

# Surgical management and results for cystic neoplasms of pancreas

Kyung Won Han<sup>1</sup>, Ryun Ha<sup>1</sup>, Kun Kuk Kim<sup>1</sup>, Jung Nam Lee<sup>1</sup>,  
Yeon Suk Kim<sup>2</sup>, Yang Seo Koo<sup>2</sup>, and Yeon Ho Park<sup>1</sup>

*Departments of <sup>1</sup>Surgery and <sup>2</sup>Internal Medicine, Gachon University Gil Medical Center, Incheon, Korea*

**Backgrounds/Aims:** The diagnosis for cystic neoplasm of pancreas is based on the morphologic criteria through imaging studies, but the pre- and postoperative diagnoses are often inconsistent. This study aims at the analysis of clinical characteristics and the results of surgical treatments. **Methods:** A retrospective review was performed on 93 patients who have undergone surgery for pancreatic cystic diseases in our hospital from January 2001 to February 2013. Among them, 69 patients were confirmed as cystic neoplasms based on pathologic findings. Their clinical manifestations, diagnostic accuracy, surgical method and complications, pathologic findings were analyzed. **Results:** Serous cystic neoplasm was the most common (n=22), followed by mucinous cystic neoplasm (n=18), intraductal papillary mucinous tumor (n=11), solid pseudopapillary tumor (n=9), neuroendocrine tumor (n=7), and cystic lymphangioma (n=2). The most common clinical symptom is abdominal pains (49.3%). Preoperative imaging studies were consistent with pathological findings in 72% of patients. Cystic fluid CEA levels of 400 ng/ml or more were reliable to detect mucin secreting tumors. Pancreatoduodenectomy was performed for 13 cases and the remaining 54 patients were treated with left-side pancreatectomy. Malignancy was found in 9 cases (13%) of mucin secreting tumors; 5 cases (27.8%) in mucinous cystic neoplasm and 4 cases (36.4%) in intraductal papillary mucinous tumor. Two of these survived without recurrences during the follow-up periods. **Conclusions:** Exact treatment protocols for cystic neoplasm of pancreas are not decided because tumors are found with atypical forms. Surgical management is suggested for resectable tumors because a good prognosis can be expected with proper surgery if precancerous lesions are suspected at the time of discovery. (*Korean J Hepatobiliary Pancreat Surg 2013;17:118-125*)

**Key Words:** Cystic neoplasm of pancreas; Malignancy; Surgical management

## INTRODUCTION

Cystic neoplasm of pancreas is a rare disease accounting for about 10-15% of cystic disease diagnosed in the pancreas. Among these, malignant cancer accounts for approximately 1% of the entire pancreas malignant cancer and shows significantly different prognosis from pancreatic adenocarcinoma. Since the most common serous cystadenoma and mucinous cystic tumor were identified by Compagno and Oertel, varieties of other forms have been reported. As the cystic neoplasms of pancreas, which does not have obvious clinical symptoms and has a relatively late onset of symptoms, is increasingly discovered owing to the health screening examination, recently. The establishment of the treatment protocol in accordance with the

natural history of the tumors has been an emerging issue. The preoperative diagnosis of patients is based on morphologic criteria through imaging studies, but preoperative and postoperative diagnoses are often inconsistent despite the development of various imaging techniques. Some of the cystic neoplasms of pancreas are precancerous lesion that requires surgical resection and sometimes progress to malignant cancer during follow-up; the prognosis of these patients is known to be relatively poor. Therefore, studies are needed on how to identify each tumor accurately and whether it is benign or malignant.

