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Initial experience with radical antegrade modular pancreatosplenectomy in a single institution

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Purpose: Radical antegrade modular pancreatosplenectomy (RAMPS) is expected to be favorable for obtaining the negative tangential margin with oncologic feasibility through the horizontal dissection in a right-to-left fashion for radical lymph node dissections.
Methods: From January 2007 to February 2015, a total of 30 RAMPS and 19 conventional distal pancreatectomy (DP) cases were enrolled. The demographics, perioperative and survival outcomes were compared according to the type of surgery.
Results: The mean operative time, blood loss and length of hospital stay were similar between 2 groups. Morbidities were reported in 14 cases of RAMPS (46.7%) and 8 cases of DP (42.1%) (P = 0.777). The rate of negative tangential margin (96.2%) and the number of harvested lymph nodes (mean ± standard deviation, 21.5 ± 8.3) were significantly higher in RAMPS group (P = 0.011, P = 0.003, respectively). In terms of survival outcomes, there was no significant difference in regard to the overall 3-year disease-free survival (DFS; 30.4% in RAMPS *vs.* 35.0% in DP, P = 0.354) or overall survival (OS; 29.9% *vs.* 29.4%, P = 0.429) between the 2 groups. After exclusion of cases with nodal invasion, however, the RAMPS group had a longer DFS than the DP group (55.6% *vs.* 27.3%, P = 0.048) although OS was similar without significant difference (42.4% *vs.* 27.3%, P = 0.197).
Conclusion: RAMPS is a safe and oncologically feasible procedure in left-sided pancreatic cancer by obtaining a successful negative tangential margin and radical lymph node dissection. The authors suggest it could also be useful for local control, especially for the limited left-sided pancreatic cancer without nodal invasion.
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Key Words: Radical antegrade modular pancreatosplenectomy, Distal pancreatectomy, Left-sided pancreas cancer

INTRODUCTION

Body and tail cancer of the pancreas is an aggressive disease with poor prognosis caused by properties of tumor itself, such as the late presentation of clinical symptoms and the ease of invasion of major vessels or adjacent organs [1-3]. Although distal pancreatectomy (DP) has been the standard procedure for left-sided pancreatic cancer [4,5], the rate of recurrence is high even in patients who undergo surgery that might be caused by

the aggressive biology of the cancer [6,7].

Radical antegrade modular pancreatosplenectomy (RAMPS), originally described by Strasberg et al. [5], is a novel approach for left-sided pancreatic cancer that includes the horizontal dissection in a right-to-left fashion and radical dissection of regional lymph nodes based on an anatomical lymphatic drainage [5,8]. Recently studies reported RAMPS could achieve negative tangential margins with oncological feasibility and this procedure has been performed increasingly for locally advanced

left-sided pancreatic cancer for improving of tumor clearance and survival [5,7,9]. However, there are only a few reports designed to compare the surgical results according to the types of surgical approach.

This study was performed to assess our experience of RAMPS for pancreatic cancer and compare the surgical outcomes of RAMPS with the conventional open DP.

