ERCP in patients with prior Billroth II gastrectomy: report of 30 years' experience

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submitted 18. June 2014
accepted after revision 28. December 2014

Bibliography
DOI http://dx.doi.org/10.1055/s-0034-1391567
Published online: 2.3.2015
Endoscopy 2015; 47: 611–616

ISSN 0013-726X

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Background and study aim: Endoscopic retrograde cholangiopancreatography (ERCP) is difficult in patients with altered anatomy following Billroth II gastrectomy. Afferent loop intubation, selective cannulation, and sphincterotomy are the main issues. Experience from a tertiary referral endoscopy center is reported.

Patients and methods: A total of 713 patients with Billroth II reconstruction who underwent ERCP between October 1982 and October 2012 were retrospectively identified from a prospectively collected database (mean age 69±27 years; 567 males). The main indications for ERCP were common bile duct stones (51.2%) and obstructive jaundice (24.8%). Procedures were always started with a duodenoscope; in cases of failure to reach the papilla the duodenoscope was changed to a gastroscope. Endoscopic sphincterotomy was performed using a long-nose sigmoid inverted sphincterotome.

Results: The successful duodenal intubation rate was 86.7% (618/713 patients). The main reason for intubation failure was a long and angulated afferent loop. Successful cannulation/opacification of the desired biliopancreatic duct was 93.8% (580/618). Biliary and/or pancreatic sphincterotomy were performed in 490 (84.5%) and 23 (4.0%) patients, respectively. The adverse event rate was 4.3% (45/1050 procedures). Peritoneal perforation occurred in 1.8% of the cases (19/1050 procedures) and always required immediate surgery. Two patients died after surgery (overall mortality 0.3%). The other adverse events resolved following conservative management or endoscopic reintervention.

Conclusions: In experienced centers, ERCP in Billroth II patients had morbidity and mortality rates that were comparable to patients with normal anatomy. The main reasons for failure were related to the inability to reach the papilla. Peritoneal perforation was the most common adverse event, and required a prompt surgical approach.

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is considered to be the first-line treatment several biliary and pancreatic diseases. ERCP may also be required in patients with surgically altered anatomy, for example following Billroth II gastrectomy [1]. ERCP in patients with Billroth II anatomy is a challenging procedure. Entering the afferent loop, progressing towards the duodenal stump, visualizing the papilla, cannulating the desired duct (biliary and/or pancreatic), and performing endoscopic sphincterotomy in a reverse position, are the main issues [2]. ERCP in normal anatomy has a 0.1%–0.6% risk of perforation [3–7], whereas in Billroth II patients this figure may increase up to 10.2% [8, 9]. The incidence of other ERCP-related adverse events (pancreatitis, bleeding, cholangitis, cholecystitis) is similar in patients with Billroth II and normal anatomy [10, 11].

The aim of this study was to analyze a 30-year experience from a tertiary referral center carrying out ERCP in patients with prior Billroth II gastrectomy.

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Patients and methods

Patients

From October 1982 to October 2012, 1050 (4.2%) out of a total of 25 000 ERCPs were performed in 713 patients with previous Billroth II gastrectomy at the Digestive Endoscopy Unit of Gemelli University Hospial, Rome, Italy. The indication for Billroth II gastrectomy was peptic ulcer in 623 patients (87.4%) and gastric neoplasia in 90 patients (12.6%). These patients were retrospectively

Table 1 Characteristics of the 713 patients with Billroth II anatomy.

	n	%
Males	567	79.5
Females	146	20.5
Age ≤ 60 years	148	20.8
Age > 60 years	565	79.2
Gastric resection for peptic ulcer	623	87.4
Gastric resection for cancer	90	12.6

identified from a prospectively collected database (567 males, 146 females; mean age 69 years [range 27 – 96]) (**Table 1**).
This study was approved by the ethical committee of the Catholic University of Rome on 19 April 2012 (P/445/CE/2012).

