Commentary

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6.1 Carcinoma of the Pancreatic Head/Periampullary Adenocarcinoma

6.1.1 Relevant Basic Information, Indications and Contraindications

Diagnosis and staging is a crucial step to provide appropriate treatment for individual patients with pancreatic adenocarcinoma. Our gold standard modality for diagnosis and staging is multiphase "pancreas protocol," thin-slice, multi-detector CT (MDCT) including chest scans. Recently introduced multi-detector technology allows high scanning speed with thin collimation, which decreases the time needed to cover a volume of interest for imaging during clearly defined perfusion phases. If the findings on MDCT are equivocal, endoscopic ultrasonography (EUS) with or without fine needle aspiration (FNA) is indicated. ERCP, MRI/MRCP, and PET-CT are indicated only for selected patients.

MDCT provides high diagnostic accuracy for assessing resectability and unresectability based on the relationship between the primary tumor and the major vessels, including the hepatic artery (HA), superior mesenteric artery (SMA), and superior mesenteric and portal vein (SMV & PV). In our practice, vascular involvement itself does not necessarily mean unresectability. If vascular involvement is limited to a short segment and allows for reconstruction, those cases are still candidates for operative resection (as of 2010, we prefer neoadjuvant therapy before surgery rather than a "surgery-first" approach). In addition to vascular involvement, nodal status is also important for determining indications for operative intervention. Distant lymph node metastasis including the paraaortic lymph nodes which means systemic disease and is a contraindication for operation. If the diagnosis of distant lymph node metastasis by MDCT is equivocal, we prefer to proceed with a PET-CT and/or open biopsy. The indication for operative exploration for each patient should be determined by a comprehensive workup that includes physiologic and nutritional status.

6.1.2 Operative Technique

6.1.2.1 Resection

Our standard operative procedure for adenocarcinoma of the head of the pancreas and periampullary region is the pylorus-preserving pancreatoduodenectomy (Traverso-Longmire procedure), if it is possible to preserve the pylorus. We use an upper midline incision from the xiphoid down to the umbilicus, or sometimes we extend the incision to the right (J-shape incision) when the patient is obese and/or exposure is difficult. Any distant

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metastasis, including liver metastases and peritoneal seeding, is a contraindication for resection. We routinely sample lymph nodes in the aortocaval groove following the Kocher maneuver (before proceeding with resection). If any positive lymph nodes are seen in this area, operation is concluded.

We prefer that the greater omentum be detached from the transverse colon rather than being divided between ligatures to preserve omentum vascularity. We agree with Drs. Mantke and Lippert's perspective that the well-vascularized omentum helps to control postoperative complications of the pancreatic anastomosis. We sometimes use the segmental omentum (omentum flap) to cover the pancreatic anastomosis to prevent serious complications.

After mobilizing the transverse mesocolon caudally from the pancreatic head and dividing the right gastroepiploic vein and artery, the nerve-plexus-covered SMV and SMA are taped separately at the inferior border of the pancreas. In cases involving SMV from which the middle colic veins drain, this tape should be placed more caudally, below the transverse mesocolon. The transverse mesocolon with middle colic artery and vein is often divided for better exposure in this area. Ischemic change in the transverse mesocolon is seen only rarely provided the marginal vessels are preserved. These tapes prove helpful in subsequent portal vein resection and plexus resection along the SMA (Fig. 6.1).

For pancreatic head adenocarcinoma without findings of vascular involvement, a retropancreatic tunnel is made under the pancreas from the SMV to the portal vein in the groove for the portal vein where the pancreas is divided. In contrast, however, in cases with vascular resection, the pancreas is divided at the level of the SMV, which provides better exposure in the area where the SMV-PV is involved. This also allows us to secure the root of the SMA and celiac artery for proximal vascular control when hepatic artery and/or SMA resection is performed (Fig. 6.2).