## METHODS

Subjects were 93 patients who have undergone surgery

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**Corresponding author:** Yeon Ho Park

Department of Surgery, Gachon University Gil Medical Center, 1198, Guwol-dong, Namdong-gu, Incheon 405-760, Korea  
Tel: +82-32-460-8418, Fax: +82-32-460-3247, E-mail: pyh@gilhospital.com

for pancreatic cystic diseases at Department of Surgery, Gil Medical Center, Gachon University from January 2001 to February 2013. Medical records were retrospectively reviewed on the 69 patients who were confirmed as cystic neoplasm, excluding the 24 patients who were confirmed with pseudocyst by pathologic examinations after surgery. The review included: patient's age, symptoms at diagnosis, pre- and post-operative clinical examinations, cystic fluid analysis in the neoplasm, diagnostic accuracy through pre- and post-operative imaging studies, surgical method and complications, pathologic findings, malignant cancer frequency, and the prognosis of these patients. Statistical analysis was conducted using SPSS 17.0 for Windows. Differences between the patient groups were compared by Chi-square test and ANOVA test in continuous variables. Statistical significance was determined based on  $p$ -value < 0.05. Postoperative follow-up period was 2-116 months and median follow-up period was 32 months.

## RESULTS

### Distribution and characteristics of patients

Among the 114 patients who underwent surgery from cystic disease of the pancreas, 93 patients were finally selected excluding the patients with complications of pseudocyst from the first intent of surgery. Patients who were diagnosed with cystic neoplasm in preoperative states, 24 patients were confirmed as pseudocyst by pathologic examination. The 69 patients whose final diagnosis was cystic neoplasms of pancreas had mean age of 57.4 years (range 20-78); women accounted for the majority of 50 patients (72.4%). Serous cystic neoplasm was the most common diagnosis (22), followed by mucinous cystic neoplasm (18), intraductal papillary mucinous tumor (11), solid pseudopapillary tumor (9), neuroendocrine tumor (7), and cystic lymphangioma (2). The age distribution did not show a statistically significant difference among patient groups, but patient group with solid pseudopapillary tumor showed youngest age than other groups. Unusually, intraductal papillary mucinous tumor occurred more in the males (Table 1).

### Clinical manifestations

Abdominal pain (49.3%) is the most common clinical

symptom. Eighteen patients (26.1%) have been found incidentally through a health screening without any symptoms, and 7 patients (10.1%) had gastrointestinal symptoms such as nausea, vomiting, and dyspepsia. Other 6 patients (8.7%) were diagnosed with cystic neoplasms of pancreas after imaging tests from urinary symptoms such as hematuria or frequent urination (Table 2).

### Location and size of cystic neoplasms

The tumors were found in the pancreatic head (18), body and neck (26) and tail (18), with 51 (73.9%) cases at body and tail, which are left of the portal vein. Serous cystic neoplasms were located evenly at the head, body and tail in 7, 8 and 7 cases, respectively; mucinous cystic neoplasms, at head, body and tail in 4, 8 and 6 cases, respectively. Intraductal papillary mucinous tumors were frequently found in proximal pancreas including head (6 cases) and body and neck (5), while solid pseudopapillary tumors were found in distal pancreas only at the body (3) and tail (6). The size of each group showed no statistically significant differences and the average size are being distributed in the range from 5.0 to 7.0 cm (Table 3).

### Accuracy of preoperative imaging studies

Most recommended diagnosis of disease through preoperative ultrasound, CT or MRI, and the endoscopic ultrasounds were compared with the final pathologic findings. 72% of the diagnoses were consistent with

**Table 1.** Characteristics of pancreatic cystic neoplasm

	No. of patients	Mean age (yr, range)	Gender (M : F)
SCN	22	56.7 (36-78)	7 : 15
MCN	18		
Benign	13	54.7 (38-65)	1 : 12
Malignant	5	67.6 (45-79)	2 : 3
IPMN	11		
Noninvasive*	7	68.1 (58-77)	4 : 3
Invasive	4	70.5 (65-75)	2 : 2
SPT	9	45.0 (20-70)	1:8
NET	7	59.0 (50-74)	1 : 7
CL	2	51.5 (33, 70)	1 : 1
Total	69	57.4 (20-78)	19 : 50

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm; SPT, solid pseudopapillary tumor; NET, neuroendocrine tumor; CL, cystic lymphangioma

\*Including borderline tumors

**Table 2.** Clinical manifestations of pancreatic cystic neoplasm

	SCN (n=22)	MCN (n=18)	IPMN (n=11)	SPT (n=9)	NET (n=7)	CL (n=2)	Total (n=69)
Abdominal pain	13	6	6	6	2	1	34
Indigestion		4					4
Nausea/vomiting	1	1			1		3
Incidental findings (asymptomatic)	7	4	2	2	2	1	18
Palpable mass					1		1
Urologic symptoms (hematuria/frequency)		1	3	1	1		6
Hematochezia	1						1
Fever/chill		2					2

