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Conversion pancreaticoduodenectomy with dual arterial reconstructions for locally advanced pancreatic cancer: Case report and literature review

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ABSTRACT

INTRODUCTION: Extended pancreatectomy for initially unresectable locally advanced (URLA) pancreatic carcinoma (PC) often requires combined arterial resection/reconstruction. By limiting candidate arterial inflow after combined resection of the celiac arterial system over a long distance, great saphenous vein graft (GSVG) is an alternative conduit for obtaining non-anatomical arbitrary arterial inflow.

PRESENTATION OF CASE: A 66-year-old woman was diagnosed with URLA pancreatic head carcinoma involving the region from the celiac axis (CA) to the common hepatic and proximal splenic artery (SA). She received 10 courses of modified FOLFIRINOX followed by concurrent chemoradiotherapy including S1 with favorable response. The duration of disease control and normalization of serum carbohydrate antigen 19–9 (CA19–9) exceeded 10 months, and conversion surgery was planned. Extended pancreaticoduodenectomy (PD) required concomitant resection of the CA to the proper hepatic and SA. The dual arterial reconstructions involved a GSVG interposition from the abdominal aorta to the distal SA to preserve the entire stomach, and from the mesenteric second jejunal artery to the right hepatic artery. The patient achieved pathological R0 resection with a histological response of Evans grade IIB.

DISCUSSION: Reconstruction of the distal SA with GSVG in extended PD enabled preservation of the subtotal stomach and distal pancreas, even when the root of the CA was transected.

CONCLUSION: Multiple arterial reconstructions using GSVG might be useful in extended pancreatectomy to preserve visceral organs, offer better quality of life in terms of oral intake and nutritional status, and control blood glucose than after total pancreatectomy concomitant with subtotal gastrectomy.

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1. Introduction

Extended pancreatectomy with microscopically cancer-free margins can offer better survival outcomes to patients with initially unresectable locally advanced (URLA) pancreatic carcinoma (PC) who had favorable responses to previous anticancer treatment [1]. Such surgeries often require combined resection of adjacent organs or structures, e.g., hepatic artery (HA), mesenterico-portal vein (PV), adrenal gland, kidney, colon, and stomach [2]. Total pancreatectomy coupled with subtotal gastrectomy must be theoretically

justified for PC invading from the root of the celiac axis to the proper HA; however, the difficulty of controlling post-operative blood glucose level often significantly decreases quality of life, making this approach unacceptable in daily clinical settings.

Efforts to secure gastric arterial blood flow in conjunction with pancreatectomy are useful in distal pancreatectomy with en-bloc celiac axis resection (DP-CAR) [3–5]. The great saphenous vein graft (GSVG), on the other hand, makes possible arbitrary reconstruction with sufficient blood flow, suggesting an available alternative to extra-anatomical conduits in extended pancreaticoduodenectomy (PD) [6,7]. Here, we report a method that adapts this technique for preservation of the distal pancreas and stomach in extended PD to treat initially unresectable pancreatic head carcinoma involving the celiac axis (CA). This work was reported in accordance with the SCARE 2020 criteria [8].