Study end points

The primary end point of the current analysis was the success rate of duodenal stump intubation during ERCP. Secondary end points were: 1) success in cannulation of the desired duct; 2) therapeutic success; 3) evaluation of ERCP-related adverse events and their management.

ERCP procedures

ERCP in patients with previous Billroth II gastrectomy was always approached with a side-viewing operative duodenoscope (Olympus TJF100, 140, 160; Pentax ED 3440, ED 3470TK; Fujinon DUO-XL, DUO-XT). In cases of failure to reach the papilla, the duodenoscope was changed to a forward-viewing gastroscope or a pediatric colonoscope. The procedure was performed under conscious sedation with fentanyl and midazolam or deep sedation/general anesthesia with propofol.
ERCP was started with the patient in the left lateral decubitus position to facilitate entering the afferent loop. After loop intubation the patient was turned to the supine position in order to obtain better radiological images. The loop anastomized towards the lesser gastric curvature was the first to be intubated because the majority of the afferent loop is in this location. If the intubated loop looked "dry," without evidence of bile and the endoscope was in the left abdominal quadrant toward the pelvis on radiograph (**Fig. 1**), the other loop was entered (**Fig. 2**). In recent years, if the afferent loop had tight and sharp angulations, a catheter and a soft angled guidewire (Terumo Radiofocus, Tokyo, Japan) was advanced under radiological control to the duodenal stump to act as a "road map" in order to determine whether it was feasible to proceed with the duodenoscope (**Fig. 3**).
Cannulation was performed using standard straight ERCP catheters (ERCP-1-HKB, Cook Endoscopy, Winston Salem, North Carolina, USA) or, in more recent years, bendable catheters (Swing Tip, Olympus Medical, Tokyo, Japan). Straight catheters are needed in Billroth II patients because the direction for cannulation is at the 6 o'clock position; steerable catheters can facilitate the correct approach to the papilla in this reverse position. A standard contrast injection technique was used for cannulation as a first-line approach; if this approach failed, guidewire-assisted cannulation was the second approach, and needle-knife precut was the third.
Endoscopic sphincterotomy in Billroth II patients is performed in a reverse position. In the current series, endoscopic sphincterotomy was initially performed with the Cremer-Van Laethem inverted sphincterotome. From 1987, a long-nose "homemade" sigmoid inverted sphincterotome was obtained by modifying existing catheters. This guarantees an almost constant reverse position of the cutting wire (at 6 o'clock) and allows the possibility of wire guidance [12] (**Fig. 4**). This inverted sphincterotome is today manufactured by Endobair (London, UK). Other groups have also designed similar sphincterotomes with good efficacy [13, 14].
Standard ERCP devices were used for other therapeutic procedures (e.g. stone extraction, stent insertion).
In cases of multiple common bile duct stones and doubtful complete stone clearance, a nasobiliary drain (NBD) was placed in order to perform a repeat cholangiography to check the area and to facilitate repeat ERCP if needed.