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm; SPT, solid pseudopapillary tumor; NET, neuroendocrine tumor; CL, cystic lymphangioma

**Table 3.** Locations and sizes of pancreatic cystic neoplasm

	Head	Neck, body	Tail	Mean size (cm, range)
SCN	7	8	7	5.2 (2.2-14.0)
MCN				
Benign	3	6	4	7.0 (2.0-15.5)
Malignant	1	2	2	6.9 (1.2-7.9)
IPMN				
Noninvasive	3	4	0	5.2 (1.7-12.0)
Invasive	3	1	0	5.8 (1.2-7.5)
SPT	0	3	6	6.2 (2.7-11.0)
NET	1	2	4	6.3 (2.3-14.0)
CL	0	0	2	5, 11.5
Total	18	26	25	6.0 (1.2-15.5)

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm; SPT, solid pseudopapillary tumor; NET, neuroendocrine tumor; CL, cystic lymphangioma

pathological findings. Distinguishing percentages were the lowest between pseudocyst and serous cystic neoplasm, and also between serous and mucinous cystic neoplasm. Among the 16 patients diagnosed with serous cystic neoplasm in preoperative imaging studies, 12 patients (75%) matched the pathology. Among the 22 patients who had the diagnosis of mucinous cystic neoplasm, 13 patients (59%) matched with the pathology and 8 patients (36.4%) were finally diagnosed with serous cystic neoplasm. Of the 12 patients who were diagnosed with intraductal papillary mucinous tumor, 10 patients (83%) were consistent with the pathology and 2 patients were diagnosed with serous cystic tumor. The four patients who were suspected of neuroendocrine tumors before surgery were diagnosed the same in pathologic examination after surgery, showing the highest diagnostic accuracy (Table 4).

### Cystic fluid analysis by fine-needle aspiration

Only the recent 6 patients took the test since the fluid tests for cystic neoplasms of pancreas by fine-needle aspiration started after the introduction of equipment. The presence of malignant cells was checked and amylase, lipase, CEA and CA19-9 were measured by cytology testing of the taken fluid. Four patients with CEA levels of 400 ng/ml or more were diagnosed with mucin secreting tumors, and the other two patients with 400 ng/ml or less was diagnosed with cystic lymphangioma and pseudocyst, respectively. Other test findings did not provide significant results.

### Surgical management and postoperative complications

Surgery was determined depending on the location and type of the tumor, being radical resection in principle. The enucleation of cystic neoplasm was performed for 1 case of mucinous cystic tumor and 1 case of cystic lymphangioma. Pancreatoduodenectomy (PD) and pyloric preserving pancreatoduodenectomy (PPPD) were performed for 13 cases; the intraductal papillary mucinous tumor was the most common with 5 cases (38.5%). All the remaining 54 patients were treated by pancreatic resection to the left-side of portal vein. Laparoscopic pancreatic resection was performed in four cases (Table 5). Regarding postoperative complications, the pseudocyst formation caused by leaking pancreatic fluid from resection margin was the most common in 16 patients (23.2%), 6 of whom were treated with percutaneous drainage catheter insertions and others were resolved by conservative management. Other complications included wound infections in 13 cases

**Table 4.** Relationships between preoperative imaging diagnosis and pathology

Imaging diagnosis*	Pathologic results					
	SCN	MCN	IPMN	SPT	NET	CL
SCN (n=16)	12 (75%)	2 (12.5%)	0	0	1	1
MCN (n=22)	8 (36.4%)	13 (59%)	0	1	0	0
IPMN (n=12)	2 (16.7%)	0	10 (83%)	0	0	0
SPT (n=10)	0	0	0	8 (80%)	2 (20%)	0
NET (n=4)	0	0	0	0	4 (100%)	0
CL (n=2)	0	0	0	0	0	2 (100%)

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm; SPT, solid pseudopapillary tumor; NET, neuroendocrine tumor; CL, cystic lymphangioma