METHODS

### Patient population and data selection

From January 2007 to February 2015, 67 pancreatectomies for resectable left-sided pancreatic malignancy were performed at the Department of Surgery of Seoul St. Mary's Hospital. The authors had traditionally performed the conventional DP with splenectomy for left-sided pancreatic cancer and RAMPS was initially performed in May 2010; since then, it was consecutively applied. We preoperatively evaluated using abdominal computed tomography scans and magnetic resonance cholangiopancreatography to determine an accurate location of the cancer, and a positron emission tomography scan was used to detect distant metastasis. One cancer, which exceeded T4 stage or required major arterial resection including the celiac axis or the superior mesenteric artery, was excluded from this study. If there were direct invasions of adjacent organs including the stomach, adrenal gland, or kidney, we concomitantly resected the invaded organs, and these cases were included. Thirty cases of RAMPS and 19 cases of conventional open DP were enrolled. All patients underwent the adjuvant concurrent chemoradiotherapy according to the policy of our institution, but none of the patients who underwent neoadjuvant chemotherapy or radiation therapy were involved in the study. All data were retrospectively reviewed: age, sex, American Society of Anesthesiologists (ASA) class, perioperative results, tumor characteristics and survival data from the outpatient department. Tumor characteristics were collected from the permanent pathology report. The transection surface at the neck of pancreas and all tangential margins of the specimen, which were not covered with peritoneum, i.e., the posterior surface and the superior and inferior border of specimen, were both painted with ink in the operating room after retrieving the specimen from the back table. The resection margin at the neck of the pancreas was sent for processing as a frozen section to clarify the cleanness of proximal margin. The anterior surface of pancreas was not inked, and the tumor penetration of the anterior peritoneum of pancreas was not considered as positive if there was no evidence of tumor invasion to adjacent organs. Postoperative complications were graded from 0 to 5 using the system proposed by DeOliveira et al. [10]. Complications were also divided into two groups; the minor complications were defined as grade 1 or 2, and the major complications were

defined as grades 3 to 5. We evaluated the incidence of digestive trouble including prolonged diarrhea defined as loose stools lasted for at least 4 weeks. The definition of a postoperative pancreatic fistula (POPF) was based on the definition of the International Study Group of the Pancreatic Fistula [11]. Postoperative mortality was defined as the mortality that developed within 30 days of the operation or was within the same time of hospital stay. We compared these perioperative outcomes according to the type of surgery; RAMPS group versus DP group. For oncological analysis, the cumulative overall survival (OS) rate and the disease-free survival (DFS) rate were calculated using the Kaplan-Meier method. Additionally, the positivity of nodal status might implicate the progression of malignancy towards systemic disease, and the locoregional treatment including surgery has the limitations of curative effects. To more objectively evaluate the effect of surgery influencing the survival rate, cases without node invasion were carefully selected and the survival outcomes of these cases were reanalyzed according to the type of surgery.

Operative technique

Conventional DP was performed as follows. The patient had an upper midline incision and the lesser sac was entered through a gastrocolic ligament in order to expose the distal anterior pancreas. The dissection proceeded from left to right. The mobilization of spleen was initially performed, and then, the pancreas was dissected to the confluence of the superior mesenteric vein (SMV), portal vein (PV) and splenic vein (SV) which facilitated the full mobilization of distal pancreas. After splenic vessels were ligated at the origin, the pancreas neck transection was performed by electrocautery allowing an adequate margin from the tumor of at least 1 cm. The pancreas stump was closured with a continuous suture using prolene #4-0.

RAMPS was performed according to the procedure introduced by Strasberg and Fields [9]. A long midline incision was made and the pancreas neck was elevated from the PV and SMV. We created a window between the pancreas and a confluence of the SMV, the PV and the SV. The pancreas neck was transected and the repair of resection margin was performed in the same way as conventional DP. The range of medial-to-lateral lymph node dissection was upward to the diaphragmatic crus, downward to the left renal vein, and to the left lateral portion of aorta on the posterior side. The dissection continued more laterally from right to the left on Gerota's fascia and divided the inferior mesenteric vein. In each case, the surgeon decided to perform the type of RAMPS, whether anterior or posterior, that would increase the chance of obtaining a negative tangential margin based on the principles described by Strasberg et al [5]. We concomitantly resected the adrenal gland in case of posterior RAMPS (Fig. 1) and the *en bloc* resection of surrounding organs
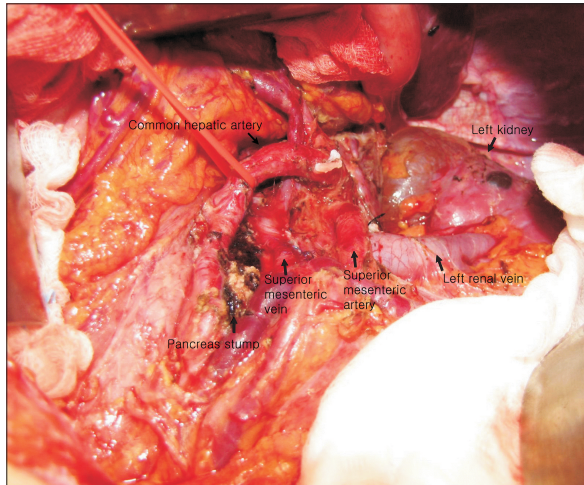
Fig. 1. View of posterior radical antegrade modular pancreatosplenectomy after the completion of the resection stage. The range of lymph node dissection included the lymphoid tissues upwards to the diaphragmatic crus, downwards to the left renal vein and the left lateral portion of the aorta on the posterior side.

