



Laparoscopic Intracorporeal Pancreaticogastrostomy in Total Laparoscopic Pancreaticoduodenectomy—A Novel Anastomotic Technique

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Abstract

Novel pancreaticogastric anastomosis technique in laparoscopic pancreaticoduodenectomy which is simple, feasible to perform, provides secure fixation between stomach and pancreas. The aim of our article is to describe our technique of intracorporeal pancreaticogastrostomy as a promising approach for future widespread application.

Keywords PD-pancreaticoduodenectomy · PJ-pancreaticojejunostomy · PG-pancreaticogastrostomy

Introduction

Laparoscopic pancreatic surgery has emerged as one of the most advanced applications of minimal invasive surgery. Gagner and Pomp were the first to describe the laparoscopic pancreaticoduodenectomy in 1994. Prolonged operative time and technical difficulty of pancreatic resection and reconstruction procedures were the reasons for initial reluctance to accept the laparoscopic technique. Pancreatic anastomotic leakage carries an increased risk of intraabdominal haemorrhage and high mortality rate. Many surgeons avoid intracorporeal pancreatic reconstruction to increase the safety of anastomosis. The risk of postoperative pancreatic fistula increases in patients with soft pancreatic texture and small pancreatic duct. The issue of pancreatic fistula in laparoscopic approach is further potentiated by technical difficulty in performing traditional duct-to-mucosa anastomosis and restricted range of movement of laparoscopic forceps. To overcome this, we consider it necessary to establish novel pancreaticogastric anastomosis technique which is simple, feasible to perform and provides secure fixation between the stomach and pancreas. The

aim of our article is to describe our technique of intracorporeal pancreaticogastrostomy as a promising approach for future widespread application.

Methods

We have used our technique in five patients since May 2015 to March 2016. The inclusion criteria were medically fit, non-obese patients with periampullary tumours and without any previous abdominal surgery. Preoperatively, all patients were thoroughly evaluated for operability and resectability. This study included four males and one female with median age of 63 years (range, 45–65 years) and median body mass index of 22.6 kg/m² (range, 17.5–25.5 kg/m²). The advantages, disadvantages and potential risk of the surgical procedure were explained to patients and relatives, and informed consent was taken. Study was approved by Institutional ethics committee.

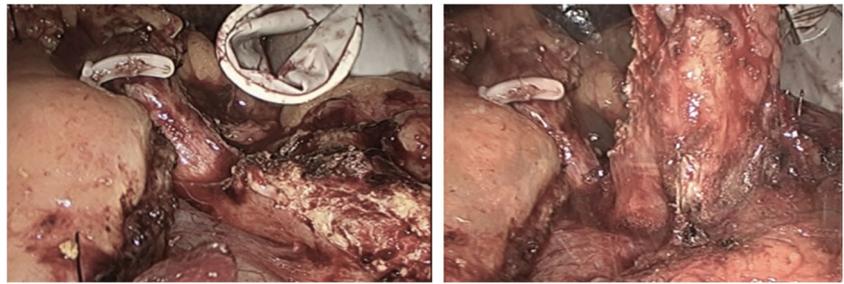
Technique

Surgery was performed under combined epidural and general anaesthesia. Pneumoperitoneum was created using a Veress needle technique and five trocars were placed in the abdominal cavity (three 10 mm and two 5 mm); diagnostic survey of the pelvic cavity and abdominal organs including liver was performed to decide the resectability of the lesion. After

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Fig. 1 Separation of pancreatic remnant from splenic vein and superior mesenteric vein



completion of the pancreaticoduodenectomy, the pancreatic remnant is mobilised from retroperitoneum and splenic vein for distance of 2.5 cm.

in stomach) (Fig. 5). The anterior gastrostomy was anastomosed with jejunum to restore GI continuity (gastrojejunostomy) (Fig. 6).