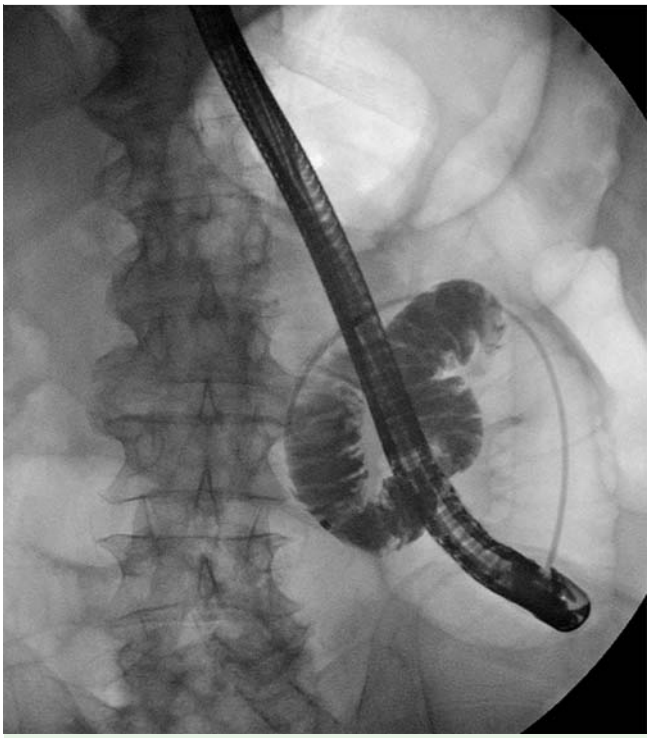
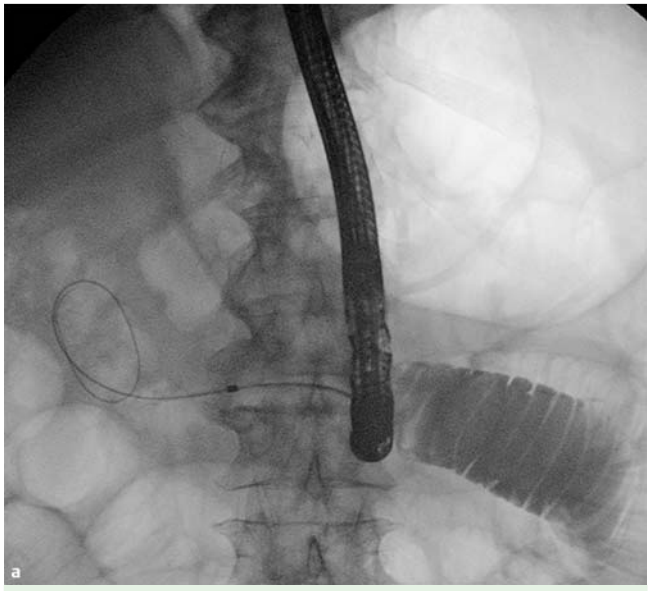


Fig. 1 Endoscopic retrograde cholangiopancreatography in patients with previous Billroth II gastrectomy. The endoscope reaches the left abdominal quadrant towards the pelvis, and the efferent loop is intubated.

Fig. 2 Retraction of the endoscope from the efferent loop with the catheter in place; the afferent loop is identified (arrow).



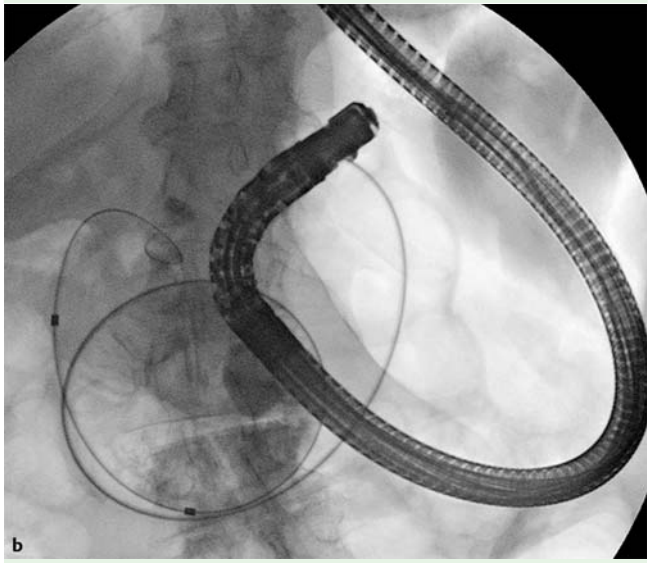


Fig. 3 A catheter is advanced into the duodenal stump. **a** The afferent loop is short and not angled. **b** A long and angled afferent loop; the procedure was interrupted.

