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ORIGINAL ARTICLE – PANCREATIC TUMORS

Distal Pancreatectomy with en Bloc Celiac Axis Resection (Modified Appleby Procedure) for Locally Advanced Pancreatic Body Cancer: A Single-Center Review of 80 Consecutive Patients

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ABSTRACT

Background. Recently, distal pancreatectomy with en bloc celiac axis resection (DP-CAR) or modified Appleby procedure for locally advanced pancreatic body cancer is increasingly reported. However, actual long-term survival data are still unknown.

Methods. This study retrospectively reviewed 80 consecutive patients with pancreatic body cancer who underwent DP-CAR at a single institution.

Results. The study included 40 men and 40 women with a median age of 65 years (range, 44–85 years). A pancreatic fistula was the most common complication, occurring in 47 patients (57.5 %). Other complications with a high incidence were ischemic gastropathy (23 patients, 28.8 %) and delayed gastric emptying (20 patients, 25 %). According to the Clavien-Dindo classification, the major complications, defined as complications of grade 3 or higher, were observed in 33 patients (41.3 %), and the in-hospital mortality involved four patients (5 %). For all 80 patients, the 1-, 2-, and 5-year overall survivals (OSs) were respectively 81.1, 56.9, and 32.7 %, and the median survival time was 30.9 months. The actual 5-year survival for the 61 patients whose surgery was performed five or more years earlier was 27.9 % (17 of 61). The 1-, 2-, and 5-year OSs for the patients who underwent preoperative therapy (100, 90, and 78.8 %) were significantly better than for those who underwent upfront surgery (77.9, 51.5, and 26.7 %; $P < 0.0001$).

Conclusions. The findings show DP-CAR to be a valid procedure for treating locally advanced pancreatic body cancer, which might contribute more to patients' survival when performed as part of multidisciplinary treatment.

Distal pancreatectomy with en bloc celiac axis resection (DP-CAR) was designed to provide microscopically negative margins of the celiac artery (CA), nerve plexus, and retroperitoneal tissue for patients with locally advanced pancreatic body cancer.[1–6] This procedure was originally developed from the Appleby procedure designed for en bloc lymphadenectomy used to treat advanced gastric cancer,[7] and several surgeons have applied the procedure to carcinoma of the body and tail of the pancreas as a modified Appleby procedure.[8–11]

In the DP-CAR procedure, the stomach was routinely preserved except in cases of severe tumor infiltration. Our first report of long-term survival for 23 patients showed that the estimated 5-year overall survival (OS) rate was 42 %, and the median survival time (MST) was 21 months.[6] Subsequently, in our second report involving 50 patients, the estimated 5-year survival rate was 24.2 %, and the MST was 24.7 months.[12]

The current study aimed to evaluate the long-term survival results for 80 consecutive patients who underwent DP-CAR at a single institution and to analyze the actual survival results for 61 patients whose surgery was performed 5 or more years earlier. Furthermore, the survival results of DP-CAR combined with pre- or postoperative chemotherapy also are reported.

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METHODS

Between May 1998 and December 2015, 80 consecutive patients who underwent DP-CAR were enrolled in this study. The indications for DP-CAR were locally advanced pancreatic ductal adenocarcinoma of the pancreas body that involved or touched the common hepatic artery (CHA), the root of the splenic artery, and/or the CA, without distant metastasis. Informed consent was obtained from all the patients preoperatively. The median follow-up period for censored cases was 63.5 months (range, 6.5–146.6 months).

Postoperative follow-up investigations consisted of physical examination, laboratory studies, and computed tomography (CT) imaging at 3- to 4-month intervals for the first 2 years, at 6-month intervals for years 3 through 5, and then at yearly intervals. At the time of the final assessment (December 2015), no patient had been lost to follow-up evaluation.

This study was conducted in accordance with the ethical standards of the Committee on Human Experimentation at our institution and was approved by the Institutional Review Board of Hokkaido University Hospital (no. 015-0347).

Preoperative Arterial Embolization

To prevent ischemic complications of the hepatobiliary system and the stomach after DP-CAR, preoperative embolization of the CHA was routinely performed by development of the pancreatic head arcade.[13–15] Since 2007, embolization of the left gastric artery (LGA) has been routinely added to reduce ischemic gastritis.[15] Embolization was performed a median of 7 days (range, 1–16 days) before DP-CAR.

