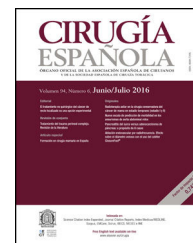




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Surgical perspectives

Which is the best option?: An updated review of the most widely used technical variations in entero-enteric anastomosis to minimise delayed gastric emptying after partial pancreatoduodenectomy



¿Cuál es la mejor opción?: una revisión actualizada de las variaciones técnicas más utilizadas en la anastomosis entérica para minimizar el vaciamiento gástrico lento tras la duodenopancreatectomía cefálica

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Partial pancreatoduodenectomy (PD) is the treatment of choice in pancreatic head tumours. Description of this technique includes antrectomy, although other variations have been proposed to save the pylorus, without clear advantages. The most widely used reconstruction in PD is Child reconstruction, in which the pancreatic-jejunal, hepatic-jejunal, and gastroenteric anastomoses are performed in a single loop with a Billroth II reconstruction. However, numerous modifications in the reconstruction of the tract to improve postoperative outcomes have been described. So, surgeons may be confused as to which is the best option for our patients. We reviewed published studies of different technical options for gastric anastomosis, and their impact on delayed gastric emptying (DGE) (Table 1).

Classical Whipple or pylorus-preserving pancreatoduodenectomy

Whipple¹ described the technique of resecting the pancreatic head by removing the gastric cavity. Later, Traverso² published his variation to spare removal of the den and the pylorus. Some

randomized controlled trials (RCTs) have shown that pylorus-preserving pancreatoduodenectomy (PPPD) provides benefits compared to Whipple pancreatoduodenectomy, with better nutritional and endocrine recovery, and better postoperative quality of life. However, other studies showed increased DGE in patients undergoing pylorus preserving pancreatoduodenectomy. In recent decades, several RCTs and meta-analyses have found similar results for the two techniques. As may be seen, it remains unclear which of the two is better with respect to DGE. Furthermore, several RCTs have been published comparing pyloric ring preservation versus its resection, with contradictory conclusions. The latest meta-analyses, including 24 RCTs and 2526 patients, suggest that pyloric resection followed by Braun's omega was the best reconstruction in terms of DGE³.

Termino-terminal gastroenteric anastomoses (Billroth I)

In 1995, Ueno⁴ proposed reconstruction of the tract in a single loop starting with the termino-terminal gastric suture, in


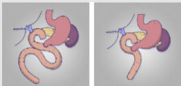

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Table 1 – Gastroenteric anastomoses.

Author	Year	Country	Study interval	Study Design	N of patients	Surgical approach	Results	Conclusion
Fujjeda ¹⁰	2017	Japan	2011–2016	RCT	68	BEE vs SSPPD + Child reconstruction 	CR-DGE: No-BEE 29.4% vs BEE 20.6%, $p = 0.401$	BEE: minor impact in reducing the incidence of DGE (did not reach a statistically significant difference)
Hwang ⁹	2016	South Korea	2013–2014	RCT	60	BEE vs PPPD + Child reconstruction 	CR-DGE: No-BEE 23.3% vs BEE 3.3%; $p = 0.052$. Multivariable logistic regression: no BEE increase DGE (OR = 16.489, 95% CI: 1.287–211.195, $p = 0.031$)	No-BEE: independent risk factor for CR-DGE.
Kakaei ⁸	2015	Iran	2013	RCT	30	BEE vs CW 	DGE: BEE 13.3% vs CW 20%, $p = 0.90$	BEE: lower rates of afferent loop syndrome and DGE
Wang ⁷	2014	China	2008–2012	RCT	62	BEE vs CW 	DGE: TGJ 20.0% vs MBEE 28.1%, $p = 0.455$	No differences related to DGE with MBEE
Tani ¹²	2006	Japan	2002–2004	RCT	45	Antecolic vs Retrocolic DJ	DGE : Antecolic 5% vs retrocolic 50%, $p = 0.0014$	Antecolic route is associated to less DGE rates
Busquets ¹⁴	2019	Spain	2013–2015	RCT	80	B-II vs R-Y 	DGE: B-II 45% vs R-Y 45%, $p = 1.000$	No differences related to DGE with the Roux-en-Y reconstruction
Shimoda ¹³	2013	Japan	2008–2011	RCT	101	B-II vs R-Y 	DGE: B-II 5.7% vs R-Y 20.4%, $p = 0.028$	B-II is better than Roux-en-Y in terms of DGE incidence
Podda ²¹	2020	Italy	2010–2018	Meta-analysis	13639	RPD vs OPD	DGE: RPD 16.8% vs OPD 16.1%, $p = 0.98$	No differences related to DGE with the RPD
De Rooij ¹⁹	2016	Netherlands	2000–2014	Meta-analysis	1833	MIPD vs OPD	MIPD was associated with less DGE (OR 0.6, 95% CI 0.5–0.8).	MIPD is associated with less delayed gastric emptying
Napoli ¹⁵	2016	Italy	2008–2015	Prospective	95	LRAPD	DGE: 52.6%. Grade A 12%, Grade B 52%, Grade C 34.6%.	DGE occurred frequently after LRAPD

RCT: randomized clinical trial, BEE: Braun entero-enterostomy, SSPPD: subtotal stomach preserving pancreatoduodenectomy, PPPD: pylorus-preservation pancreatoduodenectomy, DJ: duodeno-jejunoscopy, B-II: Billroth II, RPD: robotic pancreatoduodenectomy, OPD: open pancreatoduodenectomy, MIPD: Minimally invasive pancreatoduodenectomy, PD: pancreatoduodenectomy, DGE: delayed gastric emptying, CW: Classic Whipple, PR: pylorus-resection, PP: pylorus-preservation, CR-DGE: clinically relevant DGE, OR: Odds ratio, CI: confidence interval, TGJ: traditional gastro-yeyunoscopy, MBEE: Modified braun entero-enterostomy, R-Y : Roux-en-Y, LRAPD: Laparoscopic robotic assisted pancreatoduodenectomy.

