Original Article

Pancreatic mucinous cystic neoplasms located in the distal pancreas: a multicenter study

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Background: Mucinous cysts of the pancreas (MCN) are infrequent, usually unilocular tumors which occur in postmenopausal women and are located in the pancreatic body/tail. The risk of malignancy is low. The objective is to define preoperative risk factors of malignancy in pancreatic MCN and to assess the feasibility of the laparoscopic approach.

Methods: Retrospective multicenter observational study of prospectively recorded data regarding distal pancreatectomies was carried out at seven hepatopancreatobiliary (HPB) Units between 01/01/08 and 31/12/18 (the ERPANDIS Project).

Results: Four hundred and forty-four distal pancreatectomies were recorded including 47 MCN (10.6%). Thirty-five were non-invasive tumors (74.5%). In all, 93% of patients were female, and 60% were ASA (American Society of Anaesthesiology) II. The mean preoperative size was 46 mm. Patients with invasive tumors were older (54 *vs.* 63 years). Invasive tumors were larger (6 *vs.* 4 cm), although the difference was not significant (P=0.287). Sixty percent was operated via laparoscopic approach, which was used in 74.6% of non-invasive tumors and in 16.7% of the invasive ones. The spleen was not preserved in 93.6% of the patients. R0 resection was obtained in all patients. Two patients with invasive tumors died.

Conclusions: In our surgical series of MCN, patients with malignancy were older and presented larger tumors, although the difference was not statistically significant. Laparoscopy is a safe and feasible approach for MCN. Prospective studies are now needed to define risk factors that can guide the decision whether to administer conservative treatment or to operate.

Keywords: Distal pancreatectomy; mucinous; cystic; cancer; pancreas

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Introduction

The exponential rise in the number of abdominal radiological tests performed nowadays has increased the diagnosis of pancreatic cystic lesions, many of them asymptomatic (1-8). In fact, tumors account for only 10–15% of the pancreatic cysts diagnosed. These tumors are classified into four large groups: serous cystic neoplasms, mucinous cystic neoplasms (MCN), intraductal papillary mucinous neoplasms (IPMN) and other cystic tumors of the pancreas (1,4,6,9,10).

Mucinous cysts of the pancreas are infrequent lesions. They were initially described in 1978 as mucin-producing non-ductal cystic tumors (5,11,12), and subsequently divided in 1996 into the two different entities, MCN and IPMN. MCNs were defined as lesions with inner epithelial mucin-secreting cells and a surrounding dense ovarian type stroma (1,3,6-8,12-19). In 2006, the IAP guidelines added that an MCN could not have communication with the pancreatic duct (1,3,12,14,16-18). Preoperative differential diagnosis of MCNs with other cystic tumors is not always easy, especially with certain IPMN (3,7,9).

MCNs are usually unilocular lesions affecting postmenopausal women, located in the pancreatic body/tail. There is a certain risk of malignancy, since the epithelium of the cyst may undergo progression from adenoma to carcinoma. The original malignancy rates were between 4% and 46%, although the most recent publications lower this figure to 4–12% (1,6-9,12,14-17,19).

Classically, due to the absence of any clear preoperative criteria for malignancy and incomplete understanding of the biology of the neoplasm and its progression, the guidelines recommended removal of all MCNs (7-9,12,14,16). However, the International and European guidelines published in 2012 and 2018 respectively recommended observation for asymptomatic MCNs below 4 cm and without risk factors such as mural nodules (10,19,20).

Here we report several cases of MCN located in the pancreatic body and tail recorded over a 10-year period at seven centers. The aim is to perform a comprehensive study of resected lesions located in the body and tail as well as to define preoperative risk factors of malignancy in pancreatic MCN and to assess the feasibility of the laparoscopic approach. We present the following article in accordance with the STROBE reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-21-703/rc).