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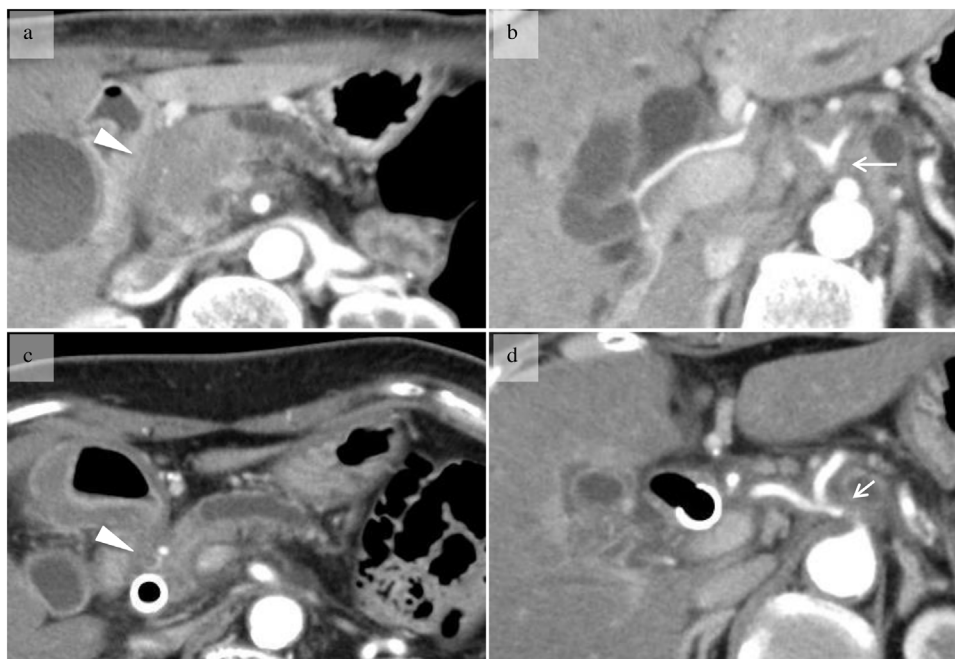


Fig. 1. Computed tomography images.

Pancreatic head cancer was initially staged as cT4N0M0, Stage III, UR-LA according to the UICC-TNM and General Rules for the Study of Pancreatic Cancer, Seventh Edition. The tumor involved the celiac axis (CA) to the common hepatic and proximal splenic arteries (a, b). After 10 courses of modified FOLFIRINOX followed by chemoradiotherapy with S1, the tumor was significantly reduced in size, but soft-tissue density along the celiac axis still persisted (c, d). Arrowhead and arrow indicate main tumor and CA, respectively.

2. Presentation of case

A 66-year-old woman was referred to our hospital for evaluation of a pancreatic head lesion that was identified on abdominal imaging after she became aware of appetite loss followed by weight loss of 10 kg over 9 months. Her medical history included ureterolithiasis 10 years ago and appendectomy at the age of 30 years. She was taking an oral diabetic agent. There was no family history of pancreatic cancer or genetic disorders. The results of the physical examination were unremarkable. Laboratory analyses revealed high levels of hemoglobin A1c (7.2 %) and tumor markers, including carbohydrate antigen 19–9 (CA19–9) (520.5 U/mL), DUPAN-2 (1510.0 U/mL), and Span-1 (202.0 U/mL). Endoscopic ultrasonography-guided fine needle aspiration cytology revealed pancreatic adenocarcinoma. She was diagnosed with cT4N0M0 (UICC-TNM classification of malignant tumors), URLA pancreatic head cancer involving the region from the celiac axis (CA) to the common hepatic and proximal splenic artery (SA) (General Rules for the Study of Pancreatic Cancer, seventh edition) (Fig. 1a, b).

She received 10 courses of modified FOLFIRINOX (mFFX) followed by chemoradiotherapy with S1. After the induction mFFX, serum CA19–9 levels quickly normalized and subsequently remained within the normal range (<37.0 U/mL). The main tumor at the pancreatic head markedly decreased in size; however, soft-tissue density along the celiac arterial system, suggestive of previous vascular invasion, was still evident on imaging (Fig. 1c, d). We discussed the surgical procedures in advance, particularly the plans for arterial reconstruction, with the vascular surgeon (NK) and plastic surgeon (TY), and concluded that reconstruction of both branches of the HA by GSVG would be difficult due to the mismatched diameters of the HA (right HA 1.6 mm, left HA 2.0 mm; data not shown). In consideration of PD, we selected the second jejunal artery as an alternative inflow with the same blood vessel diameter. We planned extended PD with dual arterial reconstruc-

tion, one of which involved the distal SA to preserve the entire stomach, and the other of which involved the HA (Fig. 2). Written informed consent was obtained after the patient understood the assumed postoperative outcomes of both total pancreatectomy concomitant with subtotal gastrectomy and this procedure.

