Portal vein reconstruction using primary anastomosis or venous interposition allograft in pancreatic surgery

Dyre Kleive, MD,[a,b] Audun Elnaes Berstad, MD, PhD,[c] Mushegh A. Sahakyan, MD,[b,d] Caroline S. Verbeke, MD, PhD,[b,e] Christian Naper, MD, PhD,[f] Sven Petter Haugvik, MD, PhD,[a,g] Ivar P. Gladhaug, MD, PhD,[a,b] Pål-Dag Line, MD, PhD,[b,h] *and* Knut Jørgen Labori, MD, PhD,[a] *Oslo and Drammen, Norway*

ABSTRACT

Objective: Superior mesenteric vein/portal vein (SMV/PV) resection and reconstruction during pancreatic surgery are increasingly common. Several reconstruction techniques exist. The aim of this study was to evaluate characteristics of patients and clinical outcomes for SMV/PV reconstruction using interposed cold-stored cadaveric venous allograft (AG+) or primary end-to-end anastomosis (AG−) after segmental vein resections during pancreatic surgery.

Methods: All patients undergoing pancreatic surgery with SMV/PV resection and reconstruction from 2006 to 2015 were identified. Clinical and histopathologic outcomes as well as preoperative and postoperative radiologic findings were assessed.

Results: A total of 171 patients were identified. The study included 42 and 71 patients reconstructed with AG+ and AG−, respectively. Patients in the AG+ group had longer mean operative time (506 minutes [standard deviation, 83 minutes] for AG+ vs 420 minutes [standard deviation, 91 minutes] for AG−; $P < .01$) and more intraoperative bleeding (median, 1000 mL [interquartile range (IQR), 650-2200 mL] for AG+ vs 600 mL [IQR, 300-1000 mL] for AG−; $P < .01$). Neoadjuvant therapy was administered more frequently for patients in the AG+ group (23.8% vs 8.5%; $P = .02$). Patients with AG+ had a longer length of tumor-vein involvement (median, 2.4 cm [IQR, 1.6-3.0 cm] for AG+ vs 1.8 cm [IQR, 1.2-2.4 cm] for AG−; $P = .01$), and a higher number of patients had a tumor-vein interface >180 degrees (35.7% for AG+ vs 21.1% for AG−; $P = .02$). There was no difference in number of patients with major complications (42.9% for AG+ vs 36.6% for AG−; $P = .51$) or early failure at the reconstruction site (9.5% for AG+ vs 8.5% for AG−; $P = 1$). A subgroup analysis of 10 patients in the AG+ group revealed the presence of donor-specific antibodies in all patients.

Conclusions: The short-term outcome of SMV/PV reconstruction with interposed cold-stored cadaveric venous allografts is comparable to that of reconstruction with primary end-to-end anastomosis. Graft rejection could be a contributing factor to severe stenosis in patients reconstructed with allograft. (J Vasc Surg: Venous and Lym Dis 2017;■:1-9.)

Numerous studies have supported the safety and feasibility of combining pancreatectomy with resection of the superior mesenteric vein/portal vein (SMV/PV). The procedure is currently considered standard of care for patients with pancreatic tumors with limited involvement of the SMV/PV. Consequently, focus on development of an optimal reconstruction technique of the SMV/PV is pivotal. Several reconstruction techniques have been described, and primary repair with end-to-end anastomosis or venorrhaphy is most frequently reported.[1] For patients in whom a tension-free anastomosis cannot be achieved, the use of various interposition grafts has been described: venous and arterial allografts, autologous veins, synthetic grafts, and grafts made from parietal peritoneum or bovine pericardium.[1-4]

Existing literature concerning venous allograft for SMV/PV reconstruction during pancreatic surgery is limited.[4-8] Furthermore, long-term results on patency at the reconstruction site are not always reported.[8] Moreover, differences in the definition of adequate patency and the measurement of stenosis at the reconstruction site make published data troublesome to interpret. The aim of this study was to evaluate characteristics of patients and clinical outcomes for SMV/PV reconstruction during pancreatic surgery using interposed cold-stored cadaveric venous allograft (AG+) and primary end-to-end anastomosis (AG−). Also, donor-specific alloantibodies (DSAs) were investigated in patients receiving AG+ in an attempt to prove the hypothesis that an allogeneic immune response directed against the graft tissue could play a role in late graft stenosis.[6]

METHODS

Study population

We performed a retrospective review of all patients undergoing pancreatic surgery with venous resection and reconstruction at Oslo University Hospital between

From the Department of Hepato-Pancreato-Biliary Surgery,[a] Department of Radiology,[c] The Intervention Centre,[d] Department of Pathology,[e] Department of Immunology and Transfusion Medicine,[f] and Department of Transplantation Medicine,[h] Oslo University Hospital, and the Institute of Clinical Medicine, University of Oslo,[b] Oslo; and the Department of Surgery, Drammen Hospital, Vestre Viken Hospital Trust, Drammen.[g]

Author conflict of interest: none.