Methods

Retrospective multicenter observational study of prospectively recorded data regarding distal pancreatectomies (DP) was carried out at seven hepatopancreatobiliary (HPB) surgical units between 1 January 2008 and 31 December 2018. Four units are high volume HPB units in Level 3 Hospitals in Spain, the highest level in our country, one is the reference center for HPB surgery and transplantation in Puerto Rico, and two are Level 2 in Spain. Three units perform more than 50 pancreatoduodenectomies per year, two between 20 and 50, and two less than 20. Five units performed more than 10 DP per year. Six authors are UEMS HPB Board Certificate.

Each participating center appointed a local manager to carry out the data collection and to liaise with the overall study coordinator. All the data were collected by the local managers at each hospital, and the project coordinator had access to medical data only.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Committee of Ethics from Hospital Universitario de Guadalajara (CEIm: 2018.17.EO) (27-11-2018). The need for patients' informed consent was waived since the study was retrospective and observational, and entailed no risk.

Inclusion criteria were any DP performed for MCN, age >18 years. Preoperative suspected diagnosis was based on CT, MRI and EUS plus biopsy. Histological confirmation was mandatory to be included as a case. Surgical approach was either open or laparoscopic, with or without spleen preservation. Complications were assessed at 90 days using the Clavien-Dindo classification, and those defined as Clavien-Dindo grade III or higher were considered major (21). Complications were recorded according to electronic medical and nursing notes or clinical histories of each patient. For complications specific to pancreatic surgery, the definitions of the International Study Group on Pancreatic Surgery for delayed gastric emptying (22), post-pancreatic hemorrhage (23) and pancreatic fistula (24) were used. The resection margins of the surgical specimen were categorized according to the Royal College of Pathologists definitions: R0 (margin to the tumor ≥1 mm), R1 (margin to the tumor <1 mm) and R2 (macroscopically positive margin) (25). Surrounding dense ovarian type stroma was mandatory to

diagnose MCN. Tumors with mild, intermediate and high dysplasia were classified as non-invasive. Invasive tumors were staged according to the TNM classification (8th ed) (26). The follow-up scheme applied at all centers comprised 6-month outpatient clinic visits during the first five years, including tumor marker assessment and CT/MRI, and after five years an annual visit (in non-invasive cases).

Variables

The variables included in the study were the following: Epidemiological: age, sex, past medical history, medication, Charlson Index, BMI and ASA; Clinical: symptoms due to MCN; Serological tests: leukocytes, amylase, CRP; hemoglobin (gr/dL), bilirubin, creatinine, prothrombin time, CEA and CA 19-9; Radiological/diagnostic: diagnostic tests performed (CT/MRI/EUS), number, size and location of MCN, vascular infiltration (arterial and venous) and preoperative biopsy; Surgical: type of approach (open/laparoscopy/conversion), spleen preservation, associated procedures, type of closure of pancreatic remnant, intraoperative bleeding (mL); postoperative course: morbidity and mortality (according to the Clavien-Dindo classification) (13), pancreatic fistula, postoperative hemorrhage and delayed gastric emptying, if present, classified according to the International Group Study Liver Surgery classification (14,15), hospital stay and readmissions. The histological data recorded were TNM, tumor size, lymph nodes harvested and R status. At the postoperative follow-up endocrine and exocrine insufficiency rates were recorded.

Statistical analysis

The chi-squared or Student's *t*-test was used to compare categorical or continuous variables respectively. Risk analysis was performed by calculating the odds ratios (with 95% CI) of invasive MCN using univariate logistic regression models with the variable of interest as dependent variable. Kaplan-Meier estimator was used to calculate overall survival, and survival differences were compared with the log-rank test. Data were analyzed using R version 3.1.3 (http://www.r-project.org) and the appropriate packages. The level of significance was set at 0.05.

