

Does antecolic reconstruction decrease delayed gastric emptying after pancreatoduodenectomy?

Nadia Peparini, Piero Chirletti

Nadia Peparini, Azienda Sanitaria Locale Roma H, 00043 Rome, Italy

Piero Chirletti, Department of Surgical Sciences, Sapienza University of Rome, 00161 Rome, Italy

Author contributions: Peparini N conceived and drafted the manuscript, critically revised the manuscript and gave the final approval; Chirletti P critically revised the manuscript and gave its final approval.

Correspondence to: Nadia Peparini, MD, PhD, Azienda Sanitaria Locale Roma H, via Mario Calò, 5-Ciampino, 00043 Rome, Italy. nadiapeparini@yahoo.it

Telephone: +39-339-2203940 Fax: +39-765-488423

Received: September 17, 2012 Revised: November 4, 2012

Accepted: November 11, 2012

Published online: December 7, 2012

© 2012 Baishideng. All rights reserved.

Key words: Antecolic reconstruction; Retrocolic reconstruction; Pancreatoduodenectomy; Pylorus-preserving pancreatoduodenectomy; Delayed gastric emptying

Peer reviewers: Mohamed Hassan, PhD, Laboratory for Molecular Tumour Therapy, Department of Dermatology, University Hospital of Duesseldorf, Mooren Str. 5, 40225 Duesseldorf, Germany; Cunha JEM, Reprint Author, Rua Oquiria 116, BR-05467030 Sao Paulo, Brazil; Izbicki JR, Reprint Author, Univ Hamburg, Dept Surg, Univ Hosp Eppendorf, Martinistr 52, D-20251 Hamburg, Germany

Peparini N, Chirletti P. Does antecolic reconstruction decrease delayed gastric emptying after pancreatoduodenectomy? *World J Gastroenterol* 2012; 18(45): 6527-6531 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v18/i45/6527.htm> DOI: <http://dx.doi.org/10.3748/wjg.v18.i45.6527>

Abstract

Delayed gastric emptying (DGE) is a frequent complication after pylorus-preserving pancreatoduodenectomy (PpPD). Kawai and colleagues proposed pylorus-resecting pancreatoduodenectomy (PrPD) with antecolic gastrojejunostomy anastomosis to obviate DGE occurring after PpPD. Here we debate the reported differences in the prevalence of DGE in antecolic and retrocolic gastrojejunostomies after PrPD and PpPD, respectively. We concluded that the route of the gastrojejunostomy anastomosis with respect to the transverse colon; i.e., antecolic route or retrocolic route, is not responsible for the differences in prevalence of DGE after pancreatoduodenectomy (PD) and that the impact of the reconstructive method on DGE is related mostly to the angulation or torsion of the gastrojejunostomy. We report a prevalence of 8.9% grade A DGE and 1.1% grade C DGE in a series of 89 subtotal stomach-preserving PDs with Roux-en Y retrocolic reconstruction with anastomosis of the isolated Roux limb to the stomach and single Roux limb to both the pancreatic stump and hepatic duct. Retrocolic anastomosis of the isolated first jejunal loop to the gastric remnant allows outflow of the gastric contents by gravity through a "straight route".

INVITED COMMENTARY ON HOT ARTICLES

Delayed gastric emptying (DGE) is a major cause of early morbidity following pancreatoduodenectomy (PD). Although it has been recently reported that pylorus-preserving pancreatoduodenectomy (PpPD) and classical Whipple's PD are equal operations regarding the postoperative development of DGE^[1], the occurrence of this complication is usually considered to be associated with PpPD. DGE after PpPD was first described by Warshaw *et al*^[2] in 1985. DGE implies a state of postoperative gastroparesis and gastric stasis for which prolonged gastric drainage is necessary with delay to return to solid food intake. However, the pathogenesis of DGE is still unclear. Postoperative decrease in plasma motilin stimulation after duodenal resection^[3], devascularization and denervation of the pylorus with subsequent pylorospasm in PpPD^[4,5] and other operative factors such as the route of gastro-

