

Portal Vein Resection

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KEYWORDS

- Pancreas cancer • Portal vein • Superior mesenteric vein
- Borderline resectable

Involvement of the superior mesenteric vein (SMV) or the portal vein (PV) by pancreatic cancer historically was a relative contraindication to pancreaticoduodenectomy (PD).¹ The Japanese,² and subsequently Fortner³ in 1973, proposed the concept of “regional pancreatectomy,” which involved deliberate and systematic resection of major peripancreatic vascular structures combined with wide soft tissue clearance. PV resection at the time of PD was originally performed in an attempt to improve survival,¹ but unfortunately this proved not to be true as this type of extended PD did not confer a survival advantage.^{4,5} Confusion among treating physicians occurred when these regional pancreatectomy patients were equated to those patients having isolated tumor involvement of the SMV, PV, or SMV-PV confluence. The former had stage III disease with a median survival of 10 to 12 months, and the latter, survival of 2 years.^{6–8} In contrast to regional pancreatectomy, contemporary vein resection (VR) is done when the operating surgeon cannot safely separate the SMV or the SMV-PV confluence from the tumor, but is not done for the purpose of achieving a greater extent of lymphatic clearance.⁷ At present, resection and reconstruction of these veins at the time of PD to facilitate a complete (R0/R1) resection of a pancreatic tumor has been shown to be associated with a low rate of perioperative morbidity and similar rates of R0 resection and overall survival when compared with patients treated with standard PD without venous resection.^{7,8}

The American Hepato-Pancreatico-Biliary Association and Society of Surgical Oncology (AHPBA/SSO) panel of experts joined forces to formulate a consensus statement published in 2009 on the subject of vein resection and reconstruction during PD. The investigators concluded that PD with vein resection and reconstruction is the standard of practice for pancreatic adenocarcinomas locally involving the SMV-PV confluence, provided that adequate inflow and outflow veins are present, that the tumor does not involve the superior mesenteric artery (SMA) or hepatic artery (HA), and that an R0/R1 resection is reasonably expected. The consensus statement went on to say that patients with nonmetastatic adenocarcinomas should be

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evaluated and resected at institutions capable of, and experienced in, resection and reconstruction of major mesenteric veins.⁹

PRINCIPLES OF MANAGEMENT

Accurately defining the extent of disease at the time of diagnosis (preoperative) and reserving surgery for those patients with localized, nonmetastatic pancreatic cancer who can undergo a complete gross resection of the primary tumor are critical elements to successful surgery for pancreatic adenocarcinoma.¹⁰ To achieve results equivalent to those for patients with tumors that do not involve adjacent vascular structures, the following principles of management¹¹ must be adhered to when considering the performance of an extended PD to include vascular resection and reconstruction:

1. Appropriate patient selection based on high-quality computed tomography (CT) imaging and review of all cases at multidisciplinary disposition conferences¹² is key to avoiding operative intervention on patients with T4 (involving celiac axis or SMA) or M1 tumors.
2. Operative and pathologic attention to margins of resection. The technical aspects of the SMA dissection in large part will determine the likelihood of local recurrence. The final margin status is determined by the size and location of the tumor, the conduct of the operation itself (the removal of all soft tissue to the right of the SMA), and the effectiveness of adjuvant or neoadjuvant therapy.
3. Advances in surgical technique, surgeon experience, and improved understanding of the anatomy of the SMV allow vascular resection to become a routine part of PD.

PREOPERATIVE STAGING

Only patients characterized as resectable or borderline resectable are considered for PD. Staging should be established by a multidetector contrast-enhanced CT scan of the abdomen with 3-dimensional reconstruction,¹³ and by review in a multidisciplinary conference.¹² The definitions of resectability are as follows:

1. **Resectable** pancreatic cancer, defined as:
 - (a) The absence of extrapancreatic disease.
 - (b) No evidence of tumor extension to the SMA, celiac axis, or HA; as defined by the presence of a normal tissue plane between the tumor and these arteries (**Fig. 1**).
 - (c) Patent SMV-PV confluence assuming that resection and reconstruction of the SMV, PV, or SMV-PV confluence can be performed when necessary.⁴

The AHPBA/SSO consensus statement further defined resectable tumors as those with no radiographic evidence of SMV and PV “abutment, distortion, tumor thrombus or venous encasement.” In addition, “clear fat (soft tissue) planes” had to be present around the celiac axis, HA, and SMA.¹³
2. **Borderline resectable: Katz classification**¹⁴

Type A

 - (a) Tumor abutment ($\leq 180^\circ$) of the SMA or celiac axis.
 - (b) Tumor abutment or encasement ($>180^\circ$) of a short segment of the HA (usually at the origin of the gastroduodenal artery [GDA]).
 - (c) Short segment occlusion of the SMV, PV, or SMV-PV confluence with a suitable PV above and SMV below, for reconstruction (**Fig. 2A,B** and **Fig. 3A,B**).

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