Correspondence: Dyre Kleive, MD, Department of Hepato-Pancreato-Biliary Surgery, Rikshospitalet, Oslo University Hospital, Sognsvannsveien 20, Nydalen, Oslo 0424, Norway (e-mail: dyrkle@ous-hf.no).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2213-333X

https://doi.org/10.1016/j.jvsv.2017.09.003

January 2006 and December 2015. Hospital records and pathology reports were reviewed. The type of procedure, venous reconstruction technique, duration of operation, intraoperative blood loss, and presence of severe complications were registered. Length of stay was defined as the day of surgery until discharge. End of data collection was set at June 30, 2016. Data from 37 of the patients in the AG+ group have been published previously.[6]

Study ethics

The Hospital Review Board approved the study (2015/18135) according to the general guidelines provided by the Regional Ethics Committee. The subgroup analysis of DSAs was approved by the Regional Ethics Committee (2016/1409/REK South East), and all patients analyzed for DSAs gave written informed consent. The manuscript was completed in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology statement.[9]

Definitions

Complications. Postoperative complications were assessed according to the Clavien-Dindo classification.[10] Major complications were defined as Clavien-Dindo grade ≥III, which are complications requiring surgical, endoscopic, or radiologic intervention as well as single or multiorgan dysfunction or death.

Patency. Preoperative and postoperative computed tomography (CT) images were evaluated in a blinded setting by an experienced staff radiologist (A.E.B.). Preoperative workup included multidetector CT with an optimized pancreatic protocol and a chest CT. Preoperative images were evaluated for tumor-vein circumferential interface (TVI) as described by Tran Cao et al[11] and for the length of tumor-vein involvement. SMV/PV diameter was measured in preoperative and postoperative axial images on portal venous-phase CT images, taken at a thickness of 1.5 to 3 mm. To eliminate the confounding effect of initial SMV/PV diameter, the change in diameter was calculated as the percentage postoperative reduction compared with preoperative SMV/PV diameter at the most narrow site, as described by others[12] (Fig 1). The degree of SMV/PV diameter change was classified as grade A (0%-49% reduction in diameter), grade B (50%-69% reduction), and grade C (≥70% lumen reduction) change. Complications associated with anastomotic stenosis of the portal venous system, including refractory ascites, hepatic encephalopathy, and gastrointestinal bleeding, have been found to occur in patients with stenosis ≥70%.[13] A grade C change was therefore regarded as severe stenosis and included fully occluded or thrombosed anastomoses. The causes and clinical implications of severe stenosis were retrieved from postoperative CT images and hospital records. Local recurrence was defined as soft tissue formation that increased in size over time in the resection area or along the cardinal visceral vessels around the pancreatic bed, as proposed by Heye et al.[14] Early failure at the reconstruction site was defined as the presence of thrombosis or no flow or low flow within the first 30 days after surgery.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study
- **Take Home Message:** In 113 patients who underwent superior mesenteric vein/portal vein reconstruction during pancreatic surgery with either primary end-to-end anastomosis or cold-stored interposition cadaveric allografts, there were no differences in complications or early outcomes between the two groups. Donor-specific antibodies developed in 10 allograft patients.
- **Recommendation:** The authors suggest both primary anastomosis and allograft reconstruction of superior mesenteric and portal veins during pancreatic surgery, although graft rejection could be a contributing factor to severe stenosis in the long term.

Patient management and operation technique

All patients were preoperatively evaluated in a multidisciplinary setting. Pylorus-preserving or classic pancreatoduodenectomy and subtotal or total pancreatoduodenectomy were performed. Since 2012, patients with preoperative findings consistent with borderline resectable pancreatic cancer, as defined by Callery et al,[15] were treated with at least four cycles of neoadjuvant chemotherapy. Reassessment with a new CT study was than performed to identify patients with resectable disease. The type of venous resection and reconstruction technique was based on intraoperative findings and the surgeon's preference. All SMV/PV resections and reconstructions were performed by experienced abdominal transplant surgeons. For patients with AG+, iliac veins removed during multiorgan harvesting procedures by the transplantation unit were used as interposition grafts. Immediately after harvesting, grafts were stored in University of Wisconsin solution at 4°C and matched to recipients according to blood group. Rejection drugs were not used for AG+ patients because of suspicion of cancer at the time of surgery and the risk of accumulating complications. Grafts stored for >14 days were discarded. All PV reconstructions were performed with polypropylene 5-0 or 6-0 running suture. A primary end-to-end anastomosis was obtained for patients in the AG− group. Perioperative use of heparin before vein resection was administered on a routine basis to all patients. Ultrasound of the reconstructed vein on postoperative day (POD) 1 was considered standard of care from 2012 onward. Patients were discharged home or to their local hospital as soon as the postoperative course was without suspicion of adverse events. Anticoagulation therapy varied throughout the study