duodeno-enteric reconstruction (antecolic *vs* retrocolic)^[6] and the type of reconstructive technique (Billroth I *vs* Billroth II reconstruction)^[7] may contribute to the occurrence of DGE. Moreover, intra-abdominal postoperative complications such as pancreatic fistula, peripancreatic collections, intraabdominal abscess or postoperative pancreatitis may increase the prevalence of DGE^[8-13]. The reported prevalence of DGE after pancreatic surgery is remarkably variable due to different adopted definitions of DGE^[10,14,15]. In fact, a consensus definition of DGE based on the impact on the clinical course and on postoperative management was proposed by the International Study Group of Pancreatic Surgery only in 2007^[16]. Kawai *et al*^[17] reported a prospective randomized controlled trial (RCT) on the prevalence of DGE in pylorus-resecting pancreatoduodenectomy (PrPD) *vs* PpPD. The authors proposed PrPD, in which the stomach is nearly entirely preserved and divided just adjacent to the pyloric ring, to obviate DGE occurring after PpPD and avoid the impairment of nutritional status occurring after classical Whipple's PD. They highlighted that the results of their RCT significantly favored PrPD over PpPD, considering the prevalence of DGE (4.5% *vs* 17.2%): in these procedures an antecolic gastro- or duodeno-jejunal reconstruction was adopted^[18]. A recent RCT comparing the occurrence of DGE after subtotal stomach-preserving pancreatoduodenectomy in pancreaticogastrostomy with retrocolic gastro-jejuno-stomy reconstruction and in pancreaticogastrostomy with antecolic gastro-jejuno-stomy reconstruction concluded that antecolic reconstruction, and not retrocolic reconstruction, decreases DGE prevalence. However, in this study, Billroth I (retrocolic) reconstructions were compared with Billroth II (antecolic) reconstructions^[19]. After subtotal stomach-preserving pancreatoduodenectomy with pancreaticogastrostomy, Oida *et al*^[20,21] considered retrocolic gastrojejunal reconstruction preferable to antecolic reconstruction for preventing DGE because pancreaticogastric anastomosis is located behind the stomach and the retrocolic route in gastroenteric reconstruction enables the gastric contents to easily reach the jejunum. In the study by Eshuis *et al*^[22], DGE was more frequent in retrocolic reconstructions, but in multivariable analysis no association between the route of reconstruction and DGE was found.

After PD, Billroth I reconstruction is considered to have a higher incidence of DGE than Billroth II reconstruction^[7], but Billroth I is considered to be a more physiologic procedure than Billroth II because Billroth I preserves the proximal jejunum in the alimentary circuit and maintains the hormonal stimuli on the remnant pancreas^[23]. In evaluation of the prevalence of DGE in antecolic and retrocolic reconstruction in gastro- and duodeno-jejuno-stomy after classical Whipple's PD and PpPD, respectively, the two compared procedures should differ only in the manner in which the jejunum is brought up in respect to the transverse colon. Kawai participated in a previously reported prospective RCT in which the adopted reconstructive procedures after PpPD were different only regarding