was performed in case of extensive disease in which the tumor invaded adjacent organs. A closed suction drain was placed in the pancreas stump, and the abdomen was closed in layers.

Statistical analysis

Fisher exact test was conducted for categorical data and the Mann-Whitney U-test was used for continuous variables. Descriptive statistics were recorded as the means ± standard deviation and the 95% confidence interval of difference in proportions was calculated with a level of significance of 0.05.

RESULTS

Patient demographics and perioperative outcomes

During the study period, 30 RAMPS and 19 conventional DP were included. The demographics and perioperative outcomes according to the type of surgery are shown in Table 1. There were 20 men (40.8%) and 29 women (59.2%), and the mean age was 63.1 ± 8.3 years. There was no significant difference in terms of sex, age, BMI and ASA class. The mean operative time was 277.8 ± 55.6 minutes in RAMPS group and 253.3 ± 41.0 minutes in DP group (P = 0.127) and the mean estimated blood loss was 300 ± 220 mL in RAMPS group and 260 ± 180 mL in DP group (P = 0.086). The mean length of postoperative hospital stay was 6.4 ± 4.3 days in RAMPS group and 8.2 ± 3.3 days in DP group (P = 0.174). No postoperative mortality was observed in either group and postoperative complications were reported in 14 patients (46.7%) in RAMPS group and 8 patients (42.1%) in DP group (P = 0.777): 4 fluid collections, 5 atelectases, 2 wound infections, 2 postoperative ileuses, 2 prolonged diar-

rheas, and 6 POPFs. The grades of six cases of POPF (12.2%) were as follows: 4 POPFs (8.2%) were grade A, and 2 (4.1%) were grade B, whereas grade C POPF was not found. There was no significant difference in the incidence of POPF (13.3% in RAMPS group and 10.5% in DP group, P > 0.999). According to the grading system by DeOliveira et al. [10], 19 minor complications (11 cases in RAMPS group and 8 cases in DP group) and one major complication in RAMPS group were observed without a significant difference (P = 0.769 and P > 0.999, respectively).

Oncological outcomes

Of the 49 patients, 43 patients (87.8%) had been diagnosed with pancreas ductal adenocarcinoma (PDAC) in the permanent pathology. Four patients having neuroendocrine carcinoma in the pathologic report which usually has a better prognosis than PDAC, were excluded from the tumor analysis or survival assay. Two patients who had metastatic renal cell carcinoma were also excluded. Tumor differentiation is shown in Table 2. The distribution of tumor differentiation, the T stage and nodal status of cancer had no significant difference between the 2 groups (P > 0.999, P = 0.071, and P = 0.349, respectively); 14 cases in RAMPS group (53.8%) and 6 cases in DP group (35.3%) were positive for lymph node metastasis. The mean count of retrieving lymph nodes was 18.4 ± 8.8 with a significant difference between the 2 groups (P = 0.003): 21.5 ± 8.3 in RAMPS group and a 13.7 ± 7.4 mean count in DP group. The mean tumor size was 4.5 ± 1.5 cm: 4.6 ± 1.6 cm in RAMPS group and 4.5 ± 1.5 cm in DP group (P = 0.913). R0 resectability was achieved in 33 patients (76.7%) and a negative tangential margin was obtained in 36 patients (83.7%). In terms of negative tangential margin status, a significant difference was observed between the 2 groups (P = 0.011): 25 patients (96.2%) in RAMPS group, and 11 patients (64.7%) in DP group.