\*Imaging diagnosis means the name of top priority in preoperative imaging studies. Case numbers are different to true numbers. Parenthesis, diagnostic accuracy

**Table 5.** Types of operation

	PD	PPPD	LP		Enucleation
			Splenectomy	Spleen-preserving	
SCN (n=22)	2	3	17	0	0
MCN (n=18)	2	0	14 (2)*	1	1
IPMN (n=11)	5	0	2	4	0
SPT (n=9)	0	0	6 (1)*	3 (1)*	0
NET (n=7)	1	0	6	0	0
CL (n=2)	0	0	1	0	1

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm; SPT, solid pseudopapillary tumor; NET, neuroendocrine tumor; CL, cystic lymphangioma; PD, pancreatoduodenectomy; PPPD, pylorus preserving pancreatoduodenectomy; LP, left-side pancreatectomy including distal pancreatectomy

\*Parenthesis, laparoscopic pancreatectomy

(18.8%) and intra-abdominal bleeding in 3 cases (4.3%). There was no case of death from surgical complications.

#### Comparison of serous cystic neoplasm with mucin-secreting cystic tumors

Clinical features were comparatively analyzed for serous cystic neoplasm, and mucinous cystic neoplasm and intraductal papillary mucinous tumor that are mucin secreting tumors considered as precancerous lesions. The main symptoms and sizes at the time of discovery were not significantly different between each patient group. Patient group with intraductal papillary mucinous tumor had significantly higher average age than the other two groups ( $p=0.023$ ). The location of this tumor was characterized that it was mainly found in the pancreatic head and body and none was found in the pancreatic tail area. The onset of malignant cancer in the two groups with mucin secreting cystic tumor was significantly higher because there was no malignant tumor in serous cystic tu-

mor, 5 cases (27.8%) in mucinous cystic neoplasm and 4 cases (36.4%) in intraductal papillary mucinous tumor ( $p<0.001$ ) (Table 6).

#### Postoperative follow-up and prognosis of patients with malignant tumors

Out of the patients where invasive malignant cells are not found in pathologic biopsy, there was no case of tumor recurrence during follow-up periods (median: 32 months, range: 2-98 months). A total of nine (13.0%) patients were diagnosed with malignant tumors. Out of the 5 patients with mucinous cystic neoplasm, four patients were managed by left-side pancreatic resection, and 1 patient was treated with enucleation. The patient who had enucleation surgery without radical resection died 5 months later from tumor recurrences, and the 3 patients who had radical resection also died from recurrences at 12, 14 and 18 months after surgery, respectively. Long-term survival (116 months) was observed only in one

**Table 6.** Comparisons between serous cystic neoplasm and mucin-secreting tumors

	SCN	MCN	IPMN
Mean age (yr)	56.7	61.2	69.3*
Mean size (cm)	5.2	7.0	5.5
Female proportion (%)	68.2	83.3*	45.5*
Location (head/body/tail)	7-8-7	4-8-6	6-5-0*
Symptomatic patients (%)	15/22 (68.2)	14/18 (77.8)	9/11 (81.8)
Malignancy incidence (%)	0/22	5/18 (27.8)*	4/11 (36.4)*

SCN, serous cystic neoplasm; MCN, mucinous cystic neoplasm; IPMN, intraductal papillary mucinous neoplasm

\*Statistically significant

**Table 7.** Prognosis of malignant cystic neoplasm in pancreas

Age (yrs)/gender	Operation	Survival (months)
Mucinous cystadenocarcinoma		
45/Female	Left-side pancreatectomy	Alive (116)
72/Male	Left-side pancreatectomy	Dead (18)
71/Female	Enucleation	Dead (5)
71/Female	Lft-side pancreatectomy	Dead (12)
78/Male	Near total pancreatectomy	Dead (14)
Invasive intraductal papillary mucinous neoplasm		
65/Female	Pancreatoduodenectomy	Dead (18)
76/Female	Pancreatoduodenectomy	Dead (38)
74/Male	Left-side pancreatectomy	Dead (8)
68/Male	Pancreatoduodenectomy	Alive (29)

patient. Out of the 4 patients diagnosed with invasive intraductal papillary mucinous tumors, 3 patients had pancreatoduodenectomy and one had left-side pancreatectomy. Three patients died from tumor recurrences after 8, 18 and 38 months after surgery respectively, and one is currently living for 29 months without recurrences (Table 7).

