

Middle pancreatectomy for pancreatic neoplasms

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Abstract

Background A middle pancreatectomy (MP) is a parenchyma-preserving procedure for benign or low-malignant neoplasms in the neck or body of the pancreas that reduces long-term endocrine and exocrine insufficiency. MP requires the handling of 2 (distal and proximal) pancreatic remnants, and therefore, the higher rates of pancreatic fistula and morbidity may occur after MP rather than after standard pancreatectomies, such as for a pancreaticoduodenectomy and distal pancreatectomy. Though there have so far been few reports regarding a high number of series in MP as opposed to standard pancreatic resections, recently reports describing more than 50 case outcomes of MP were published.

Methods A literature search, which examined articles related to MP, was performed using the PubMed database. Data were compiled to generate conglomerate results of mortality and morbidity rates, and the long-term pancreatic functional insufficiency and recurrence after MP.

Results The mortality rates varied from 0 to 3%, and the morbidity from 13 to 62%. The rates of pancreatic fistula in more than 50 cases of MP varied from 8 to 30%. The rates of endocrine and exocrine insufficiency were very low (range, 0–9% and 0–8%, respectively).

Conclusions MP is a safe procedure for the treatment of benign or low-grade malignant neoplasms in the pancreatic neck or body, and in this procedure, the postoperative endocrine and exocrine functions are well preserved.

Keywords Middle pancreatectomy · Pancreatic fistula · Endocrine insufficiency · Exocrine insufficiency

Introduction

Recently, the incidental discovery of cystic or endocrine neoplasms has been increasing in the pancreas, and these neoplasms are often histopathologically benign or low-malignant [1–3]. The neoplasms located in the pancreatic neck or body have usually been resected by standard operations such as a pancreaticoduodenectomy or a distal pancreatectomy [4–6]. However, these extended resections performed for benign or low-malignant neoplasms result in the removal of normal pancreatic tissue, which increases the risk of loss of exocrine and endocrine functions [7–9]. Although enucleation is an option in some of these lesions, it should be avoided in neoplasms that are embedded deep in the substance of the gland because of the risk of injury to the main pancreatic duct, and when neoplasms are not clearly benign and margins cannot be compromised [10].

A middle pancreatectomy (MP), also known as a central or medical pancreatectomy, was proposed as an alternative technique in these cases, and it preserves the pancreatic parenchyma, extrahepatic bile duct, duodenum, and spleen, thereby reducing the risk of exocrine and endocrine insufficiency [11–13]. These procedures were applied for benign or low-grade neoplasms including intraductal papillary mucinous neoplasms (IPMNs), mucinous cystic neoplasms, solid and cystic tumors, serous cystic tumors, endocrine tumors, or focal chronic pancreatitis. In this study, we reviewed the English literature regarding the use of more than 20 patients with MPs for pancreatic neoplasms and investigated the indications for operation,

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postoperative morbidity, and development of pancreatic functional insufficiency.

History

In 1957, Guillemin and Bessot [14] first performed a central segmental pancreatic resection with the anastomosis of both pancreatic remnants with an omega-shaped jejunal loop for the treatment of chronic pancreatitis. Two years later, Letton and Wilson [15] performed, in 2 cases of severe traumatic injury of the pancreatic body, a Roux-en-Y jejunal loop anastomosis to the tail of the pancreas and blind closure of the pancreatic head remnant instead of a distal pancreatectomy with a splenectomy. The first MP for a neoplasm, which was benign insulinoma of the pancreatic isthmus, was performed by Dagradi and Serio in 1984 [16]. Since then, several authors have reported this technique using the following terminology: MP [17], central pancreatectomy [11–13], or middle segmental pancreatectomy [18, 19]. Recently, a few reports have described numerous middle pancreatectomies, retrospectively analyzing the perioperative course, morbidity and mortality, and long-term results regarding tumor recurrence and endocrine and exocrine function [17, 19, 20].

Surgical technique

After a midline or transverse upper abdominal laparotomy, the lesser sac is opened by separating the transverse colon from the omentum, preserving the gastroepiploic vessels. Thereafter, the anterior aspect of the pancreas is exposed by dividing the adhesions between the posterior surface of the stomach and the pancreas. Intraoperative ultrasonography is carried out to localize the tumor, and to determine the relationship between the tumor and the vascular structure and the main pancreatic duct. The superior mesenteric, portal, and splenic veins are identified and dissected from the posterior aspect of the pancreas, with care taken to ligate multiple small side branches to the pancreas. The lesion including the tumor is resected with a margin of at least 1 cm to both cut ends, and the bleeding points in the cut edge are sutured by 5-0 monofilament sutures. The pathological analysis is important for the cut ends by an intraoperative frozen section (Fig. 1a).

