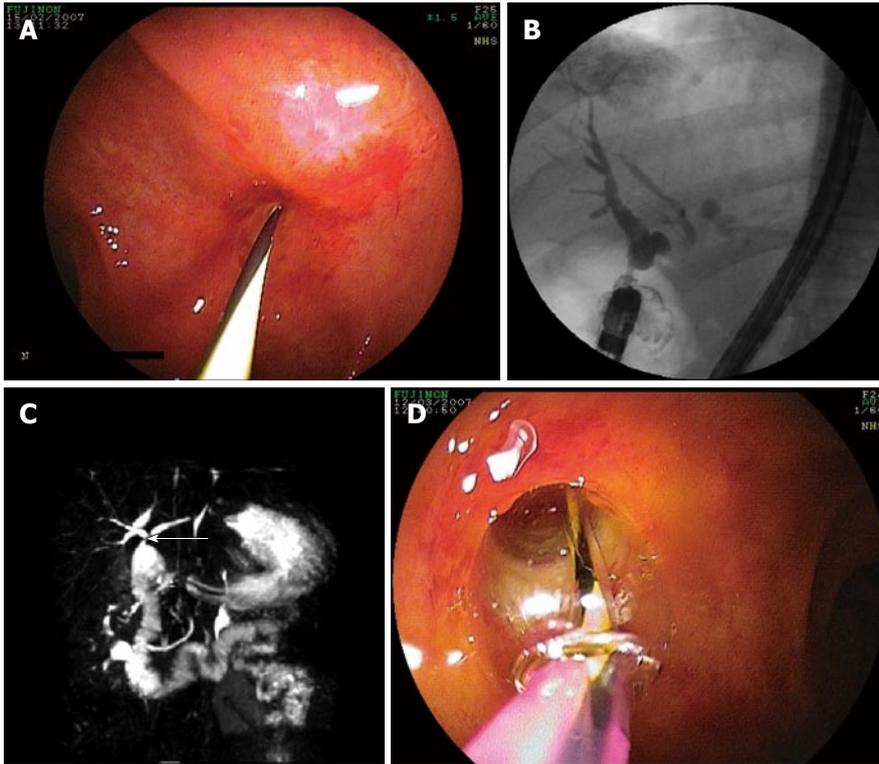


Figure 6 The small hepaticojejunostomy orifice (type A) barely permits the passage of a 0.035 inch wire (A), short stricture (type 1) on the cholangiogram (B), corresponding MRC image (C) and dilation with constant radial expansion-through the scope balloon (D). This is an example of a type A1 hepaticojejunostomy stricture.

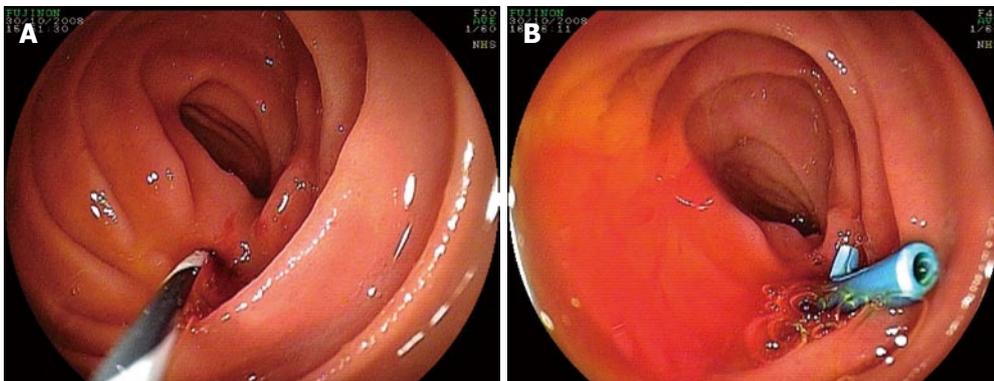


Figure 7 Small hepaticojejunostomy orifice (type A) (A). The 7 Fr plastic stent is seen in the small bowel lumen (B). This is an example of a type A2 hepaticojejunostomy stricture.

