

Distal duodenectomy: a new option of surgical treatment for duodenal tumors

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ABSTRACT

Objective — to assess severity, safety and functional advisability of distal pancreatectomy using original surgical technique developed in the Blokhin National Medical Research Centre of Oncology.

Material and methods. There were 10 patients with duodenal malignancies who have undergone distal pancreatectomy in the Blokhin National Medical Research Centre of Oncology for the period 2006—2018. Distal pancreatectomy for primary duodenal tumors was performed in 8 patients, 2 patients underwent surgery for external invasion of the duodenum.

Results. Postoperative complications Clavien—Dindo grade 1 and 2 occurred in 4 (40%) patients. Surgical complication grade 2 occurred in 1 (10%) patient (pancreatic fistula with effective conservative management). There were no cases of leakage of duodenal stump and duodenojejunostomy, impaired bile flow and stenosis of anastomosis with delayed stomach emptying.

Conclusion. Distal duodenectomy is associated with low postoperative morbidity, good functionality and quality of life. This procedure is preferred for non-epithelial and neuroendocrine tumors, as well as with secondary malignant duodenal invasion.

Keywords: distal duodenectomy, pancreaticoduodenectomy, GIST, non-epithelial duodenal tumors, neuroendocrine duodenal tumors.

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Distal duodenectomy: a new option of surgical treatment. Primary small bowel malignancies are relatively rare tumors making up only 2% of all gastrointestinal neoplasms [1]. Duodenal tumor is the most common type of small bowel neoplasms (over 50% of all small bowel tumors). However, duodenal malignancies account only 0.3% of all gastrointestinal tumors.

Adenocarcinoma is the most common duodenal malignancy (80%) [2, 3]. Sarcoma, neuroendocrine tumors and lymphomas are less common. Incidences of these tumors are 7, 5 and 3%, respectively. Gastrointestinal stromal tumors (GIST) are the most common sarcomas (4.5% of all duodenal malignancies) [4, 5].

Primary malignant tumors are usually localized in descending part of the duodenum. Less common localizations are inferior horizontal part and duodenojejunal junction. Malignant tumors are extremely rare observed in proximal parts of the duodenum [6—8].

Gastropancreaticoduodenectomy is the standard procedure for duodenal tumors. However, postoperative complications occur in 30—70% of patients [9]. The most common complication is leakage of pancreatojejunostomy and biliodigestive anastomosis (30 and 9%, respectively). Various authors reported postoperative mortality rate up to 5% [10—13]. Pancreatic fistulas after gastropancreaticoduodenectomy occur in 10—15% of cases [14].

According to the literature, minor procedures are recommended for non-epithelial tumors (except lymphomas) if tumor cells are absent along resection margin (R0) [15—17]. These surgeries result favorable early outcomes and quality of life. At the same time, overall survival rates are similar to those after extended surgical interventions [14—18]. Mandatory requirements for surgical intervention are negative resection margin and preserved tumor capsul.

Similar data are also described in patients with duodenal adenocarcinoma. Different authors reported simi-

Table 1. Characteristics of patients undergoing distal pancreatectomy

Age (years)	Minimum	Maximum	Mean
	28	74	56
Gender	male		female
	6		4
Primary duodenal tumors	Leiomyosarcoma		GIST
	1		7
Neoadjuvant therapy for GIST	Yes		No
	3		4
Duodenal invasion by other tumors	CRC*		PRT**
	1		1

Note: * CRC — colorectal cancer; ** PRT — primary retroperitoneal tumor.

lar long-term outcomes results in patients with duodenal adenocarcinoma after minor surgery and gastropancreaticoduodenectomy [15, 19, 20].

Thus, minor surgery is justified in patients with non-epithelial tumors and considered as an alternative to advanced procedures for duodenal adenocarcinoma. Minor duodenal surgery includes atypical resection, distal segmental resection and pancreas-sparing total duodenectomy. The objective of our study was to assess severity, safety and functional advisability of distal pancreatectomy. Surgical technique was developed in the Blokhin National Medical Research Centre of oncology.

Material and methods

There were 10 patients (6 men and 4 women) with duodenal malignancies who have undergone distal pancreatectomy in the Blokhin National Medical Research Centre of oncology for the period 2006—2018 (**Table 1**).

