

Introduction: Distal resection of the pancreas is a routine procedure in high-volume centres. However, the volume of this procedure can vary. This variation plays a very important role in laparoscopic approach of pancreatic surgery and can be a real challenge if the anatomical situation is underestimated.

Aim of the study: To present our experience in minimally invasive treatment of the pancreatic tumours and to discuss different approaches to different anatomical situations.

Material and methods: We performed a retrospective analysis of patients, who underwent laparoscopic pancreas resection for pancreatic cancer in our hospital since 2014 to 2016 February. According to extension of operation, patients were divided into two groups: distal pancreatectomy and left hemipancreatectomy for cases that required preparation of the portal vein. Demographic characteristics, and operative and postoperative data were compared between both groups.

Results: Out of 16 patients, distal pancreatectomy was performed for 7 (43.8%) and left hemipancreatectomy for 9 (56.2%) patients. For 1 (14.3%) laparoscopic distal pancreatectomy and for 2 (22.2%) laparoscopic left hemipancreatectomy patients surgical conversion to laparotomy was performed. The average operation time was 205 (195–245) min for distal pancreatectomy and 412.5 (280–520) min for left hemipancreatectomy group ($p = 0.001$), blood loss 125 (20–250) ml and 250 (50–1800) ml accordingly ($p = 0.138$). Totally postoperative fistula occurred in 7 (43.8%) cases; out of them, 5 (71.4%) patients were from the left hemipancreatectomy group.

Conclusions: Laparoscopic left hemipancreatectomy is more complicated than distal pancreatectomy. Extension and technique selection of distal resection of the pancreas depends on the Yonsei criteria and tumour relation to the portal vein.

Key words: laparoscopy, pancreas cancer, pancreas surgery, distal pancreatectomy.

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Laparoscopic distal resection of the pancreas. Can be all resections of body and tail of the pancreas called the same?

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Introduction

Pancreatic cancer is one of the most aggressive and lethal malignancies. It is the fourth cause of cancer-related death in the United States [1]. Long-term survival in pancreatic cancer is still very low. So far, there is no other effective treatment apart from the surgery, if the disease has not spread locally. This means that pancreatic cancer resection for resectable cancer should always be attempted [2]. The type of surgical procedure provided for resectable pancreatic cancer depends on the tumour localisation and its accordance with blood vessels. Distal pancreatectomy is indicated in cases of pancreatic body or tail malignancy. Recently, minimally invasive techniques have been applied to procedures at multiple centres internationally [3, 4].

The first reported operation on a human pancreas was performed by Wandersleben in 1841 [5]. Minimally invasive surgery in the management of pancreatic diseases began in the early 1990s. Distal pancreatectomy with laparoscopic approach was first described in 1992 by Canadian surgeon Michael Gagner. Nowadays this is the most commonly performed laparoscopic pancreatic procedure in high-volume centres [6].

Several studies have shown laparoscopic distal pancreatectomy advantages: shorter hospital stay, decreased blood loss, reduced morbidity, fewer overall complications, faster recovery, and cost effectiveness (due to the shorter hospital stay) in comparison with open surgery [7, 8].

Multiple factors such as: patient's BMI, history of previous operation, underlying disorders (cardio-pulmonary), and Yonsei criteria (describes: restriction of tumour to the pancreas, intact fascial layer between the distal pancreas and the left adrenal gland and kidney, and tumour localization at least 10–20 mm from the celiac axis) must be considered in the selection of patients for laparoscopic distal pancreatectomy procedure [7, 9, 10].

Aim of the study

To present our experience in minimally invasive treatment of pancreatic tumours and to discuss different approaches to different anatomical situations.

Material and methods

We retrospectively reviewed the medical records of patients, who underwent laparoscopic distal pancreatectomy for the treatment of suspected pancreatic tumour in Vilnius University Hospital Santariskiu Klinikos from 2014 to 2016 February.

After primary analysis of our collected data, we have found that the necessity of portal vein preparation during distal pancreatectomy was asso-

ciated with extension of operation. Therefore, we have divided laparoscopic distal pancreatectomy cases into two procedures: ordinary distal pancreatectomy and left hemipancreatectomy.

Two types of operation were performed. The radical antegrade modular pancreatosplenectomy was described previously by Strasberg *et al.* [11], and the clockwise technique by Asbun and Stauffer [12]. Intraoperative ultrasonography was performed in all cases to localize the lesion and decide upon the resection line. Laparoscopic staplers were used for pancreas resection. All patients diagnosed with malignant tumours underwent splenectomy. Splenectomy was also performed for patients with large tumours near the splenic hilum, because spleen preservation would have been technically challenging. A closed suction drainage tube was inserted toward the left subphrenic space at the pancreatic stump.

The variables that we analysed were as follows: preoperative characteristics (patients gender, age, body mass index), tumour localisation and size, technique of surgery (radical antegrade modular pancreatosplenectomy or clockwise), with or without splenectomy, conversion rate, operation time, presence of fistula (evaluated by classification presented by Bassi *et al.* [13]), length of stay after operation and results of histological examination (which showed histological type of tumour, the resection was radical (R0) or not (R1) and number of resected lymph nodes).

