Ann Surg Oncol
https://doi.org/10.1245/s10434-023-14293-7

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – PANCREATIC TUMORS

Bovine Pericardial Graft for Portomesenteric Reconstruction During Robotic Pancreatoduodenectomy

Marcel Autran C. Machado, MD, FACS, Bruno V. Mattos, MD, Murillo Macedo Lobo Filho, MD, Augusto C. Carvalho, MD, and Fabio Makdissi, MD

Nove de Julho Hospital, São Paulo, Brazil

ABSTRACT

Background. Minimally invasive pancreatoduodenectomy (PD) is one of the most complex procedures in oncologic surgery. We present a video of robotic portomesenteric reconstruction with bovine pericardial graft during PD.

Methods. A 52-year-old woman was referred with a mass in the head of the pancreas. The tumor was in contact with the portomesenteric axis. The multidisciplinary team decided to perform an upfront resection. The surgery was performed as a pylorus-preserving pancreaticoduodenectomy with lymphadenectomy. The superior mesenteric artery first approach was used to expose the head of the pancreas, so that the entire surgical specimen was attached only through the tumor invasion of the portomesenteric axis. After resection of the invaded portomesenteric axis, its large extension precluded primary reconstruction, so a bovine pericardial graft was used for venous reconstruction. After completion of the venous anastomosis, reconstruction of the digestive tract was performed as usual.

Results. Surgical time was 430 min; clamp time was 55 min; and portomesenteric reconstruction took 41 min. Estimated blood loss was 320 mL without transfusion. Pathology confirmed T3N1 ductal adenocarcinoma with free margins. No pancreatic or biliary fistula was observed, and she was discharged on postoperative day 8. A postoperative examination confirmed the patency of the graft. The patient is doing well 6 months after surgery and has no signs of the disease.

Conclusions. A bovine pericardial graft is useful for reconstruction and readily available, eliminating the need to harvest an autologous vein or use synthetic grafts. This procedure can be safely performed with the robotic platform.

First Received: 9 June 2023
Accepted: 30 August 2023

M. A. C. Machado, MD, FACS
e-mail: dr@drmarcel.com.br

Published online: 25 September 2023

Minimally invasive pancreatoduodenectomy (PD) is one of the most complex procedures in oncologic surgery. PD is the procedure of choice for resectable tumors located in the head of the pancreas. With the introduction of new and more effective chemotherapeutic agents and technical improvements, the indications for PD and the complexity of these operations have increased. Vascular resections and neoadjuvant therapies are becoming more common, making the resection phase of PD more challenging.[1–4]

Invasion of the great vessels, particularly the portal vein and superior mesenteric vein, is a relative contraindication to a minimally invasive approach. Despite the potential advantages in terms of microdissection and microsuturing, the robotic approach for pancreatic cancer with vascular invasion is still rare.[3,4]

We present here a video of robotic portomesenteric reconstruction with bovine pericardial graft during PD in a patient with ductal adenocarcinoma of the pancreas. A 52-year-old woman presented with epigastric pain and weight loss. No jaundice or other clinical signs were noted and the patient had no relevant surgical or medical history. An abdominal computed tomography (CT) examination was performed, showing a mass in the head of the pancreas with a dilated main pancreatic duct. The tumor was in contact and likely invaded the right anterior portion of the portomesenteric axis (Fig. 1). There was no evidence of distant metastasis and the superior mesenteric artery was not in contact with the tumor. The multidisciplinary team decided to perform an upfront resection. A robotic approach was proposed and consent was obtained.