Surgical Technique

The DP-CAR procedure has been described in detail previously.[6,16] It included en bloc resection of the CA, CHA, left gastric arteries, the celiac plexus and bilateral ganglions, the total nerve plexus around the superior mesenteric artery (SMA), a part of the right crus of the diaphragm and the left Gerota fascia, the left adrenal gland, and the retroperitoneal tissues containing lymph nodes. The stomach was routinely preserved, except in patients with severe infiltration of the stomach by the cancer.

The standard operative procedure of the right-sided approach to the CA and SMA consisted of the following three steps: (1) Kocher's maneuver to reach the anterior surface of the aorta just caudal to the SMA and its surrounding plexus, (2) complete eradication of the right celiac ganglion to expose the right crus of the diaphragm, and (3) division of the median arcuate ligament to expose just the bottom of the CA where it should be divided. The plexus around the SMA was first incised at the dorsal part (opposite side of the tumor), and then the excision was extended in a longitudinal direction aimed just proximal to the inferior pancreaticoduodenal artery (IPDA) to achieve complete resection of the plexus. The SMA branches, such as the replaced right hepatic artery, the dorsal pancreatic artery, the accessory middle colic artery, and the IPDA, were identified on preoperative three-dimensional CT angiography to avoid injury during surgery.

Statistical Analysis

Cumulative overall survival was estimated by the Kaplan–Meier method, and a comparison of the survival curves was performed using the log-rank test. All survival analyses were calculated from surgery. The significance level was set at a P value lower than 0.05. Statistical analysis was performed using JMP 10.0 software (SAS Institute, Inc., Cary, NC, USA) for Windows.

RESULTS

Clinical and Pathologic Characteristics of the 80 Patients

The clinical and pathologic characteristics of this study are shown in Table 1. Concomitant portal and/or superior mesenteric vein resection was necessary for 49 patients (61.3 %). The stomach was concomitantly resected in seven patients (total gastrectomy in three patients and partial resection in four patients) due to direct cancer invasion. Unplanned arterial reconstruction was required for four patients due to accidental injuries during the operations. Two patients underwent anastomosis between the middle colic artery-gastroepiploic artery because of injury to the inferior pancreatoduodenal artery.[17] One patient underwent end-to-end hepatic artery reconstruction, and one patient underwent aorto-hepatic artery reconstruction with a great saphenous vein autograft.

Of the 80 patients, 54 received pre- and/or postoperative chemotherapy, and the remaining 26 patients underwent surgery alone. Of the 54 patients treated with chemotherapy, 42 received postoperative chemotherapy, two received preoperative chemotherapy, and ten received both pre- and postoperative chemotherapy. Only two patients received radiotherapy with preoperative chemotherapy.

The pre- and/or postoperative chemotherapy regimen included either S-1 (oral fluoropyrimidine agent containing tegafur, gimeracil, and oteracil potassium), gemcitabine (GEM), or a combination of S-1 and GEM. For eight

TABLE 1 Clinical characteristics of 80 patients

Patients	
Median age: years (range)	65 (44–85)
Men/women	40/40
Median perioperative data	
Operative time: min (range)	436 (248–1037)
Blood loss: ml (range)	880 (162–15970)
Blood transfusion: *n* (%)	12 (15)
Comcomitant resection	
Portal vein: *n* (%)	49 (61.3)
Other organ (stomach, colon, jejunum, etc.) (%)	13 (16.3)
Arterial reconstruction: *n* (%)	5 (6.3)
With chemotherapy: *n* (%)	54 (67.5)
Preoperative alone	2
Postoperative alone	42
Both pre- and postoperative	10
No chemotherapy: *n* (%)	26 (32.5)
UICC (7th, 2009) pathologic stage	
Primary tumor: *n* (%)	
Tis–T2	2 (2.5)
T3	48 (60.0)
T4	30 (37.5)
Lymph node metastasis: *n* (%)	
N0	30 (37.5)
N1	50 (62.5)
Stage: *n* (%)	
0–1	2 (2.5)
2	48 (60.0)
3	28 (35.0)
4	2 (2.5)
Histopathologic type: *n* (%)	
Well	6 (7.5)
Moderate	50 (62.5)
Poor	21 (26.3)
Adenosquamous	3 (3.8)
Residual tumor status; *n* (%)	
R0	74 (92.5)
R1	6 (7.5)
R2	0 (0.0)

UICC Union for International Cancer Control

patients, the preoperative treatment included long-term chemo (radio) therapy for a locally advanced initially unresectable lesion.[18]

