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Glutaraldehyde-fixed parietal peritoneum graft conduit to replace completely the portal vein during pancreaticoduodenectomy: A case report

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ABSTRACT

INTRODUCTION: Combined total portal vein (PV) and superior mesenteric artery (SMA) resection during pancreaticoduodenectomy (PD) is a challenging task that is no longer considered as a contra-indication to achieve R0 in borderline resectable (BR) and locally advanced (LA) pancreatic ductal adenocarcinoma (PDAC).

PRESENTATION OF CASE: We report a 66-year-old female with BR-PDAC of the head of the pancreas in whom PV and SMA were replaced with a glutaraldehyde-fixed autologous peritoneo-fascial graft (APG) and a splenomesenteric arterial bypass, respectively, during the PD.

DISCUSSION: When PV venorrhaphy or end-to-end anastomosis is not feasible, APG conduit, immediately available without extra-incision, does not need postoperative anticoagulation and is associated with a low risk of infection and thrombosis. If fixed in glutaraldehyde, handling, risk of compression when placed intra-peritoneally and long-term patency of the graft are improved.

CONCLUSION: Glutaraldehyde-fixed APG is a strategy that every surgeon should bear in mind for PV replacement during PD and other HBP surgical procedures, especially if a vascular resection is unforeseen.

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1. Introduction

Combined total portal vein (PV) and superior mesenteric artery (SMA) replacement in pancreatic surgery is a challenging task in borderline resectable (BR) and locally advanced (LA) pancreatic ductal adenocarcinoma (PDAC). Approximately one-third of patients with PDAC displays major vascular invasion. To achieve R0, subsequent complex venous and arterial resections during pancreaticoduodenectomy (PD) are no longer considered as a contra-indication [1,2]. When simple venorrhaphy or end-to-end anastomosis is technically not feasible during PD, graft interposition must be considered. Autologous peritoneo-fascial graft (APG), harvested on posterior rectus fascia and reinforced by the muscle sheath, can be used as a conduit to ensure venous axis continuity [3,4]. APG has the advantage of being associated with a lower infection risk, does not require postoperative anticoagulation, is directly available without any extra-incision and is less expensive compare to other synthetic and biological vascular substitutes [4]. If fixed in glutaraldehyde, an aldehyde that is well known to improve handling and provide biomechanical stability of autologous peri-

cardium used for patches, valve substitutes and conduits in cardiac surgery [5], manipulation, risk of compression when placed intra-peritoneally and long-term patency of the APG was reported to be improved in pancreatic surgery [6]. With this case report, we aim to highlight the value of a glutaraldehyde-fixed APG as vascular substitute to replace the portal vein during a PD for a BR-PDAC. In this patient, a splenomesenteric arterial bypass was also necessary for the reconstruction of the SMA. The article has been reported in line with the SCARE [7] and PROCESS criteria [8].

2. Case report

A 66-year-old female who suffered from sudden onset of jaundice and weight loss of 15 kg for 4 months was hospitalized at our university. On admission, blood tests were within normal ranges except a cholestasis with a total bilirubin, alkaline phosphatase and gamma-glutamyl transferase at 8,47 mg/dL (normal range <1,2 mg/dL), 555 U/L (normal range <105 U/L) and 121 U/L (normal range <40 U/L), respectively. An abdominal computed tomography (CT) with intravenous contrast enhancement revealed a 3 cm lesion located in the uncinate process of the head of the pancreas with a dilatation of bile (intra-/extra-hepatic) and main pancreatic ducts (Fig. 1) and atrophy of distal part of the gland. The tumor was defined as BR [9] because of a contact with superior mesenteric vein and SMA $\leq 180^\circ$. Diffusion-weighted magnetic res-

