



Clinical significance of circumportal pancreas, a rare congenital anomaly, in pancreatectomy



Takao Ohtsuka^{a,d,*}, Yasuhisa Mori^a, Kousei Ishigami^b, Takaaki Fujimoto^a, Yoshihiro Miyasaka^a, Kohei Nakata^a, Kenoki Ohuchida^a, Eishi Nagai^a, Yoshinao Oda^c, Shuji Shimizu^{d,e}, Masafumi Nakamura^{a,**}

^a Department of Surgery and Oncology, Graduate School of Medical Sciences, Kyushu University, Japan

^b Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Japan

^c Department of Anatomic Pathology, Graduate School of Medical Sciences, Kyushu University, Japan

^d Department of Endoscopic Diagnostics and Therapeutics, Kyushu University Hospital, Fukuoka, Japan

^e International Medical Department, Kyushu University Hospital, Fukuoka, Japan

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ABSTRACT

Background: Circumportal pancreas is a rare congenital pancreatic anomaly. The aim of this study was to clarify the clinical characteristics of patients with circumportal pancreases undergoing pancreatectomy. **Methods:** The medical records of 508 patients who underwent pancreatectomy were retrospectively reviewed. The prevalence of circumportal pancreas and related anatomical variations were assessed. Surgical procedures and postoperative outcomes were compared in patients with and without circumportal pancreas.

Results: Circumportal pancreas was observed in 9 of the 508 patients (1.7%). In all nine patients, the portal vein was completely encircled by the pancreatic parenchyma above the level of the splenoportal junction, and the main pancreatic duct ran dorsal to the portal vein. The rate of variant hepatic artery did not differ significantly in patients with and without circumportal pancreas. Pancreatic fistula developed more frequently in patients with than without circumportal pancreas (44% vs. 14%, $p = 0.03$), but other clinical parameters did not differ significantly in these two groups.

Conclusions: Despite being rare, circumportal pancreas may increase the risk of postoperative pancreatic fistula in patients undergoing pancreatectomy. However, a prospective, large-cohort study is necessary to determine the real incidence of relevant anatomical variations and the definitive clinical significance of this rare anomaly.

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1. Introduction

Circumportal pancreas, also called portal annular pancreas, is a rare congenital pancreatic anomaly present in 1.1%–2.5% of normal people.^{1–5} Aberrant fusion of the ventral and dorsal pancreatic primordium can result in three types of congenital pancreatic

anomalies: annular pancreas, pancreas divism, and circumportal pancreas. Circumportal pancreas may develop during aberrant embryogenesis, with the ventral and dorsal pancreatic primordia fusing over the portal vein (PV)/superior mesenteric vein (SMV).^{1,6} Most patients with circumportal pancreas are asymptomatic. During pancreatectomy, however, there may be two transection plates, one each on the ventral and dorsal sides of the PV/SMV, increasing the risk of pancreatic fistula (PF).^{6–8} In addition, the incidence of a variant hepatic artery is reportedly enhanced in patients with circumportal pancreas.² Recent advances in diagnostic modalities have led to better understanding of patient anatomy, allowing preoperative determination of the proper surgical approach to each patient. Previous reports on circumportal pancreases have included a review of the literature,¹ radiological case series,^{2–5} and case reports,^{6–11} with no surgical case series reported to date. This study

* Corresponding author. Department of Surgery and Oncology, Graduate School of Medical Sciences, Kyushu University, 3-1-1 Maidashi, Higashi-ku, Fukuoka, 812-8582, Japan.

** Corresponding author. Department of Surgery and Oncology, Graduate School of Medical Sciences, Kyushu University, 3-1-1 Maidashi, Higashi-ku, Fukuoka, 812-8582, Japan.

E-mail addresses: takao-o@surg1.med.kyushu-u.ac.jp (T. Ohtsuka), mnaka@surg1.med.kyushu-u.ac.jp (M. Nakamura).

was therefore performed to clarify the clinical characteristics of patients with circumportal pancreases undergoing surgery.

1.1. Patients and methods

This study was approved by the ethics committee of Kyushu University Hospital, which waived the requirement for written informed consent because of the retrospective design of this study. In accordance with the guidelines for research ethics of the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Health, Labour and Welfare of Japan (<http://www.lifescience.mext.go.jp/bioethics/ekigaku.html>), the study protocol is published on our home page (<http://www.surg1.med.kyushu-u.ac.jp/research/research.html>).

The medical records of 508 consecutive patients who underwent pancreatoduodenectomy (PD) or distal pancreatectomy (DP) at the level of the SMV/PV from 2010 to 2015 at Kyushu University Hospital were retrospectively reviewed. Because this study focused on the region around the PV/SMV, all operations that included procedures not involving the PV/SMV such as tunneling, distal pancreatectomy with the resection line of the pancreas separate from the PV/SMV, or enucleation of the pancreatic tumor, were excluded. Patients who underwent central pancreatectomy (high risk for PF because of the presence of two pancreatic cut margins) and total pancreatectomy (no risk for PF) were also excluded. Data collected included patient age, sex, preoperative American Society of Anesthesiologists (ASA) physical status classification system score (<https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system>), pathological results of the resected specimen, presence of a circumportal pancreas, presence of a variant hepatic artery, type of operation (PD or DP), surgical approach (open or laparoscopy), performance of additional resection (e.g. PV/SMV resection combined with hepatic resection or colectomy), consistency of the pancreas at the cut margin (soft or hard), operation time (min), blood loss (mL), need for blood transfusion, occurrence of overall complications, occurrence of PF, and postoperative hospital stay (days).