the route; i.e., antecolic or retrocolic, for Billroth II type duodeno-jejunal anastomosis. The prevalence of DGE was significantly lower in the antecolic duodeno-jejuno-stomy group than in the retrocolic duodeno-jejuno-stomy group^[6]. However, another recent RCT showed no difference in the prevalence of DGE between antecolic and retrocolic gastro/duodeno-jejuno-stomy following classical Whipple's PD/PpPD after standardization of both the antecolic and retrocolic types of Billroth II gastro/duodeno-jejuno-stomy with respect to the distance from the hepatico-jejuno-stomy and angulation of the jejunal loop. In this study, the occurrence of DGE was not affected by the type of performed PD; i.e., classical Whipple's PD *vs* PpPD, or the type of adopted reconstruction of the gastro/duodeno-jejuno-stomy; i.e., antecolic *vs* retrocolic^[24]. Ueno *et al*^[25] indicated that the transient torsion or angulation in the reconstruction of the alimentary tract is the main cause of DGE after PpPD. Several methods were proposed to promote the alimentary transit from the stomach through the jejunal loop, such as alignment of the stomach contour to avoid angulation of the jejunal loop distally to the duodeno-jejunal anastomosis in a Billroth I type of reconstructive procedure^[25], and straight antecolic duodeno-jejuno-stomy twisting the jejunum 30° counterclockwise to preserve the patency of the efferent jejunum and placing the stomach in the left subcolic fossa to straighten it in a Billroth II type of reconstruction^[26]. In the RCT by Chijiwa *et al*^[27] no significant difference in the prevalence of DGE was found between retrocolic vertically performed duodenojejuno-stomy and antecolic duodenojejuno-stomy (Table 1).

Regarding the resection method, Kawai *et al*^[17,18] highlighted that PrPD preserves the capacity of the stomach and obviates to pylorospasm, denervation and devascularization of the pylorus ring, which can occur in PpPD, and demonstrated that PrPD decreases the incidence of DGE in respect to PpPD. Recently, these surgical procedures of subtotal stomach-preserving (or pylorus-resecting) pancreatoduodenectomies have been adopted in surgical treatments of malignant tumors of the periampullary region and of the head of the pancreas. Our group has been adopting subtotal stomach-preserving pancreatoduodenectomy since 1995 for several considerations. After pancreaticoduodenectomy, gastric preservation favors adequate weight gain due to higher caloric intake; moreover, and most of all, normal acid secretion acts as a physiologic stimulus promoting the intestinal secretion of secretin and CCK-PZ, as well as the subsequent stimulation of pancreatic exocrine secretion with better digestion of protein and fat (weight gain). Lastly, preservation of the stomach with resection of the pylorus favors better gastric emptying^[28,29]. Regarding the impact of the reconstructive method on DGE, we think that the route of the gastro/duodeno-jejunal anastomosis with respect to the transverse colon (antecolic or retrocolic) or the type of reconstruction performed (Billroth I or Billroth II procedure) are not truly responsible for the differences in the prevalence of DGE after PD. We believe

Table 1 Summary of the cited studies on prevalence of delayed gastric emptying after pancreaticoduodenectomy

Ref.	Type of study	No. of patients	Studied groups	Significant difference in prevalence of DGE
Eshuis <i>et al</i> ^[22]	CCS	77	PD/PpPD + PJ-B II AG/DJ	Not found
		77	PD/PpPD + PJ-B II RG/DJ	
Oida <i>et al</i> ^[20]	CCS	14	MSSPPD + PG-B II AGJ	PG-B II RGJ < PG-B II AGJ
		28	MSSPPD + PG-B II RGJ	
Masui <i>et al</i> ^[26]	CCS	12	PpPD + PJ-B II ADJ	PJ-B II AMDJ < PJ-B II ADJ
		106	PpPD + PJ-B II AMDJ	
Kawai <i>et al</i> ^[17]	RCT	66	PrPD + PJ-B II AGJ	PrPD < PpPD
		64	PpPD + PJ-B II ADJ	
Kurahara <i>et al</i> ^[19]	RCT	22	SSPPD + PG-B I RGJ	PG-B II AGJ < PG-B I RGJ
		24	SSPPD + PG-B II AGJ	
Gangavatiker <i>et al</i> ^[24]	RCT	35	PD/PpPD + PJ-B II AG/DJ	Not found
		37	PD/PpPD + PJ-B II RG/DJ	
Chijiwa <i>et al</i> ^[27]	RCT	17	PpPD + PJ-B II ADJ	Not found
		18	PpPD + PJ-B II VRDJ	
Tani <i>et al</i> ^[6]	RCT	40	PpPD + PJ-B II ADJ	PJ-B II ADJ < PJ-B II RDJ
		40	PpPD + PJ-B II RDJ	

