

# A new preoperative prognostic scoring system to predict prognosis in patients with locally advanced pancreatic body cancer who undergo distal pancreatectomy with en bloc celiac axis resection: A retrospective cohort study

Takumi Miura, MD, Satoshi Hirano, MD, PhD, Toru Nakamura, MD, PhD, Eiichi Tanaka, MD, PhD, Toshiaki Shichinohe, MD, PhD, Takahiro Tsuchikawa, MD, PhD, Kentaro Kato, MD, PhD, Joe Matsumoto, MD, PhD, and Satoshi Kondo, MD, PhD, Sapporo, Hokkaido, Japan

**Background.** Distal pancreatectomy with en bloc celiac axis resection (DP-CAR) provides good local control for locally advanced pancreatic body cancer, but early recurrence still occurs. In this study, we aimed to establish a new scoring system to predict prognosis using preoperative factors in patients with locally advanced pancreatic body cancer who undergo DP-CAR.

**Methods.** Prognostic factors were analyzed using various data collected retrospectively from 50 consecutive patients who underwent DP-CAR. Using these preoperative factors, a scoring system to predict prognosis was established.

**Results.** Multivariate analysis identified intraoperative blood loss ( $\geq 940$  mL; hazard ratio [HR], 25.179;  $P = .0003$ ), preoperative platelet counts ( $< 150 \times 10^9/L$ ; HR, 7.433;  $P = .0043$ ), preoperative C-reactive protein (CRP) levels ( $\geq 0.4$  mg/dL; HR, 7.064;  $P = .0018$ ), and preoperative carbohydrate antigen 19-9 (CA19-9) levels ( $\geq 300$  U/mL; HR, 8.197;  $P = .0053$ ) as independent adverse prognostic factors. For the 3 preoperative factors, preoperative platelet counts  $< 150 \times 10^9/L$ , preoperative CRP levels  $\geq 0.4$  mg/dL, and preoperative CA19-9 levels  $\geq 300$  U/mL were allocated 1 point each. The total score was defined as the Preoperative Prognostic Score (PPS). The estimated disease-specific 1- and 5-year survival rates for the 26 patients with PPS0 were 95.7%, and 49.1%, respectively, and for the 15 patients with PPS1, they were 86.7% and not available, respectively. The median survival times for PPS0 and PPS1 were 50.6 and 22.3 months, respectively. In contrast, in the 9 patients with PPS2/3, 1- and 5-year survival rates were 33.3% and 0%, respectively, and median survival time was only 7.7 months.

**Conclusion.** A new prognostic scoring system using the preoperative platelet count, CRP, and CA19-9 enables preoperative prediction of prognosis and facilitates selection of appropriate treatment for borderline resectable cases of locally advanced pancreatic body cancer. (Surgery 2014;155:457-67.)

From the Department of Surgical Oncology, Hokkaido University Graduate School of Medicine, Sapporo, Hokkaido, Japan

PANCREATIC CANCER is among the most recalcitrant tumors, with a high malignant potential and a poor prognosis. Recent progress has been made in the diagnosis of this disease, but it is still

difficult to detect pancreatic cancer at an early stage. Cancer of the body of the pancreas is frequently detected as advanced-stage cancer because of its fewer specific symptoms, such as the obstructive jaundice that is associated with tumors of the head of the pancreas. However, it is possible to achieve prolonged survival if a histologically clear resection (R0 resection) is performed, even if the pancreatic cancer is locally advanced.<sup>1-3</sup>

In cancer of the body of the pancreas, the tumor often involves or touches the common hepatic artery and/or celiac axis with perineural

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Reprint requests: Takumi Miura, MD, Department of Surgical Oncology, Hokkaido University Graduate School of Medicine, North-15, West-7, Kita-ku, Sapporo, Hokkaido 060-8648, Japan. E-mail: [taku-miu20@feel.ocn.ne.jp](mailto:taku-miu20@feel.ocn.ne.jp).