Reconstruction

The specimen was put in the endobag. The pancreatic bed was separated from superior mesenteric vein and splenic vein (Fig. 1). Stay sutures were taken at the upper and lower edges with vicryl 2-0 (Fig. 2). Pancreaticogastrostomy is done on posterior part of the stomach using invagination/dunking technique. In our technique, pancreaticogastrostomy was performed intracorporeally in two layers. The outer layer consists of interrupted silk sutures 2-0 that incorporates the capsule of pancreas and seromuscular layers of the stomach (Fig. 3). Full thickness gastrostomy was done through the anterior wall of the stomach of size 5 cm (Fig. 4a). The posterior wall of the stomach was opened just adjacent to the pancreatic seromuscular suture (Fig. 4b). The pancreas was delivered into the stomach by pulling the stay sutures (Fig. 5). The pancreatic duct was cannulated with infant feeding tube 5F and this was fixed to pancreas with a purse-string suture. The inner layer was sutured with 3-0 interrupted black silk sutures. This layer incorporated the capsule and a portion of the cut edge of the pancreas and the full thickness of the posterior wall of stomach (invagination/dunking of pancreas

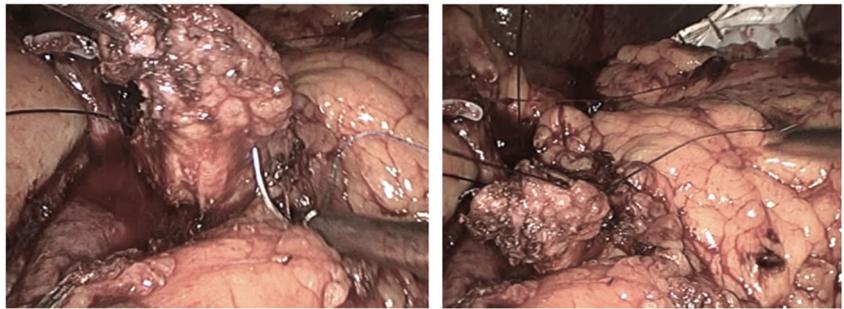
Result

All the procedures were performed by the same surgeon. The mean blood loss was 183 ml (range, 50–400 ml) and the median operative time was 302 min (range, 315–490 min). The median hospital stay was 11 days (range, 8–20 days) and the drainage tube at the anastomotic site was left in place for a median of 7 days after surgery (range, 8–25 days), s.amylase and drain amylase were done on postoperative day 2nd, 4th and on 7th day. One patient developed a postoperative pancreatic fistula of International Study Group of Pancreatic Fistula (ISGPF) grade B [1] on postoperative day 5, and subsequently developed postoperative delayed gastric emptying of International Study Group of Pancreatic Surgery (ISGPS) grade C [2]. Both these complications were treated with conservative management. No major complications occurred in the other patients, and the postoperative follow-up period was uneventful. All resection margins were tumour-free at the final histopathology.

Pathological Outcome

Case	1	2	3	4	5
Tumour size	1.8 × 1.2 × 1 cm	0.6 × 0.5 × 0.5 cm	2.5 × 2 × 1.5 cm	1 × 1 × 0.5 cm	1 × 1.5 × 0.5 cm
Location	Periampullary	Periampullary	Periampullary	Periampullary	Periampullary
Surgical margin	Free	Free	Free	Free	Free
Tumour grade	Moderately differentiated grade II	Well differentiated grade I	Moderately differentiated grade II	Well differentiated grade I	Well differentiated
LN yield	6	3	9	7	9
LN positive	0	0	2	1	0
Stage	II (T3N0)	II (T2N0)	IIB (T3N1)	III (T3N1)	II (T2N0)

Fig. 2 Anchoring suture in the remanent pancreas 2 cm distal to transection plane



Discussion

The standard pancreaticoenteric anastomosis performed following lap pancreaticoduodenectomy is pancreaticojejunostomy (PJ). There is still controversy regarding the relative superiority of PG (pancreaticogastrostomy) versus PJ (pancreaticojejunostomy) in terms of outcomes, in spite of PG which has been acceptable method of reconstruction after PD (pancreaticoduodenectomy) over the past 50 years. The most important consideration is to achieve a good pancreaticoenteric anastomosis. Pancreatic leakage only remains a serious complication after standard pancreaticoduodenectomy (PD) or pylorus-preserving pancreaticoduodenectomy (PPPD) [3–5]. Pancreatic fistula is occasionally followed by several other potentially life-threatening complications, such as massive haemorrhage of eroded vessels and peritonitis. To prevent these complications, two main anastomotic techniques for reconstruction after PD, pancreaticojejunostomy (PJ) and pancreaticogastrostomy (PG), exist. According to four randomised trials comparing PJ and PG, there is no difference