CCS: Case control study; RCT: Randomized controlled trial; PD/PpPD: Pancreaticoduodenectomy or pylorus-preserving pancreaticoduodenectomy; PJ-B II AG/DJ: Pancreaticojejunostomy with Billroth II antecolic gastro/duodenojejunostomy; PJ-B II RG/DJ: Pancreaticojejunostomy with Billroth II retrocolic gastro/duodenojejunostomy; MSSPPD: Modified subtotal stomach-preserving pancreaticoduodenectomy; PG-B II AGJ: Pancreaticogastrostomy with Billroth II antecolic gastrojejunostomy; PG-B II RGJ: Pancreaticogastrostomy with Billroth II retrocolic gastrojejunostomy; PJ-B II ADJ: Pancreaticojejunostomy with Billroth II antecolic duodenojejunostomy; PJ-B II AMDJ: Pancreaticojejunostomy with Billroth II antecolic modified reconstruction with straightening of the stomach and twisted duodenojejunostomy; PrPD: Pylorus-resecting pancreaticoduodenectomy; PJ-B II AGJ: Pancreaticojejunostomy with Billroth II antecolic gastrojejunostomy; SSPPD: Subtotal stomach-preserving pancreaticoduodenectomy; PG-B I RGJ: Pancreaticogastrostomy with Billroth I retrocolic gastrojejunostomy; PJ-B II VRDJ: Pancreaticojejunostomy with Billroth II retrocolic modified reconstruction with vertical duodenojejunostomy; PJ-B II RDJ: Pancreaticojejunostomy with Billroth II retrocolic duodenojejunostomy; DGE: Delayed gastric emptying.

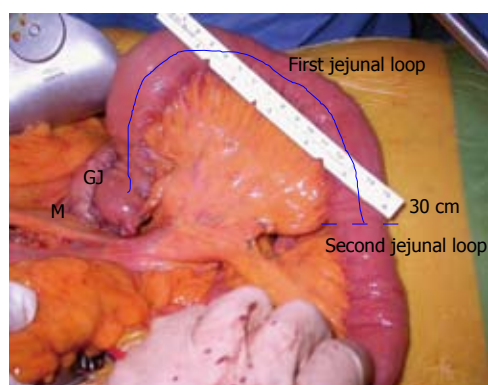


Figure 1 Retrocolic gastro-jejunal anastomosis in Roux-en-Y reconstruction after subtotal stomach-preserving pancreaticoduodenectomy. M: Mesocolic window; GJ: Gastro-jejunal anastomosis. Dashed line indicates the level of jejunal division.

that, after a PD, the impact of reconstructive methods on DGE is related mostly to the angulation or torsion of the reconstruction of the gastro/duodeno-jejunostomy because all the reported modified procedures associated with lower DGE, in Billroth I as well Billroth II types of reconstruction, are related to the reconstructive anatomy of the alimentary circuit and are aimed to facilitate the outflow of the ingests from the gastric/duodenal remnant. An antecolic gastro/duodeno-jejunostomy can favor a straight construction and gastric emptying by gravity in a Billroth II reconstruction after PD or PpPD^[24] as well as a retrocolic Billroth II gastrojejunostomy after a subtotal stomach-preserving pancreaticoduodenectomy with pancreaticogastrostomy reconstruction can favor

the transit of the gastric contents towards the jejunum in consequence of the retrogastric site of pancreaticogastric anastomosis^[20,21]. A Billroth II reconstruction can avoid the jejunal angulation produced by a Billroth I procedure in which the anastomosis of the proximal jejunum to the gastric/duodenal stump is performed at first, followed by pancreatico-jejunostomy and hepatico-jejunostomy^[25] (or by hepatico-jejunostomy in a case in which a pancreaticogastrostomy is carried out).

