Pancreas-sparing distal duodenectomy for infra-papillary neoplasms

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ABSTRACT

INTRODUCTION For neoplasms that arise in the third and fourth parts of the duodenum (D₃, D₄), a duodenectomy that preserves the pancreas can provide adequate tumour clearance while avoiding the additional dissection and risk of the common alternative, pancreatoduodenectomy.

PATIENTS AND METHODS Pancreas-sparing distal duodenectomy (PSDD) was performed in 14 patients with infrapapillary duodenal neoplasms between 1991–2002, and the clinical outcome is reviewed. The operation entails careful separation of the lower pancreatic head from D₃, complete mobilisation of the ligament of Treitz and end-to-end duodenojejunal anastomosis 1–3 cm below the major duodenal papilla.

RESULTS There were 9 men and 5 women of median age 56 years, who presented with iron-deficiency anaemia ($n = 8$), gastric outlet obstruction ($n = 4$), anaemia and gastric outlet obstruction ($n = 1$), epigastric pain or mass (1 each). There were 11 malignant neoplasms (adenocarcinoma 5, stromal tumour 4, recurrent seminoma 1, plasmacytoma 1), 2 benign neoplasms (villous adenoma, lipoma) and 1 patient with steroid-induced ulceration. In addition to D₃ and D₄, resection included the distal part of D₂ in 5 patients, while 4 required concomitant partial colectomy. Median operation time was 240 min and median blood loss 1197 ml, being greater for malignant than benign lesions (1500 ml versus 700 ml). There was one death from gangrenous cholecystitis, one early re-operation for anastomotic bleeding and one late re-operation for delayed gastric emptying secondary to anastomotic stricture, but no pancreatic complications. At a median follow-up of 47 months, three patients had died of recurrent disease while the other 10 were alive and well with no upper gastrointestinal symptoms.

CONCLUSIONS Provided there is a minimum 1-cm clearance at the papilla, PSDD is a useful alternative to formal pancreatoduodenectomy in patients with unusual neoplasms arising from the third and fourth parts of the duodenum. Although a major undertaking in its own right, it avoids the extra time of a pancreatic resection and the extra risk of a pancreatic anastomosis.

KEYWORDS

Pancreas-sparing distal duodenectomy – Duodenal pathology – Surgery

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Although it comprises 75% of the total length of the gastrointestinal tract, the small bowel gives rise to merely 2–6% of all primary gastrointestinal malignancies.^{1,2} The duodenum constitutes only the first 25 cm of the small bowel, yet duodenal neoplasia accounts for 35% of all benign and 17% of all malignant small bowel tumours.^{3,4} The surgical management of duodenal pathology is challenging because of its retroperitoneal position and shared blood supply with the pancreas. For supra-ampullary and peri-ampullary neoplasms, the customary surgical option is pancreatoduodenectomy (PD), even if the pancreas is not involved and even in premalignant disease. A less radical procedure is local resection of the papilla (ampullectomy) with the adjacent pancreatic tissue

containing the terminal bile and pancreatic ducts.⁵ More recently, pancreas-sparing total duodenectomy (PSTD) has been described, generally referring to total resection of the duodenum including the papilla but not the adjacent pancreatic tissue or the terminal biliary and pancreatic ducts.^{6–16} Its suggested advantages over local resection are that the dissection is carried out in a defined tissue plane – a long-term solution for diffuse duodenal disease (*e.g.* in familial adenomatous polyposis) – and simpler ductal anastomoses.

One report describes a pancreas-sparing suprapapillary duodenectomy for an exophytic hepatocellular carcinoma (HCC) directly invading the duodenum.¹⁷ Reports of the surgical management of infrapapillary duodenal pathology

are largely limited to case reports and small series.^{18–24} For neoplasms that arise in the third and fourth parts of the duodenum (D₃, D₄), a conservative duodenectomy that preserves the pancreas and papilla can provide adequate tumour clearance while avoiding the additional dissection and risk associated with the biliary and pancreatic anastomoses implicit in the common alternative PD (or PSTD). Other advantages of this procedure include a shorter operative time and the preservation of more normal anatomy and function allowing postoperative endoscopic surveillance. We describe our experience with pancreas-sparing distal duodenectomy (PSDD) for infrapapillary neoplasms.

Patients and Methods

PSDD was performed in 14 patients with infrapapillary duodenal neoplasms between 1991–2002; at least one of the authors was involved in every operation. Their clinical and histopathological features have been reviewed retrospectively. Data were collected from the hospital records and included details on the presentation, surgical resection (length of the operative procedure, estimated blood loss, type and position of anastomosis), adjuvant therapy and pathological features. Complications and clinical outcome were also reviewed.