Survival and follow-up outcomes

Survival results are presented in Tables 3, 4. The median follow-up time was 33 months (range, 8–97 months), and 15 patients (34.9%) are still alive; 13 of 15 patients (86.7%) are alive without disease and 2 patients (13.3%) are alive with recurrent tumor. The mortality occurred from 7 to 51 months after surgery and the median survival was 26.0 ± 21.8 months; 27.5 ± 14.9 months in RAMPS group and 26.0 ± 29.2 months in DP group (P = 0.769). In the current study, 13 deaths (50%) and 8 recurrences (30.8%) developed in RAMPS group while 15 deaths (88.2%) and 8 recurrences (47.1%) occurred in DP group. The overall 1-, 2- and 3-year cumulative DFS after surgery was 86.1%, 60.9%, and 30.4% in RAMPS group whereas it was 52.4%, 52.4%, and 35.0% in DP group, respectively (P = 0.354). The 1-, 2-, and 3-year OS after surgery was 64.7%, 44.8%, and 29.9% in RAMPS group whereas it was 58.8%, 35.3%, and 29.4% in DP group, respectively (P = 0.429) (Fig. 2).

Table 1. Patient demographics and perioperative outcomes

Characteristic	Total (n = 49)	RAMPS group (n = 30)	DP group (n = 19)	P-value
Age (yr)	63.1 ± 8.3	63.7 ± 8.2	62.1 ± 8.5	0.503
Sex				
Male:female	20:29	13:17	7:12	0.769
Body mass index (kg/m^2)	22.5 ± 3.1	22.5 ± 3.3	22.6 ± 2.7	0.967
ASA class				>0.999
Class I	11 (22.4)	7 (23.3)	4 (21.1)	
Class II	21 (42.9)	13 (43.3)	8 (42.1)	
Class III	17 (34.7)	10 (33.3)	7 (36.8)	
Operative time (min)	270.8 ± 49.9	277.8 ± 55.6	253.3 ± 41.0	0.127
Estimated blood loss (mL)	280 ± 130	300 ± 220	260 ± 180	0.086
Intraoperative transfusion (%)	23 (46.9)	15 (50)	8 (42.1)	0.770
Postoperative pain[a]				
POD 1	5.0 ± 1.8	4.7 ± 1.8	5.4 ± 1.8	0.223
POD 3	4.0 ± 1.9	4.2 ± 1.9	3.8 ± 1.9	0.554
POD 7	1.5 ± 0.9	1.8 ± 1.0	1.3 ± 0.7	0.127
Postoperative hospital stay (day)	7.3 ± 3.9	6.4 ± 4.3	8.2 ± 3.3	0.174
ICU stay (day)	1.4 ± 0.5	1.5 ± 0.5	1.3 ± 0.6	0.448
Start of soft diet (day)	4.1 ± 0.8	4.1 ± 0.7	4.1 ± 0.8	0.692
Overall complications	22 (44.9)	14 (46.7)	8 (42.1)	0.777
Fluid collection	4 (8.2)	3 (10)	1 (5.3)	0.649
Atelectasis	5 (10.2)	3 (10)	2 (10.5)	>0.999
Wound infection	2 (4.1)	2 (6.7)	0 (0)	0.515
Ileus	2 (4.1)	0 (0)	2 (10.5)	0.145
Prolonged diarrhea	2 (4.1)	1 (3.3)	1 (5.3)	>0.999
Fever	1 (2)	1 (3.3)	0 (0)	>0.999
POPF	6 (12.2)	4 (13.3)	2 (10.5)	>0.999
Grade A	4 (8.2)	3 (10)	1 (5.3)	
Grade B	2 (4.1)	1 (3.3)	1 (5.3)	
Grade C	0 (0)	0 (0)	0 (0)	0.777
Complication grade[b]				>0.999
Grade I	14 (28.6)	9 (30)	5 (26.3)	
Grade II	7 (14.3)	4 (13.3)	3 (15.8)	
Grade III	1 (2.0)	1 (3.3)	0 (0)	
Minor complications[c]	21 (42.9)	13 (43.3)	8 (42.1)	0.769
Major complications[c]	1 (2.0)	1 (3.3)	0 (0)	>0.999