regarding the prevalence of pancreatic fistula between these reconstruction techniques [6–9]. However, it has been suggested that PG is associated with fewer overall complications than PJ [8, 10]. Several different methods of anastomosing the pancreas to the stomach have been employed, including PG using several mattress sutures [11] and the so-called binding PG using two purse-string sutures at the posterior gastric wall [12]. Minilaparotomy has been advised to ensure safe anastomosis. Although a hybrid laparoscopic open technique may reduce operative risk, it also results in loss of the potential advantages of minimally invasive surgery. Since the first clinical application of PG performed by Waugh and Clagett in 1946 [13], a large variety of modifications of the technique has been published in the literature. These modifications include invagination or duct-to-mucosa anastomosis, use of transanastomotic tubes for internal-external drainage of pancreatic juice, use of fibrin sealant, use of multiple transfixing mattress sutures [11] or two purse-string binding sutures [12], respectively. Recently published studies on PG had shown that the prevalence of pancreatic fistula ranged from 0 to 16%, and the mortality rate

Fig. 3 Fixation of the pancreas to the posterior wall of the stomach

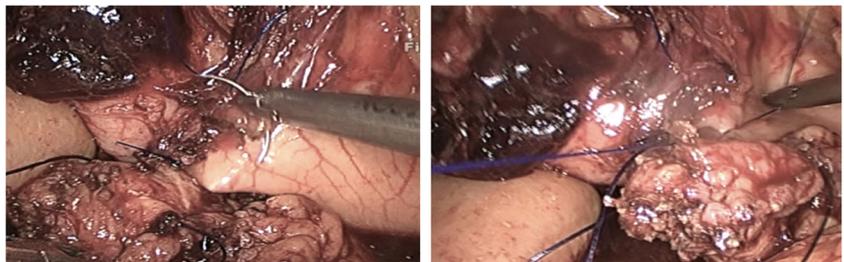
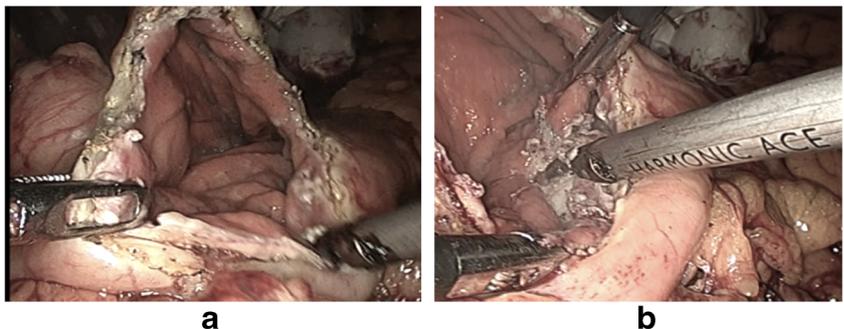


Fig. 4 a and b Anterior and posterior of gastrostomy



Case	Diagnosis	Open time (min)	Blood loss (ml)	Stenting tube	PF (ISGPF)	DGE (ISGPS)	Length of stay (days)
1	Ampullary ca	310	150	Internal		A	8
2	Ca head pancreas	350	175	Internal	GRADE B	C	12
3	Ampullary ca	270	200				14
4	Ca head pancreas	286	210	Internal		A	13
5	Ca head pancreas	290	180				9

varied from 0 to 12.3% in studies with 41 up to 250 patients [13–22]. Several reports have described techniques for laparoscopic pancreaticojejunostomy but most are adaptations of open procedures [23–28]. To enable safe reconstruction in pure LPD (laparoscopic pancreaticoduodenectomy) [14], we developed a new PG technique. Wellner et al. reported that PG was superior to PJ in terms of postoperative pancreatic fistula formation judged according to the ISGPF criteria [29]. One published case report has described reconstruction with PG in LPD [30]. In that case, the remnant pancreas was invaginated into the stomach and was fixed in place with two continuous purse-string sutures around the incision in the gastric wall using self-retaining monofilament sutures (V-Loc). In another published data, a small hole was made in posterior wall of the stomach and was extended bluntly [31]; the remnant was then pulled and positioned with few sutures between pancreatic capsule and gastric mucosa and the stomach was fixed to the anterior abdominal wall. In one study, they are using pancreatic duct stent and fixed it percutaneously.