The operation entails extensive mobilisation of the duodenum by Kocher's manoeuvre including the ligament of

Treitz, with ligation and division of the mesentery of the duodenojejunal flexure and transection of the upper jejunum. The duodenojejunal specimen is then passed beneath the superior mesenteric vessels into the supracolic compartment, and D₃ is carefully separated from the lower pancreatic head taking care not to injure the pancreas. At the proximal extent of the resection, the duodenum is divided 1–3 cm below the major duodenal papilla, and an end-to-end duodenojejunal anastomosis is performed in two layers either anterior or posterior to the superior mesenteric vessels (Fig. 1). When the proximal transection line lies close to the papilla, the papilla is identified by palpation and, if necessary, opening the duodenum anteriorly before completing the cut at a safe level. If this were not possible, one would have to perform a PD.

Results

There were 9 men and 5 women of median age 56 years (range, 27–75 years). The principal presentation was iron-deficiency anaemia in 9 patients, one of whom had overt melaena and haematemesis and another gastric outlet obstruction. Three patients had gastric outlet obstruction alone, and one each had epigastric pain or mass. All but one patient with steroid-induced ulceration had duodenal neoplasia. There were 11 malignant neoplasms, of which 5 were primary duodenal adenocarcinomas, 4 were stromal tumours, one had a recurrent seminoma and one a plasmacytoma. There were 2 benign neoplasms, one villous adenoma and one ulcerated submucosal lipoma simulating cancer of D₃ (Table 1).

In addition to D₃ and D₄, resection included the distal part of D₂ in 5 patients, while 4 required concomitant partial colectomy because of involvement of adjacent ascending (2), transverse (1) and splenic (1) mesocolon. All anastomoses were end-to-end, four being performed anterior to the superior mesenteric vessels. One juxtapapillary anastomosis was protected by temporary pancreatic diversion (as previously described²⁵). Median operation time was 240 min (range, 180–350 min) and median blood loss 1197 ml (range, 200–4500 ml), being greater for malignant than benign lesions (1500 ml [range, 200–4500 ml] versus 700 ml [range, 300–1295 ml]). Median time to resumption of oral food was 10 days (range, 6–21 days) and median hospital stay was 11 days (range, 7–30 days).

Three patients had resection margins that were positive for cancer on definitive histopathology (Table 1); in two of these, the resection was definitely thought to be palliative at the time. Patient no. 4 had an advanced adenocarcinoma of D₃ and D₄ with infiltration into the adjacent mesentery and nodes that were obviously involved. A previous gastroenterostomy at another hospital had failed to relieve his vomiting (despite a patent stoma), and he was both emaciated

Table 1 Clinical details of patients

No.	Sex	Age (Years)	Presentation	Diagnosis	Co-morbidity	Resection	Adjuvant treatment
1	M	53	Gastric outlet obstruction	Adenocarcinoma (stage II)	Treated seminoma	Distal D ₂ /D ₃ /D ₄	–
2	M	68	Anaemia	Adenocarcinoma (stage III)	Coeliac disease	D ₃ /D ₃	Chemo [#]
3	F	47	Anaemia	Adenocarcinoma (stage II)	–	D ₃ /D ₄	–
4	M	54	Anaemia, gastric outlet obstruction	Adenocarcinoma (stage III)	–	D ₃ /D ₄ *	–
5	M	70	Anaemia	Adenocarcinoma (stage I)	–	Distal D ₂ /D ₃ /D ₄	–
6	F	43	Anaemia	GIST	–	D ₃ + right colon	–
7	M	52	Anaemia	GIST	–	D ₃ /D ₄ + right colon*	DXT
8	M	27	Anaemia	GIST	–	D ₄ + transverse colon*	DXT
9	M	50	Epigastric mass	GIST	–	D ₃ /D ₄	–
10	M	43	Gastric outlet obstruction	Recurrent seminoma	Treated seminoma	D ₃ /D ₄ + left colon	–
11	F	73	Anaemia	Small bowel plasmacytoma	Hereditary haemorrhagic telangiectasia	Distal D ₂ /D ₃ /D ₄	–
12	M	71	Melaena-anaemia	Steroid-induced ulceration	Wegener's granulomatosis	Distal D ₂ /D ₃ /D ₄	–
13	F	60	Epigastric pain	Villous adenoma	–	Distal D ₂ /D ₃ /D ₄	–
14	F	71	Gastric outlet obstruction	Submucosal lipoma	–	D ₃ /D ₄	–

GIST, gastrointestinal stromal tumour; DXT, radiotherapy; D₂/D₃/D₄, second, third and fourth parts of the duodenum.