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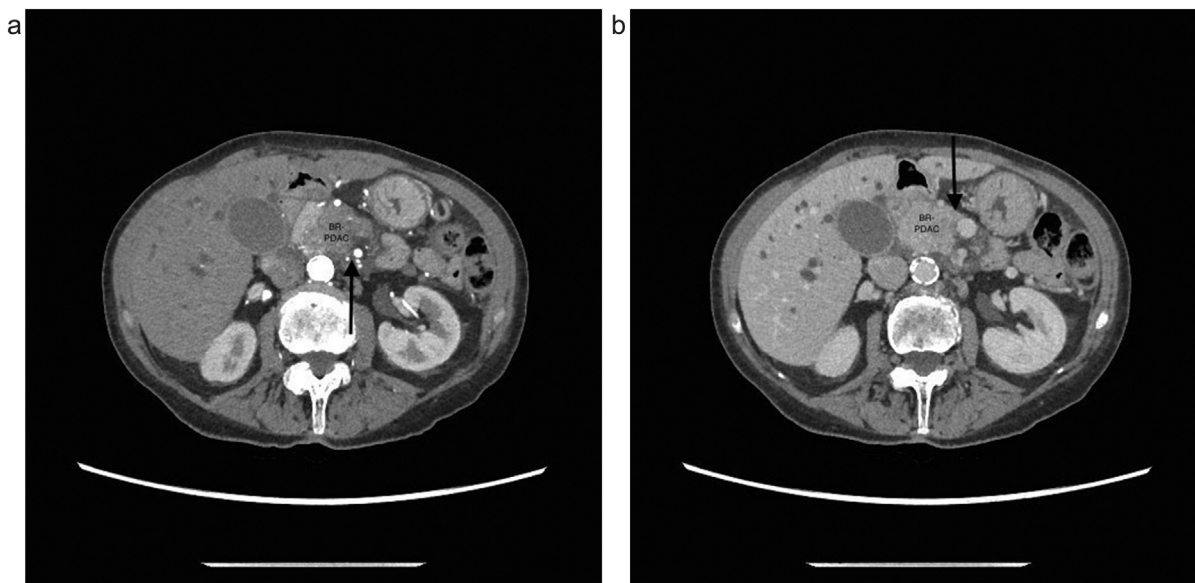


Fig. 1. Arterial (a) and portal (b) contrast enhancement abdominal computed tomography (CT) showing a 3 cm pancreatic ductal adenocarcinoma located in the uncinate process and defined as borderline resectable (BR-PDAC) because of a contact with superior mesenteric artery and portal vein <math><180^\circ</math> (black arrows).