Results

In our DP database (the ERPANDIS project) 444 cases of DP were recorded. Forty-seven were performed in patients with MCN (10.6%). Thirty-five MCNs were non-invasive tumors (74.5%) and 12 were invasive (25.5%). Epidemiological data are shown in *Table 1*. Ninety-three per cent of patients were female, 60% were ASA II, and 81% had a Charlson 0–1. The mean preoperative radiological size was 46 mm. Only 32% were preoperatively biopsied. Age was the only variable that presented significant differences between non-invasive and invasive tumors, since patients with invasive tumors were older (54 *vs.* 63 years). Invasive tumors were larger (mean values of 6 *vs.* 4 cm) although the difference was not significant (P=0.287). In the univariate analysis, no preoperative factors showed statistical significance between non-invasive and invasive MCN.

Intraoperative data are included in *Table 2*. In patients with MCN who underwent surgery, 59.6% were operated laparoscopically: this rate rose from 38.1% between 2008–2013 to 76.9% between 2014–2018. The laparoscopic approach was used in 74.6% of non-invasive MCNs and in 16.7% of the invasive type (P<0.001). The most frequent intervention was removal of the pancreatic body and tail (60%) without spleen preservation (93.6%). Intraoperative blood loss was higher in non-invasive tumors, although the difference was not statistically significant. Intraoperative transfusion rates were similar.

Postoperative results are summarized in *Table 3*. Twenty-five per cent were Clavien stage 3 or 4. Mortality in the 47 MCN patients (both groups) was 0%. Morbidity, pancreatic fistula and readmission rates were lower in patients with invasive tumors, although the mean stay in this group was twice as long. All differences were statistically significant.

Thirty-five patients (74.5%) had a non-invasive MCN (14 mild, 10 intermediate and 11 high dysplasia). No relationship was found between any preoperative variable and grade of dysplasia. Median lymph nodes retrieved were 12 nodes (range, 6–25) in malignant cases and 5 nodes (range, 2–16) in benign tumors. Histological studies (*Table 4*) showed a low rate of lymph node involvement in invasive tumors (20%). In all patients an R0 resection was obtained. During follow-up (median 3 years), two patients who presented local recurrences of invasive tumors and disease progression died. Actuarial survival is shown in *Figure 1*.

Discussion

MCN occurs only rarely, and so experience with this tumor is limited even at large reference centers. It is important

Table 1 Preoperative data

Variables	Series, N=47	Non-invasive MCN, N=35	Invasive MCN, N=12	P	OR [95% CI]	pOR
Age, mean (SD), years	57.0 (14.1)	54.8 (14.6)	63.4 (10.7)	0.037	1.05 [0.99–1.11]	0.075
Gender				0.324		
Male	3 (7%)	1 (3%)	2 (16.7%)		Ref.	
Female	44 (93%)	34 (97%)	10 (83.3%)		1.00 [0.18–8.48]	0.996
ASA				1.00		
I	7 (14.9%)	5 (14.3%)	2 (16.7%)		Ref.	
II	29 (61.7%)	22 (62.9%)	7 (58.3%)		0.78 [0.12–7.10]	0.801
III	11 (23.4%)	8 (22.9%)	3 (25.0%)		0.93 [0.10–10.3]	0.949
BMI	25.1 (4.56)	25.0 (5.01)	25.5 (2.83)	0.685	1.03 [0.87–1.21]	0.752
Charlson Index	0.77 (0.98)	0.68 (0.87)	1.11 (1.36)	0.467		
0	24 (51.1%)	19 (54.3%)	5 (41.7%)		Ref.	
1	14 (29.8%)	10 (28.6%)	4 (33.3%)		1.52 [0.31-7.07]	0.590
2	6 (12.8%)	4 (11.4%)	2 (16.7%)		1.90 [0.22-1.32]	0.522
3	2 (4.26%)	2 (5.71%)	0 (0.00%)		NA	
4	1 (2.13%)	0 (0.00%)	1 (8.33%)		NA	
Radiological size (mm)	45.9±41.6	41.4±40.8	59.4±43.6	0.287	1.01 [0.99–1.03]	0.257
Preoperative biopsy				0.725		
Yes	15 (31.9%)	12 (34.3%)	3 (25.0%)		Ref.	
No	32 (68.1%)	23 (65.7%)	9 (75.0%)		1.51 [0.36–8.27]	0.586