*Positive margins on definitive histopathology.

[#]Patient received 2 cycles of postoperative chemotherapy (5-fluorouracil and folinic acid).

and anaemic. Palliative duodenectomy corrected these problems, although the resolving gastric atony, the need for nutritional support and social circumstances kept him in hospital for 7 weeks afterwards. Patient no. 7 had a massive GIST of dumb-bell shape, the deeper moiety being closely adherent to the inferior vena cava (which was partly occluded). Resection was probably incomplete to the naked eye, and pathological examination confirmed tumour at the caval margin; the lesion was a high-grade sarcoma. Patient no. 8 also had a massive GIST (18-cm diameter) at, and just proximal to, the duodenojejunal flexure with wide invasion

into the transverse mesocolon. Although the resection was macroscopically complete, tumour was reported at the mesocolic margin on histology so the patient received adjuvant radiotherapy; he is alive and well 10 years later. Each of these GISTs required concomitant colectomy, and all three patients had had pre-operative gastrointestinal haemorrhage, whether overt or occult.

One patient died postoperatively on day 16 from gangrenous cholecystitis after re-exploration on day 14. There was one early re-operation for anastomotic bleeding and one late re-operation for delayed gastric emptying secondary

Figure 2 Barium meal demonstrating postoperative anastomotic stricture.

to an anastomotic stricture (Fig. 2). One other patient had transient gastric atony that settled with conservative treatment. There were no pancreatic complications. Two patients with incomplete resection of stromal tumours received adjuvant radiotherapy. At a median follow-up of 47 months (range, 3–179 months), three patients had died of recurrent disease while the other 10 were alive and well with no upper gastrointestinal symptoms.

Discussion

PD has become accepted as a safe and appropriate procedure for selected patients with benign, premalignant and malignant diseases of the duodenum. With increased experience in specialised units, operative mortality after PD is reported to be 2–4%, yet the incidence of postoperative morbidity can still approach 50%.^{26–29} Similarly, a review of the literature of reported cases of PSTD reveals operative mortality to be low at 2% (1 of 43 patients⁹), but the morbidity remains high at 60% (26 of 43 reported cases), most of the complications being secondary to anastomotic leaks (11 of 43 patients^{6,8,11–13,15}). Thus PSDD, which eliminates the risk associated with biliary and pancreatic anastomoses of PD and PSTD, is an attractive alternative for isolated neoplasms of the infrapapillary duodenum without pancreatic involvement. This fact is reflected in a review of the literature of reported cases of PSDD (Table 2): there was one death secondary to an anastomotic leak (3%), and the morbidity rate was 41% (13 of 31 patients). Only 2 cases of pancreatic fistula were observed. Our series compares favourably with the reported literature with a postoperative mortality rate of 7% and a morbidity rate of 21% (Table 2).

The median operative time for PSDD in this series was 240 min (range, 180–330 min), considerably shorter than

the mean operative time of approximately 420 min reported for PD.^{27,50} Although reported figures are limited, times given for PSTD range between 217–360 min,^{8,12,16} whilst those for PSDD range between 300–330 min.^{19,21,25} Median blood loss of 1197 ml in this series was similar to that previously reported for PD (970 ml²⁷), PSTD (690 ml¹⁶) and PSDD (1347 ml¹⁹). Blood loss was noted to be greater among the malignant cases (1500 ml) than the benign cases (700 ml), especially when concomitant partial colectomy was needed (2350 ml).

The indications for PSDD range from the obvious to the controversial. The operation can be considered for any benign neoplasm or ulceration of the distal duodenum, including Crohn's disease if medical treatment fails.¹⁹ PSDD has also been described for patients with severe injuries of the distal duodenum.¹⁹ Although villous adenomas at this site may be benign, larger neoplasms often contain foci of malignancy that can be missed on pre-operative biopsy.^{51,52} Up to 40% of these lesions are carcinoma *in situ*^{51,52} and thus potentially curable without a radical procedure. One patient in our series was free of recurrence 41 months after PSDD for a villous adenoma, and there is a reported case of similar success at 24 months.¹⁹ In patients with multiple villous adenomas, particularly in FAP, distal duodenectomy is insufficient as the entire duodenal mucosa is at risk.