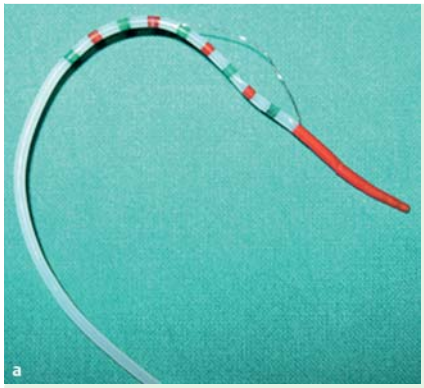


Fig. 4 The sphincterotome enables controlled sphincterotomy. **a** The "homemade" sigmoid inverted sphincterotome. **b** The sphincterotome is wire guided. **c** The cutting wire is directed at the 6 o'clock position.

At the end of the procedure the site of the afferent loop (lesser or greater curvature) was annotated in the database to facilitate future reinterventions.

Key technical aspects of ERCP in Billroth II patients

- Begin ERCP in Billroth II patients with a therapeutic duodenoscope; switch to a forward-viewing endoscope if the papilla cannot be reached.
- Place the patient in the left lateral decubitus position and turn them to the supine position after afferent loop intubation.
- Use fluoroscopy to assess correct loop intubation.
- Use an inverted sphincterotome.

Results

A total of 1050 ERCPs were attempted in 713 patients with previous Billroth II gastrectomy (1.47/patient; range 1 – 33). The indications for ERCP are summarized in ▶ **Table 2**.

Table 2 Indications for endoscopic retrograde cholangiopancreatography in 713 patients with prior Billroth II gastrectomy.

	n	%
Common bile duct stones	365	51.2
Obstructive jaundice	177	24.8
Acute cholangitis	61	8.6
Chronic pancreatitis[1]	55	7.7
Acute biliary pancreatitis	21	2.9
External biliary fistula	20	2.8
Benign biliary strictures[2]	9	1.3
External Pancreatic fistula	3	0.4
Duodenal fistula[3]	2	0.3

[1] Six also underwent extracorporeal shock wave lithotripsy.
[2] Eight postoperative biliary stricture, 1 hydatid cyst-related biliary stricture.
[3] Nasobiliary and nasopancreatic drains were inserted.

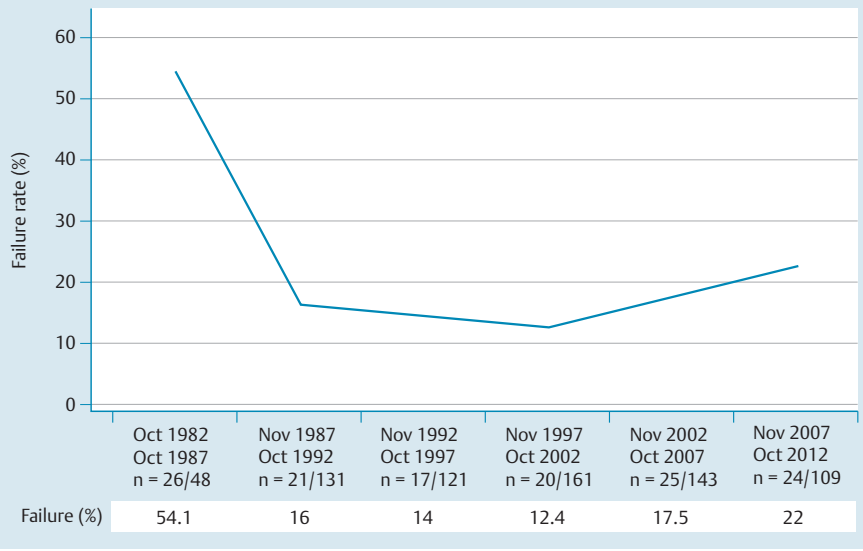


Fig. 5 Endoscopic retrograde cholangiopancreatography failure in patients with Billroth II anatomy (n = 713) during 30 years of experience.