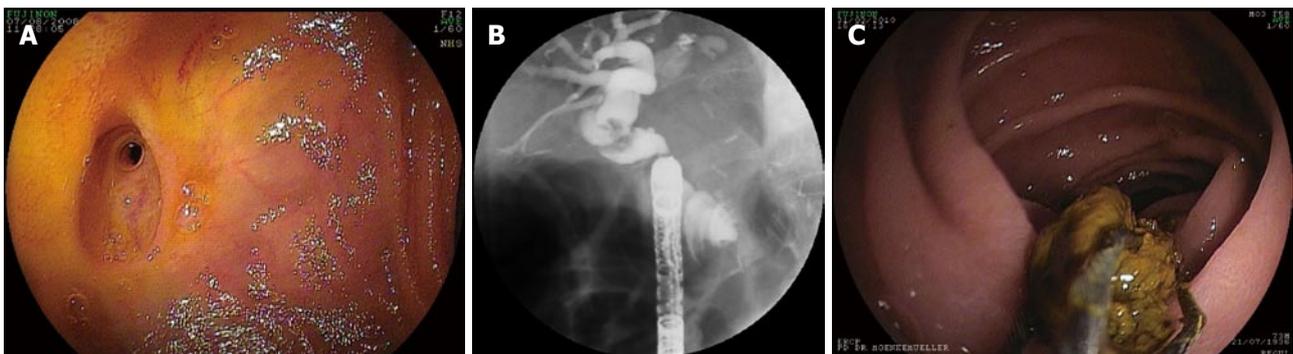


Figure 8 Wide opening of the hepaticojejunostomy (type B) (A) accompanied with short (cholangiographic type 1), supra-anastomotic stricture (type S) with dilated proximal bile duct and visible stone (B). After dilation of the stricture with a constant radial expansion-through the scope balloon, the stones were extracted with Dormia basket (C). This is an example of a B1 hepaticojejunostomy stricture.

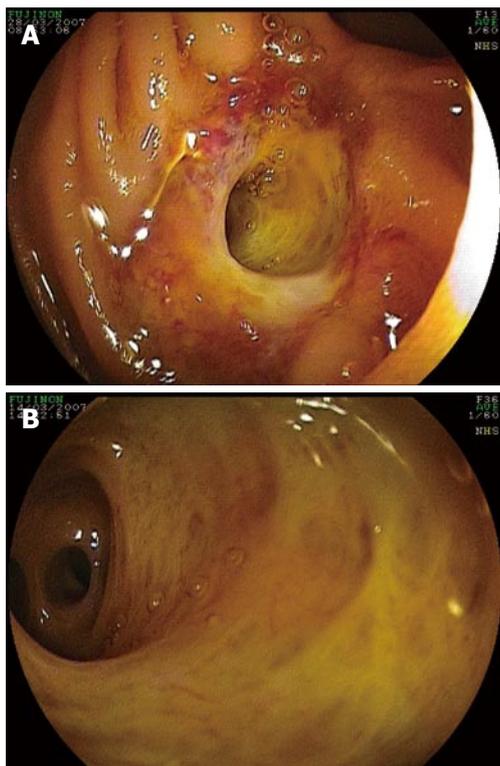


Figure 9 This patient had an exceptionally large hepaticojejunostomy (type C) (A), permitting the careful insertion of tip of the scope to perform a direct cholangioscopy (B). This is a type C hepaticojejunostomy without strictures (type 0).

therapeutic ERCP with the BAE in patients with altered bowel anatomy is feasible, allowing for the localization of the afferent limb, visualization of the HJ or papilla of Vater and demonstration of anastomotic strictures or bile duct stones of the choledochojejunostomy^[5-17,19]. Besides diagnostic capabilities, BAE-ERCP also permits therapeutic interventions such as sphincterotomy, biliary stent placement, biliary balloon dilation and stent extraction^[5-18]. Anastomotic strictures account for the majority of secondary long-term complications of hepaticojejunostomies such as hepaticolithiasis (stones in the hepatic duct), liver abscess and secondary biliary cirrhosis if left untreated^[2,3]. Almost 50% of the strictures develop within the first 5 years after surgery whereas the remaining occur at later intervals^[2,3]. Recurrences requiring further treatment occur in about 20%-25% of cases^[2,3,20,21].

During BAE-ERC we observed that the HJ and biliary tree have specific appearances that may allow it to be classified based on endoscopic and cholangiographic appearances. In almost half of our cases, the opening of the HJ was very small, barely permitting the passage of a 0.035 inch wire or a tapered 5 Fr catheter (type A), suggestive of a stenosis at the level of anastomosis. However, the cholangiographic appearance was vital in determining the length of the stricture, as in some cases the stricture was short and in others long. Short strictures are classified as type 1 and long strictures as type 2. Thus, a small HJ orifice (type A) with a short stricture (type 1) is classified as A1. The therapeutic approach to this type

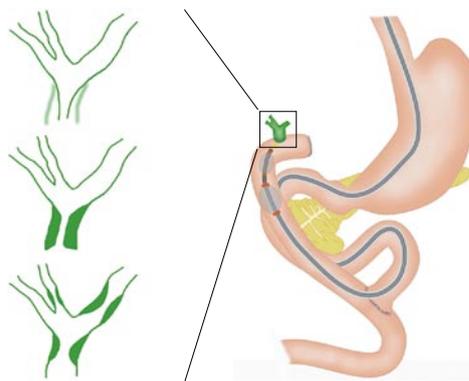


Figure 10 This figure exemplifies the proposed classification (adapted from^[18]).