The proximal pancreatic remnant is reported to be sutured in almost all of the literature. Muller [19] revealed that the pancreatic remnant was covered with the same jejunal loop as the anastomosis loop of the distal remnant. The reconstruction of the distal pancreatic remnant is performed by a pancreaticojejunostomy or a pancreaticogastrostomy, according to the surgeon's preference. The external suture rows are performed as a single suture between the remnant pancreatic capsule, parenchyma, and

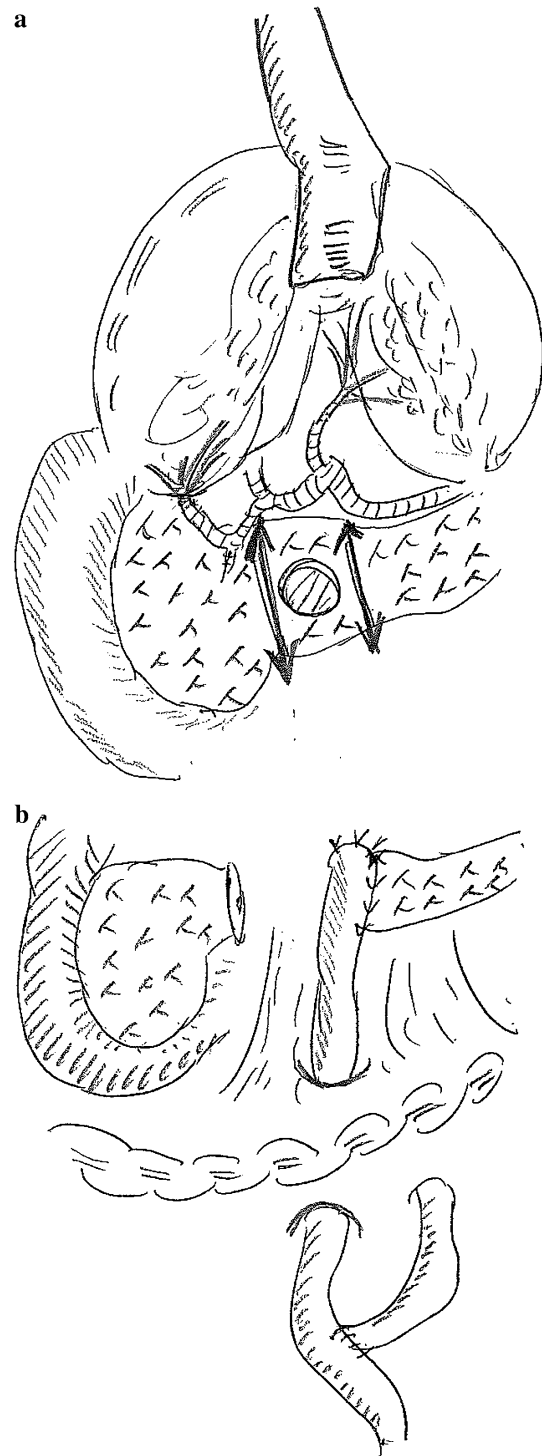


Fig. 1 **a** The tumor, located in the pancreatic body, is resected after deciding the cut lines using intraoperative ultrasonography. **b** The reconstruction of the distal pancreatic remnant is performed by a pancreaticojejunostomy

jejunal or gastric seromuscular (Fig. 1b). The internal suture rows, duct-to-mucosa, are performed between the pancreatic ductal and jejunal or gastric mucosa [21, 22].

Table 1 Postoperative mortality and morbidity rates of central pancreatectomy

References	Year	No. of patients	Mean operation time (min)	Mean intraoperative blood loss (ml)	Mortality no. (%)	Morbidity no. (%)	Pancreatic fistula no. (%)	Reoperation no. (%)	Endocrine insufficiency no. (%)
Ikeda et al. [18]	1995	24	–	–	0 (0)	3 (13)	1 (4)	0 (0)	2/24 (8)
Sauvanet et al. [23]	2002	53	–	–	1 (2)	22 (41)	16 (30) ^a	3 (6)	4/49 (8)
Balzano et al. [10]	2003	32	207	443	0 (0)	20 (62)	16 (50)	1 (3)	3/32 (9)
Iacono et al. [24]	2005	20	–	–	0	7 (35)	–	0 (0)	0 (0)
Muller et al. [19]	2006	40	304	564	1 (3)	17 (43)	3 (7.5)	2 (5)	1/40 (3)
Crippa et al. [17]	2007	100	248	311	0 (0)	58 (58)	17 (17) ^b	0 (0)	4/100 (4)
Adham et al. [20]	2008	50	221	–	0 (0)	23 (46)	5 (10)	6 (12)	1/50 (2)