According to the ISGPS clinical criteria^[16], we have recently reported a prevalence of 8.9% (8 cases) of grade A DGE and 1.1% (1 case) of grade C DGE in a series of 89 subtotal stomach-preserving PD followed by Roux-en-Y retrocolic reconstruction with anastomosis of the isolated Roux limb (i.e., first jejunal loop) to the stomach and single Roux limb (i.e., second jejunal loop) to the pancreatic stump and hepatic duct^[30] (Figure 1).

We chose anastomosing the isolated proximal jejunum to the gastric remnant because, after removal of the duodenal source of CCK and secretin, preservation of the first jejunal loop in the reconstruction of the alimentary circuit maintains the physiologic jejunal secretion of secretin and CCK-PZ subsequent to alimentary transit and can compensate (at least in part) for the abolished duodenal hormonal release^[29]. Then, the anastomosis of the isolated first jejunal loop to the gastric remnant, although retrocolic, avoided any angulation and torsion allowed the outflow of the gastric contents by gravity through a “straight route” (Figure 2). It is widely known that postoperative complications are related to the occurrence of DGE. Therefore, controlling the prevalence

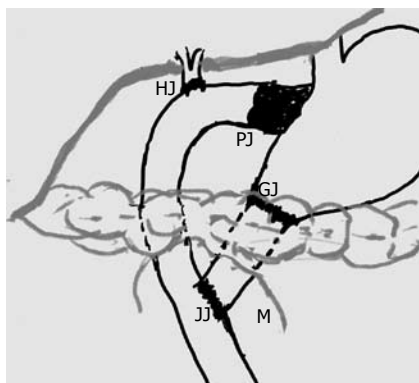


Figure 2 Roux-en-Y retrocolic reconstruction. HJ: Hepatico-jejunal anastomosis; PJ: Pancreatico-jejunal anastomosis; GJ: Gastro-jejunal anastomosis; JJ: Jejunio-jejunal anastomosis; M: Mesocolic window.

of other postoperative complications can contribute to reduce the occurrence of DGE. Postoperative pancreatic fistula occurred in seven patients (7.8%) of our series. Six cases of grade A fistula resolved spontaneously and in only one grade B fistula was percutaneous drainage necessary. Postoperative hemorrhage occurred in two of 89 (2.2%) patients, biliary fistula in eight (8.9%) patients and acute pancreatitis in one (1.1%). One patient with pre-existing stenosis of the hepatic artery developed thrombosis of the hepatic artery.

In conclusion, PrPD may contribute to a decrease in the prevalence of DGE due to pylorospasm, denervation and devascularization of the pylorus ring, which may occur after PpPD. A “straight” route, not necessarily an “antecolic” route, may obviate to the prevalence of DGE due to torsion or angulation in the reconstruction of the alimentary tract.