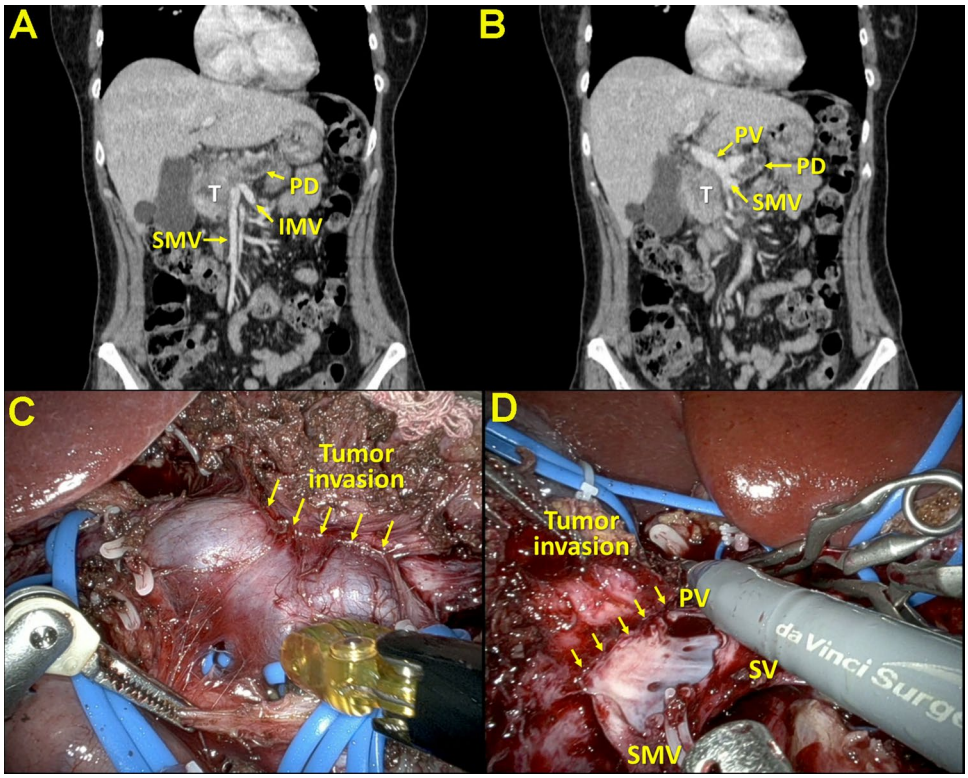

FIG. 1 Invasion of the portomesenteric axis. **A** Preoperative CT image in the coronal view shows a tumor in the pancreatic head with partial obstruction of the SMV and IMV. The PD is dilated. **B** Preoperative CT scan in the coronal view. The SMV and PV are not completely occluded by the tumor. **C** Intraoperative view shows partial invasion of the portomesenteric axis by the tumor (arrows). **D** Intraoperative view shows that the portomesenteric axis is connected to the tumor after partial resection (arrows). *CT* computed tomography, *IMV* inferior mesenteric vein, *PD* pancreatic duct, *PV* portal vein, *SV* splenic vein, *SMV* superior mesenteric vein, *T* tumor

The Da Vinci Xi system was used and four robotic arms (four 8 mm trocars) were placed along with an additional laparoscopic port (15 mm). The surgeon sat at the robotic console and the assistant surgeon stood on the left side of the patient to perform suction, irrigation, clipping, and change of robotic instruments. The operation was performed as a pylorus-preserving pancreaticoduodenectomy with lymphadenectomy. The superior mesenteric artery first approach was used to expose the head of the pancreas so that the entire surgical specimen was attached only through the tumor invasion of the portomesenteric axis.[5] All venous branches from the portomesenteric system were encircled and temporarily clamped to completely remove the surgical specimen along the invaded vascular segment. The patient received 5000 UI systemic heparin immediately before clamping the portal vein. We used laparoscopic bulldogs instead of robotic bulldogs because robotic bulldogs are not available at our hospital; therefore, we had an experienced surgeon at the bedside (FM).

After resection of the invaded portomesenteric axis, its large extent precluded primary reconstruction and the defect was measured (approximately 4 × 1 cm). A patch of bovine pericardium (Biopatch, Biomedical, São Paulo, Brazil) was used for venous reconstruction (Fig. 2). An elliptical patch measuring 4 × 1 cm was prepared. The patch was sutured to the venous wall with a running 6-0 Prolene suture. Immediately before clamping the veins, the patient received systemic heparin. After completion of the vein anastomosis, reconstruction of the digestive tract was performed as usual. In brief, pancreaticojejunostomy was performed using a two-layer technique without pancreatic stent. We used a running duct-to-mucosa with 5-0 PDS suture and the outer layer with interrupted 4-0 Prolene suture. Hepaticojejunostomy was performed with a running 5-0 PDS suture and duodenojejunostomy was performed according to our recently published growth factor technique.[6]