of stricture may be different from one that has a wide HJ orifice (type B). From our own experience, in cases of type A1 HJ stricture, it is advisable to place a stent into the bile duct in order to enlarge and “soften” the small HJ and, in a second session, proceed with balloon dilation of the HJ stricture, a lesson we learned from our case of balloon-induced perforation (Patient No. 9, Table 1). In the same vein, long strictures may fare better with bougienage and/or previous stenting and subsequent balloon dilation. However, our study was not designed to evaluate whether this classification has implications in therapeutic outcomes. We mainly wanted to describe the types of hepaticojejunostomies that can be found and propose a potential classification or basis for future standardized classifications. Whether our classification will have wide applicability is unknown at present. However, we strongly believe that describing the different appearances of the HJ has practical consequences. We also believe that this classification may lead to a better understanding of the post-surgical changes of the HJ and a better appreciation of the diagnostic and therapeutic success of endoscopic interventions. Therefore, other endoscopists interested in treating patients with biliopancreatic disorders after major surgical interventions with altered upper GI anatomy may apply the presented information. We truly expect that our results should be reproducible. Indeed, upon reviewing the reported literature, we find that the reported endoscopic and cholangiographic pictures could fall into the classification presented herein.

A potential limitation of the study is its retrospective design. Nevertheless, the immense collection of endoscopic and cholangiographic images, coupled with the careful, prospective collected database of our centers, has allowed us to make these careful observations. Indeed, our series has the advantage of providing an extensive and detailed endoscopic and cholangiographic description of the HJ.

In summary, this endoscopic-radiological description and the proposed classification is practical as it provides a quick and accurate initial endoscopic assessment of the HJ, potentially allowing for adequate therapeutic planning, as the shape, length and complexity of the HJ and biliary tree may mandate the type of diagnostic and ther-

apeutic accessories to be used to treat the stricture (e.g., balloon *vs* bougie dilatation, Soehendra screw-type stent extractor or 3.3F peripheral angioplasty balloon over a 0.018 inch guidewire). Furthermore, such a practical classification method to characterize the HJ stenosis may be reproducible and thus allow better comparison of the diagnostic and therapeutic results of BAE-ERC in patients with Roux-en-Y anastomosis and HJ.

ACKNOWLEDGMENTS

Ivan Jovanovic, MD, PhD is a recipient of the ASGE Cook Don Wilson Award 2010. This work was performed during his award period with Prof. Klaus Mönkemüller at the Marienhospital Bottrop, Germany.

COMMENTS

Background

Performing an endoscopic retrograde cholangiopancreatography (ERCP) in patients with Roux-en-Y and hepaticojejunostomy (HJ) anastomosis is technically very challenging or impossible, frequently mandating an operative intervention. The advent of balloon-assisted enteroscopy (BAE) has increased the authors' ability to reach the HJ and perform ERCP.

Research frontiers

Although there are various types of hepaticojejunostomies, there have been no focused attempts to categorize these endoscopically. In this study, the authors describe the endoscopic and radiological characteristics of the hepaticojejunal anastomosis of patients with HJ and propose a practical HJ stricture classification.

Innovations and breakthroughs

The authors observed that the hepaticojejunostomies have characteristics that may allow the stenosis to be classified based on endoscopic and cholangiographic appearances: the HJ orifice aspect may appear small (type A) or large (type B), normal (C), double (i.e. separate anastomosis for the left and right hepatic ducts) (D). The stricture may be short (type 1), long (type 2) and type 3, intrahepatic biliary strictures not associated with anastomotic stenosis. In addition, the anastomosis may not be strictured (0) or the stricture may be above the anastomosis, i.e. supra-anastomotic stricture (S).

Applications

By understanding the anatomy of hepaticojejunostomies, this classification potentially allows for adequate therapeutic planning, as the shape, length and complexity of the HJ and biliary tree choice may dictate the type of diagnostic and therapeutic accessories to be used.

Terminology

A standardized classification may allow for better understanding and comparison of studies of patients undergoing BAE-ERCP in the setting of altered upper gastrointestinal anatomy.

Peer review

The authors present a combined endoscopic and radiological classification of HJ as visualized by balloon-assisted endoscopic retrograde cholangiopancreatography. While the clinical implications of such a scoring system are not known nor validated in other reports, it does provide a framework for other investigators to use, modify or refute.

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