Table 3 Results of duodenal intubation and biliopancreatic cannulation after endoscopic retrograde cholangiopancreatography in 713 patients with Billroth II anatomy.

	n	%
Successful duodenal intubation	618	86.7
Duodenoscope	600	97.1
Gastroscope	11	1.8
Pediatric colonoscope	7	1.1
Failed duodenal intubation	95	13.3
Long and angulated afferent loop	73	76.8
Jejunal loop perforation	19	20.0
Lack of cooperation (conscious sedation)	3	3.2
Successful cannulation/opacification	580/618	93.8
Duodenoscope	567/600	94.5
Gastroscope	13/18	72.2
Overall success	580/713	81.3

Table 4 Endoscopic retrograde cholangiopancreatography procedures on 580 patients with previous Billroth II gastrectomy.

	n	%
Biliary sphincterotomy[1]	490	84.5
Extraction of common bile duct stones	318	54.8
Plastic and metallic biliopancreatic stents	158	27.2
Diagnostic ERCP[2]	78	13.4
Pancreatic sphincterotomy[3]	23	4.0
Balloon dilation of a previous sphincterotomy[4]	19	3.3
Extraction of pancreatic stones/plugs[5]	12	2.1
Papillectomy	1	0.2

ERCP, endoscopic retrograde cholangiopancreatography.
[1] Including 53 (10.8%) needle-knife precut.
[2] Diagnostic procedures were performed when magnetic resonance cholangiopancreatography was not yet available.
[3] Including 4 minor papilla sphincterotomy; 16 patients also had biliary sphincterotomy.
[4] Surgical or endoscopic.
[5] Six patients underwent extracorporeal shock wave lithotripsy.

The duodenal stump was successfully reached in 618 patients (86.7%; 95% confidence interval [CI] 84.2–89.2)–600 with a duodenoscope, 11 with a gastroscope, and 7 with a pediatric colonoscope. The overall failure rate decreased after the first 5 years of experience and remained stable during the subsequent years (**Fig. 5**). Duodenal intubation failed in 95 patients (13.3%). The reasons for failure were: long and angulated afferent loop, including patients with Braun side-to-side jejuno-jejunostomy (n = 73 [76.8%]); jejunal loop perforation (n = 19 [20%]); and insufficient sedation and/or lack of cooperation (n = 3 [3.2%]). The total number of successful opacification and cannulation procedures was 580/618 (93.8%; overall success rate 81.3%) (**Table 3**).

In this series, 500 patients out of 580 (86.2%) required therapeutic interventions (**Table 4**). Among 365 patients with common bile duct stones, 100 (27.4%) received an NBD because multiple stones had been present. Repeat cholangiography showed residual fragments to be present in 20 of these cases. Repeat ERCP in these patients was always successful without adverse events.

Table 5 Endoscopic retrograde cholangiopancreatography in patients with Billroth II anatomy: adverse events in 1050 procedures.

	n	Specific, %	Overall, %
Morbidity	45		4.3
Peritoneal perforation	19	42.3	1.8
Delayed postendoscopic sphincterotomy bleeding	11	24.4	1.0
ERCP-related cholangitis	5	11.1	0.5
Mild pancreatitis	5	11.1	0.5
Retroperitoneal perforation	3	6.7	0.3
Respiratory failure	2	4.4	0.2

ERCP, endoscopic retrograde cholangiopancreatography.

The overall morbidity in 1050 procedures was 4.3% (n = 45; 95% CI 3.1–5.5) (**Table 5**). The most common adverse event of the procedure was peritoneal perforation in 19 patients (19/713 patients [2.7%]; 19/1050 procedures [1.8%]), which was recognized immediately during endoscopy and always treated by urgent surgery. No attempt was made to repair or mark the perforation site endoscopically. During surgery the perforation site was easily identified. All of the perforations occurred when using the duodenoscope to intubate the afferent loop and were less frequent in patients under conscious sedation with midazolam (15/1012; 1.4%) than in those under general anesthesia (4/38, 10.5%; $P < 0.01$ [chi-squared test]).