REFERENCES

- 1 **Paraskevas KI**, Avgerinos C, Manes C, Lytras D, Dervenis C. Delayed gastric emptying is associated with pylorus-preserving but not classical Whipple pancreaticoduodenectomy: a review of the literature and critical reappraisal of the implicated pathomechanism. *World J Gastroenterol* 2006; **12**: 5951-5958
- 2 **Warshaw AL**, Torchiana DL. Delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy. *Surg Gynecol Obstet* 1985; **160**: 1-4
- 3 **Suzuki H**, Mochiki E, Haga N, Shimura T, Itoh Z, Kuwano H. Effect of duodenectomy on gastric motility and gastric hormones in dogs. *Ann Surg* 2001; **233**: 353-359
- 4 **Gauvin JM**, Sarmiento JM, Sarr MG. Pylorus-preserving pancreaticoduodenectomy with complete preservation of the pyloroduodenal blood supply and innervation. *Arch Surg* 2003; **138**: 1261-1263
- 5 **Kim DK**, Hindenburg AA, Sharma SK, Suk CH, Gress FG, Staszewski H, Grendell JH, Reed WP. Is pylorospasm a cause of delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy? *Ann Surg Oncol* 2005; **12**: 222-227
- 6 **Tani M**, Terasawa H, Kawai M, Ina S, Hirono S, Uchiyama K, Yamaue H. Improvement of delayed gastric emptying in pylorus-preserving pancreaticoduodenectomy: results of a prospective, randomized, controlled trial. *Ann Surg* 2006; **243**: 316-320
- 7 **Goei TH**, van Berge Henegouwen MI, Slooff MJ, van Gulik TM, Gouma DJ, Eddes EH. Pylorus-preserving pancreaticoduodenectomy: influence of a Billroth I versus a Billroth II type of reconstruction on gastric emptying. *Dig Surg* 2001; **18**: 376-380
- 8 **Miedema BW**, Sarr MG, van Heerden JA, Nagorney DM, McIlrath DC, Ilstrup D. Complications following pancreaticoduodenectomy. Current management. *Arch Surg* 1992; **127**: 945-949; discussion 949-950
- 9 **Park YC**, Kim SW, Jang JY, Ahn YJ, Park YH. Factors influencing delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy. *J Am Coll Surg* 2003; **196**: 859-865
- 10 **van Berge Henegouwen MI**, van Gulik TM, DeWit LT, Al-lema JH, Rauws EA, Obertop H, Gouma DJ. Delayed gastric emptying after standard pancreaticoduodenectomy versus pylorus-preserving pancreaticoduodenectomy: an analysis of 200 consecutive patients. *J Am Coll Surg* 1997; **185**: 373-379
- 11 **Kimura F**, Suwa T, Sugiura T, Shinoda T, Miyazaki M, Itoh H. Sepsis delays gastric emptying following pylorus-preserving pancreaticoduodenectomy. *Hepatogastroenterology* 2002; **49**: 585-588
- 12 **Riediger H**, Makowiec F, Schareck WD, Hopt UT, Adam U. Delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy is strongly related to other postoperative complications. *J Gastrointest Surg* 2003; **7**: 758-765
- 13 **Räty S**, Sand J, Lantto E, Nordback I. Postoperative acute pancreatitis as a major determinant of postoperative delayed gastric emptying after pancreaticoduodenectomy. *J Gastrointest Surg* 2006; **10**: 1131-1139
- 14 **Yeo CJ**, Barry MK, Sauter PK, Sostre S, Lillemoe KD, Pitt HA, Cameron JL. Erythromycin accelerates gastric emptying after pancreaticoduodenectomy. A prospective, randomized, placebo-controlled trial. *Ann Surg* 1993; **218**: 229-237; discussion 237-238
- 15 **Fabre JM**, Burgel JS, Navarro F, Boccarat G, Lemoine C, Domergue J. Delayed gastric emptying after pancreaticoduodenectomy and pancreaticogastrostomy. *Eur J Surg* 1999; **165**: 560-565
- 16 **Wente MN**, Bassi C, Dervenis C, Fingerhut A, Gouma DJ, Izbicki JR, Neoptolemos JP, Padbury RT, Sarr MG, Traverso LW, Yeo CJ, Büchler MW. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). *Surgery* 2007; **142**: 761-768
- 17 **Kawai M**, Tani M, Hirono S, Miyazawa M, Shimizu A, Uchiyama K, Yamaue H. Pylorus ring resection reduces delayed gastric emptying in patients undergoing pancreaticoduodenectomy: a prospective, randomized, controlled trial of pylorus-resecting versus pylorus-preserving pancreaticoduodenectomy. *Ann Surg* 2011; **253**: 495-501
- 18 **Kawai M**, Yamaue H. Pancreaticoduodenectomy versus pylorus-preserving pancreaticoduodenectomy: the clinical impact of a new surgical procedure; pylorus-resecting pancreaticoduodenectomy. *J Hepatobiliary Pancreat Sci* 2011; **18**: 755-761
- 19 **Kurahara H**, Shinchi H, Maemura K, Mataka Y, Iino S, Sakoda M, Ueno S, Takao S, Natsugoe S. Delayed gastric emptying after pancreaticoduodenectomy. *J Surg Res* 2011; **171**: e187-e192
- 20 **Oida T**, Mimatsu K, Kano H, Kawasaki A, Fukino N, Kida K, Kuboi Y, Amano S. Antecolic and retrocolic route on delayed gastric emptying after MSSPPD. *Hepatogastroenterology* 2012; **59**: 1274-1276
- 21 **Oida T**, Mimatsu K, Kano H, Kawasaki A, Kuboi Y, Fukino N, Amano S. Preventing delayed gastric emptying in pancreaticogastrostomy by a modified subtotal-stomach-preserving pancreaticoduodenectomy: Oida modification. *Hepatogastroenterology* 2011; **58**: 1384-1388
- 22 **Eshuis WJ**, van Dalen JW, Busch OR, van Gulik TM, Gouma DJ. Route of gastroenteric reconstruction in pancreaticoduodenectomy and delayed gastric emptying. *HPB (Oxford)* 2012; **14**: 54-59
- 23 **Inoue K**, Tobe T, Suzuki T, Hosotani R, Kogire M, Fuchi-