Mean age of patients was 56 years. Distal pancreatectomy was performed for primary duodenal tumors in 8 patients (leiomyosarcoma in 1 patient, GIST in 7 cases). Neoadjuvant chemotherapy with imatinib 400 mg daily was administered in 3 out of 7 patients with duodenal GIST. Partial regression of the tumor resulted subsequent R0-resection (no tumor cells within resection margin). In other 2 cases, distal pancreatectomy was performed for external invasion of the duodenum (transverse colon cancer and primary retroperitoneal tumor).

Surgical aspects

Median laparotomy is used for distal pancreatectomy. Thorough examination of the abdominal cavity is followed by mobilization of the duodenum using Kocher and Cattell—Braash maneuvers. Anterior peritoneum is dissected from hepatoduodenal ligament along subhepatic space and right lateral canal to the level of cecum. Therefore, dissection of the peritoneum continues to the left and cranially towards ligament of Treitz. The next stage is retraction of mobilized right half of the colon and entire small bowel to the left and up. This maneuver results expose of the duodenum throughout.

Technical limitation for distal duodenectomy was the distance between macroscopically visible border of the tu-

mor and major duodenal papilla. Intraoperative endoscopic examination is necessary to determine the boundaries of duodenectomy if tumor infiltration is close to major duodenal papilla. Minimum distance (3 cm) was in a patient with GIST after previous neoadjuvant therapy with imatinib and significant positive effect who underwent distal duodenectomy (**Fig. 1**). Intraoperative emergency histological examination of proximal resection margin of the duodenum is required in these cases. Advanced surgery including gastropancreaticoduodenectomy or pancreas-sparing duodenectomy is required if tumor cells are observed along resection margin. R0-resection was carried out in all 10 cases that provides a favorable oncological prognosis.

Mobilization of duodenojejunal junction is performed as soon as proximal border of duodenectomy is determined. Ligament of Treitz is intersected for this purpose. We intersected jejunum 10—15 cm distal to ligament of Treitz between the first and the second jejunal arteries for better mobility using a suturing device. Next, we intersected mesentery of proximal jejunum and distal duodenum, ligated first jejunal artery and adjacent veins (**Fig. 2, b, 3, a**).

The following delicate surgical stage is mobilization of descending part and inferior angle of the duodenum from the pancreatic head tissue. Duodenal mobilization should be carried out considering anatomical features of blood supply of descending and inferior horizontal parts of the duodenum in order to minimize pancreatic damage.

These duodenal segments are supplied from superior and inferior pancreatoduodenal arteries. Each of these arteries is divided into 2 trunks (anterior and posterior). These branches pass towards each other, anastomose and form anterior and posterior arterial arches. Anterior and posterior arterial pancreatoduodenal arches are located in the groove between pancreatic head and duodenum. Short duodenal trunks from anterior and posterior arterial arches supply anterior and posterior duodenal walls, respectively (**See Fig. 2, a**). Venous drainage of the duodenum follows the arteries, these veins drain into the portal system [21]. Mobilization of distal descending part and inferior angle of the duodenum is associated with separate ligation of anterior and posterior duodenal branches of the pancreatoduodenal vessels and preservation of both vascular arches (**see Fig. 2, b**).



Fig. 1. Patient with GIST of descending part of the duodenum.