Billroth I, followed by pancreatic suture and, finally, biliary suture. In their article, they evaluated patients after PPPD and reconstruction with Billroth I with end-to-side duodenojejunostomy, and did not observe any cases of DGE. Subsequently, a study published by Goei⁵ in 2001 compared the incidence of DGE with Billroth I or Billroth II reconstruction after PPPD in 174 patients. In this retrospective study, a higher incidence of DGE after Billroth I reconstruction was found (76 % after Billroth I vs 32% after Billroth II ($p < 0.05$). To date, there is scarce evidence that Billroth I is a good option for enterogastroenteric anastomosis.

Braun omega enteroenterostomy

In 2015, Watanabe⁶ compared the incidence of DGE after adding a Braun enteroenterostomy (BEE) to the gastroenteric suture after PPPD. In his retrospective study including 185 patients, the group undergoing BEE had a lower incidence of DGE (4% of patients with BEE and 21% of those without BEE, $p < 0.01$). In fact, BEE was the only independent factor associated with DGE in the multivariate analysis (OR 5.04, $p < 0.01$). To date, four RCT studies have been published in this regard. The two older ones argue for the use of Braun omega,

with less alkaline reflux or less DGE^{7,8}. However, the two most recent studies show that Braun's omega showed a similar DGE^{9,10} (Table 1).

Ascension of the jejunal loop and relation of the gastric suture to the colon

As a technical detail, Park's group in Korea demonstrated in 2003 that the passage of the jejunal loop via the retro-mesenteric route was slower than the mesenteric passage of the jejunal loop¹¹. The authors suggested that the oedema of the jejunal loop at its retro-mesenteric passage could lead to worse gastric swelling. Recently, several groups have shown that antecolic gastroenteroanastomosis is useful in reducing DGE compared to retrocolic reconstruction, and it has become the technique used worldwide, either with gastric sparing or with antrectomy. The fact that antecolic reconstruction favours vertical positioning of the stomach may explain the improvement in stomach wall displacement. In the RCT published by Tani¹², 40 patients were randomized to either retrocolic or antecolic reconstruction of the duodenojejunos-tomy after PPPD. DGE occurred in 5% of patients with the antecolic route for duodenojejunos-tomy versus 50% with the retrocolic route ($P = 0.0014$), showing that antecolic reconstruction decreases postoperative morbidity and length of hospital stay by decreasing DGE.

Roux-en-Y gastroenteroanastomosis in partial pancreatoduodenectomy

Several authors have proposed performing a Roux-en-Y gastroenteroanastomosis with partial pancreatoduodenectomy to improve postoperative outcomes. In 2013 Shimoda¹³ published a randomised study comparing Roux-en-Y reconstruction with Billroth II reconstruction in 101 patients. The group demonstrated a higher rate of DGE and longer hospital stay in the Roux-en-Y group (5.7 vs 20.4%, $p = 0.028$ and 31.6 ± 15 days vs 41.4 ± 20.5 days, $p = 0.037$). Recently, our group also published a randomized study with 80 patients that failed to demonstrate differences between Billroth II and Roux-en-Y gastroenteroanastomosis¹⁴.

Minimally invasive pancreatoduodenectomy (MIPD)

Several studies indicate a lower DGE in MIPD compared to open pancreatoduodenectomy (OPD) with, however, some controversy. The Pisa group published a review of 96 robotic PDs in 2016, showing a DGE rate of 52.6%¹⁵. Later, Wang¹⁶ published a propensity-score study with 87 cases of robotic pancreaticoduodenectomy (RPD) and 87 cases of OPD, and less DGE was noted in the RPD (3.4 vs 13.8, $p = 0.015$). In a recent study¹⁷ including 304 RPD and 172 OPD, DGE was 3.5% in the RPD group and 13.6% in the OPD ($p < 0.001$). Finally, Oosten¹⁸ found RPD to be associated with a lower incidence of DGE (9.4%) compared to OPD (23.5%; $P = 0.006$).

The meta-analyses are also contradictory. So, De Rooij¹⁹ compared MIPD and OPD, showing that DGE occurred less frequently in MIPD (OR 0.6, 95%CI 0.5–0.8). Contradictorily, Peng²⁰ in 2017 analysed 5 studies without finding differences in terms of DGE (RR = 0.52; 95%CI 0.26–1.04; $P = 0.06$). Similarly, Podda²¹ compared RPD with laparotomic PD based on 18 studies involving 13,639 patients and found similar rates of DGE (16.8% vs 16.1%; OR 1.00, 95% CI 0.74–1.34; $P = 0.74$) (Table 1).

In conclusion, there remain many technical options for gastric reconstruction in pancreatoduodenectomy. Child's reconstruction is the most widespread technique, although patients continue to suffer from delayed gastric emptying. MIPD could provide better results with respect to the DGE.

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