The extent of lymphadenectomy for pancreatic head adenocarcinoma in our practice is similar to Drs. Mantke and Lippert's description. We do not perform routine extended lymphadenectomies

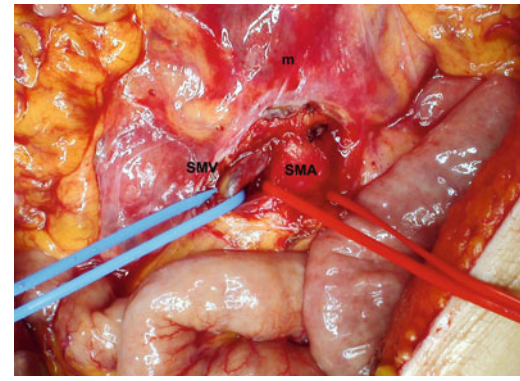

Fig. 6.1 The superior mesenteric artery and vein are identified below the transverse mesocolon. The superior mesenteric artery is secured with the surrounding plexus. (*SMA* superior mesenteric artery, *SMV* superior mesenteric vein, *m* transverse mesocolon)

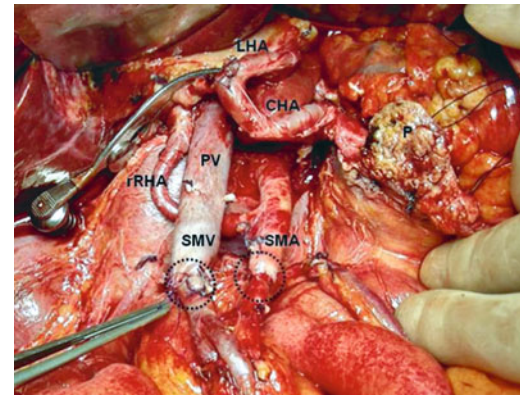

Fig. 6.2 Radical pancreatoduodenectomy with resection and reconstruction of the superior mesenteric artery and vein (*SMA* superior mesenteric artery, *SMV* superior mesenteric vein, *PV* portal vein, *CHA* common hepatic artery, *LHA* left hepatic artery, *rRHA* replaced right hepatic artery, *P* pancreas). A *block dotted circle* represents the size of vascular reconstruction of *SMA* and *SMV*

based on the results of several randomized, controlled trials (Yeo et al. 1999, 2002; Nguyen et al. 2003; Nimura et al. 2004; Farnell et al. 2005). The paraaortic lymph node is only sampled for staging, and the lymph node on the left side of the SMA is not resected routinely unless positive lymph nodes are observed in this region.

In addition to lymphadenectomy, the extent of resection of the neurolymphatic plexus along the SMA is crucial for achieving an R0 resection for pancreatic head adenocarcinoma, especially in

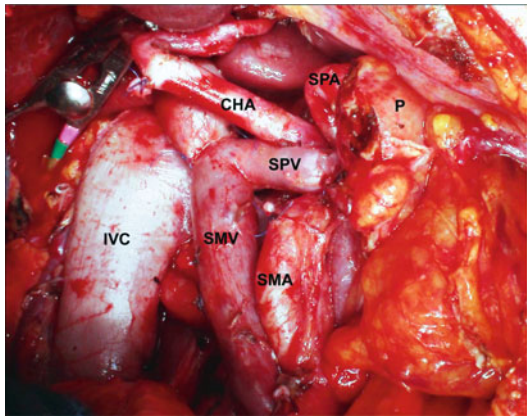

Fig. 6.3 Radical pancreatoduodenectomy. About one-half to two-thirds circle of the plexus around the superior mesenteric artery is resected (*SMA* superior mesenteric artery, *SMV* superior mesenteric vein, *CHA* common hepatic artery, *SPA* splenic artery, *SPV* splenic vein, *IVC* inferior vena cava, *P* pancreas)

