Pancreatogastrostomy - History and Current Evidence

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ABSTRACT

Two anastomotic techniques are available for reconstruction after pancreatoduodenectomy: pancreatojejunostomy, which is the traditional and most widely used technique, and pancreatogastrostomy. The latter was introduced into clinical practice more than 50 years ago, and has recently received increasing attention due to favorable outcome when compared to pancreatojejunostomy in randomized controlled trials. We briefly review the history, current evidence and emerging applications of pancreatogastrostomy.

Key words: pancreatoduodenectomy, pancreatogastrostomy, outcomes

HISTORICAL PERSPECTIVE

It is hardly known that the history of pancreatogastrostomy (PG) dates back to the very beginning of pancreatic surgery. Already Walter Kausch, in his 1912 publication of the first successful pancreatoduodenectomy (PD) performed in Berlin in 1909 (1), discussed the possibility of reconstruction by anastomosis of the pancreatic remnant to the stomach. In his opinion this reconstruction technique was "unsafe and dangerous".

Following experimental studies by Tripodi and Sherwin published in 1934 (2), Waugh and Clagett (3) in 1946 were the first to publish the clinical application of pancreatogastric anastomosis in PD for cancer. The method was adopted or reintroduced by several authorities around the world and reported as cases in the 1950s (4–6) and small series since the 1970s (7).

THEORETICAL AND TECHNICAL ASPECTS OF PANCREATOGASTROSTOMY

Theoretical aspects that could PG make more secure in comparison to the traditional pancreatojejunostomy (PJ) have been discussed already by the early

pancreatic surgeons (8). First, the gastric wall is in direct anatomical proximity to the pancreas. It usually provides a thick and strong barrier for a deep invagination of the pancreatic remnant. In addition, there is a potential to prevent the activation of pancreatic enzymes by the acidic gastric milieu and lack of intestinal enterokinase and bile. On the other hand, gastric acid might be neutralized to some degree by the alkaline pancreatic juice to prevent ulceration at the gastroenterostomy.

Regarding technical details, in order to achieve invagination of the pancreatic remnant, adequate and usually more extensive mobilization than with pancreatojejunostomy is necessary. This can be challenging in the case of a fibrotic pancreas with heavy adhesion to the retroperitoneal tissue, as for example found in chronic pancreatitis.

Various techniques of PG have been described (9–18): single-layer, double layer, binding technique, with duct-to-mucosa anastomosis, mattress sutures, pancreatic duct stenting, gastric partitioning, additional anterior gastrotomy, and reinforcement by biodegradable meshes, glue, falciform ligament and omental flaps. There is however no meaningful data to compare these different techniques among each other. Semantically, pancreatogastrostomy refers to techniques involving duct-to-mucosa anastomosis, while pancreatogastrostomy means that duct-to-mucosa suture is omitted (19). For simplicity the word pancreatogastrostomy is used for all techniques here.

RETROSPECTIVE STUDIES COMPARING PANCREATOGASTROSTOMY AND PANCREATOJEJUNOSTOMY IN PANCREATODUODENECTOMY

The first metaanalysis of PD comparing PG with pancreatojejunostomy (PJ) appeared in 1991 (20) and incorporated over 2600 patients out of over 8000 PDs from retrospective data in the available literature. The authors found a reduced morbidity with PG compared to different types of PJ. The next large metaanalysis was performed by Wente et al in 2007 (21), when data from three randomized controlled trials (RCT) had already become available. Analysis of the contemporary retrospective data from 13 comparative studies published between 1990 and 2004 disclosed a clear superiority of PG over PJ in terms of reduced rate of postoperative pancreatic fistula (POPF), bile leaks, intraabdominal fluid collections, overall complications and even mortality.

RANDOMIZED TRIALS COMPARING PANCREATOGASTROSTOMY AND PANCREATOJEJUNOSTOMY IN PANCREATODUODENECTOMY

The first RCT comparing PG and PJ was reported from Baltimore by Yeo et al in 1995 (22) and did not detect a difference regarding POPF rate and mortality. It took 10 more years until the first European RCTs were published. Bassi et al from Verona, Italy (23) randomized only high-risk patients with a soft pancreas and found no difference in POPF rates, but demonstrated significantly less multiple complications, intraabdominal fluid collections and bile leaks with PG. Duffas et al (24) performed the first multicenter RCT in France and did not observe significant differences in outcome after PG or PJ.

A special technique of PG with pancreatic partitioning was evaluated in a RCT by Fernandez-Cruz and colleagues in Barcelona, Spain (10). They demonstrated a significantly lower rate of clinically relevant POPF with PG, now reported according to the 2004 International Study Group for Pancreatic Surgery (ISGPS) classification (25). Furthermore, overall complication rate, intraabdominal fluid collections and delayed gastric emptying were significantly reduced after PG with gastric partitioning.

The next RCT was reported by Wellner et al (26) from Freiburg, Germany in 2012 but did not reveal differences regarding perioperative outcome. A two-center RCT was published by Figueras and coworkers (27) from Girona and Valencia, Spain in 2013 and demonstrated a significantly reduced POPF and readmission rate. The most recent single-center RCT reported in 2014 by El-Nakeeb et al (28) from Mansoura, Egypt compared isolated Roux-Y PJ to PG and did not disclose significant differences regarding perioperative outcome.