The cases with surgical conversion were excluded from further analysis of postoperative data (blood loss, operation time, length of postoperative stay and presence of fistula).

All data were analysed with SPSS version 23.0 (IBM SPSS Inc., Chicago, IL, USA). Shapiro-Wilk test was used to check for normal distribution. Parametric data were analysed by Student's *t*-test and expressed as means and standard deviations. Non-parametric data were analysed with the use of Mann-Whitney *U* test and reported as medians and ranges. Categorical variables were analysed by Fisher's exact test. *P* values < 0.05 were considered as statistically significant.

Results

From 2014 to February 2016, we performed laparoscopic pancreas resections on 16 patients with suspected pancreatic tumour. Out of them, 7 (43.8%) were male and 9 (56.3%) were female. The average patients age was 62.7 ±17.2 years, body mass index (BMI) – 30.3 ±5.1 (23.4–39.5) kg/m², and tumour size – 31.1 ±11.6 mm. Seven (43.8%) patients underwent laparoscopic distal pancreatectomy, and 9 (56.2%) underwent left hemipancreatectomy. The routine histological investigation of the surgically removed pancreas specimen has established malignancy in 10 (62.5%) cases. R0 resection rate was 70% and the average number of resected lymph nodes was 5.2 (1–14). All patients tolerated the surgery well and were discharged from the hospital after 12.6 (5–30) days. The early follow-up period showed no recurrent disease in all cases.

Detailed comparison of laparoscopic ordinary distal pancreatectomy and left hemipancreatectomy cases is presented in the Table 1.

Discussion

There are few techniques of laparoscopic distal pancreatectomy procedure: radical antegrade modular pancreatosplenectomy (RAMPS) (Fig. 1) described by Strasberg *et al.* [11] and a clockwise technique (CW) (Fig. 2) described by Asbun and Stauffer [12]. We performed laparoscopic distal pancreatectomies by both of them. Both techniques are good and their choice depends on tumour localization. For patients diagnosed with pancreatic head tumour, which is close to portal vein, we recommend RAMPS technique, because better visualization of blood vessels can be achieved.

Despite selection of the patients, all laparoscopic surgery is known to have some major disadvantages. Difficult handling of bleeding is one such complication. This complication often demands conversion to open surgery. Björns-son *et al.* found, that the rate of conversion in laparoscopic distal resection of the pancreas varies between 11% and 30.8% [8]. We had 3 (18.8%) cases of massive bleeding. All of them required conversion to open surgery. In the first case (a patient from the left hemipancreatectomy group, operated using RAMPS technique) pancreatic mobility was limited and preparation of blood vessels was complicated, because of tumour invasion in the fascia layer between the pancreas and the left adrenal gland (one of the Yonsei criteria) and massive haemorrhage from the splenic vein occurred. Laparoscopic management of bleeding was inconvenient, because of high BMI (39.4 kg/m²). The second patient (from the distal pancreatectomy group, CW) had laparoscopically unmanageable bleeding from the splenic edge. In the third case, patient (from the left hemipancreatectomy group, CW) had BMI of 35.3 kg/m² and the tumour was located 15 mm from celiac axis (one of the Yonsei criteria). Bleeding occurred in the beginning of pancreas mobilization from the superior mesenteric vein. There are some publications that present evidence of a decline in complications and conversion to open surgery with the increase in experience with laparoscopic surgery [14]. Another disadvantage is an inability to perform intraoperative frozen sections [15] and high R1 resection rates. In our study R1 resection was observed in 30% of malignant cases. However, this can be explained by the use of an endoscopic stapler, which can distort results of resection. The relatively small number of removed lymph nodes and R0 resection is associated with the learning curve.

Usually distal pancreatectomy is performed with splenectomy. However, the spleen is important for the immune system and spleen-preserving distal pancreatectomy is preferred and advisable only for benign disease, when lymph node removal is not as crucial [16, 17]. Two major spleen-preserving procedures are the Warshaw procedure, which conserves the spleen by blood flow from the short gastric vessels, and the Kimura procedure, which preserves the spleen with splenic vessels [18]. In our series, 13 (81.3%)

Table 1. Comparison of laparoscopic distal pancreatectomy and left hemipancreatectomy data.