Fig. 6.4 All surgical margins are inked in separate colors (*PL* uncinate-SMA margin, *PV* PV groove, *A* anterior margin)

cases where the main tumor is located in the uncinate process. Although we do not undertake routine resection of the nerve plexus along the SMA, it is indicated if an R0 resection is deemed. For plexus resection, the anterior surface of the SMA with the plexus is divided longitudinally, exposing the adventitia of the SMA itself. The dissection is extended toward the root of the SMA, where it is cancer-free. At this point, the inferior pancreaticoduodenal artery (IPDA) is ligated and divided at its origin, usually prior to portal vein resection or dissection of the uncinate process from the SMV and PV. Ligating the IPDA first helps to decrease bleeding by preventing congestion of the specimen. Next, rightward traction is applied to the cut margin of the plexus, which is then resected longitudinally from the right side to the posterior side (about one-half to two-thirds circle of the plexus is resected) (Fig. 6.3). The margin in this region is inked separately on the specimen as the SMA plexus margin (Fig. 6.4). Postoperative diarrhea may be happened but it can usually be managed successfully by medication and resolves in 6–12 months.

For portal vein resection, our procedure is almost identical to that described by Drs. Mantke and Lippert. We prefer an external iliac vein graft because of its size. The junction of the splenic vein is not always preserved after using test clamps to ensure the prevention of splenic congestion.

6.1.2.2 Reconstruction

Our reconstruction procedure is similar to that described by Drs. Mantke and Lippert. The jejunal limb is brought up through a window in the transverse mesocolon. Anastomosis of the end of the pancreas to the side of the jejunal stump is accomplished using a duct-to-mucosa anastomosis for the inner layer and transfixing sutures for the outer layer. We use 5-0, absorbable, monofilament, interrupted sutures with an RB-2 needle (PDS™ II, Ethicon, Johnson and Johnson, Somerville, NJ, USA) for duct-to-mucosa suture without a stent. We usually place 6 to 8 sutures using a Castroviejo needle holder aided by surgical loupes (2.5X). A Castroviejo needle holder under magnification is easy to handle for fine sutures. Transfixing outer sutures are made between the full thickness of the pancreas and the wider seromuscular layer of the jejunum using 3-0, nonabsorbable, monofilament, interrupted sutures (Prolene™, Ethicon). We usually place four sutures in the outer layer, two for the cranial and two for the caudal positions to the inner anastomosis. The ligatures should be tied gently and not too tightly.

For the end-to-side hepaticojejunostomy, we use 5-0, absorbable, monofilament, interrupted sutures (PDS™ II, Ethicon) without a stent. For

the antecolic, end-to-side duodenojejunostomy, we use a double continuous technique with 4-0 absorbable sutures (PDS™ II, Ethicon).

6.1.2.3 Drainage

We routinely place two closed-suction drains (Silicone Flat Drains™, BARD, Covington, GA, USA) for pancreatic and biliary anastomosis. One drains the biliary anastomosis and posterior pancreatic anastomosis, and the other drains the anterior and cranial pancreatic anastomosis (around the stump of the gastroduodenal artery).

6.1.3 Additional Treatment and Postoperative Care

- Antibiotic prophylaxis is used with a second-generation cephalosporin. The initial dose is given in the operating room prior to skin incision and is continued until postoperative day (POD) #3.
- Octreotide is not used.
- A nasogastric tube is placed intraoperatively and is removed on POD #1–2. Clear water is resumed on the day following nasogastric tube removal, and a liquid diet is started on POD #5–6.
- Enteral feeding is used selectively and only for patients with malnutrition.
- A proton pump inhibitor is used routinely for prevention of peptic ulcer.
- Drain volume and amylase content are measured daily. If the drain amylase activity is less than three times that of the serum on POD #3, the drains are removed by POD #7 regardless of the volume. In contrast, if the drain amylase activity is greater than three times that of the serum on POD #3, the drain is maintained until the amylase activity is normalized or the pancreatic fistula is well localized. If clinical symptoms (fever, leukocytosis) are observed, we obtain a CT to exclude an undrained peripancreatic fluid collection. Drain exchange or percutaneous drainage is indicated if necessary. Antibiotics are also administrated if infection is evident.