In LPD, reconstruction is usually performed by end-to-side PJ with duct-to-mucosa anastomosis. Just as in open surgery, LPD carries an increased risk of pancreatic fistula formation in patients with a small pancreatic duct. This increased risk may be attributed to the technical difficulty of performing the duct-to-mucosa anastomotic portion of the pancreatic enteric reconstruction. In such patients, magnification by laparoscopy may be useful for performing duct-to-mucosa anastomosis, but the restricted range of motion of laparoscopic forceps sometimes makes this anastomosis difficult. Our technique does not require duct-to-mucosa anastomosis, and it can be easily used in patients with a small pancreatic duct. Our technique may also reduce the risk of intraabdominal abscess formation due to minor leakage of pancreatic juice from the injured pancreatic capsule, because the sutures between the pancreas and the gastric wall are placed inside the stomach. Since the pancreatic capsule is not damaged outside the stomach, this technique may be safe in patients with a soft pancreatic texture. One patient in our series developed a postoperative pancreatic fis-

Fig. 5 Dunking of pancreas and fixation with silk

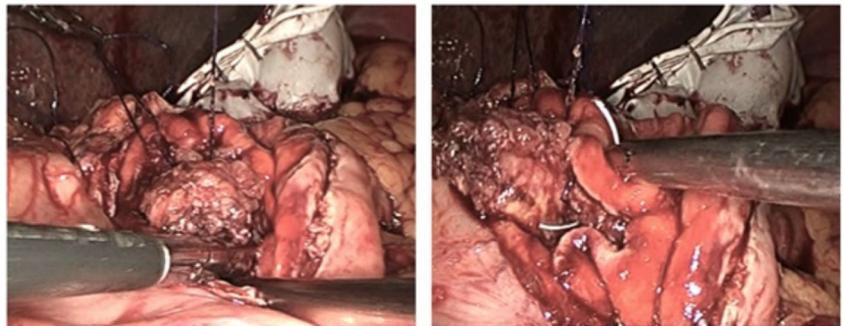
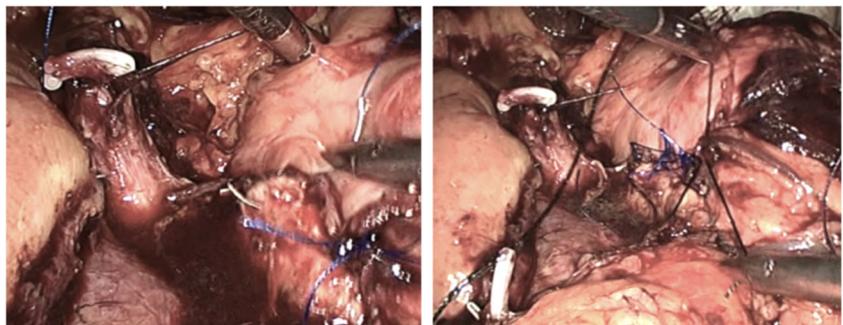


Fig. 6 Suturing of remnant pancreas to the posterior wall of stomach



tula (ISGPF grade B). A meta-analysis of randomised clinical trials found that placement of a stent in the pancreatic duct does not reduce the incidence of postoperative pancreatic fistula. However, subgroup analysis found that use of an external stent significantly reduced the incidence of postoperative pancreatic fistula [2]. The majority of the selected patients of these studies used PJ for reconstruction, and subgroup analysis for external duct stenting in PG was not reported. Placement of an external stent across the PG anastomosis is not necessarily an essential part of PG, but could be used adjunct to reduce the risk of pancreatic fistula formation. Delayed gastric emptying, which is one of the most common postoperative complications after pancreatic surgery, occurred in 19–57% of patients [1]. In patients with PG, gastric peristalsis is disturbed because the posterior wall of the stomach is held in place by the PG anastomosis. Additionally, incision of the anterior wall of the stomach increases the risk of delayed gastric emptying [1]. The long-term oncologic and surgical outcomes after use of our procedure should be investigated, and future research should investigate whether LPD provides any significant advantages over other methods of performing pancreaticoduodenectomy. It is difficult to draw any sound conclusions about the safety or limitations of our technique with so little information about patient selection, but we consider our technique a relatively easy method for reconstruction in pure LPD. Our technique may also provide an alternative reconstruction method for use in a hybrid procedure. As reconstruction with PG in LPD is still a new technique; further clinical evaluation to compare outcomes between the use of PG and PJ in LPD is warranted.

Conclusions

We present a novel pancreaticogastric anastomosis technique specifically developed for LPD. Our new technique is technically easy and provides excellent fixation between the gastric wall and pancreas. Main pancreatic duct dilatation is not required, and the risk of intraabdominal abscess formation is minimised. Although further clinical evaluation is required, this technique is immediately clinically applicable and may serve as the basis for additional research.

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