

Techniques of Vascular Resection and Reconstruction in Pancreatic Cancer

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KEYWORDS

• Pancreaticoduodenectomy • Vascular resection • Vascular reconstruction • Whipple

KEY POINTS

- Accurate staging and stage-specific therapy are used by a multidisciplinary team.
- Neoadjuvant treatment response (in contrast to disease progression) is associated with increased survival duration and predicts successful surgery.
- Vascular resections, whether venous or arterial, must be planned events (in contrast to an intraoperative surprise) for best possible outcomes.
- In situations of cavernous transformation of the portal vein, diversion of mesenteric flow before beginning the portal dissection is critically important to the performance of a safe operation.
- Revascularization of the common hepatic artery during an Appleby procedure lowers the risk of biliary/hepatic ischemia and gastric atony.

INTRODUCTION

Vascular resection during pancreatectomy was performed within two decades from Whipple and coworkers¹ first description of pancreaticoduodenectomy (PD) in 1935. The concept of “regional pancreatectomy” subsequently led by Fortner in the early 1970s failed to improve outcomes because wide tissue and lymphatic clearance around the tumor did not improve patient survival.^{2–5} Vascular resections are currently performed to obtain an R0 margin during PD when the only area that prevents a gross complete resection of the tumor is vascular involvement otherwise amenable to

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reconstruction. Even in the pre-neoadjuvant treatment era, venous resections for isolated vein involvement conferred a 2-year survival benefit.^{6–8} After the American Hepato-Pancreato-Biliary Association/Society of Surgical Oncology consensus statement in 2009, PD with venous resection and reconstruction became the standard of care in the treatment of pancreatic adenocarcinoma.⁹ Arterial resection and reconstruction during PD was also part of the early regional pancreatectomy approach; however, enthusiasm for these procedures was lost because of technical difficulties of the operation, resulting in higher morbidity and mortality. With the improved surgical techniques available in specialized centers, arterial resections in appropriately selected patients have once again been adopted and proven to be safe.^{10–12}

In addition to technical advances in surgery, advances in systemic chemotherapy have also resulted in improved response rates and prolonged survival.^{13–18} Patients with borderline resectable pancreatic adenocarcinoma should be offered neoadjuvant systemic chemotherapy and/or chemoradiation based on all nationally recognized guidelines.^{16,18,19} Multiple centers are now also starting to offer neoadjuvant therapy for resectable pancreatic cancer, representing a shift in the treatment paradigm in recognition of significantly improved survival rates recently reported with this approach.¹⁷ The improved response rate to current chemotherapy regimens (FOLFIRINOX, gemcitabine-abraxane, GTX) has rendered patients, initially deemed unresectable, to be considered for resection.^{13,14} There are increasing numbers of reports touting the positive effect of neoadjuvant therapy on margin status, lymph node positivity, and tumor response.¹⁶ Neoadjuvant therapy allows for selection of patients with biologically responsive tumors to be considered for major vascular resection and reconstruction with curative intent.¹⁷

This article describes the technical aspects of these major operations, including accurate preoperative staging and planning, the technical aspects of venous and arterial resection and reconstruction during pancreatectomy, and key points of the perioperative care of these patients.

PREOPERATIVE PLANNING

Inherent in the planning for vascular resection during pancreatectomy is preoperative staging and the delineation of vascular involvement by the tumor. A computed tomography (CT)-based staging system for pancreatic cancer has been developed at the Medical College of Wisconsin and cited in national consensus guidelines (**Table 1**).^{9,20,21} A multidisciplinary team approach to any new diagnosis of pancreas cancer is the foundation of success.¹⁸ All team members follow the same principles to optimize and efficiently administer all intended parts of the treatment program. Key principles of this program are discussed next.

Clinical Staging

High-definition cross-sectional imaging is the mainstay for defining tumor-vessel relationships and aberrant vascular anatomy. Multidetector, dual-phase, contrast-enhanced CT provides accurate clinical staging based on reproducible anatomic relationships. The tumor is defined and classified as being resectable, borderline resectable, locally advanced A/B, or metastatic.¹³ In a resectable tumor, there is no evidence of arterial involvement (abutment or encasement) and tumor-induced narrowing of the portal vein (PV), superior mesenteric vein (SMV), or PV-SMV confluence, if present, is less than 50% (**Fig. 1**). Borderline resectable tumors include tumors with abutment of the superior mesenteric artery (SMA) and celiac artery (CA) of 180° or less and/or short-segment encasement of the common hepatic artery (CHA) amenable for

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