OR, odds ratio; 95% CI, 95% confidence interval; Ref., reference category; NA, not applicable; pOR, OR-associated P value; MCN, mucinous cystic neoplasms; ASA, American Society of Anaesthesiology.

to differentiate between invasive and non-invasive types. Non-invasive MCN is not aggressive; it has an excellent prognosis, a 100% survival rate and a practically zero risk of recurrence, as we saw in our 35 patients with non-invasive tumors and also in the other series published (*Table 5*) (6-8,12-14,17,20). However, the 5-year survival of invasive MCN is 30% (20–60%), even though lymph node involvement is low (range, 0–30%; 20% in our series). Therefore, it is very important to resect MCNs before they evolve into invasive cancers (6-8,12,14,17). Defining preoperative risk factors for malignancy would help the research for an adequate balance between the oncological outcomes and the reduced quality of life that a pancreatectomy entails (6,8,15).

The information in the literature on preoperative risk factors for malignancy should be considered with caution. This is because some authors consider high-grade dysplasia or invasive carcinoma (T1a to T1c and higher) to be malignant, while others, such as our group, only consider malignancy in cases of invasive MCNs. This difference in characterization is the reason for the wide variability in malignancy in the series published (8,12,16,27). The use of the term "minimally invasive" without a clear definition may have increased the confusion even further. The TNM classification divides tumors less than 2 cm into three subgroups T1a, T1b, and T1c, which appear to have a better prognosis than other invasive tumors (12,20). As well as the use of the TNM classification, a thorough histological study is also essential since benign and malignant lesions may coexist (12,13).

The size of the MCN and the presence of mural nodules and/or solid component are the most widely accepted preoperative indicators of possible malignancy (6,8,13-15). Location in the pancreatic head, a hypervascular radiological pattern, high intracystic CEA, advanced age (though without a well-defined cutoff) and male sex, have

Table 2 Intraoperative data

Variables	All, N=47	Non-invasive MCN, N=35	Invasive MCN, N=12	P	OR [95% CI]	pOR
Laparoscopic approach				0.001		
Yes	28 (59.6%)	26 (74.3%)	2 (16.7%)		Ref.	
No	19 (40.4%)	9 (25.7%)	10 (83.3%)		12.9 [2.70–105]	0.001
Surgery				0.295		
Body + tail	29 (61.7%)	21 (60.0%)	8 (66.7%)		Ref.	
Tail	14 (29.8%)	12 (34.3%)	2 (16.7%)		0.42 [0.05–2.11]	0.312
Extended left	4 (8.5%)	2 (5.7%)	2 (16.7%)		2.30 [0.21–25.5]	0.474
Spleen preservation				1.000		
Yes (spleen vessel preservation)	3 (6.4%)	2 (5.7%)	1 (8.3%)		Ref.	
No	44 (93.6%)	33 (94.3%)	11 (91.7%)		0.64 [0.05–21.4]	0.752
Blood loss (mL) (mean)	220	95	967	0.156	1.01 [1.00–1.01]	0.067
Intraoperative transfusion				1.000		
Yes	4 (8.51%)	3 (8.57%)	1 (8.33%)			
No	43 (91.5%)	32 (91.4%)	11 (91.7%)		0.96 [0.10–29.5]	0.973
Drain				1.000		
Yes	39 (83.0%)	29 (82.9%)	10 (83.3%)			
No	8 (17.0%)	6 (17.1%)	2 (16.7%)		1.00 [0.12–5.46]	0.996

OR, odds ratio; 95% CI, 95% confidence interval; Ref., reference category; pOR, OR-associated P value; MCN, mucinous cystic neoplasms.

also been associated with malignancy (4,5,7,9,12,16,17,27).

There is no definitive consensus on the relation between malignancy risk and size. Invasive lesions smaller than 3 cm are very rare (6,8,13,16). In our series all malignant tumors were larger than 4 cm. The generally accepted cut-off point for deciding on observation or surgery is 4 cm, and it was recently proposed that asymptomatic tumors less than 4 cm, without a mural nodule and with a clear diagnosis of MCN, are candidates for close observation (6,10,17,20).