While the aforementioned trials had relatively low case numbers (n=90-151), a recent multicenter RCT from Belgium (29) successfully assessed 329 patients for comparison of PG and PJ in an intention to treat (ITT) analysis. The results show a significant reduction of clinically relevant POPF and complications of Clavien-Dindo grade $\geq 3a$. The results of another large multicenter RCT from Germany (RECOPANC) have recently been published by Keck et al (30). In ITT analysis of 320 patients, there was no significant difference in pancreatic fistula rate or other complications except an increased rate of low-grade postpancreatectomy hemorrhage with PG. The relevant factors influencing POPF rate were pancreatic texture and surgeon case

load. Low-volume surgeons had an about 50% reduction in POPF rate with PG compared to PJ, but due to limited case number this subgroup analysis was not statistically significant. In long-term follow-up, there was no difference in pancreatic function. The authors concluded that PG is a safe and probably technically less demanding anastomosis, especially for high-risk patients with a soft pancreas.

The current literature provides many metaanalyses comparing PG and PJ. No metaanalysis has yet included all current RCTs. In brief, eight metaanalyses published in 2014 (31–38) agree that PG is superior to PJ in terms of reduced rate of POPF, intraabdominal fluid collections and biliary leaks.

SPECIFIC ASPECTS OF COMPLICATION

MANAGEMENT AND PANCREATOGASTROSTOMY

Postpancreatectomy hemorrhage (PPH) is classified as intraluminal and extraluminal according to the ISGPS (39). An increased rate of intraluminal PPH has been observed with PG compared to PJ (17, 40, 41), which was attributable to bleeding from the PG anastomosis site and pancreatic cut surface. The theoretical advantage that anastomotic bleeding can be managed by endoscopic intervention in PG (42) could not be confirmed in a recent large retrospective series (43).

Late extraluminal bleeding is a grave complication after PD. Reduced mortality has been observed with PG compared to PJ in critical conditions like extraluminal bleeding and completion pancreatectomy (41). An advantage of PG is that in case of completion pancreatectomy, the hepaticojejunostomy loop is not affected. Furthermore, PG has been proposed as a salvage procedure to avoid completion pancreatectomy for severe POPF after PJ (44, 45).

PANCREATIC FUNCTION

AFTER PANCREATOGASTROSTOMY

A commonly encountered prejudice is that pancreatic function is worse after PG than with PJ. Several investigators studied pancreatic duct morphology and exocrine function after PG and observed a high rate of pancreatic duct dilatation and exocrine insufficiency (46–52). This is however a common finding after PD in general (53, 54).

Data from comparative retrospective studies is based on relatively small case numbers and yields conflicting results. Six studies demonstrate no significant difference between PG and PJ (55–60), four studies report reduced pancreatic function with

PG compared to PJ (61–64), one study shows improved fat absorption with PG (65) and another improved gastrointestinal motility (66) with PG versus PJ.

An early small RCT from Japan disclosed equal pancreatic function after PG and PJ (67). The recent RCT performed by Figueras et al (27) evaluated endocrine and exocrine pancreatic function 6 months after the operation, and found a significantly better exocrine function with PG compared to PJ. The Egyptian RCT (28) however demonstrates reduced pancreatic exocrine and endocrine function with PG compared with isolated Roux-Y PJ. Probably the best current evidence comes from the German multicenter RECOPANC trial. In follow-up after one year, no relevant differences were detected regarding quality of life and pancreatic endocrine and exocrine function.

In summary, data on pancreatic function after PG as compared to PJ remains inconsistent and further prospective evaluation is necessary.

NOVEL AND RARE INDICATIONS FOR PG

Endoscopic surveillance after resection of cystic neoplasms

There is a risk of recurrence after resection of intraductal papillary mucinous neoplasms (IPMN). Few authors have advocated PG in these patients to facilitate postoperative surveillance by endoscopy (68–70). There is however no large-scale data to support this assumption.

PG in central pancreatectomy

Central pancreatectomy (CPE) is a rarely performed procedure and current literature yields about 1000 published cases since the 1980s (71). It is experiencing increased interest in recent years as a means of parenchyma-sparing resection of borderline and preneoplastic lesions like cystic neoplasms of the pancreas, which are increasingly diagnosed and resected. PG has gained popularity in laparoscopic central pancreatectomy, probably because it is technically less demanding than PJ and offers a safe anastomosis as well: A recent survey of 51 published laparoscopic CPE shows that in over 60%, PG was used for reconstruction (72).

PG in distal pancreatectomy

POPF remains a problem after DPE and a recent European multicenter RCT failed to demonstrate a reduction of POPF with stapler closure of the

pancreatic stump (73). Pancreatogastrostomy for drainage of the pancreatic stump after distal pancreatectomy has been applied by Japanese surgeons and reported to yield favorable outcomes including reduced POPF and POPF-related complications as well as cost (74,75). There is even an ongoing RCT comparing PG versus stump closure during DPE in Japan (UMIN000007426).

Pancreatogastrostomy in surgical education

Last but not least, PG offers a safe and relatively easy to learn anastomotic technique suited for pancreatic surgery residents in training (76).

CONCLUSIONS

More than 100 years after the first PD and more than 50 years after its first clinical application, PG emerge as a valuable option for reconstruction in PD and CPE due to several reasons. Current first level evidence suggests a reduction of pancreatic fistula and other complications with PG compared to PJ in PD. Pancreatic function after PG seems to be equal to PJ, although more data is needed to confirm this assumption. It remains unclear if there is a benefit from the various published technical modifications. PG is a relatively easy to perform but safe anastomotic technique for reconstruction after PD and possibly also for central and distal pancreatectomy. More data is needed to evaluate its role in minimal invasive procedures, central and distal pancreatectomy, as well as in surgical education.

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