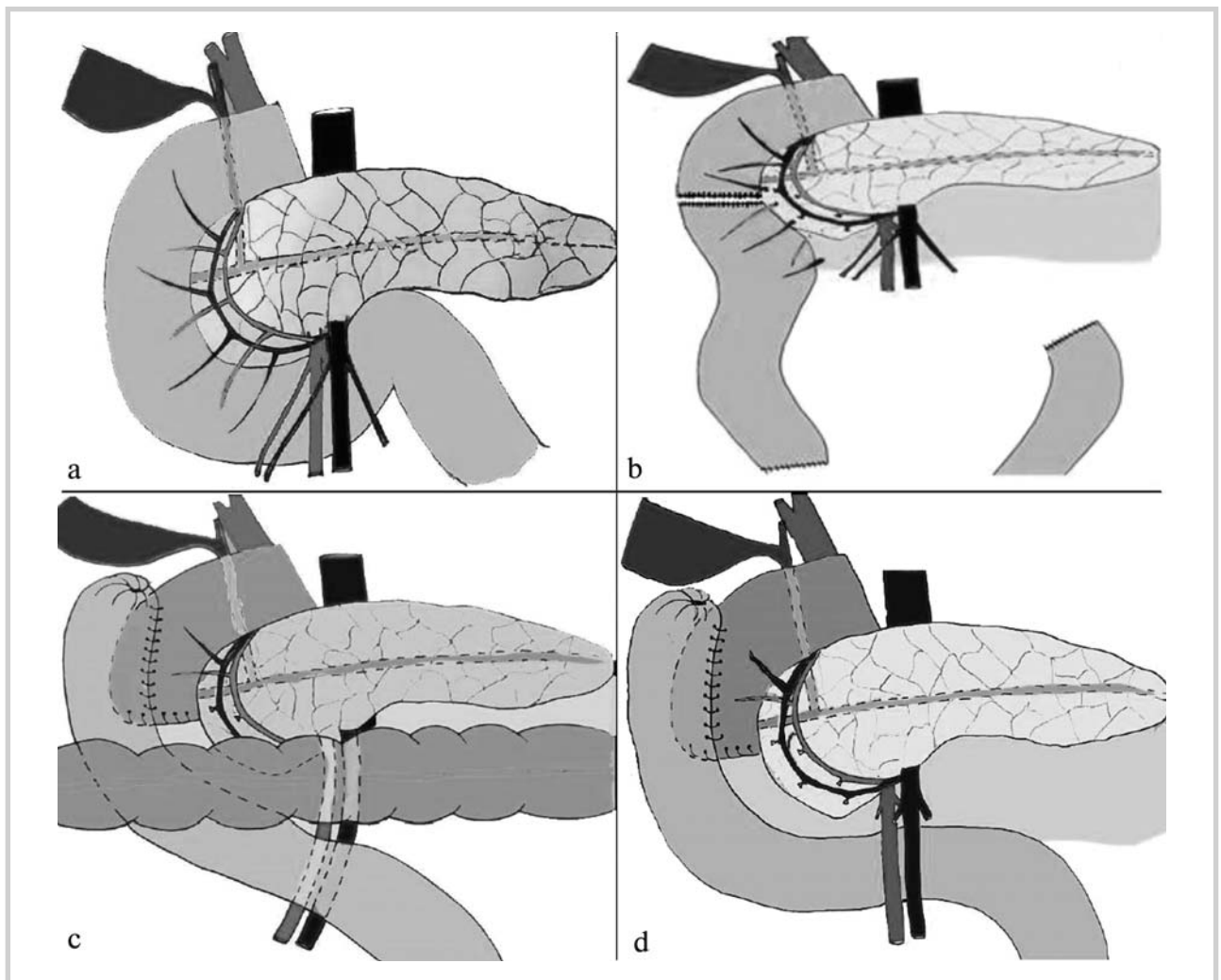


Fig. 2. Technical scheme of distal duodenectomy.