Table 6 Results from published series on endoscopic retrograde cholangiopancreatography in patients with Billroth II anatomy.

Study First author, year [ref.]	Patients, n	Type of endoscope	Successful afferent loop intubation, %	Successful biliopancreatic cannulation, %	Afferent loop peritoneal perforation, %	Mortality due to peritoneal perforation, %
Osnes, 1986 [2]	147	Side viewing	92	100	0.7	0.7
Costamagna, 1994 [12]	175	Side viewing	94.7	93.2	1.1	0
Hintze, 1997 [13]	59	Side viewing	92	100	N/A	N/A
Kim, 1997 [9]	23	Forward viewing	91.3	95.2	0	0
Kim, 1997 [9]	22	Side viewing	68	100	18.2	0
Lin, 1999 [18]	56	Forward viewing	76.8	81.4	0	0
Çiçek, 2007 [8]	59	Side viewing	86.4	88.2	10.2	1.7
Nakahara, 2009 [19]	43	Prototype anterior oblique viewing	88.3	94.7	0	0
Current series	713	Side viewing	86.7	93.8	2.7	0.3

N/A, not addressed.

Peritoneal perforation during the first ERCP occurred in 17/713 patients (2.4%; 95%CI 1.3–3.5), and 2/337 patients (0.6%; 95%CI 0.1–1.4) experienced perforation during the subsequent ERCPs performed for biliary stent exchange (P =0.0294 [chi-squared test]).

Two patients died after surgery (overall mortality 2/713 [0.3%]; specific mortality 2/19 [10.5%]). Other early adverse events included postsphincterotomy bleeding, retroperitoneal perforations, ERCP-related cholangitis (3 malfunctioning biliary stent, 2 residual stones), mild pancreatitis, and respiratory failure (**Table 5**). These adverse events resolved by conservative management or endoscopic reintervention. The three retroperitoneal perforations were secondary to sphincterotomy, balloon dilation of the papilla, and laceration of a duodenal diverticulum, respectively, and all were managed conservatively.

Discussion

ERCP in patients who have undergone previous Billroth II gastrectomy is a challenging procedure. Recognition of the afferent loop at the site of gastrojejunostomy is the first problem to be solved, but the progression into the loop may then be hindered by situations such as anastomosis angulations, adhesions, excessive length, Braun entero-entero-anastomosis, and distorted anatomy at the duodeno-jejunal angle [12]

The choice between a forward-viewing and side-viewing endoscope is a matter of debate. Some authors advocate the routine use of forward-viewing endoscopes (gastroscope or pediatric colonoscopies) to manage long afferent loops because they are easier to handle and can facilitate recognition of the afferent loop. The major drawbacks of forward-viewing endoscopes are the difficult visualization of the papilla and the lack of the elevator which facilitates cannulation maneuvers [15]. This limitation underlies the recommendation of other authors who routinely use side-viewing duodenoscopes, believing that, with experience, the ease of identification of the afferent loop and papilla is comparable to the forward-viewing endoscope [15].

Kim at al. [9] randomized 45 patients with a Billroth II gastrectomy who underwent ERCP using either a forward- or side-viewing endoscope. After reaching the papilla, cannulation failed in one patient in the forward-viewing group, whereas it was always successful with the side-viewing endoscope. The rate of successful sphincterotomy was comparable between the two groups (83 % vs. 80%, respectively). Another possible advantage of the forward-viewing endoscope was a lower rate of adverse events. Kim et al. reported jejunal perforation in 4 of 22 patients (18.2%) using the side-viewing endoscope compared with none with the forward-viewing endoscope.

The reported success in therapeutic ERCP in patients with previous Billroth II gastrectomy is slightly higher with the duodenoscope than the forward-viewing endoscope (**Table 6**). According to the authors' experience, the therapeutic duodenoscope is preferred, making biliopancreatic cannulation and subsequent endotherapy (even pancreatic) easier thanks to better visualization of the papilla, the presence of the elevator, and the large operative channel.