The median age of patients in the series published was 50 years (range, 43–53 years), while in our series it was slightly higher (57 years), due to the fact that patients with invasive tumors had a mean age of 63.4 years (6,7,13-15,17,19,27) (*Table 5*). We observed that patients with invasive tumors were older with statistical significance. MCN is more frequent in women than in men, with rates of 93% to 100% and a mean of 95% (6,7,9,13,16,19,27). In our series women accounted for 93% of cases.

No specific symptoms of MCN have been described in the literature: the most common symptom is abdominal pain (range, 23.4–60%) although up to 30% of MCNs are asymptomatic (6,7,14,16,17,27). Both in the literature and in our series, tumors are always unique (13,14,17,19), usually in the pancreatic body and tail (range, 86–98%) (6,13-15,17,27). As our series included only DP, we were unable to determine how many pancreatic head MCNs have been treated over the, study period.

In the case of an MCN suitable for surgery, we perform standard cancer surgery if malignancy is suspected, including regional lymphadenectomy and splenectomy (6,7,10). The choice of approach (open or laparoscopic) will depend on the expertise of the surgeon (10), and on the tumor size; in large tumors, in the laparoscopic approach the cyst may rupture and intracystic content may spread (6,8). Postlewait *et al.* demonstrated the validity of the hand-assisted technique (8), though this option is not often used in Europe. If malignancy is not suspected, a non-oncological distal pancreatectomy with or without

Table 3 Postoperative events

Variables	All, N=47	Non-invasive MCN, N=35	Invasive MCN, N=12	P	OR [95% CI]	pOR
Clavien-Dindo				0.030		
0	14 (29.8%)	9 (25.7%)	5 (41.7%)		Ref.	
1	13 (27.7%)	12 (34.3%)	1 (8.33%)		1.50 [0.01–1.46]	0.108
2	8 (17.0%)	3 (8.57%)	5 (41.7%)		3.00 [0.51–2.04]	0.232
3	11 (23.4%)	10 (28.6%)	1 (8.33%)		1.80 [0.01–1.40]	0.149
4	1 (2.1%)	1 (2.9%)	0 (0.00%)		NA	
5	0 (0.00%)	0 (0.00%)	0 (0.00%)		NA	
Clavien-Dindo >III	12 (25.5%)	11 (31.4%)	1 (8.33%)	0.412	0.23 [0.01–1.43]	0.128
Pancreatic fistula				1.000		
No	38 (80.8%)	28 (77.1%)	10 (90.9%)		Ref.	
Yes	9 (19.62%)	8 (22.9%)	1 (9.09%)		0.38 [0.01–2.57]	0.363
Hospital stay (mean), days	7.26	5.68	11.8	0.030	1.20 [1.03–1.39]	0.019
Discharge with drain				0.659		
Yes	7 (14.9%)	6 (17.1%)	1 (8.33%)		Ref.	
No	40 (85.1%)	29 (82.9%)	11 (91.7%)		2.04 [0.29–57.2]	0.524
Readmission				0.044		
No	36 (76.6%)	24 (68.6%)	12 (100.0%)		Ref.	
Yes	11 (23.4%)	11 (31.4%)	0 (0.00%)		NA	

OR, odds ratio; 95% CI, 95% confidence interval; Ref., reference category; NA, not applicable; pOR, OR-associated P value; MCN, mucinous cystic neoplasms.