The pathologic stage was diagnosed according to the seventh tumor-node-metastasis (TNM) classification of the Union for International Cancer Control (UICC).[19] Regional lymph node metastases developed in 50 patients (62.5 %), but none were in the paraaortic area. Carcinoma in situ and no lymph node metastasis (stage 0) was diagnosed for one patient at final staging by remarkable effect of preoperative chemotherapy. For two patients, a minute peritoneal nodule around the primary tumor proved to be an M1 lesion and was diagnosed as stage 4 disease. For 74 patients (92.5 %), R0 resection was achieved, whereas R1 resection was found in six patients, including the pancreatic cut end margin in two patients, the dissected margin of the SMA nerve plexus in two patients, the retroperitoneal tissue margin in one patient, and the dissected margin of the portal vein in one patient.

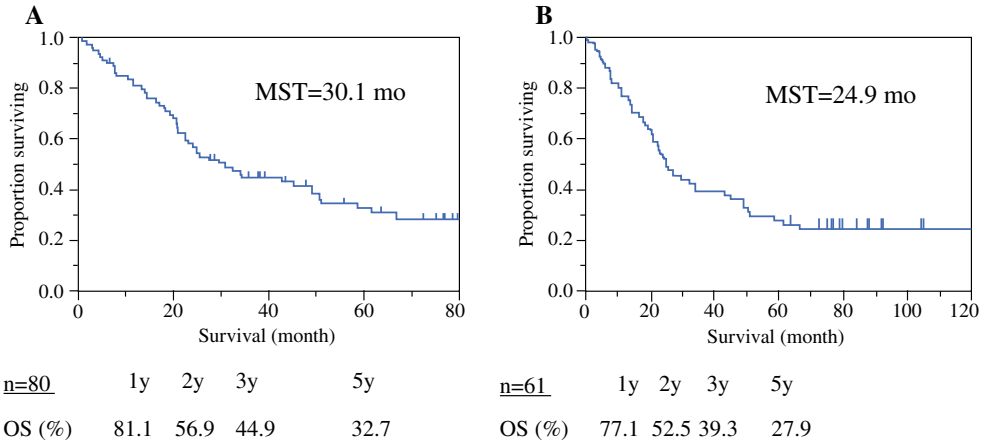
TABLE 2 Morbidity and mortality after distal pancreatectomy with en bloc celiac axis resection (DP-CAR)

Pancreatic fistula: *n* (%)	47 (58.8)
Grade A	18 (22.5)
Grade B	24 (30.0)
Grade C	5 (6.3)
Ischemic gastropathy: *n* (%)	23 (28.8)
Not severe	18 (22.5)
Severe (with perforation)	5 (6.3)
Delayed gastric emptying: *n* (%)	16 (20.0)
Grade A	3 (3.8)
Grade B	1 (1.3)
Grade C	12 (15.0)
Liver abscess: *n* (%)	3 (3.8)
Partial liver infarction: *n* (%)	5 (6.3)
Cholecystitis: *n* (%)	3 (3.8)
Reoperation: *n* (%)	6 (7.5)
Clavien-Dindo classification: *n* (%)	
Grade 0–2	47 (58.8)
Grade 3	25 (31.3)
Grade 4	4 (5)
Grade 5 (mortality)	4 (5)
Median postoperative hospital stay: days (range, median (range)	38 (12–208)

Operative Morbidity and Mortality

The postoperative morbidity and mortality in this study are shown in Table 2. Pancreatic fistula was the most common complication, occurring for 47 patients (57.5 %) according to the definition of the International Study Group of Pancreatic Surgery (ISGPF).[20] Ischemic gastropathy[14] due to decreased gastric blood flow, which was the second most common complication, occurred for 23 patients (28.8 %). According to the Clavien-Dindo classification,[21] major complications, defined as complications of grade 3 or higher, were observed in 33 patients (41.3 %). The postoperative hospital stays ranged from 17 to 208 days (median, 39 days).