The operative time was 430 min; clamping time was 55 min and portomesenteric reconstruction took 41 min. Estimated blood loss was 320 mL without transfusion. Pathology confirmed a T3N1 ductal adenocarcinoma with free margins. The patient had a marked elevation of transaminases, which was likely due to prolonged venous clamping. However, recovery was uneventful and the patient was discharged on postoperative day 8. No pancreatic or biliary fistula was observed and drains were removed before hospital discharge. A postoperative duplex scan confirmed the patency of the graft. The patient received 5000 UI heparin subcutaneously (three times daily) during hospitalization and oral rivaroxaban 10 mg was maintained for 3–6 months. Pathology confirmed pancreatic ductal adenocarcinoma with free surgical margins. Of 26 lymph nodes harvested, three were positive (T3N1). A postoperative contrast-enhanced CT scan showed good patency of the portomesenteric axis. The patient is well 6 months after surgery and has no signs of the disease.

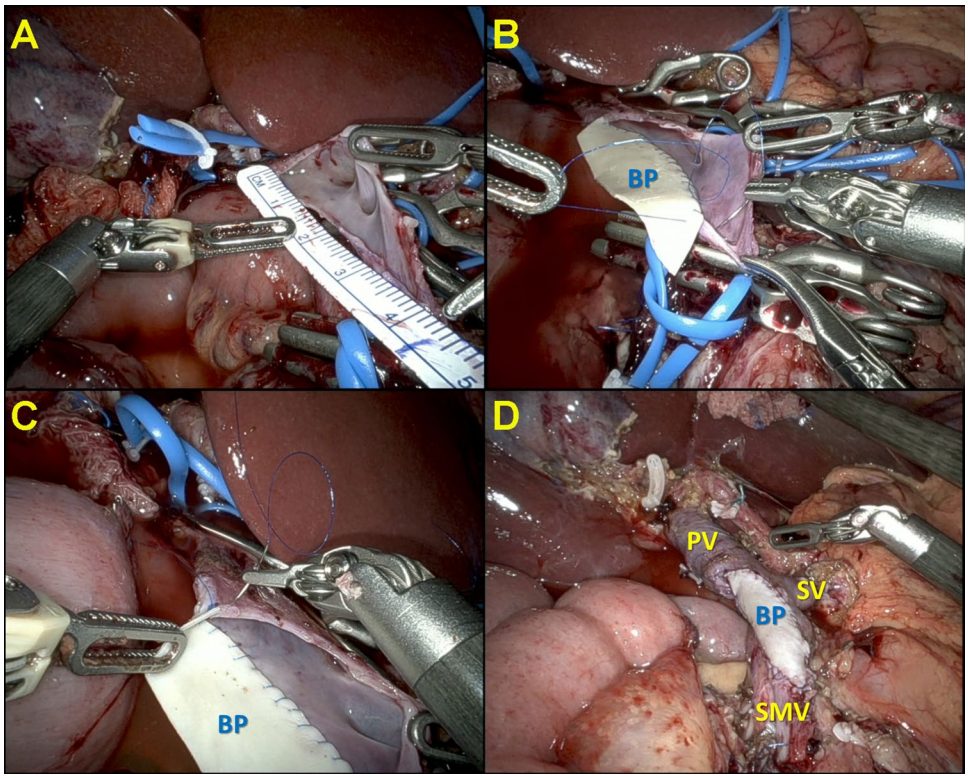

FIG. 2 Portomesenteric reconstruction with bovine pericardial graft during robotic pancreatoduodenectomy. **A** Intraoperative view after resection of the surgical specimen along a large segment of the portomesenteric axis. The defect is measured with a tape (4 × 1 cm). **B** Intraoperative view. The BP is fabricated and sutured to the vein wall with a 6-0 Prolene running suture. **C** The posterior wall is already completed and the anterior wall is sutured to the BP. **D** Final view after portomesenteric reconstruction with BP during robotic pancreatoduodenectomy. *BP* bovine pericardial graft, *PV* portal vein, *SMV* superior mesenteric vein, *SV* splenic vein

Portomesenteric reconstruction is required if more than one-third of the vein is resected. Otherwise, a primary venorrhaphy can be performed. A bovine pericardial graft is useful for reconstruction and is readily available, eliminating the need to harvest an autologous vein or use synthetic grafts.[7,8] This procedure can be safely performed using the robotic platform. This video can help oncologic surgeons perform this complex procedure.