After laparotomy, cancer negativity was confirmed at the root of the CA, superior mesenteric artery (SMA), and both right and left HA, and the hepatic duct was divided. The second jejunal artery (JA) was carefully encircled in jejunal mesentery to prepare arterial inflow, and the confluence of the first JA and inferior pancreaticoduodenal artery (IPDA) was also encircled. The distal part of the SA was secured without cancer invasion, followed by transection of the left gastric vessels. A GSVG was harvested from her right lower leg, and outflow anastomosis of the graft to SA was established in an end-to-side fashion using a 6–0 Prolene® continuous suture; the graft was passed down retro-colically, and side-to-end anastomosis of the abdominal aorta to the graft was also established. The graft harvest and arterial reconstruction was performed by an expert vascular surgeon under surgical loupes. Sufficient arterial blood flow, which was measured as 94 mL/min, was confirmed by transit-time ultrasonic flowmeter (VeriQ3, MediStim, Oslo, Norway) immediately after the reconstruction. The distal pancreas was divided, and the SA and CA were transected in order. The J1A–IPDA confluence was transected, the upper jejunum was divided, the right and left HA followed by the PV were resected, and a specimen was removed. The PV was reconstructed with a left renal vein graft [9] with a 4–0 Prolene® continuous suture (Fig. 3a). The entire stomach was preserved, and sufficient blood flow was confirmed by ICG fluorescence imaging (Fig. 3b). The second JA inflow was prepared in the jejunal mesentery and brought up retro-mesenterically to the hepatic hilum, followed by sacrifice of the redundant jejunum. Microscopic end-to-end anastomosis of the second jejunal arterial inflow to the right HA was applied by interrupted suture with 8–0 Prolene®. These proce-