^a Pancreatic fistula was defined as amylase-rich fluid in the abdominal drainage after day 5 or in percutaneously aspirated abdominal collections, and at reoperation caused by massive bleeding

^b Clinically significant pancreatic fistula (grade B and C) defined by the International Study Group on Pancreatic Fistula [45]

Table 2 Exocrine function after middle pancreatectomy

References	Year	No. of patients	Exocrine test	Exocrine insufficiency, no. (%)
Asanuma et al. [34]	1993	2	Pancreatic functional diagnostic test	0 (0)
Rotman et al. [37]	1993	14	Fecal fat excretion test	0 (0)
Ikeda et al. [18]	1995	24	Pancreao-lauryl fat excretion test	2 (8)
Iacono et al. [8]	1998	13	Fecal fat excretion test	0 (0)
Takeyoshio et al. [35]	1999	3	Pancreatic functional diagnostic test	0 (0)
Sperti et al. [36]	2000	10	Fecal chymotrypsin test	0 (0)
Shibata et al. [38]	2004	10	<i>p</i> -aminobenzoic acid test	0 (0)
Iacono et al. [24]	2005	20	Pancreao-lauryl fat excretion test	0 (0)

Perioperative course

In more than 20 patients with MP, the mortality rate after MP varies from 0 to 3%, and the morbidity varies from 13 to 62% (Table 1) [10, 17–20, 23, 24]. The most predominant complication reported in the literature is a pancreatic fistula, with a frequency that varies from 8 to 50%, with higher pancreatic fistula rates as opposed to standard pancreatic resection. These reports are convincing because MP requires the handling of 2 divided edges of the pancreas, creating 2 opportunities for pancreatic fistula. One of the reasons that the rates of perioperative death or intraabdominal bleeding caused by pancreatic fistula after an MP are low may be the minimal exposure to enzymatic activation by a bile leak. However, recently in more than 50 cases, the rates of pancreatic fistula decreased, ranging from 8 to 17% [17, 19, 20]. Other surgical complications reported in the literature are intra-abdominal abscess, fluid collection, splenic vein thrombosis with infarction of the spleen, pancreatitis, and delayed gastric emptying [7, 17–20]. Most recent reports stressed that MP is a safe procedure with acceptable morbidity and mortality rates [17, 19, 20].

Long-term outcome after MP

The main goal of MP is the preservation of endocrine and exocrine function. In the literature, the incidence of new onset or the worsening of diabetes after MP varies from 0 to 10% (Table 1) [9, 10, 17–20, 25], and some have demonstrated the preservation of endocrine function by means of an oral glucose tolerance test [23, 24, 26]. The reason for maintaining the endocrine function in patients undergoing an MP may be the preservation of the pancreatic tail, which includes a high concentration of the islet population [27].

With respect to the exocrine function, most reports have defined exocrine insufficiency as the need for taking enzymes; however, this assessment may be subjective and obscure [17, 28–33]. Some reports evaluated exocrine function via a pancreatic functional diagnostic test [34, 35], fecal chymotrypsin excretion test [36], pancreo-lauryl fat excretion test [18, 24], fecal fat excretion test [8, 37], or the *p*-aminobenzoic acid test in small series [38] and showed that the exocrine function after an MP was preserved well (Table 2). Furthermore, some reports showed that postoperative nutrition in the patients undergoing MP is

better preserved than in the patients undergoing a distal pancreatectomy by following up the change in body weight or by a serum albumin survey [10, 17, 38].

Because of its limited oncologic radicality, MP is accepted for benign and low-grade malignant neoplasms or pancreatic metastases from other carcinomas not requiring lymph node clearance. With respect to IPMN, a few reports showed the recurrence of remnant parenchyma or distant metastasis after MP [17, 19, 20]. Crippa et al. [17] claimed that MP should be indicated only for small, benign branch duct lesions of the mid pancreas and should be avoided in main-duct neoplasms. Most importantly, in order to avoid the recurrence of remnant pancreas after MP, a preoperative careful diagnosis of malignant potential by imaging findings [1, 2, 39, 40] and intraoperative frozen section analysis of the 2 resection margins (pathological findings of cut ends of duodenal site and splenic site) should be performed [17, 41–44].

Conclusions

Recent reports of a large series showed that MP was a safe procedure for the treatment of benign or low-grade malignant neoplasms. Furthermore, the rate of new onset of diabetes mellitus was minimal, and the exocrine function was preserved well after MP, suggesting that MP was an effective treatment for selected patients. However, because of limited oncologic radicality, MP is not accepted for high-grade malignant neoplasms, such as common pancreatic ductal carcinoma and invasive ductal carcinoma derived from IPMN, requiring lymph node clearance. Therefore, a preoperative and intraoperative careful diagnosis of malignant potential is most important for indications for MP in patients with pancreatic neoplasms.

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