Values are presented as mean ± standard deviation or number (%).
RAMPS, radical antegrade modular pancreatosplenectomy; DP, distal pancreatectomy; ASA, American Society of Anesthesiologists; POD, postoperative day; ICU, intensive care unit; POPF, postoperative pancreatic fistul.
[a]Estimated by visual analog scale. [b]System of grading complications by DeOliveira et al. [10]. In this system, grade I complications require antipyretics, diuretics or basic monitoring without pharmacologic treatment, surgical, endoscopic, and radiological interventions. Grade II complications require pharmacologic treatment with blood transfusion, total parenteral nutrition or drugs such as intravenous medications. Grade III complications require surgical, endoscopic, or radiologic intervention. Grade IV complications are life-threatening complications including organ dysfunction or central nervous system complications requiring ICU management. Grade V complications result in death. [c]In the system of grading complications by DeOliveira et al. [10], grades 1 and 2 are considered as minor and grades 3 to 5 are defined as major complications.

After the exclusion of cases with nodal invasion, 23 N0 cases (12 cases in RAMPS group and 11 cases in DP group) were reanalyzed. Among them, the overall 1-, 2-, and 3-year DFSs in RAMPS group were 100%, 83.3%, and 55.6% whereas there were 54.5%, 54.5%, and 27.3% in DP group, respectively (P = 0.048). The overall 1-, 2-, and 3-year OSs were 70.7%, 56.6%, and 42.4% in RAMPS group whereas they were 63.6%, 36.4%, and 27.3% in DP group, respectively (P = 0.197). Survival outcomes according to the type of surgery in N0 cases are shown in Fig. 2.

DISCUSSION

In conventional DP, the left-to-right dissection and the late ligation of splenic vessels followed by the mobilization of pancreas were usually performed. Contrary to this, the right-to-left dissection of the plane and the early ligation of

Table 2. Oncologic outcome and survival analysis

Characteristic	Total (n = 43)	RAMPS group[a] (n = 26)	DP group[b] (n = 17)	P-value
Tumor differentiation				>0.999
Well differentiated	5 (11.6)	3 (11.5)	2 (11.8)	
Moderately differentiated	34 (79.1)	21 (80.8)	13 (76.5)	
Poorly differentiated	4 (9.3)	2 (7.7)	2 (11.8)	
T stage				0.071
T2	5 (11.6)	1 (3.8)	4 (23.5)	
T3	38 (88.4)	25 (96.2)	13 (76.5)	
N stage				0.349
N0	23 (53.5)	12 (46.2)	11 (64.7)	
N1	20 (46.5)	14 (53.8)	6 (35.3)	
TNM staging				0.069
Stage IB	3 (7)	0 (0)	3 (17.6)	
Stage IIA	20 (46.5)	12 (46.2)	8 (47.1)	
Stage IIB	20 (46.5)	14 (53.8)	6 (35.3)	
Tumor size (cm)	4.5 ± 1.5	4.6 ± 1.6	4.5 ± 1.5	0.913
Count of retrieving lymph node	18.4 ± 8.8	21.5 ± 8.3	13.7 ± 7.4	0.003
R0 resection	33 (76.7)	22 (84.6)	11 (64.7)	0.158
Negative tangential margin	36 (83.7)	25 (96.2)	11 (64.7)	0.011
Recurrence	16 (37.2)	8 (30.8)	8 (47.1)	0.343
Metastasis	22 (51.2)	11 (42.3)	11 (64.7)	0.215

Values are presented as number (%) or mean ± standard deviation.
RAMPS, radical antegrade modular pancreatosplenectomy; DP, distal pancreatectomy.
[a]Two patients who had neuroendocrine carcinoma and two who had metastatic renal cell carcinoma were excluded in this analysis. [b]Two patients who had neuroendocrine carcinoma were excluded in this analysis.