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invasion, which spreads toward the celiac plexus and ganglia directly or perineurally via the nerve plexus surrounding the splenic and common hepatic arteries. To treat this disease, which is often considered unresectable despite the absence of distant metastases, we have performed distal pancreatectomy with en bloc splenectomy and en bloc celiac axis resection (DP-CAR).<sup>4,5</sup> This procedure was originally designed for en bloc lymphadenectomy for advanced gastric cancer with combined total gastrectomy by Appleby.<sup>6</sup> The lack of a need for arterial reconstruction is a great advantage of this procedure, because collateral pathways via the superior mesenteric artery, pancreaticoduodenal arcades, and gastroduodenal artery maintain the arterial blood supply to the hepatobiliary system. Because the collateral pathways also ensure arterial flow to the right gastroepiploic artery, the whole stomach can be preserved unless the pancreatic tumor involves the stomach.

We have been able to perform R0 resection and provide relief of intractable cancer-related pain for patients with locally advanced pancreatic body cancer who underwent DP-CAR with definite indications, and we previously reported a comparatively good prognosis and satisfactory quality of life for these patients.<sup>5,7,8</sup>

Despite excellent local control, with R0 resection achieved in >90% of cases, early recurrence (predominantly in the liver) still occurred postoperatively.<sup>5</sup> Therefore, it is necessary to develop an innovative system to predict the prognosis after DP-CAR using preoperative factors to avoid operating on patients who will not derive any benefit from the procedure.

The purpose of this study was to investigate the prognostic factors and establish a useful system to predict prognosis using preoperative factors in patients with locally advanced pancreatic body cancer who underwent DP-CAR, as well as to determine the appropriate indications for DP-CAR, especially for borderline resectable cases.

## PATIENTS AND METHODS

**Indications for DP-CAR and the operative procedure.** The indication for DP-CAR was locally advanced ductal adenocarcinoma of the body of the pancreas, such as that which involved or touched the common hepatic artery, the root of the splenic artery, and/or the celiac axis, without distant metastasis. The gastroduodenal artery and the superior mesenteric artery had to be preserved. Tumor progression was usually evaluated with preoperative imaging modalities, including computed tomography (CT), magnetic resonance

imaging, and endoscopic ultrasonography. The operative procedures routinely included en bloc resection with the celiac, common hepatic, and left gastric arteries, the celiac plexus and bilateral ganglia, and the nerve plexus around the superior mesenteric artery; a part of the crus of the diaphragm and Gerota's fascia, the left adrenal gland, the retroperitoneal fat tissues bearing lymph nodes above the left renal vein, the transverse mesocolon covering the body of the pancreas, and the inferior mesenteric vein were also resected with the distal pancreas and the spleen. Resection of the portal vein and middle colic vessels was optional. Generally, reconstruction of the arterial system was not required when the celiac axis was resected, because of early development of the collateral arterial pathway via the pancreaticoduodenal arcades from the superior mesenteric artery.<sup>5</sup> Preoperative coil embolization of the common hepatic artery was routinely used to enlarge the collateral arterial pathway and prevent ischemia-related complications.<sup>9</sup> The whole alimentary tract, including the stomach and the biliary system without cancer invasion, was preserved. If the tumor of the pancreatic body invaded other organs directly, concomitant resection of the alimentary tract was performed. Total gastrectomy was also performed in patients who had previously undergone distal gastrectomy.

**Patients' characteristics.** Between May 1998 and December 2008, 50 consecutive patients with ductal carcinoma of the body of the pancreas, excluding intraductal papillary-mucinous neoplasms, underwent DP-CAR in our department (Table I). Informed consent was obtained from all patients preoperatively. This study was conducted in accordance with the ethical standards of the Committee on Human Experimentation of our institution. This study included 26 males and 24 females, and their median age was 64 years (range, 48–85). All patients were followed for a median period of 45.3 months (range, 13.4–137.6). Concomitant resections of the portal vein were performed in 32 patients. Other organs, such as the stomach, colon, duodenum, and jejunum, that were directly invaded by the tumor were concomitantly resected in 12 patients. Total gastrectomy was additionally performed in 2 patients. R0 resection was achieved in 46 patients (92%). Operative time ranged from 306 to 1037 minutes (median, 454). Intraoperative blood loss ranged from 420 to 15,970 mL (median, 940). A transfusion was required intraoperatively by 9 patients. Postoperative morbidity occurred in 27 patients: Pancreatic fistula in 20 patients, and ischemic

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