APPENDIX

Pancreatoduodenectomy is the procedure of choice for resectable tumors located in the head of the pancreas. Vascular resections are becoming more common but are a relative contraindication to a minimally invasive approach. We present a video of robotic portomesenteric reconstruction with bovine pericardial graft during pancreatoduodenectomy in a 52-year-old woman. The tumor was in contact with, and had partially invaded, the right anterior portion of the portomesenteric axis. The Da Vinci Xi system was used. The operation was performed as a pylorus-preserving pancreaticoduodenectomy. The superior mesenteric artery first approach was used so that the entire surgical specimen was attached only through the tumor invasion of the portomesenteric axis. After resection of the invaded portomesenteric axis, its large extent precluded primary reconstruction and the defect was reconstructed with a patch of bovine pericardium. The patch was sutured to the vein wall with a running 6-0 suture. The operation time was 430 min; clamping time was 55 min and portomesenteric reconstruction took 41 min. Recovery was uneventful and the patient could be discharged on postoperative day 8. No pancreatic or biliary fistula was observed. A postoperative contrast-enhanced CT scan showed good patency of the portomesenteric axis. Portomesenteric reconstruction is required if more than one-third of the vein was resected. A bovine pericardial graft is useful for reconstruction and is readily available, eliminating the need to harvest an autologous vein or use synthetic grafts. This procedure can be safely performed using the robotic platform. This video will help oncologic surgeons perform this complex procedure.

SUPPLEMENTARY INFORMATION The online version contains supplementary material available at https://doi.org/10.1245/s10434-023-14293-7.

REFERENCES

1. Croome KP, Farnell MB, Que FG, Reid-Lombardo KM, Truty MJ, Nagorney DM, Kendrick ML. Pancreaticoduodenectomy with major vascular resection: a comparison of laparoscopic versus open approaches. *J Gastrointest Surg*. 2015;19(1):189–94.
2. Ouyang G, Zhong X, Cai Z, Liu J, Zheng S, Hong D, et al. The short- and long-term outcomes of laparoscopic pancreaticoduodenectomy combining with different types of mesentericoportal vein resection and reconstruction for pancreatic head

adenocarcinoma: a Chinese multicenter retrospective cohort study. *Surg Endosc*. 2023;37(6):4381–95.
3. Shyr BU, Chen SC, Shyr YM, Wang SE. Surgical, survival, and oncological outcomes after vascular resection in robotic and open pancreaticoduodenectomy. *Surg Endosc*. 2020;34(1):377–83.
4. Machado MA, Mattos BH, Lobo Filho MM, Makdissi FF. Robotic resection and reconstruction of the superior mesenteric vein without graft during pancreatoduodenectomy (with video). *J Gastrointest Surg*. 2021;25(11):3010–2.
5. Machado MA, Mattos BV, Lobo Filho MM, Makdissi FF. Robotic artery-first approach during pancreatoduodenectomy. *Ann Surg Oncol*. 2021;28(11):6257–61.
6. Machado MA, Mattos BV, Lobo Filho MM, Makdissi FF. A new technique of duodenojejunostomy may reduce the rate of delayed gastric emptying after pylorus-preserving pancreatoduodenectomy: the growth factor technique (with video). *Surg Oncol*. 2023;46:101902.
7. Burla L, Schwegler I, Weibel P, Weber M, Zientara A, Attigah N. Intraoperatively self-made bovine pericardial graft for portomesenteric reconstruction in pancreatic surgery. *Langenbecks Arch Surg*. 2020;405(5):705–12.
8. Jara M, Malinowski M, Bahra M, Stockmannn M, Schulz A, Pratschke J, Puhl G. Bovine pericardium for portal vein reconstruction in abdominal surgery: a surgical guide and first experiences in a single center. *Dig Surg*. 2015;32(2):135–41.