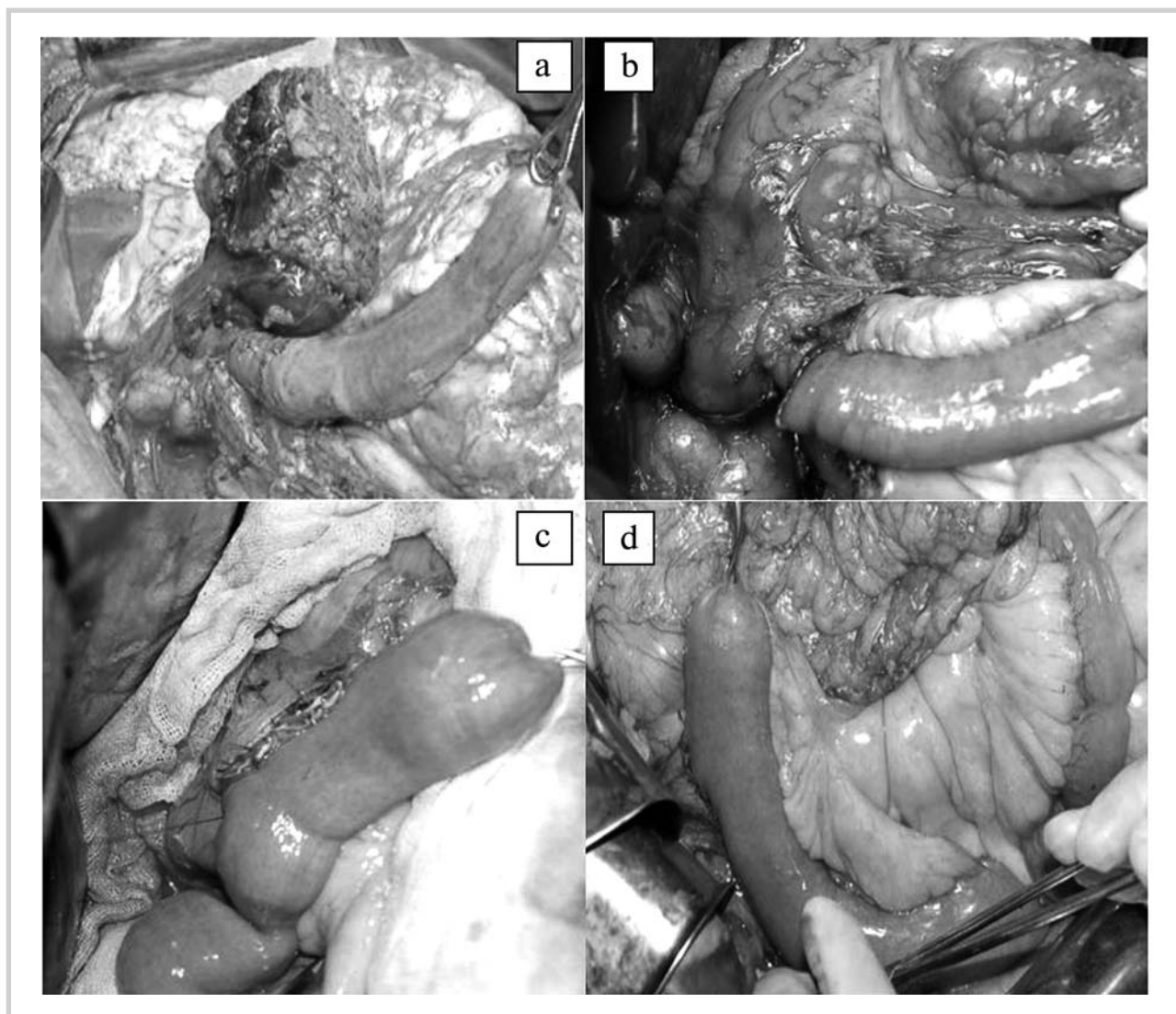


Fig. 3. Intraoperative images of certain stages of distal duodenectomy.

Duodenum is intersected using linear stapling device (see Fig. 2, b and 3, b). Mechanical suture of the jejunal stump is dipped under a purse-string suture. Stump of the descending part of the duodenum is covered by interrupted serous-muscular sutures considering the limited distance to major duodenal papilla that prevents large invagination.

In our opinion and according to the literature, duodenojejunostomy in side-to-side fashion is the most advisable approach to restore continuity of the intestinal tract [22]. In all 10 cases, we have formed an anastomosis in side-to-side fashion between anterior-external wall of the descending part of the duodenum and distal jejunal stump (see Fig. 2, c, d and 3, c, d). Isoperistaltic anastomoses were formed in 9 (90%) cases, antiperistaltic — in 1 (10%) patient. It is advisable to pass the jejunum behind the colon (through a window in the mesentery of the transverse colon) and anterior to superior mesenteric vessels. In some cases, it is more convenient to place the jejunum behind

superior mesenteric vessels (in the bed of excised inferior horizontal and descending part of the duodenum). We used this technique only in one (10%) patient.

Mean time of surgery was 250 min (range 150—300), intraoperative blood loss — 300 ml (range 150—600) (Table 2). Duration of intervention and blood loss depended on type of surgical procedure especially in patients with duodenal invasion from the outside.

Adequate abdominal drainage with mandatory drain placement near uncinated process and inferior edge of the pancreatic head is necessary considering the probability of the development of postoperative pancreatic fistulas.

Postoperative morbidity was assessed using Clavien—Dindo classification [23]. Early postoperative complications grade 1—2 occurred in 4 (40%) patients. Complications grade 2 were observed in 2 patients including 1 (10%) patient with pancreatic fistula and subsequent effective conservative treatment. Polysegmental pneumonia developed in 1 patient.