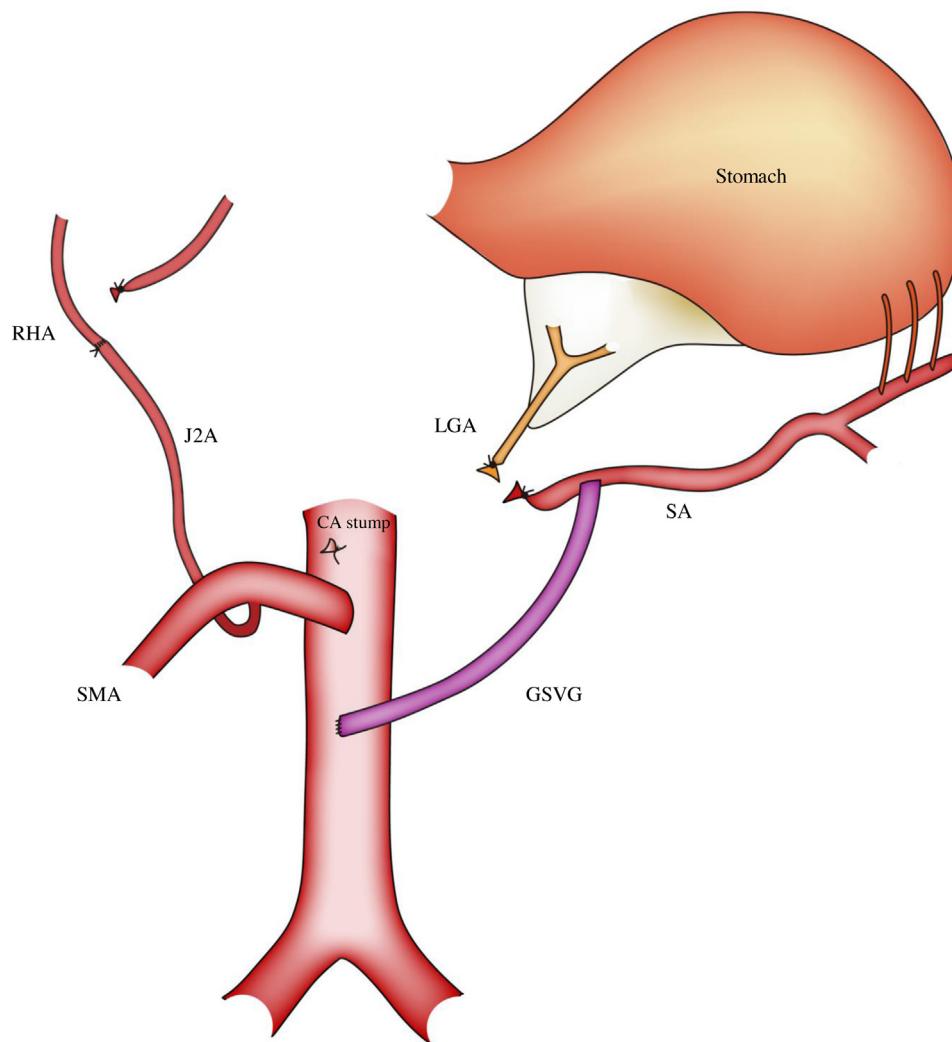


Fig. 2. Illustration of arterial reconstructions.

Extended PD with dual arterial reconstruction was planned. One reconstruction involved the distal SA to preserve the entire stomach, and the other involved the RHA. CA, celiac axis; SMA, superior mesenteric artery; J2A, second jejunal artery; RHA, right hepatic artery; GSVG, great saphenous vein graft; SA, splenic artery; LGA, left gastric artery.

dures were performed by an expert plastic surgeon (Fig. 3c). The blood flow after reconstruction of the right hepatic artery was not measured using the flowmeter, but was instead confirmed by visual pulsation and ICG fluorescence imaging (data-not shown). The period from graft harvest to SA reconstruction, HA reconstruction, and the overall procedures took 84, 94, and 1035 min, respectively, without blood transfusion; intraoperative blood loss was estimated to be 105 mL. An expert hepatobiliary-pancreatic surgeon certified by the Japanese Society of Hepatobiliary Pancreatic Surgery performed the PD. Unfractionated heparin (total dose of 3000units) was intravenously administered as a bolus just prior to SA reconstruction. After arterial anastomosis, hemostasis and good flow were confirmed, and protamine sulfate with a total dose of 30 mg was also administered intravenously to antagonize heparinization. The activated coagulation time (ACT) was monitored during SA reconstruction, as ACT was prolonged to 238 s during the anastomosis, and then normalized to 161 s by protamine after the reconstruction. During microscopic HA reconstruction, no anticoagulation therapy was administered. Post-operatively, unfractionated heparin (total dose, 10000 units/day) was intravenously administered on post-operative day 2 and grad-

ually up-dosed (total dose, 20000 units/day) until the DD or FDP values had almost normalized.

Post-operatively, the patient suffered from CD IIIa-liver infarction and abscess, which required percutaneous drainage. The pathological diagnosis was pancreatic well-differentiated tubular adenocarcinoma, pT3N0M0; the cancer was pStage IIA based on the Eighth edition of the UICC criteria, and grade IIb based on the Evans classification. Histologically, no residual cancer cells were observed in the resected margin (Fig. 4), so R0 resection was considered to have been achieved during this conversion surgery (Fig. 5). She was discharged on post-operative day 92 and initiated adjuvant chemotherapy with gemcitabine. Subsequently, she had an initial recurrence in the peritoneum 12 months after surgery and 25 months after initial chemotherapy, and she died from pancreatic cancer 12 months later. Graft patency was observed by 3D-CT angiography up to 14.7 months after the operation (Fig. 3d).