Table 3. Disease-free survival and overall survival according to surgical procedure in 43 PDAC patients: RAMPS *vs*. DP

Surgical procedure	No.	Disease-free survival (%)				Overall survival (%)			
		1 yr	2 yr	3 yr	P-value	1 yr	2 yr	3 yr	P-value
RAMPS	26	86.1	60.9	30.4	0.354	64.7	44.8	29.9	0.429
DP	17	52.4	52.4	35.0		58.8	35.3	29.4	
Total	43	72.6	58.3	33.3		62.2	41.7	29.6	

PDAC, pancreas ductal adenocarcinoma; RAMPS, radical antegrade modular pancreatosplenectomy; DP, distal pancreatectomy.

Table 4. Disease-free survival and overall survival according to surgical procedure in 23 PDAC patients without nodal invasion: RAMPS *vs*. DP

Surgical procedure	No.	Disease-free survival (%)				Overall survival (%)			
		1 yr	2 yr	3 yr	P-value	1 yr	2 yr	3 yr	P-value
RAMPS	12	100	83.3	55.6	0.048	70.7	56.6	42.4	0.197
DP	11	54.5	54.5	27.3		63.6	36.4	27.3	
Total	23	79.5	70.7	42.4		67.5	47.2	34.4	

PDAC, pancreas ductal adenocarcinoma; RAMPS, radical antegrade modular pancreatosplenectomy; DP, distal pancreatectomy.