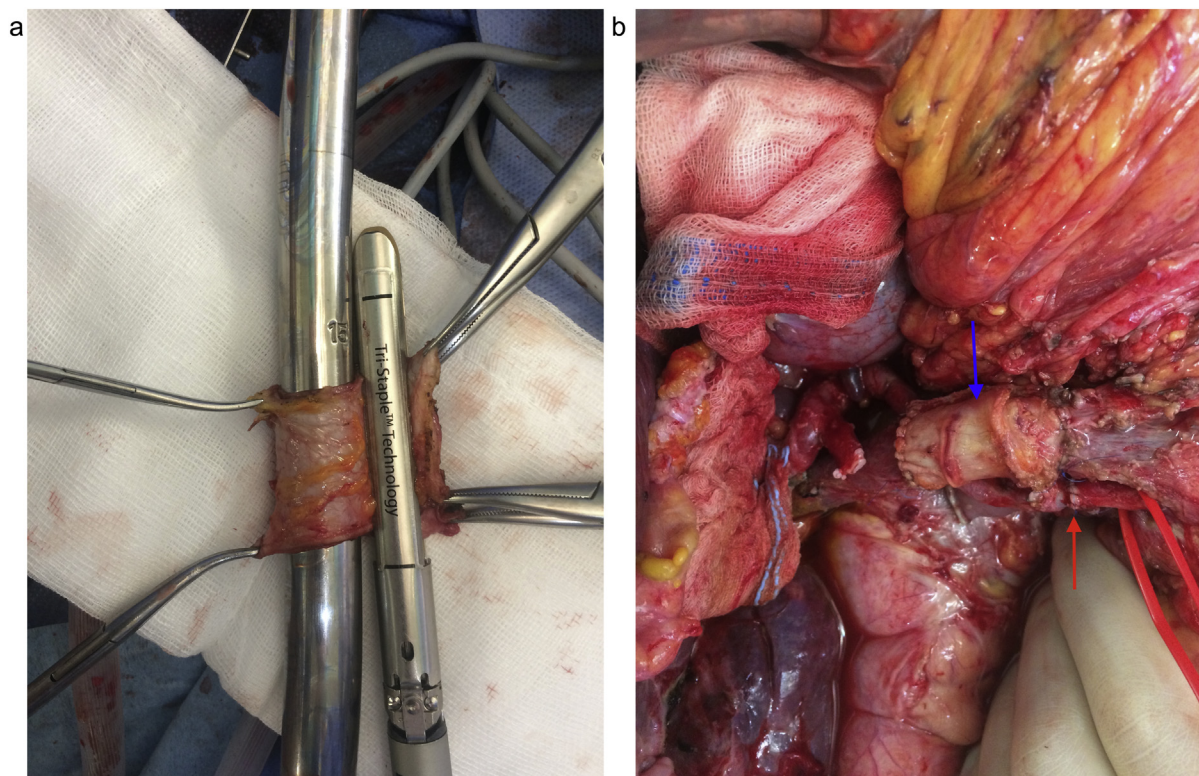


Fig. 2. Glutaraldehyde-fixed autologous peritoneo-fascial graft (APG) harvested on posterior rectus fascia, tubulized (peritoneal surface inside) with a vascular stapler (a) and sutured between superior mesenteric (SMV) and portal vein (PV) to achieve the total portal vein (PV) replacement (blue arrow) (b). Splenomesenteric bypass performed with an end-to-end anastomosis between splenic artery and distal stump of the superior mesenteric artery (SMA) (red arrow) (b).

onance imaging (MRI) did not revealed any other lesion, especially in the liver. 18-FDG PET-CT imaging confirmed hyper-metabolism of the pancreas head solely. Endoscopic ultrasonography with fine needle biopsy revealed a PDAC. The tumor marker carbohydrate antigen CA 19-9 was increased at 869 kU/l (normal range <math><37</math> kU/l) in this icteric patient. After multidisciplinary discussion, a 6 cures folfirinox-based neoadjuvant approach was decided and a short metallic biliary stent was placed by endoscopic retro-

grade cholangio-pancreatography. Surgery was planned 4 weeks after the last cure of folfirinox. Pre-operative CT and MRI demonstrated a slight reduction of the BR-PDAC size (2,5 cm). CA19-9 tumor markers were decreased at 154,7 kU/l. Pre-operative radiotherapy was not considered owing the potential risk of increased post-operative complications in case of major venous and/or arterial resection. Laparoscopic resectability was first assessed by the absence of peritoneal carcinomatosis and liver metastases on per-

operative ultrasound. During laparotomy, duodenum and right colon were extensively mobilized through a Kocher and Cattell-brausch maneuvers, respectively. A SMA first-approach [10,11] was realized as we do systematically during PD for PDAC. BR lesion as suspected by preoperative imaging vascular assessment was confirmed as a solid tumor contact with the SMA $\leq 180^\circ$ was observed. SMV and PV were identified and dissected at the root of mesentery and at the level of liver hilum, respectively. Autologous arterial and venous grafts were considered as a long segment of PV and SMA >3 cm seemed to be involved by the tumor. Due to both venous and arterial involvement, a total pancreatectomy was preferred to avoid risk of pancreatic fistula and delayed bleeding from vascular anastomosis [12]. Pancreas was transected at the level of the portal vein. First, a distal pancreatectomy was performed with a special attention to prepare the splenic artery to expedite the splenomesenteric bypass after tumor explantation. The splenic vein was liberally sacrificed to facilitate PV resection. Risk to develop left segmental portal hypertension was low as inferior mesenteric vein was drained in the splenic vein. Then, a piece of peritoneum reinforced by the muscle sheath was harvested on posterior rectus fascia, fixed in a 2,5 % glutaraldehyde solution (250 mL of a 10 % glutaraldehyde solution diluted with 750 mL of normal saline) for 5 min and rinsed abundantly in saline as described by Elias et al. [6]. The APG graft was then tubulized (peritoneal surface inside) with a vascular stapler around a Hegar bougie appropriately chosen according the PV diameter (Fig. 2). Finally, PV and SMA were clamped proximally and distally and divided. PD and extended lymphadenectomy with en-bloc resection of mesenteric vessels was completed. Splenomesenteric bypass was first performed with an end-to-end anastomosis between splenic artery and distal stump of the SMA. Then, APG graft was sutured between SMV and PV to achieve the total PV replacement with two hemi-circumferential running sutures of 5-0 monofilament (Fig. 2). Per-operative ultrasound of the liver demonstrated normal intra-hepatic portal vein flow. Viability of the gut was assessed by palpation of mesenteric patent arterial pulse and doppler transducer. Surgical procedure ended with hepatico- and gastro-jejunoanastomosis. Histopathology demonstrated a well-differentiated PDAC of 2,5 cm. Five of 25 lymph nodes were involved by tumor. All resection margins were negative. Fibrous reaction and no microscopic malignant infiltration was found through the wall of the resected portal vein (>1 mm) and the SMA (R0). According to the TNM classification (8th edition), the PDAC was pT2N2Mx. Postoperative course was uneventful and patient was discharged after 16 days without any anticoagulation. Post-operative control CT was performed 6 weeks after surgery and demonstrated flow through the APG and distal SMA.