6.1.4 Results

Our results are summarized in Table 6.1.

Table 6.1 Outcomes after resection for pancreatic head adenocarcinoma at Teikyo University Hospital (2006/2007)

Parameter	Number	%
Patients	40	
Hospital mortality	1	3
Hospital stay (median, range) (in days)	28 (7–75)	
Relaparotomy	2	5
Death without local complications	0	0
Classic pancreatoduodenectomy	14	35
PPPD	26	65
Portal vein resection	25	63
HA resection	2	5
SMA resection	1	3
Tumor stage (UICC)		
Ia	1	3
Ib	0	0
IIa	12	30
IIb	23	56
III	1	3
IV	3	8
R0 resection	33	83
R1 resection	6	15
R2 resection	1	2
Postoperative local morbidity		
Postoperative bleeding[a]	2	5
Delayed gastric emptying[b]	3	8
Pancreatic fistula[c]	5	13
Bile leak[d]	1	3
Wound infection	2	5
Other	8	20
Postoperative systemic morbidity		
Systemic complications	3	8

[a]Any bleeding requiring intervention
[b]By ISGPS definition
[c]By ISGPF definition
[d]Any bilirubin-rich drainage on or after POD #3

6.2 Carcinoma of the Body and Tail of the Pancreas

6.2.1 Relevant Basic Information, Indications and Contraindications

Preoperative resectability is assessed from the MDCT results, which image the relationship between the tumor and the adjacent vessels, including the splenic, common hepatic, celiac, superior mesenteric artery, and splenic and portal veins.

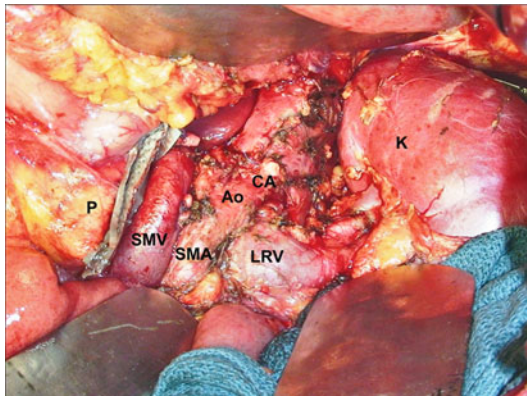

Fig. 6.5 Radical distal pancreatectomy with celiac artery resection (DP-CAR) (*SMA* superior mesenteric artery, *SMV* superior mesenteric vein, *Ao* aorta, *CA* celiac artery, *LRV* left renal vein, *P* pancreas, *K* kidney)

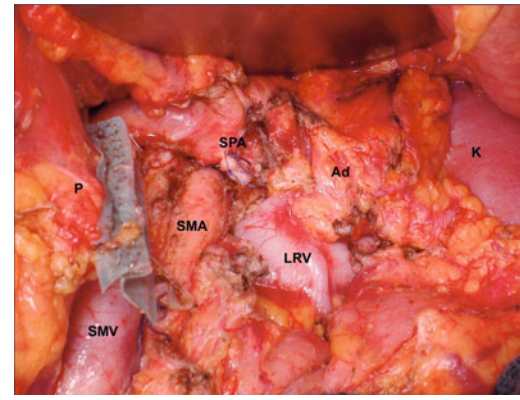

Fig. 6.6 Radical distal pancreatectomy. The left adrenal gland is preserved (*SMA* superior mesenteric artery, *SMV* superior mesenteric vein, *SPA* splenic artery, *LRV* left renal vein, *P* pancreas, *Ad* adrenal gland, *K* kidney)