splenic vessels were used in RAMPS. Because the surgeon can gradually dissect the inferior border of pancreas under direct view in a state of being apart from the tumor, RAMPS might be favorable to achieve a negative tangential margin. The body and tail of pancreas is located within the pararenal space, which lies between the peritoneum and anterior renal fascia. The kidney and adrenal gland are placed within the perirenal space, which lies behind the anterior renal fascia and in front
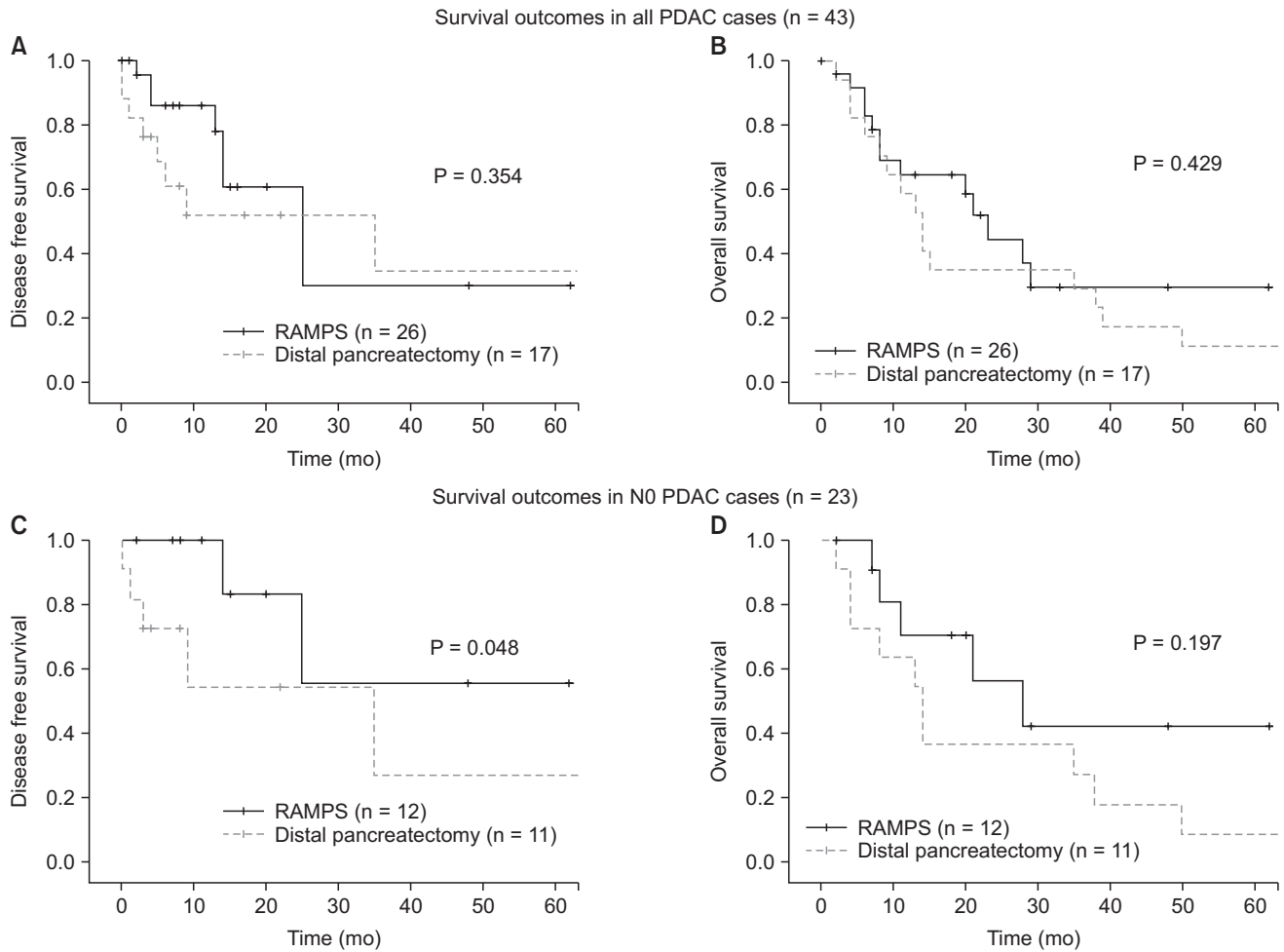
Fig. 2. A Kaplan-Meier survival curve of radical antegrade modular pancreatosplenectomy (RAMP) and distal pancreatectomy in all pancreas ductal adenocarcinoma (PDAC) cases (n = 43) and in PDAC cases without nodal invasion (n = 23); disease-free survival (A, C) and overall survival rate (B, D).

of a layer named the posterior renal fascia. In conventional DP, the dissection plane is usually placed just behind the posterior capsule of pancreas and in front of the anterior renal fascia. The operator usually lifts up the spleen located in the rib cage, and that motion causes an expressive force on the posterior part of pancreas. Therefore, the dismounting of the posterior aspect of pancreas can commonly occur in conventional DP, and it causes failure of obtaining a negative tangential margin. Making the correct posterior dissection plane is very important for the pancreatic cancer because the posterior margin is the most common site of remnant tumor cells which means R1 resection. Therefore, the right-to-left dissection of RAMPS is advantageous in order to secure the sufficient margin, especially in the posterior plane rather than the conventional DP. In our study, the negative rate of tangential margin was 96.2% in RAMPS group which was higher than those in DP group (64.7%, P = 0.011). These results were better than the reported negative tangential margin rate of conventional DP and also comparable with previous reports using RAMPS, i.e., 91% in the study of Strasberg et al. [5,7] and 91.7% in the study of Chang et al. [6].