Adenocarcinoma of the duodenum is the least common type of periampullary tumour, but the prognosis is generally better than for carcinoma of the pancreas or distal bile duct.^{53,54} PD is clearly indicated for duodenal adenocarcinomas that lie close to the papilla, but not necessarily so beyond that point. In the largest series of PSDDs for duodenal carcinoma ($n = 13$),²⁰ survival rates were poorer than for PD ($n = 35$) at one year (76% versus 91%), two years (63% versus 73%) and 5 years (0% versus 69%). The likely explanation is that the peripapillary tumours presented earlier with obstructive jaundice. Our series includes 5 patients with adenocarcinoma of the infrapapillary duodenum treated by PSDD. Two of the five had advanced disease (stage III); in one of these, the resection was palliative with positive margins (patient no. 4). This patient died 3 months' postoperatively, whilst the others remain disease-free at median 56 months (range, 46–64 months). Although it is one conceivable option for palliation, luminal stenting remains difficult in the distal duodenum and does nothing to address persistent bleeding from the malignant ulcer. At present, one cannot say that PD is a better oncological operation than PSDD because comparative data do not exist. However, regional lymph node clearance is technically feasible in both procedures.

Duodenal GIST is a rare lesion accounting for 10–33% of all malignant duodenal tumours.⁵⁵ It is generally agreed that the treatment of choice is surgical removal of the mass.^{1,56–58} Local resection is appropriate when feasible, but

Table 2 Documented cases of PSDD

Reference	Year	No. of cases	Histopathology	Postoperative complications	Outcome
Kawano <i>et al.</i> ¹⁸	1995	1	GIST	None	?
*Maher <i>et al.</i> ¹⁹	1996	24	11 adenocarcinoma 4 other tumours 5 trauma 2 Crohn's disease 2 other [#]	1 death (anastomotic leak) 2 pancreatic fistula 2 delayed gastric emptying 2 anastomotic bleed 2 wound infection	Median survival 18.5 months Others, alive and well at 2 yrs
*Sohn <i>et al.</i> ²⁰	1998	2	2 adenocarcinoma	2 cholangitis	
Suzuki & Yasui ²¹	1999	1	1 GIST	1 delayed gastric emptying	Alive and well at 2 years
Orda <i>et al.</i> ²²	2000	1	1 GIST	None	Alive and well at 13 years
Ammori ²³	2002	1	1 benign duodenal stricture (laparoscopic)	Laparoscopic Roux-en-Y gastrojejunostomy, Laparoscopic revision gastrojejunostomy	?
Eisenberger <i>et al.</i> ²⁴	2004	1	1 GIST	None	Alive and well at 1 year
Present series	2005	14	5 adenocarcinoma 4 GIST 1 recurrent seminoma 1 plasmacytoma 1 steroid-induced ulceration 1 villous adenoma 1 lipoma	1 re-operation for anastomotic stricture 1 delayed gastric emptying None Gangrenous cholecystitis Early re-operation for anastomotic bleeding Alive and well at 63 months None None None	1 death 3 months post-operatively, median survival 56 months 1 death 3 months post-operatively, median survival 120 months Died at 16 days Died at 47 months Alive and well at 41 months Alive and well at 165 months

GIST, gastrointestinal stromal tumour.

*Both studies from the same institution; Sohn *et al.*²⁰ includes an additional 2 cases of adenocarcinoma to the previously described 11 cases.[#]1 complicated peptic ulcer disease, 1 high small bowel obstruction.

wide resection can be justified as invasion of adjacent organs does not preclude a cure. Duodenal GISTs have a mean survival of 50 months³⁵ and a 5-year survival of almost 50%.³⁹ The 10-year survival is also 50% with resection but only 10% without resection.⁴⁰ The reports of duodenal GISTs that have been resected completely with PSDD have shown freedom of recurrence at 12–156 months.^{18,21,22,24} Two of our 4 patients with stromal tumours had incomplete resections, and each of them was submitted to radical radiotherapy thereafter. Three of the 4 are

alive and well with no evidence of recurrence at 36, 120 and 179 months, while one died during radiotherapy secondary to dehiscence of an ileocolic anastomosis that had previously healed.

Conclusions

PSDD appears to be a safe and useful alternative to PSTD and formal PD in patients with adenomas, stromal tumours and

unusual neoplasms arising from the third and fourth parts of the duodenum, provided there is a minimum 1-cm clearance at the papilla. Although a major undertaking in its own right, it avoids the extra time of a pancreatic resection and the extra risk of a pancreatic anastomosis.

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