Parameter	Laparoscopic distal pancreatectomy (n = 7)	Laparoscopic left hemipancreatectomy (n = 9)	Value of P
Female/male (n)	3 (42.9%)/4 (57.1%)	6 (66.7%)/3 (33.3%)	0.615
Age (years)	58.4 ±15.5	66 ±18.7	0.402
BMI (kg/m ²)	30 ±3.7	30.5 ±6.2	0.855
Tumor localization (n)			0.049
Tail	6 (85.7%)	2 (22.2%)	
Body-tail	1 (14.3%)	4 (44.4%)	
Body	0	3 (33.3%)	
Tumor size (mm)	32.86 ±14.4	29.8 ±9.6	0.616
Operation technique (n)			0.089
RAMPS	0	4 (44.4%)	
CW	7 (100%)	5 (55.6%)	
Splenectomy (n)	5 (71.4%)	8 (88.9%)	0.55
Intraoperative complication (n)	1 (14.3%)	2 (22.2%)	1
Surgical conversion (n)	1 (14.3%)	2 (22.2%)	1
Blood loss (ml)*	125 (20–250)	250 (50–1800)	0.138
Operation time (min)*	205 (195–245)	412.5 (280–520)	0.001
Presence of fistula (n)*	2 (20%)	3 (42.9%)	1
Postoperative stay (days)*	7.5 (7–16)	9.5 (5–30)	0.295
Malignancy (n)	3 (42.9%)	7 (77.8%)	0.302
Histology (n)			–
Ductal adenocarcinoma	0	5 (55.6%)	
Neuroendocrine tumor	2 (28.6%)	1 (11.1%)	
Mucinous cystadenocarcinoma	1 (14.3%)	0	
Insulinoma	1 (14.3%)	1 (11.1%)	
Mucinous cystadenoma	1 (14.3%)	2 (22.2%)	
Chronic pancreatitis	1 (14.3%)	0	
Heterotopic splenic tissue	1 (14.3%)	0	
RO resection (n)	2 (66.7%)	5 (71.4%)	0.569
Resected lymph nodes (n)	4.7 (1–9)	5.6 (1–14)	0.683

* The cases with surgical conversion were excluded from data analysis

BMI – body mass index; RAMPS – radical antegrade modular pancreatectomy; CW – Clockwise technique

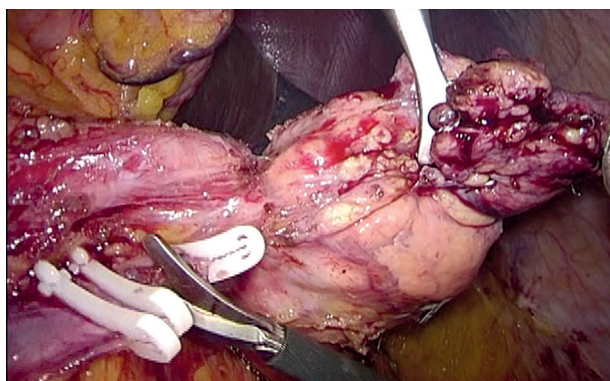


Fig. 1. Radical antegrade modular pancreatectomy

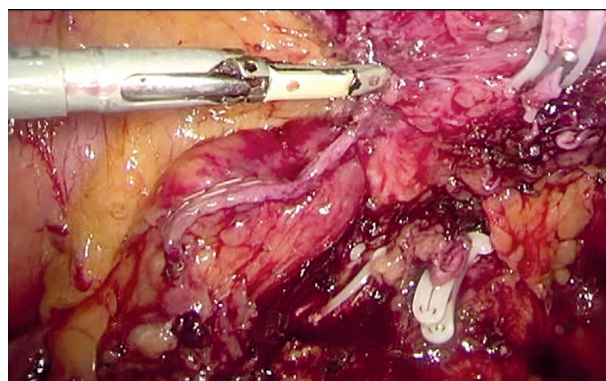


Fig. 2. Clockwise technique of distal pancreatectomy

patients underwent splenectomy, most of them because of tumour invasion in the splenic hilum.

In different series, the operating time was reported as longer, similar, or shorter compared with the open approach. This may be explained by the difference in the surgeons learning curve [7]. After the first two laparoscopic

distal pancreatectomy procedures we almost reduced the average operation time by a factor of almost two.

After primary analysis of our collected data, we found that the necessity of portal vein preparation during distal pancreatectomy was associated with extension of operation. We divided laparoscopic distal pancreatectomy cases

into two procedures: ordinary distal pancreatectomy and left hemipancreatectomy. In our small case series, there were no notable differences between the distal pancreatectomy and left hemipancreatectomy groups comparing the data of intraoperative complications, surgical conversions, presence of fistula rates, the average blood loss, and postoperative stay, but we found that the left hemipancreatectomy procedure lasted significantly longer.

The most frequent complication after distal pancreatectomy is a postoperative pancreatic fistula, occurring in 4% to 69% of patients [19]. In our study, totally postoperative fistula was found in 7 (43.8%) cases. Out of them, 5 (71.4%) patients were from left hemipancreatectomy and 2 (28.6%) from distal pancreatectomy group. Two (28.6%) of them were diagnosed with postoperative fistula of type 4B and were after surgical conversion, 3 (42.8%) patients had 4A and 2 (28.6%) – 3B type fistula. We do not use fibrin glue for fistula prevention, because the results of retrospective reviews and trials are contrary. Several randomized controlled trials have reported effective techniques to prevent postoperative pancreatic fistula (seromuscular jejunal patch, mesh reinforcement, and pasireotide injection), but no strategy has been confirmed in a second consecutive randomised controlled trial [19].

In conclusion, distal resection of the pancreas and left hemipancreatectomy are not identical procedures. Laparoscopic left hemipancreatectomy requires more laparoscopic skills and this procedure should be performed with a growing experience. Extension and technique selection of distal resection of the pancreas depends on the Yonsei criteria and tumour relation to the portal vein.

The authors declare no conflicts of interest.

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