We pay special attention to the extent of invasion into the retroperitoneal soft tissue and left adrenal gland, because the retroperitoneal margin is the area where is most likely to be involved with cancer cells (R1 resection). In our practice, cases with vascular involvement including the celiac artery, hepatic artery, and portal vein are still considered potential operative candidates. In selected cases, a radical resection is possible with distal pancreatectomy combined with celiac artery resection with or without portal vein resection as described by Hirano et al. (as of 2010, we prefer neoadjuvant therapy before resection rather than a "surgery-first" approach) (Hirano et al. 2007) (Fig. 6.5). In addition to vascular involvement, nodal status is also important for determining resectability. Distant lymph node metastasis including the paraaortic lymph nodes means systemic disease and is a contraindication for resection. If the diagnosis of distant lymph node metastasis by MDCT is equivocal, we prefer to proceed with PET-CT and/or open biopsy. Operative indication for each patient should be determined by a comprehensive workup, including physiologic and nutritional status.

6.2.2 Operative Technique

6.2.2.1 Resection

Our standard procedure for carcinoma of the body and tail of the pancreas is antegrade distal pancreatectomy with splenectomy, which is almost identical to the description by Drs. Mantke and Lippert. The antegrade approach (divide pancreas first) has advantages over the conventional approach (mobilize spleen first) in terms of better exposure of the root of the celiac artery and SMA, and securing the retroperitoneal margin as described by Strasburg et al. (Strasberg et al. 2007) (Fig. 6.6).

We divide the pancreas using a stapler with Neoveil® bioabsorbable staple-line reinforcement material (Gunze, Kyoto, Japan) or Duet TRS™ (Covidien, Mansfield, MA, USA), if applicable. When the stapler is used, it is closed very slowly to prevent breakdown of the pancreatic parenchyma. If the pancreatic parenchyma is thick, we use Doyen intestinal forceps to make the parenchyma thinner before stapling. If the parenchyma is either too thick or too fragile, we divide the pancreas by means of electrocautery with or without a fishmouth closure.

6.2.2.2 Drainage

A closed-suction drain (Silicone Flat Drains™, BARD, Covington, GA, USA) is placed near the pancreatic stump.

6.2.3 Additional Treatment and Postoperative Care

- Antibiotic prophylaxis is used with a second-generation cephalosporin. The initial dose is given in the operating room prior to skin incision, and is continued until postoperative day (POD) #3.

Table 6.2 Outcomes after resection for pancreatic body/tail adenocarcinoma at Teikyo University Hospital (2006/2007)

Parameter	Number	%
Patients	16	
Hospital mortality	0	0
Hospital stay (median, range) (in days)	21 (12–54)	
Relaparotomy	0	0
Death without local complications	0	0
Portal vein resection	4	25
Celiac artery resection	4	25
Tumor stage (UICC)		
Ia	0	0
Ib	0	0
IIa	5	31
IIb	3	19
III	3	19
IV	5	31
R0 resection	10	63
R1 resection	4	25
R2 resection	2	12
Postoperative local morbidity		
Postoperative bleeding[a]	0	0
Delayed gastric emptying[b]	4	25
Pancreatic fistula[c]	3	19
Wound infection	2	12
Other	2	12
Postoperative systemic morbidity		
Systemic complications	0	0

[a]Any bleeding requiring intervention
[b]By ISGPS definition
[c]By ISGPF definition

- Octreotide is not used.
- A nasogastric tube is placed intraoperatively and removed on POD #1. Clear water is resumed on the day following nasogastric tube removal, and a liquid diet is started on POD #3.
- Drain volume and amylase activity are measured daily. If the drain amylase activity is less than three times that of the serum on POD #3, the drains are removed by POD #7 regardless of the volume. If the drain amylase activity is greater than three times that of the serum on POD #3, the drain is maintained until the amylase value is normalized or pancreatic fistula is well localized. If clinical symptoms (fever, leukocytosis) are observed, we obtain a CT to exclude an undrained peripancreatic fluid collection. Drain exchange or percutaneous drainage is indicated if necessary. Antibiotics are also administrated if infection is evident.

6.2.4 Results

Our results are summarized in Table 6.2.

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