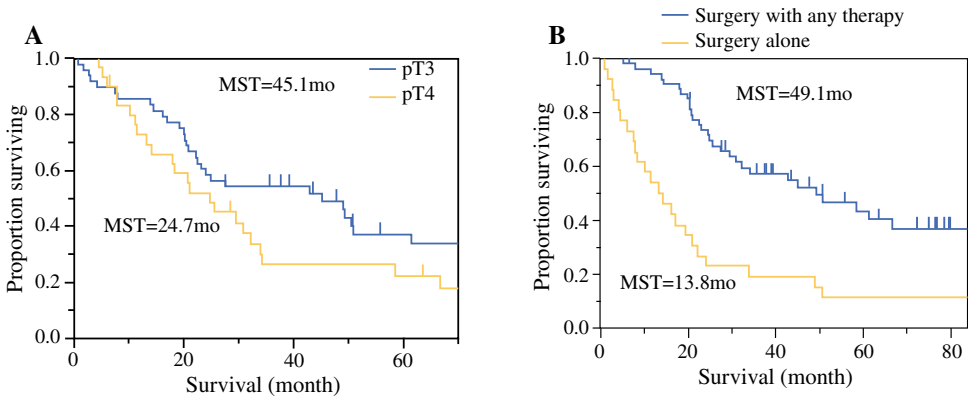
The 30-day mortality rate was 1.3 % (1 of 80 patients), and the in-hospital mortality rate was 5 % (four of 80



n=80	1y	2y	3y	5y
OS (%)	81.1	56.9	44.9	32.7

n=61	1y	2y	3y	5y
OS (%)	77.1	52.5	39.3	27.9

FIG. 1 Kaplan–Meier survival curves for patients with pancreatic body cancer who underwent distal pancreatectomy with en bloc celiac axis resection (DP-CAR). **a** Overall survival of all 80 patients. **b** Overall survival at the time of the latest follow-up visit for the 61 patients whose surgery was performed 5 or more years earlier. *MST* median survival time



	1y	2y	3y	5y
pT3 (n=48)				
OS (%)	85.4	58.3	54.2	37.2
pT4 (n=30)				
OS (%)	72.7	51.9	26.3	22.5

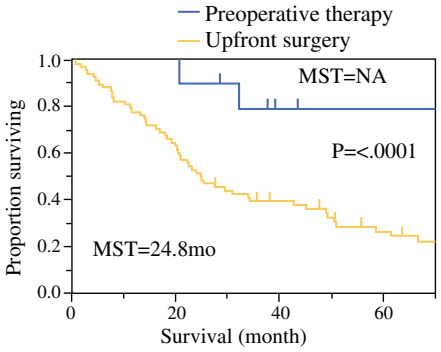
	1y	2y	3y	5y
With any therapy (n=54)				
OS (%)	94.4	73.4	57.5	43.6
Surgery alone (n=26)				
OS (%)	53.9	23.1	19.2	11.5

FIG. 2 **a** Comparison of the survival curves for patients who underwent DP-CAR with pT3 or pT4. No significant difference was found between the two groups ($P = 0.11$). **b** Comparison of the survival curves for patients treated using distal pancreatectomy with en bloc celiac axis resection (DP-CAR) who had received other treatments or no treatment. The patients treated with surgery alone had a shorter survival than those treated with surgery plus other treatments (MST, 13.8 vs. 49.1 months; $P < 0.0001$). *MST* median survival time

patients). The first patient who died was a 71-year-old man who experienced anastomotic leakage of partial gastrectomy on day 22 after surgery. Urgent relaparotomy was performed, but he died of multiple organ failure on day 86 after the initial surgery. The second patient was an 85-year-old man whose postoperative course was satisfactory except for ischemic gastritis, but he died of cardiac arrest 92 days after surgery. The third patient was a 60-year-old woman who experienced ischemic duodenal perforation on day 7 after surgery. Urgent relaparotomy was performed, but she died of multiple organ failure on day 22 after the initial surgery. The last patient was a 73-year-old woman who experienced SMA bleeding from the stump of the dorsal pancreatic artery. Stent placement into the SMA was performed using the interventional radiology technique, and the bleeding was controlled, but she died of severe ischemic liver failure on day 53 after surgery.

