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## Research review

# Delayed gastric emptying after pancreaticoduodenectomy



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## ABSTRACT

**Background:** Delayed gastric emptying (DGE) remains an unsolved complication after pancreaticoduodenectomy (PD) with conflicting reports of its cause. We aimed to compare the effect of surgical techniques involving the stomach in PD in lowering the risk of postoperative DGE.

**Methods:** Online search and review of key bibliographies in PubMed, Medline, Embase, Scopus, Cochrane, and Google Scholar was performed. Studies comparing PD surgical techniques were identified. Primary outcome was postoperative DGE. Methodological quality was assessed using Strengthening the Reporting of Observational Studies in Epidemiology and Consolidated Standards of Reporting Trials. Calculated pooled relative risk and odds ratios (ORs) with the corresponding 95% confidence interval (CI) were used in the meta-analyses.

**Results:** Overall, 376 studies were reviewed, of which 22 studies were selected including a total of 5172 patients. The incidence of DGE was lower in antecolic compared with retrocolic gastrojejunostomy (risk ratio [RR], 0.260; CI, 0.157–0.431;  $P < 0.001$ ;  $n = 1067$  patients) and in subtotal stomach preserving PD compared with pylorus preserving PD (RR, 0.527; CI, 0.363–0.763;  $P < 0.001$ ;  $n = 663$  patients). There was no significant difference between classic PD versus pylorus preserving PD (OR, 0.64; CI, 0.40–1.00;  $P = 0.05$ ;  $n = 1209$  patients), pancreaticogastrostomy versus pancreaticojejunostomy (RR, 1.02; CI, 0.62–1.68;  $P = 0.94$ ;  $n = 961$  patients), Roux-en-Y versus Billroth II gastrojejunostomy (RR, 0.946; CI, 0.788–1.136;  $P = 0.5513$ ;  $n = 470$  patients), or minimally invasive PD versus open PD (OR, 0.99; CI, 0.62–1.56;  $P = 0.96$ ;  $n = 802$ ).

**Conclusions:** In PD, surgical techniques using antecolic reconstruction route and subtotal stomach preserving PD seem to be associated with a lower risk of DGE. Further randomized controlled trials are necessary to evaluate these results taking other causes into consideration.

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## Introduction

Delayed gastric emptying (DGE) has been one of the common, yet unresolved postoperative complications after pancreaticoduodenectomy (PD) for both benign and malignant indications [1–3]. It was first reported by Warshaw and Torchiana [4]. It significantly affects the quality of life, especially in pancreatic head cancer patients in whom PD is most commonly done, where their short survival is compounded with such a debilitating complication, hence the need to minimize its incidence. The mechanism of DGE is still unclear but has been suggested to be predisposed by variable factors as the extent of gastric resection, loss of the pylorus, interrupted gastrointestinal neural connections, diabetes, local ischemia, loss of gastrointestinal hormonal production, or with some postoperative complications as pancreatic fistula and intra-abdominal abscesses [5–10]. Pylorus preserving pancreaticoduodenectomy (PPPD) was developed by Traverso and Longmire with preservation of the nerve supply to the pylorus in a trial to decrease the high incidence of 20%–40% of DGE reported with the classic pancreatico-duodenectomy (cPD) described by Whipple [1,11–14]. Ever since, many surgeons have adopted this technique with better overall outcomes reported [15]. However, prospective studies and meta-analyses failed to confirm the superiority of PPPD in terms of DGE [16–18].

Another technique examined by authors since the late 1990s, subtotal stomach preserving pancreaticoduodenectomy (SSPPD), in which only the pyloric ring is removed with preservation of about 90% of the stomach [19–21]. In this procedure the gastric outlet is thought to be wider than that in PPPD, together with the preservation of the blood supply, and the innervation of the prepyloric region is thought to help reduce the incidence of DGE [15,22–24].

The route of reconstruction of the gastrointestinal tract was evaluated, antecolic (AC) or retrocolic (RC), based on which goes better with gravity and which one allows less kinking of the anastomosis than the other. Also, the use of Roux-en-Y (R-Y) is a technique devised to reduce the activation of pancreatic juice by biliary secretion and therefore believed by some authors to reduce the incidence of postoperative-related morbidity and mortality compared with Billroth II (B-II) reconstruction [25]. However, in the B-II reconstruction, the gastric passage can more easily and smoothly pass down to the jejunum because of two direct routes to the afferent and the efferent jejunum compared with the R-Y reconstruction [26].

Regarding the pancreatic anastomosis, pancreaticojejunostomy (PJ) was considered the classical method of digestive tract reconstruction after PD and is widely used in clinical practice; however, it is claimed to be complicated because pancreatic exocrine secretions can be activated by intestinal enterokinase in the jejunum, which increase the chance of postoperative pancreatic fistula [27,28]. In 1946, Waugh and Clagett introduced pancreaticogastrostomy (PG) as an alternative for PJ in clinical practice claiming a better blood supply, less tension, and absent activation of pancreatic enzymes [29–32].

Recently, minimally invasive PD (MIPD) including laparoscopy and robotic-assisted surgery has received more

interest in many intra-abdominal surgeries especially with the maturation of surgeons' skills and advances in technology; they have been shown by some authors to be beneficial in terms of less incidence of complications and hospital stay [33]. However, there is currently scant powerful evidence that informs the advantages of using MIPD over conventional open PD (OPD) [34].

The aim of this study was to review and pool the data from published literature comparing the incidence of DGE among different techniques used for gastric reconstruction in PD patients.

## Materials and methods

### Literature search and study selection

A comprehensive search of Medline, Embase, Google Scholar, Scopus, and the Cochrane database was performed for all articles published in English language comparing operative outcomes among different surgical techniques: PPPD versus cPD, SSPPD versus PPPD, AC versus RC reconstruction after PPPD, R-Y versus B-II reconstruction, PG versus PJ reconstruction. The search was conducted using the following MeSH terms: "pancreaticoduodenectomy with delayed gastric emptying," "subtotal stomach preserving pancreaticoduodenectomy, pylorus preserving pancreaticoduodenectomy with delayed gastric emptying," "antecolic, retrocolic reconstruction with delayed gastric emptying," "Roux-en-Y, Billroth II reconstruction with delayed gastric emptying," "pancreaticogastrostomy, pancreaticojejunostomy reconstruction with delayed gastric emptying." The related articles' function was used to expand the search from each relevant study identified. All citations and abstracts identified were thoroughly reviewed. Bibliography of retrieved articles was further screened for any additional eligible studies. The latest search was performed in March 2015. If there was a meta-analysis already done for any of the compared groups mentioned previously, we referred to that publication, whereas for those comparisons where no meta-analysis was done, we pooled the data and performed the meta-analysis using statistical methods as detailed subsequently. All reported data included those patients in studies where there was no difference between the compared groups regarding age, sex, histopathology, and preoperative comorbidities.

### Outcomes of interest

The primary end point was DGE with recording of postoperative nasogastric tube (NGT) use duration and output amount. The secondary end points included operative time, blood loss, and length of hospital stay (LOS) in addition to other postoperative complications as overall morbidity, mortality, pancreatic fistula, and abdominal collection.

### Inclusion criteria

For the inclusion criteria in the analysis, studies had to

- (1) compare the outcome measures (especially DGE) between the groups mentioned previously;

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