- gami A, Miyashita T, Tsuda K, Seino Y. Plasma cholecystokinin and pancreatic polypeptide response after radical pancreatoduodenectomy with Billroth I and Billroth II type of reconstruction. *Ann Surg* 1987; **206**: 148-154
- 24 **Gangavathiker R**, Pal S, Javed A, Dash NR, Sahni P, Chatopadhyay TK. Effect of antecolic or retrocolic reconstruction of the gastro/duodenojejunostomy on delayed gastric emptying after pancreaticoduodenectomy: a randomized controlled trial. *J Gastrointest Surg* 2011; **15**: 843-852
- 25 **Ueno T**, Takashima M, Iida M, Yoshida S, Suzuki N, Oka M. Improvement of early delayed gastric emptying in patients with Billroth I type of reconstruction after pylorus preserving pancreatoduodenectomy. *J Hepatobiliary Pancreat Surg* 2009; **16**: 300-304
- 26 **Masui T**, Doi R, Kawaguchi Y, Uemoto S. Delayed gastric emptying improved by straight stomach reconstruction with twisted anastomosis to the jejunum after pylorus-preserving pancreaticoduodenectomy (PPPD) in 118 consecutive patients at a single institution. *Surg Today* 2012; **42**: 441-446
- 27 **Chijiwa K**, Imamura N, Ohuchida J, Hiyoshi M, Nagano M, Otani K, Kai M, Kondo K. Prospective randomized controlled study of gastric emptying assessed by (13)C-acetate breath test after pylorus-preserving pancreaticoduodenectomy: comparison between antecolic and vertical retrocolic duodenojejunostomy. *J Hepatobiliary Pancreat Surg* 2009; **16**: 49-55
- 28 **Caronna R**, Cardi M, Sammartino P, Mangioni S, Pittau G, Scozzafava S, Catinelli S, Chirletti P, Stipa V. Functional results of a personal technique of reconstruction after pancreaticoduodenectomy. *J Exp Clin Cancer Res* 2003; **22**: 187-189
- 29 **Chirletti P**, Peparini N, Caronna R, Papini F, Vietri F, Gualdi G. Monitoring fibrosis of the pancreatic remnant after a pancreaticoduodenectomy with dynamic MRI: are the results independent of the adopted reconstructive technique? *J Surg Res* 2010; **164**: e49-e52
- 30 **Caronna R**, Peparini N, Cosimo Russillo G, Antonio Rogano A, Dinatale G, Chirletti P. Pancreaticojejuno anastomosis after pancreaticoduodenectomy: brief pathophysiological considerations for a rational surgical choice. *Int J Surg Oncol* 2012; **2012**: 636824

S- Editor Song XX L- Editor A E- Editor Li JY