Table 4 Histology and follow up

Variables	All, N=47	Non invasive MCN, N=35	Invasive MCN, N=12	P	OR [95% CI]	pOR
Histological size	4.35	3.85 [2.00, 6.05]	4.75 [2.38, 9.25]	0.362	1.08 [0.93–1.26]	0.288
Lymph node status:				0.686		
Negative	23 (92%)	13 (100%)	10 (80%)		Ref.	
Positive	2 (8%)	0	2 (20%)		NA	
Margin status: R0	47 (100%)	35 (100%)	12 (100%)	1.000	NA	
Local tumor relapse at 3 years				0.152		
No	28 (93.3%)	18 (100%)	10 (83.3%)		Ref.	
Yes	2 (6.7%)	0	2 (16.7%)		NA	
Follow up						
Deaths (3 years)	2	0	2 (16.6%)	0.206	NA	

OR, odds ratio; 95% CI, 95% confidence interval; Ref., reference category; NA, not applicable; pOR, OR-associated P value; MCN, mucinous cystic neoplasms.

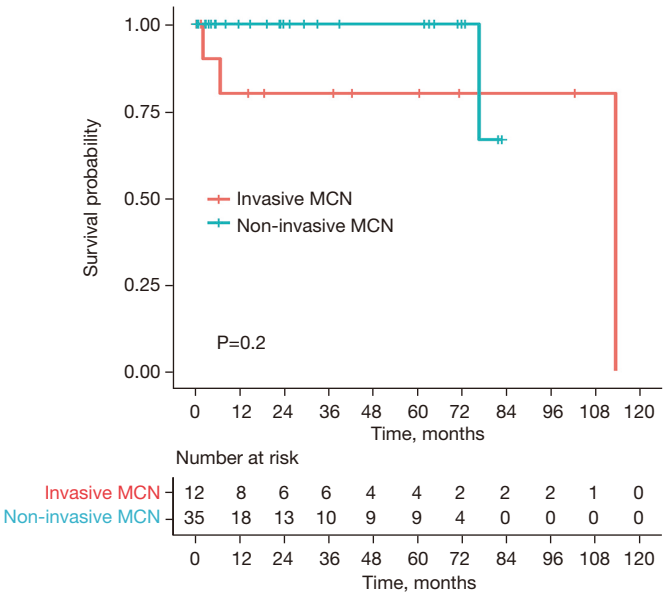

Figure 1 Actuarial survival. MCN, mucinous cysts of the pancreas.

preservation of splenic vessels is the best therapeutic option, if possible by means of laparoscopy (6,10,17,20). Enucleation is a valid alternative, although it is also scarcely used because it can only be carried out in certain locations and presents a greater risk of recurrence and pancreatic fistula (7,10,15,20). Kang *et al.* reported enucleation in between 2% and 9% of cases (6). The number of central pancreatectomies performed in MCN is very small (6,16,17).

As our series is based on a DP database, we do not have information on the use of other techniques, but it should be borne in mind that DP accounts for 90% of the surgeries performed. The proportion of laparoscopic DP ranges from 8.5% to 63% (19,27): in our series it was 59.6% overall, broken down into 75% in non-invasive tumors and 17% in invasive tumors. Between 2007 and 2012 Kang *et al.* were able to use a laparoscopic approach in 89.3% with a progressive increase in spleen preservation (6). Over the course of our 11-year study, the use of laparoscopy rose from 38% (2008–2012) to 77% (2013–2018). In another study by Postlewait, MCNs operated by laparoscopic approach were smaller, and the benefits observed included less blood loss, less transfusion, shorter hospital stay and more spleen preservation, although complication rates were similar (19). In our series, patients operated by laparoscopy usually had non-invasive tumors; hospital stay and blood loss were lower, but the rates of readmission and complications were similar and the pancreatic fistula rate was higher. It is likely that the group of seven units had different levels of expertise in laparoscopic surgery but similar levels in HPB surgery, and this may be the cause of these results.

The general morbidity in our series is higher than that described elsewhere for DP, which ranges between 5% and 50% (7), but this is probably because our assessment was particularly exhaustive, especially with regard to Clavien stages I and II. Our rate for Clavien stage III or higher (25%) was well within the range reported above. Similarly, the slightly above average figures for readmission at 90 days may be due to the patient management protocol, in some units where patients are discharged with the drain still in place and later readmitted for drainage withdrawal in order to decrease hospital stay.