Postoperative Survival and Recurrence of Disease

The estimated 1-, 2-, and 5-year overall survival rates for all 80 patients were respectively 81.1, 56.9, and 32.7 %, and the MST was 30.9 months (Fig. 1a). Of the 80 patients, 17 survived longer than 5 years. The actual 5-year survival rate at the time of the latest follow-up evaluation (31 December 2015) for the 61 patients whose surgery was



	1y	2y	3y	5y
Preoperative therapy (n=12)				
OS (%)	100	90.0	78.8	78.8
Upfront surgery (n=68)				
OS (%)	77.9	51.5	39.5	26.7

FIG. 3 Comparison of the survival curves for patients treated using distal pancreatectomy with en bloc celiac axis resection (DP-CAR) who had received preoperative therapy or no preoperative therapy. The patients who underwent upfront surgery had a significantly shorter survival than those who received any preoperative therapy ($P < 0.0001$). *MST* median survival time

performed 5 or more years earlier was 27.9 % (17 of 61) (Fig. 1b). Survival did not differ significantly between pT3 and pT4 disease (MST: 45.1 vs 24.7 months; $P = 0.11$) (Fig. 2a). On the other hand, the patients treated with surgery alone had a shorter survival than those treated with surgery plus other treatments (MST: 13.8 vs. 49.1 months; $P < 0.0001$) (Fig. 2b). Moreover, the estimated overall survival rates for the patients with preoperative therapy were significantly higher than for those who had upfront surgery ($P < 0.0001$, Fig. 3).

Of the 80 patients, 44 died of recurrent disease, and primary recurrence was observed 1.5–48.3 months after surgery (median 8.5). A total of 11 patients had multiple organ recurrences. The most frequent site of recurrence was the liver (19 patients), followed by the local site (14 patients) and the peritoneum (eight patients). Liver recurrence was observed a median 5 months (range, 1.5–26.6 months) after surgery, whereas the median times for local and peritoneal recurrence were respectively 11.3 months (range, 2.5–43.6 months) and 7.2 months (range, 5.7–12.8 months) after surgery.

DISCUSSION

Recently, the number of reports regarding DP-CAR has been gradually increasing, but accurate data for long-term results are limited. In a literature review, Zhou et al.[22] showed that the MST after surgery ranged from 9.3 to 26 months in 19 studies involving 203 patients who underwent DP-CAR. However no actual survival data were available .

In the current report, the actual 5-year survival rate at the latest follow-up visit was 27.9 % for 61 patients whose surgery had been performed 5 or more years earlier, which could represent mature results. For locally advanced pancreatic body cancer (T3 or T4), the actual 5-year survival rate of 27.9 % seems to be a good result.

One reason for the good outcomes in the current series could have been the high R0 resection rate (92.5 %). Because pancreatic body cancer tends to progress toward the dorsal side, infiltrating arteries and retroperitoneal tissue, en bloc resection of as much tissue as possible, including the CA, the plexus around the SMA, bilateral ganglions, the left adrenal grand, and Gerota fascia is required to achieve R0 resection. We believe that excision of the CA itself is not a goal of DP-CAR, but complete dissection of retroperitoneal tissue combined with CA is important to achieve a high R0 rate. From the standpoint of dissecting the retroperitoneal tissue, our approach has almost the same concept as posterior radical antegrade modular pancreatosplenectomy (posterior RAMPS),[23] which includes dissection of the left side of the SMA and CA to the level of the aorta and the left adrenal gland, with the left renal fascia and the distal pancreas combined.

Strasberg et al.[24] showed good long-term results (actual 5-year survival of 30.4 %) using the RAMPS procedure for pancreatic body cancer. They also showed that 42 (89.3 %) of 47 patients had negative tangential margins. Their cohort included fewer cases of pathologic T4 tumor (1 of 47) than the current series (30 of 80), but the R0 rate and the actual survival rate were similar. On the other hand, Takahashi et al.[25] showed that DP-CAR did not improve long-term survival (MST, 9.7 months) due to the high rate of R1 resection (44 %). These data suggest that DP-CAR should be performed only when R0 resection can be achieved by precise assessment of preoperative diagnostic imaging.

Our indications for DP-CAR consisted of the two following criteria: (1) tumor involving or touching the CHA and/or the CA with at least a 5–7-mm cancer-free margin to be ligated at its origin from the aorta and (2) tumor close to the root of the splenic artery within 10 mm without involving either the CHA or CA. The first criterion is used mostly for T4 tumor, and the distance from the tumor edge on the CA to the aorta is quite important to keep the surgical margin free in the CA stump. The latter criterion is used mostly for T3 tumor, which may cause a positive margin in the splenic arterial stump if conventional distal pancreatectomy is performed. Because these criteria and surgical procedures were consistent through the study period, a high R0 rate could be achieved. For pT3 tumor, DP-CAR resulted in a better long-term survival, with an

MST of 45.1 months. Hence, patients with T3 tumor might be better candidates for DP-CAR as a preemptive strategy.