## DISCUSSION

Unlike pancreatic adenocarcinoma, the cystic neoplasms of pancreas are known to show relatively good prognosis even though it is diagnosed with carcinoma. In addition, it is difficult to establish a uniform rule for clinical course, differentiation and treatment because most tumors with the exception of serous cystic tumors show a variety of pathologic findings such as pre-cancer and cancer in benign tumors.<sup>1</sup>

Serous cystic neoplasm is most common among cystic neoplasms of pancreas, accounting for 40% of frequency and being discovered accidentally. Approximately 20 cases of malignant cancer were reported around the world,

but most tumors are considered to be benign in clinical studies.<sup>2-4</sup> A large number of reports on the surgical results of serous cystic tumors claimed that the incidence of malignant cancer is extremely rare, but such problems are rather the inability of differential diagnosis from different precancerous lesions.<sup>2</sup> Galanis et al.<sup>3</sup> found 2 patients (1.3%) with the malignant tumors after 158 cases of serous cystic tumor resection who showed very good prognosis after resection due to the focal invasions. The authors found no malignant tumors after surgery for 22 patients with serous cystic neoplasms. Most patients undertook surgeries because differential diagnosis was not apparent with other premalignant diseases such as mucinous cystic neoplasms. Seven patients who were found with cystic neoplasms of pancreas by chance during health screening, all underwent surgery because they failed to completely rule out the possibilities of other pre-cancerous lesions. Twelve (75%) out of 16 patients were diagnosed with serous cystic tumor as a top priority in preoperative radiologic examinations and had the same pathologic biopsy results. The others were diagnosed with mucinous cystic neoplasms (2), with neuroendocrine tumors (1), and with cystic lymphangioma (1), respectively. Thus, surgical resections may be recommended as far as possible if it was difficult to distinguish from serous cystic tumors in the preoperative diagnosis. It was reported that the radical resection accounting for the location of tumor is safer and has less chances of complications rather than enucleation of cystic neoplasm.<sup>4</sup> All patients who were confirmed with serous cystic tumors received radical resections at our hospital.

Mucinous cystic neoplasm is considered to be a precancerous lesion accounting for 30-40% of the entire cystic neoplasm. It commonly indicated malignant transformations only in some of the tumors and has a variety

of distributions for benign tumor, borderline tumor, carcinoma in situ and invasive carcinoma.<sup>5,6</sup> Thus, a complete tumor resection should be done in accordance with the malignant cancer; appropriate surgical treatment is required because it is known to have a better prognosis as compared with pancreatic adenocarcinoma even if it was diagnosed with a malignant cancer. The patient's ages and tumor sizes have been proposed as preoperative predictors of mucinous cystic neoplasms with malignancy.<sup>5,7</sup> In our study, the average age (67.6 years) of patients diagnosed with malignant tumors was significantly higher than that of patients (54.7 years) with benign mucinous cystic neoplasms ( $p=0.013$ ). The size of benign and malignant tumors was not significantly different. Out of total 114 patients who underwent surgery for cystic diseases of the pancreas, 11 cases have been observed with infiltrations or adhesions with surrounding tissues in the preoperative radiologic examination, and thus, are suspected of malignant mucinous cystic neoplasms. Of these, only two were diagnosed with malignancy in the final pathologic diagnosis; six were diagnosed with pancreatitis and pancreatic pseudocyst, and two, with solid pseudopapillary tumor. Thus, it turned out to be significantly difficult to judge the presence of malignant behaviors in mucinous cystic neoplasms or to distinguish it from other diseases. Out of 69 patients who underwent surgery for cystic neoplasms of pancreas, 29 patients (42.0%) had mucinous cystic neoplasms or intraductal papillary mucinous tumors, both of which are the mucin secreting cystic neoplasms of pancreas considered as pre-cancerous lesions. Twenty two patients were diagnosed with mucinous cystic neoplasms as priority during preoperative radiologic examinations, but only 13 patients (59%) were diagnosed as the same in the pathologic findings. 8 patients (36.4%) were diagnosed with serous cystic neoplasms and one case was diagnosed with solid pseudopapillary tumor, it was not easy to distinguish between serous cystic neoplasms and mucinous cystic neoplasms with diagnostic imaging tests alone.