Radical dissection and sufficient harvest of lymph nodes are another main goal of RAMPS. In RAMPS procedure, the lymph nodes dissection has been performed on the basis of anatomic lymph node drainage of distal pancreas reviewed by O'Morchoe [8]. The regional lymph nodes including gastrosplenic nodes, infrapancreatic nodes and splenic nodes were removed and the three lymph node groups including the gastroduodenal node and lymph nodes along the superior and inferior border of the pancreas were also eliminated in RAMPS. In our study, the mean counts of retrieved lymph nodes were higher in RAMPS group with a significant difference (P = 0.003). We suppose our results might suggest the superiority of the RAMPS over the conventional DP in terms of oncologic feasibility including the negative rate of tangential margin and the radical dissection of lymph nodes.

Additionally, pancreatic cancer easily invades adjacent organs

and major blood vessels. In RAMPS, the operator can achieve the *en bloc* resection without a transection of the tumor or separation of main mass from adjacent organs through gradual dissection. Although our data did not contain the actual invasion rate of adjacent organs on the permanent pathologic reports, authors suppose RAMPS could provide more opportunities for local treatment and curative resection for locally advanced pancreatic cancer with organ invasion.

In our study, the overall 1-, 2-, and 3-year DFS and OS after surgery showed no significant difference between the 2 groups. However, the N1 status would suggest the advancement of malignant cells beyond pancreas that progresses toward systemic disease. In such cases, the locoregional treatment including surgery has the limited effect for eradication of disease, and the great possibility of recurrence cannot be avoided even after achieving radical surgery. Therefore, we excluded the case having nodal invasion and recalculated the DFS and OS. The re-estimated DFS was significantly higher in RAMPS group although the recalculated OS had similar results between the 2 groups. The authors suppose, with prudence, that the advantage of RAMPS including the obtained negative tangential margin and radical lymph node dissection can be helpful in providing more curative chances for patients who have localized pancreatic cancer to have the cancer confined within the pancreas or adjacent tissues.

Although the RAMPS operation has many advantages as previously described, there are still many concerns about the invasiveness of operation due to its radical nature and unaccustomed procedures. However, our results for the RAMPS were comparable with the perioperative outcomes for conventional DP. 18 patients (46.2%) experienced postoperative morbidities without significant difference. Especially in terms of gastrointestinal (GI) trouble, severe diarrhea might be the one of serious worries that can occur after RAMPS. Several surgeons have concerned about this because RAMPS is routinely accompanied by complete dissection of the celiac axis and SMA lymph nodes that could lead to resection of the celiac ganglions and the nerve plexus around the SMA. These splanchnic nerves are sympathetic that stabilize bowel motility and secretion of bowel mucosa, and the loss of nerve plexuses during RAMPS could result in prolonged diarrhea that subsequently deteriorates the postoperative quality of life. Therefore, it can be reasons that cause surgeons hesitant to perform this operation. In our study, however, there was no significant difference of GI trouble between the 2 groups, and it could be controlled by antidiarrheal agents without additional procedures. Authors suppose these results might be associated with preservation of intestinal continuity even after an operation. RAMPS has preserved the duodenum and maintained the intestinal continuity, and the patients who underwent RAMPS could maintain the secretion of duodenal hormones such as secretin or cholecystokinin, and the intrinsic innervations could also control the secretion and motility of small intestine [12-14]. Our results about morbidities suggest RAMPS would be a safe and tolerable procedure as well as the conventional DP.

The results of this study should be carefully interpreted because of their limitations. Since we retrospectively reviewed cases, the 2 groups could be not exactly comparable and selection bias could be not avoided. In addition, this study had a weak power of statistical significance due to the small size of cases. The authors suppose the minimizing of bias through a large-sized randomized controlled prospective study and the recruiting of long-term follow-up data should be achieved. In conclusion, we obtained not only the successful negative tangential margins and radical lymph node dissection but also feasible outcomes for postoperative morbidities in RAMPS group. Moreover, DFS in the case without nodal invasion was better in RAMPS group, which implicates RAMPS is useful for local control especially for the limited left-sided pancreas cancer without nodal invasion. Therefore, authors suggest the surgical approach for RAMPS would be safe and oncologically feasible in left-sided pancreatic cancer. Further prospective, well-designed trials with a large number of samples are required to confirm our results.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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