Previous reports showed that the mortality rate for DP-CAR varied from 0 to 18 %.[22] The in-hospital mortality rate of 5 % in the current study could not be overlooked because it was worse than that of 2.8 % for pancreaticoduodenectomy provided from the Japanese national clinical database.[26] Therefore, DP-CAR should be performed in a high-volume center of pancreatic surgery after appropriate informed consent has been obtained from each patient.

Concerning morbidity, ischemic gastritis occurred for 28.8 % of the patients, which might cause delayed gastric emptying. The left gastric artery has been embolized concomitantly with CHA since 2007, but, ischemic gastritis has continued to occur at the same rate. The incidence of ischemic gastritis could be related to the anatomic characteristics of the stomach's arterial flow in each patient. Okada et al.[27] reported that a modification of the DP-CAR procedure with preservation of the left gastric artery could prevent ischemic gastritis. Although the result of the modified DP-CAR seems excellent for gastric function, the procedure should be limited to tumor located far from the left gastric artery. To prevent ischemic gastritis, further modification should be necessary, such as reconstruction of the left gastric artery.

Despite the surgical aggressiveness of DP-CAR, approximately half of the patients experienced recurrent disease. In particular, hepatic recurrence was found a median of 5 months after surgery. We previously reported a preoperative prognostic scoring system using three variables to predict good a prognosis for patients with locally advanced pancreatic body cancer[12]: (1) preoperative platelet counts ($>150 \times 10^9$/L), (2) C-reactive protein levels (<0.4 mg/dL), and (3) preoperative carbohydrate antigen 19-9 (CA19-9) levels (<300 U/mL) The scoring system could help surgeons to select appropriate candidates for DP-CAR. Baumgartner et al.[28] reported that 11 patients underwent DP-CAR after completing neoadjuvant chemoradiation therapy and achieved a median overall survival of 26 months. A limitation of their study was its small sample size, including censored cases. Both the report of Baumgartner et al.[28] and our study (in Fig. 3) show that DP-CAR with preoperative treatment resulted in an extremely good prognosis. Based on the current study, with selection of patients who have no potential systemic disease such as liver metastasis, at least 5 months of preoperative therapy is recommended for locally advanced pancreatic body cancer.

CONCLUSIONS

The findings show that DP-CAR is a valid procedure for treating locally advanced pancreatic body cancer and might be particularly beneficial as part of multidisciplinary treatment.

DISCLOSURE None.

REFERENCES

1. Hishinuma S, Ogata Y, Matsui J, et al. Two cases of cancer of the pancreatic body undergoing gastric preservation with distal pancreatectomy combined with resection of the celiac axis (in Japanese with an English abstract). *Jpn J Gastroenterol Surg*. 1991;24:2782–6.
2. Mayumi T, Nimura Y, Kamiya J, et al. Distal pancreatectomy with en bloc resection of the celiac artery for carcinoma of the body and tail of the pancreas. *Int J Pancreatol*. 1997;22:15–21.
3. Konishi M, Kinoshita T, Nakagori T, et al. Distal pancreatectomy with resection of the celiac axis and reconstruction of the hepatic artery for carcinoma of the body and tail of the pancreas. *Hepatobiliary Pancreat Surg*. 2000;7:183–7.
4. Kondo S, Katoh H, Hirano S, et al. Results of radical distal pancreatectomy with en bloc resection of the celiac artery for locally advanced cancer of the pancreatic body. *Langenbecks Arch Surg*. 2003;388:101–6.
5. Hishinuma S, Ogata Y, Tomikawa M, et al. Stomach-preserving distal pancreatectomy with combined resection of the celiac artery: radical procedure for locally advanced cancer of the pancreatic body. *J Gastrointest Surg*. 2007;11:743–9.
6. Hirano S, Kondo S, Hara T, et al. Distal pancreatectomy with en bloc celiac axis resection for locally advanced pancreatic body cancer: long-term results. *Ann Surg*. 2007;246:46–51.
7. Appleby LH. The coeliac axis in the expansion of the operation for gastric carcinoma. *Cancer*. 1953;6:704–7.
8. Nimura Y, Hattory T, Miura K, et al. A case of advanced carcinoma of the body and tail of the pancreas resected by the Appleby operation (in Japanese). *Operation*. 1976;30:885–9.
9. Kimura W, Han I, Furukawa Y, et al. Appleby operation for carcinoma of the body and tail of the pancreas. *Hepatogastroenterology*. 1997;44:387–93.
10. Miyakawa S, Horiguchi A, Hanai T, et al. Monitoring hepatic venous hemoglobin oxygen saturation during Appleby operation for pancreatic cancer. *Hepatogastroenterology*. 2002;49:817–21.
11. Yamaguchi K, Nakano K, Kobayashi K, et al. Appleby operation for pancreatic body-tail carcinoma: report of three cases. *Surg Today*. 2003;33:873–8.
12. Miura T, Hirano S, Nakamura T, et al. A new preoperative prognostic scoring system to predict prognosis in patients with locally advanced pancreatic body cancer who undergo distal pancreatectomy with en bloc celiac axis resection: a retrospective cohort study. *Surgery*. 2014;155:457–67.
13. Kondo S, Katoh H, Shimizu T, et al. Preoperative embolization of the common hepatic artery in preparation for radical pancreatectomy for pancreas body cancer. *Hepatogastroenterology*. 2000;47:1447–9.
14. Kondo S, Katoh H, Hirano S, et al. Ischemic gastropathy after distal pancreatectomy with celiac axis resection. *Surg Today*. 2004;34:337–40.
15. Abo D, Hasegawa Y, Sakuhara Y, et al. Feasibility of a dual microcatheter–dual interlocking detachable coil technique in preoperative embolization in preparation for distal pancreatectomy with en bloc celiac axis resection for locally advanced pancreatic body cancer. *J Hepatobiliary Pancreat Sci*. 2012;19:431–7.
16. Tanaka E, Hirano S, Tsuchikawa T, et al. Important technical remarks on distal pancreatectomy with en-bloc celiac axis