The preoperative presence of a circumportal pancreas was determined as previously described (Fig. 1).¹ Briefly, all patients underwent contrast-enhanced multi-detector computed tomography with 64-, 128-, or 320-channel detector rows and slices 1–3 mm thick. Images of four phases (early arterial, pancreatic parenchymal, portal venous, and equilibrium phases) were obtained. All imaging results were assessed by an experienced radiologist (K.I.). A circumportal pancreas was defined as complete encircling of the PV/SMV by the pancreatic parenchyma on the portal phase of axial images, confirmed by aberrant pancreatic tissue extending behind the PV/SMV and fusing with the pancreatic

body on multiplanar reformatted images. The occurrence of a circumportal pancreas was confirmed by operative findings (Fig. 2). The occurrence of a variant hepatic artery and of a variant main pancreatic duct (MPD), on imaging examination and intraoperatively, was also recorded.

Overall complications, including significant complications (grades II–IV), were determined according to the Clavien–Dindo classification.¹² Complications after pancreatectomy, including PF,¹³ delayed gastric emptying (DGE),¹⁴ and hemorrhage,¹⁵ were graded according to the definitions of the International Study Group of Pancreatic Surgery, and grade B and C complications were noted. During the postoperative period, the patients were examined by surgeons every day regarding their physical condition and the character of discharge from the drain, if placed. The amylase level in the drainage fluid was routinely evaluated on postoperative days 1, 3, and 7, if a drain was placed. If the patients had abnormal signs such as infectious fluid from the drain, nausea, and/or abdominal pain and fever that led to suspicion for the presence of an intra-abdominal fluid collection, a bacterial culture, blood examination, and/or radiological imaging were performed, and the patients were managed based on the results.

Statistical analysis was performed using JMP statistical software (version 11.0.0; SAS Institute, Cary, NC, USA). Continuous data are expressed as median (range) and were compared using the Mann–Whitney *U* test. Categorical data were compared using Fisher's exact test or the χ^2 test. A probability value of <0.05 was considered statistically significant.

2. Results

The characteristics of the 508 patients included in this study are shown in Table 1. There were 293 men (57.7%) and 215 (42.3%) women with a median age of 66 years (range, 16–91 years). Of these patients, 92 (18.1%), 383 (75.4%), and 33 (6.5%) had ASA scores of 1, 2, and 3, respectively. The most frequent disease was pancreatic ductal adenocarcinoma in 247 (48.6%) patients, followed by intraductal papillary mucinous neoplasm of the pancreas in 88 (17.3%), bile duct carcinoma in 52 (10.2%), neuroendocrine tumor in 38 (7.5%), and others in 84 (16.5%). A variant hepatic artery was noted in 121 patients (23.8%), including 45 with the right hepatic artery (RHA) originating from superior mesenteric artery (SMA), 21 with the RHA over the common hepatic duct, 12 with the RHA originating from the celiac artery, 11 with the left hepatic artery originating from the left gastric artery, 9 with the common hepatic artery originating from the SMA, 6 with both the RHA originating from the SMA and the left hepatic artery originating from the left gastric artery, 6 with the RHA originating from the gastroduodenal artery, and 11 with other anomalies.

Of the 508 patients, 362 (71.3%) underwent PD and 146 (28.7%) underwent DP. Conventional open surgery was performed in 463 (91.1%) patients and laparoscopic surgery in 45 (8.9%). Of these patients, 85 (16.7%) underwent resection of another organ in addition to pancreatectomy, including 52 who underwent combined resection of the PV/SMV and reconstruction; 9 who underwent hepatic resection, including 2 who underwent hepatopancreatoduodenectomy for widespread bile duct carcinoma; 7 who underwent colorectal resection; 5 who underwent gastrectomy for gastric cancer; 3 who underwent spleen-preserving pancreas tail resection; 3 who underwent DP with en-bloc celiac axis resection; and 6 who underwent other operations.

There were no operation-related deaths during a median postoperative hospital stay of 20 days (range, 8–186 days). Postoperative complications occurred in 128 patients (25.2%), including PF in 76 patients, DGE in 26, and hemorrhage in 2. Five patients required a re-operation, including two for PF and one each for

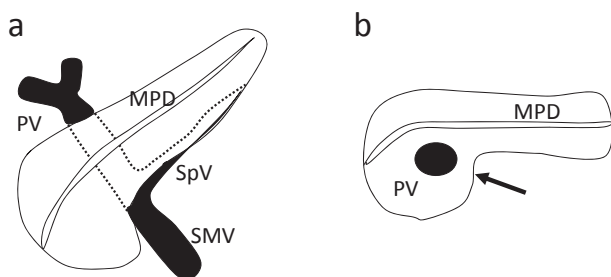


Fig. 1. View of a circumportal pancreas. (a) Overview and (b) axial view of a circumportal pancreas. In this patient, the portal vein above the level of the splenoportal junction was completely encircled by the aberrant pancreatic parenchyma, and the main pancreatic duct was ventral to the portal vein. PV: portal vein, SpV: splenic vein, SMV: superior mesenteric vein, MPD: main pancreatic duct.

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