In recent years, the introduction of balloon-assisted enteroscopy has increased the success rate of duodenal stump intubation when performing ERCP in Billroth II patients [16]. Nevertheless, the small operative channel of the enteroscope (2.8 mm), the forward view, the lack of the elevator, and the absence of ERCP-dedicated catheters are limitations that can reduce the therapeutic efficacy of the enteroscope when performing ERCP in altered anatomy.

However, most published series have confirmed that the duodenoscope presents a higher incidence of perforations due to the natural shape of the instruments and the side-viewing characteristics [9]. In our experience, the majority of perforations were caused by the tip of the endoscope, when excessive scope torsion was applied, and when limb visualization was limited.

Advancing a catheter to depict a fluoroscopic "road map" can be useful to pass the angle of Treitz, which is fixed and is the site where perforations usually occur. It is also useful for the identification of anatomical features (i.e. angulations, long loop) in which termination of the procedure can reduce the risk of perforation.

Evolution in scope design has reduced the risk of jejunal perforation with the duodenoscope in Billroth II patients. The only jejunal perforation reported in another series [17] occurred with a duodenoscope with a long and potentially harmful distal end (TJF V10, Olympus); this device was very quickly replaced by a duodenoscope with a smooth, regular, distal end (TJF 100, Olympus).

In the current series, sphincterotomy was performed using an inverted sphincterotome. An alternative technique for endoscopic sphincterotomy in Billroth II patients is the use of a needle-knife over a 7-Fr stent. The needle-knife technique is a "free hand" rather than a well-controlled cutting technique. The wire-guided inverted sphincterotome can perform a more controlled endoscopic sphincterotomy, giving us more confidence in this particular and difficult setting.

Leaving an NBD in place in cases of suspected incomplete stone clearance can facilitate repeat ERCP if necessary. Following the route of the NBD resulted in easier duodenal stump intubation, without perforations, according to our experience.

In the current series, general anesthesia or deep sedation with propofol reduced the rate of procedure failure from lack of cooperation or desaturation, but a significantly ($P<0.01$) higher rate of perforation occurred compared with procedures performed under conscious sedation with midazolam. This fact can be related to an earlier procedure termination when the patient reports pain due to excessive traction on the mesentery.

According to our data, the risk of peritoneal perforation during repeated ERCP in the same Billroth II patient, is still present but is reduced compared with the first attempt. The persistence of this risk can be related to different performance of the endoscope and to operator skill.

A learning curve for advanced ERCP in Billroth II patients is present, and success increase after the first 50 cases (**Fig. 5**). In our 30-year experience, there has been a slight increase in failures in more recent years, which may be due to the referral of difficult cases that had already failed in other hospitals.

ERCP in altered anatomy is a challenging procedure. The increasing number of bariatric surgical procedures, such as Roux-en-Y reconstruction, has led to a growing interest in enteroscopy techniques. Billroth II patients are becoming rare but are still encountered.

According to our experience the key technical aspects specific to the Billroth II situation are: to begin with a duodenoscope and to switch to a forward-viewing endoscope in cases of failure to reach the papilla; to position the patient in the left lateral decubitus position and to turn them to the supine position after afferent loop intubation; and to use fluoroscopy to confirm correct loop intubation, contrast-based cannulation with straight catheters, and an inverted sphincterotome for sphincterotomy.

Competing interests: Dr. Costamagna has the following declarations: Olympus Japan (grant/research support), Cook Inc. (advisory committees or review panels; grant/research support), Boston Scientific Corp.(advisory committees or review panels; speaking and teaching), Given Imaging (speaking and teaching), Taewoong Medical Inc. (advisory committees or review panels). Dr. Tringali is a former consultant for Boston Scientific. Dr. Bošković is a consultant for Cook Inc.

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