Table 2. Intra- and postoperative features

Surgery time (min)	Max	Median	Min
	300	300	150
Blood loss (ml)	Max	Median	Min
	600	250	150
Postoperative hospital-stay (days)	Max	Median	Min
	16	13	10
Anastomosis	«side-to-side»	«end-to-side»	«end-to-end»
	10	0	0
	Isoperistaltic		Antiperistaltic
	9		1
Surgical procedure	Behind superior mesenteric vessels	Anterior to superior mesenteric vessels	
	1		9
	Distal duodenectomy	Distal duodenectomy + hemicolectomy	Distal duodenectomy + removal of PRT
	7	2	1
Postoperative complications	I	III	IV
	4 (40%)	0	0
Leakage	Duodenal stump	Duodenojejunostomy	
	no	no	

All patients underwent contrast-enhanced X-ray examination of the anastomosis after 5–7 days. There was no leakage of the duodenal stump and duodenojejunostomy in all cases.

We did not diagnose impaired biliary drainage and/or stenosis of the duodenojejunostomy with reduced gastric emptying after surgery. Postoperative mortality was absent. Mean postoperative hospital-stay was 13 days (range 10–16).

Discussion

According on the world and our own data, surgery is preferable approach in patients with duodenal tumors (with the exception of lymphoma). Optimal surgical strategy in these patients is being currently discussed.

Minor resections should be considered in patients with non-epithelial tumors. GISTs are the most common non-epithelial tumors of the gastrointestinal tract (up to 80% of cases) [24]. Lymphoma and other sarcomas are rarer (18–19 and 1–2%, respectively). Long-term postoperative results after advanced and minor resections are similar in patients with duodenal non-epithelial tumor. So, limited resections are preferred [4, 14, 25]. Moreover, these procedures are associated with lower postoperative morbidity, better functional outcomes and quality of life. Regional lymph node metastases are rare in patients with GIST (up to 2–3%), and lymphadenectomy is performed only in case of suspicious lymph nodes [26]. Therefore, minor resections are preferred in patients with non-epithelial duodenal tumors.

Minor resections are also preferable in patients with neuroendocrine tumors (NETs). Duodenal NETs are rare and account only 2–3% of all gastrointestinal neuroendocrine tumors [5]. Some authors reported favorable long-

term results after limited duodenectomy even in patients with regional lymph node metastases [27, 28].

We evaluated severity, safety and functionality of distal duodenectomy in 10 patients with non-epithelial duodenal tumors or secondary duodenal invasion. According to our data, surgical complications after distal duodenectomy occurred only in 1 (10%) patient (pancreatic fistula). Adequate intraoperative drainage and conservative treatment resulted closure of pancreatic fistula within 20 days without additional interventions.

Leakage of duodenal stump and duodenojejunostomy as well as mortality were absent. All patients had good functionality of the gastrointestinal tract without gastric emptying disturbances in early and long-term postoperative period. There were no local intramural recurrences in long-term period.

Early postoperative results and mortality are incomparably higher after gastropancreaticoduodenectomy compared with minor resections. Leakage of pancreatojejunostomy and biliodigestive anastomosis occurs in 30% and 9% of cases, respectively [9], pancreatic fistula — in 10–15%, postoperative mortality is up to 5% [12, 13].

The issue of effectiveness of minor resections in patients with duodenal adenocarcinoma is still relevant and controversial. Negative resection margin (R0) and regional lymph node metastases are the most significant criteria affecting the prognosis in these patients [29–31]. Various authors consider that R0 minor resection does not deteriorate long-term results. J. Cloyd et al. [32] retrospectively analyzed surgical treatment (gastropancreaticoduodenectomy vs. distal duodenectomy) of 1611 patients with duodenal adenocarcinoma. The authors reported similar overall survival despite extended lymphadenectomy during gastropancreaticoduodenectomy. Minor resections may be considered as an alternative in patients with duo-

denal adenocarcinoma considering comparable overall survival, better early outcomes and quality of life.

Conclusion

Distal duodenectomy is associated with low postoperative morbidity, good functionality and quality of life, as well as shorter length of hospital-stay compared with advanced surgery. Minor duodenal resections are preferred in

patients with duodenal non-epithelial (with the exception of lymphoma), neuroendocrine tumors and secondary duodenal invasion considering similar long-term outcomes.

The issue of effectiveness of minor resections in patients with duodenal adenocarcinoma is still relevant and controversial. Various authors reported similar long-term results after extended and minor resections in patients with duodenal adenocarcinoma. However, there are no randomized controlled trials devoted to this issue.

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