resection for locally advanced pancreatic body cancer (with video). *J Hepatobiliary Pancreat Sci*. 2012; 19:141–7.
17. Kondo S, Ambo Y, Katoh H, et al. Middle colic artery-gastroepiploic artery bypass for compromised collateral flow in distal pancreatectomy with celiac artery resection. *Hepatogastroenterology*. 2003;50:305–7.
18. Kato K, Kondo S, Hirano S, et al. Adjuvant surgical therapy for patients with initially unresectable pancreatic cancer with long-term favorable responses to chemotherapy. *J Hepatobiliary Pancreat Sci*. 2011;18:712–6.
19. Sobin LH, Gospodarowicz MK, Wittekind Ch (eds). *TNM Classification of Malignant Tumours.* 7th ed. Wiley-Blackwell, Oxford, 2009.
20. Bassi C, Dervenis C, Butturini G, et al. International Study Group on Pancreatic Fistula Definition. Postoperative pancreatic fistula: an international study group (ISGPF) definition. *Surgery*. 2005;138:8–13.
21. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg*. 2009;250:187–96.
22. Zhou YM, Zhang XF, Li XD, et al. Distal pancreatectomy with en bloc celiac axis resection for pancreatic body–tail cancer: is it justified? *Med Sci Monit*. 2014;20:1–5.
23. Strasberg SM, Drebin JA, Linehan D. Radical antegrade modular pancreatosplenectomy. *Surgery*. 2003;133:521–7.
24. Mitchem JB, Hamilton N, Gao F, et al. Long-term results of resection of adenocarcinoma of the body and tail of the pancreas using radical antegrade modular pancreatosplenectomy procedure. *J Am Coll Surg*. 2012;214:46–52.
25. Takahashi Y, Kaneoka Y, Maeda A, et al. Distal pancreatectomy with celiac axis resection for carcinoma of the body and tail of the pancreas. *World J Surg*. 2011;35:2535–42.
26. Kimura W, Miyata H, Gotoh M, et al. A pancreaticoduodenectomy risk model derived from 8575 cases from a national single-race population (Japanese) using a web-based data entry system: the 30-day and in-hospital mortality rates for pancreaticoduodenectomy. *Ann Surg*. 2014;259:773–80.
27. Okada K, Kawai M, Tani M, et al. Preservation of the left gastric artery on the basis of anatomical features in patients undergoing distal pancreatectomy with celiac axis en bloc resection (DP-CAR). *World J Surg*. 2014;38:2980–5.
28. Baumgartner JM, Krasinskas A, Daouadi M, et al. Distal pancreatectomy with en bloc celiac axis resection for locally advanced pancreatic adenocarcinoma following neoadjuvant therapy. *J Gastrointest Surg*. 2012;16:1152–9.