The limitations of the study are its retrospective nature and the lack of standardized protocols at the seven hospitals. The fact that only cases located in the body and tail were recorded might also be considered a limitation, although this is the most frequent site. The main strengths of the study are the significant number of cases performed at HPB units with extensive experience, the fact that the results are comparable to those of previous series, and the fact that it is one of the first papers on this subject carried out in Europe.

In conclusion, MCNs are relatively rare tumors for which no clearly defined management strategy is currently available. These unique tumors occur mostly in women, are of variable size, and are located in the body and tail. We did not find well-defined risk factors for malignancy; patients

Table 5 Data from previous series

Authors	Study period	MCN	%BT	Inv *vs.* non-Inv	Age, years	Female gender	DP	Lap. approach	Spleen preservation	Conversion	Size (cm)	Complication rate (total/major)	R1	Hospital stay, days	30-day readmission	Mortality
Goh 2006 (SR)	1996–2005	344	94.6%	93/247 (27%)	47	99.7%	ND	ND	ND	ND	6.6	ND	ND	ND	ND	ND
Crippa 2008	1998–2005	163	96.3%	28/135 (17%)	45	95%	153 (94%)	8.5%	17%	ND	5	49%	ND	9	7.5%	0%
Le Baluer 2011	1998–2008	60	91.7%	10/50 (16.7%)	43	98.3%	ND	ND	ND	ND	4.2	ND	ND	ND	ND	ND
Gil 2013	2004–2011	47	89.4%	5/42 (10.6%)	48.5	91.5%	39 (83%)	43.2%	48.6%	ND	5.2	42.6%	0%	9.5	ND	0%
Nguyen 2014	1994–2013	38	86.8%	2/36 (5.3%)	53.5	97.4%	31 (81.6%)	ND	ND	ND	4.2	ND	ND	ND	ND	ND
Roch 2017	2003–2016	108	97.2%	7/101 (6.5%)	48	92.6%	ND	ND	ND	ND	5.8	ND	ND	ND	ND	ND
Postlewait 2018	2000–2014	349	ND	ND	52.8	92.7%	289 (82.8%)	47.1%	11.1%	4.25	5.4	50.2%/17.7%	5.8%	7	13.8%	1%
Kang 2018	1990–2012	55	94.5%	9/46 (16.3%)	47.9	100%	46 (83.6%)	63%	19.6%	ND	6.1	ND	ND	13.3	ND	0%
Hui 2018	1991–2016	63	88.9%	10/53 (15.9%)	51.9	98.2%	58 (88.9%)	ND	ND	ND	6	ND	0%	ND	ND	ND
Ohtsuka 2020	1984–2018	364		43/321 (11.8%)	48	98%	354 (97%)	42%	ND	ND	5	ND	ND	ND	ND	ND
Our series	2008–2018	47	100%	12/35 (25.5%)	57	93%	47 (100.0%)	59.6%	6.4%	9.7%	4.4	70.2%/25.5%	0%	7.3	(90 days) 23%	0%
Range		38–364	86.8–100%	5.3–27%	43–57	83–100%	81.6–100%	8.5–59.6%	6.4–48.6%	4.25–9.7%	4.2–6.6	49–70.2%	0–5.8%	7–13.3	7.5–23%	0–1%

SR, systematic review; MCN, mucinous cystic neoplasms; %BT, percentage of tumors located in body/tail; Inv, Invasive; DP, % of distal pancreatectomies; Lap, laparoscopy; ND, no data.

with malignancy were older and presented larger tumors, but age and tumor size were not statistically significant. In our series, the laparoscopic approach proved feasible and safe, and its use increased over the course of the study period; it was mainly used in non-invasive tumors and only rarely in invasive ones. Morbidity rates were high but the mortality rate was zero. Prospective studies are now needed to define risk factors that can guide the decision whether to administer either conservative or surgical treatment.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-21-703/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Committee of Ethics from Hospital Universitario de Guadalajara (CEIm: 2018.17.EO) (27-11-2018). The need for patients' informed consent was waived since the study was retrospective and observational, and entailed no risk.

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