Inadequate biopsy was often presented as the recurrence factor after surgical resections of mucinous cystadenocarcinoma.<sup>7,8</sup> Even though the resection tissues were diagnosed as benign or borderline tumors in the past, if recurrences occurred later, it turned out to be insufficient diagnosis for malignant cells of the past biopsy.<sup>8</sup> It was considered important that the patient's prognosis

and tumor recurrence took detailed pathologic examinations and keeping it in mind that mucinous cystic neoplasms could have a variety of aspects of tissue cells. The authors diagnosed only benign and malignant tumors but did not strictly investigate the borderline tumors. However, considering that tumor recurrences were not found in patients diagnosed with benign tumors, the prognosis of borderline tumors included herein are expected to be very good. Therefore, the importance of early diagnosis and aggressive surgery are being emphasized once again before proceeding to malignant tumors.

Intraductal papillary mucinous tumor is a disease that gradually increases in numbers among cystic neoplasms of pancreas. It is often difficult to pathologically differentiate from mucinous cystic neoplasms, which is similar in that opinions vary from benign tumors to carcinoma in situ or invasive cancer. Especially when the main pancreatic duct types are known, and that surgery is needed in most cases pursuant to pancreatic adenocarcinoma because malignant cancers are more commonly found in this type.<sup>9,10</sup> The likelihood of malignancy is higher and requires more attention, for cases such as obstructive jaundice, main pancreatic duct type and hybrid type, where the main pancreatic duct significantly expands more than 10-15 mm, intramural nodules are larger than 10 mm, duct wall irregularities, or tumors are larger than 3 cm.<sup>11,12</sup> Jang et al.<sup>13</sup> reported that careful diagnosis and treatment protocols were required because the incidences of malignant tumors are more than 25% if the tumor size is larger than 2 mm, and there exists the intramural nodule even if it is the branch duct type. In our study, patients diagnosed with invasive intraductal papillary mucinous tumors did not show statistically significant differences from benign tumors of patients' ages and tumor sizes. In the preoperative radiologic diagnosis, 12 cases were diagnosed with intraductal papillary mucinous tumors as top priority, 4 of which were main pancreatic duct types; 2 hybrid types; and 6 branch duct types. Of the four patients who were diagnosed with invasive tumors, 3 patients had the main pancreatic duct type. The 3 patients who were diagnosed with main pancreatic duct type were also diagnosed with invasive tumors in preoperative imaging tests before surgery because of characteristic findings such as the main pancreatic duct dilatation, irregularities and intramural nodules. The location of the tumor in the pancreatic

duct seems to be a relatively important factor to predict the malignant potential of the intraductal papillary mucinous tumor, but further studies will be needed for a larger number of patients.

Cystic neoplasm of the pancreas has limitations in diagnosis and differential diagnosis only by the abdominal computed tomography (CT), thus, the fine needle aspirations of the cyst fluid, endoscopic ultrasound and magnetic resonance imaging (MRI) are performed in the course of preoperative diagnosis.<sup>14</sup> Especially, it is reported to increase the diagnostic accuracy as to analyze the cystic fluid amylase, lipase and the tumor factors such as CEA, CA19-9 and CA125.<sup>15,16</sup> The differentiation of potentially malignant cystic neoplasm before surgery plays an important role to define the treatment plan.<sup>17</sup> It is not recommended to excise a part of the cyst wall in the operating room and try frozen section examination<sup>1</sup> because it may degrade the diagnostic accuracy and cause disseminations of cyst fluid and potential malignant cells. Fine needle aspiration through the endoscopic ultrasound is also an invasive test and may cause the risk of tumor seeding or complications such as bleeding and perforation. However, we did not experience particular complications from preoperative fine needle aspirations and troubles during the surgery. Since the introduction of test equipments, 6 patients were checked by fine needle aspirations and the mucinous cystic neoplasm was predicted when the CEA level of the cystic fluid is over 400 ng/ml or CA19-9 is greater than 40 U/ml. The number of patients was limited, but all four patients whose CEA levels were higher than 400 ng/ml were diagnosed as mucinous cystic neoplasms and showed the specificity of 100%. Thus, it is suggested that to perform both endoscopic ultrasounds and fine needle aspirations for all patients in the future to increase the accuracy of the diagnosis. Researches would be needed for a larger number of patients, but by considering the experiences to date, it is often judged that the serous cystic neoplasm is the primary suspect when the CEA and CA19-9 of the fluids are in the normal range. However, there are still limitations for accurately diagnosing mucinous cystic neoplasms even if these diagnoses are used. We experienced that two patients who had relatively high CEA and CA19-9 of the fluid were diagnosed with pancreatic pseudocyst and cystic lymphangioma, respectively. It is recommended on one hand to use a combination of