3. Discussion

Vascular resections and reconstructions have become routine procedures in reference HPB centers and are no longer considered as a contra-indication to pancreatic resection for BR/LA PDAC as it offers the only chance for R0 resection without any increased of postoperative morbidity and mortality [1,2,13].

Although most vascular resections associated with PD can be reconstructed using standard techniques, graft interposition may be required if length of blood vessels involvement is such that it does not allow end-to-end anastomosis. Considering the subsequent risk of graft infection due to operative field bacterial contamination during PD, vascular reconstruction with biological materials should be preferred to synthetic grafts (polytetrafluoroethylene, PTFE) [3]. To replace the PV, vascular substitutes such as autologous (left renal vein, internal jugular vein, saphenous and right ovarian veins) and cadaveric cryopreserved veins, bovine pericardium, and parietal peritoneum have been described [14].

Parietal peritoneum is harvested on diaphragm, hypochondrium, falciform ligament or on posterior rectus fascia reinforced by the muscle sheath (APG) and can be used as a patch or a conduit [3]. Parietal peritoneal graft overcomes drawbacks such as the need of long-term antibiotic and anticoagulation therapies [15], costs and does not need extra-incision [3]. Indeed, parietal peritoneum graft is directly available in case of urgent or unplanned vascular resection. Parietal peritoneum graft, firstly described during the '60s in preclinical studies, was reported for IVC reconstruction in different surgical procedures such as resection of large liver, retroperitoneal or pancreatic tumors, liver transplantation for Budd-Chiari syndrome or penetrating trauma [3]. Recently, parietal peritoneum graft was described for the reconstruction of the mesenterico-portal vein in pancreatic resection mainly as a lateral patch [14]. The patency rate was reported to be longer in case of lateral reconstruction than for the tubular grafts [14]. To avoid kinking, narrowing or collapse, a thicker and more resistant graft, as the APG, could ideally better fit for a tubular-shaped vascular reconstruction [3]. To solidify the tubular graft, APG can be fixed in glutaraldehyde solution as described by Elias et al. [6]. Glutaraldehyde is a well known aldehyde that destroys mesothelial cells and fibroblasts, prevents autolysis, allows resistance to enzymatic degradation and improves maintenance of visco-elastic properties of tissue by producing cross-linking between collagen helices and stabilizing the extracellular matrix [5,6]. APG has been reported to facilitate manipulation of the tubular graft and decrease the risk of compression when placed intra-peritoneally [6].

4. Conclusion

Glutaraldehyde-fixed APG is an interesting strategy that every surgeon should bear in mind for PV reconstruction technique during PD and other HBP surgical procedures, especially if the vascular resection is unforeseen. This technique is inexpensive, easy to perform, immediately available, does not need postoperative anticoagulation and is associated with a low risk of infection or thrombosis.

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Ethical approval

The case report is exempt from ethical approval.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

NM, FA and PH took part at the surgery. NM and FA wrote the article. PH and AD reviewed the manuscript.

Registration of research studies

This is not a research study.

Guarantor

NM is the guarantor of this work.

Provenance and peer review

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Declaration of Competing Interest

The authors declare that they do not have conflict of interests.

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