various diagnostic methods for the preoperative diagnosis in order to reduce unnecessary surgery for patients with observable progress, and on the other hand, to prevent the delays in surgery.<sup>17</sup>

Despite some controversies, most studies recommended surgical resection in principle for the management of cystic neoplasms of pancreas. The biggest reason is said to be the difficulty of accurate diagnosis on the preoperative tumor pathological form and the difficulty to identify the presence of malignancy.<sup>18,19</sup> It is also said that the development of surgical techniques has significantly lowered the mortality and complications of pancreatic resections. In recent years, the increasing application of laparoscopic pancreatic surgery has made surgical treatments more common. Nevertheless, it is important that relatively good prognosis is noted if tumors are operated early and completely removed despite the diagnosis of malignancy. It is also known that mucinous cystic tumor or intraductal papillary mucinous tumor which includes borderline tumors or carcinoma in situ has high, long-term survival rates if it is being completely resected. Even the malignant cancer was reported to have long-term survival rates around 50-76% after radical resections.<sup>19,20</sup> In case of the authors, malignant cancers were found in about 30% of the 29 patients with mucin secreting cystic tumors, including 5 patients (27.8%) of mucinous cystic tumors and 4 patients (36.4%) of intraductal papillary mucinous tumors. Long-term survival is not available due to the small number of patients, but they showed relatively poor prognosis after surgical resections. The reason is mostly because that most patients with infiltrative status had delays in diagnosing. Among the five patients with mucinous cystadenocarcinoma, four patients had left adrenal gland resections and or bowel resections due to the invasion. The patient who died of early recurrences 5 months after surgery was the case who only had enucleation as the mucinous cystic tumor was not suspected in the preoperative diagnosis. Four patients with invasive intraductal papillary mucinous tumors were characterized by distributions mainly in head of the pancreas (n=3), thus, they had pancreaticoduodenectomy and one had left-side subtotal pancreatectomy. One of the patients with double primary cancer was diagnosed with bladder cancer at the same time. Mucinous cystadenocarcinoma showed the median survival of 14 months (5-116 months); invasive intra-

ductal papillary mucinous neoplasm (invasive IPMN), 24 months (8-38 months), respectively. Thus, more thorough follow-ups and observations are required and aggressive surgical resections should be recommended if the cystic neoplasms of pancreas are found and cancer risk factors have been suspected. Lee et al.<sup>19</sup> argued that the possibility of malignancy should be considered in cases such as the presence of solid parts, expansion of main pancreatic duct, expansion of common bile duct, and enlargement of lymph node in imaging studies. When male patients older than 70 years had occurred jaundice and weight loss, they needed careful evaluations, even if the sizes were relatively smaller than 3 cm.

Laparoscopic resections of pancreas seemed to be commonly applied recently. We experienced four cases, and all of which were the left pancreatic resection. Postoperative complications included one intra-abdominal bleeding, and one pseudocyst formation from pancreatic fluid leakage. We have limited experience, but increasing reports indicate that benefits of laparoscopic surgeries are certain, and that surgical complications are not that different as compared with conventional open surgeries.<sup>21,22</sup> Therefore, large scale prospective studies would be needed for the future applications of laparoscopic surgeries to patients with malignant pancreatic body and tail tumors as well as benign tumors.

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