3. Discussion

This case report introduces the procedure and outcome of non-anatomical, dual arterial reconstruction using multiple conduits

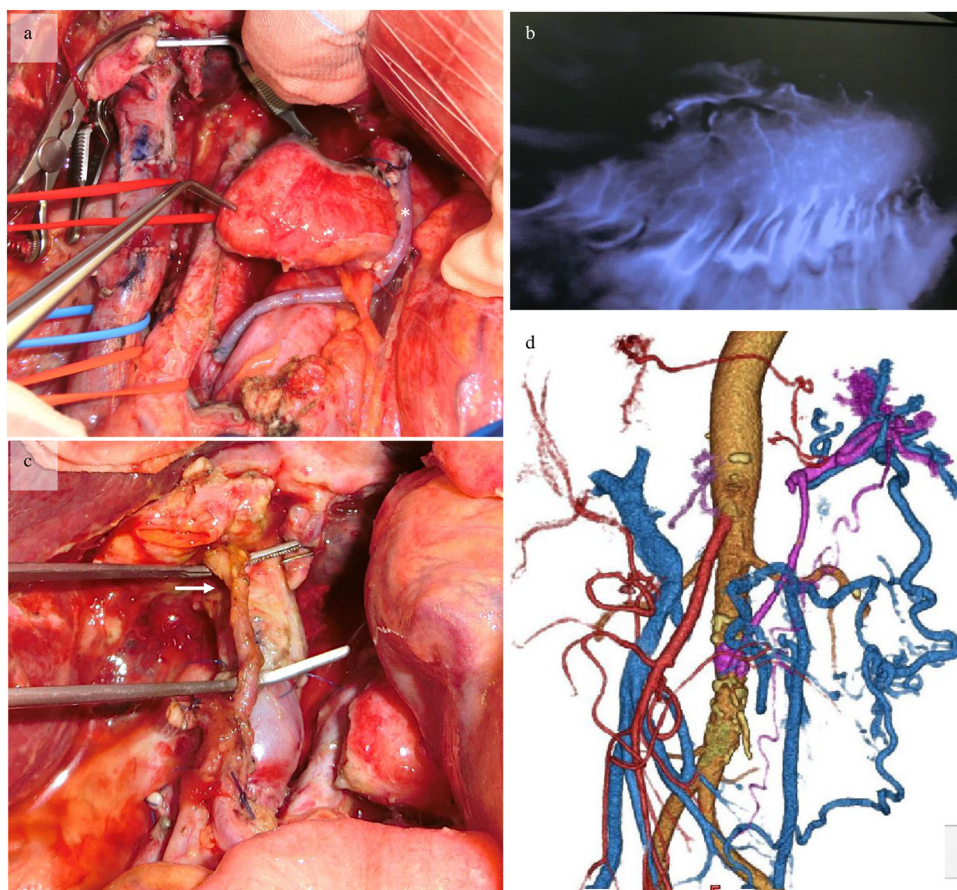


Fig. 3. Intra-operative view and post-operative 3D-CT images. a, Intra-operative view after specimen removal. b, ICG fluorescent image confirmed sufficient blood flow in the remnant stomach. c, Microscopic end-to-end anastomosis of the second jejunal arterial inflow to the right hepatic artery was applied by interrupted suture with 8–0 Prolene (arrow). d, Post-operative 3D-CT image.

- Viable tumor
- Main pancreatic duct
- Splenic and common/proper hepatic artery
- PV

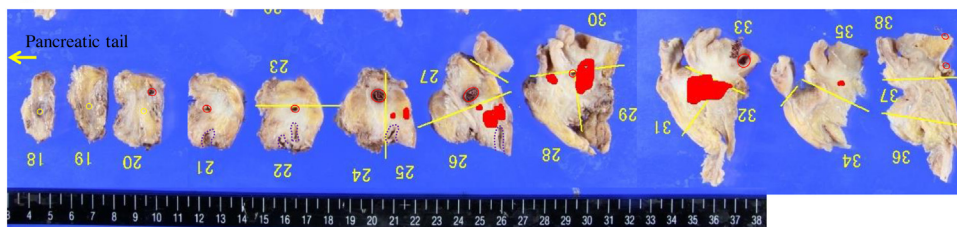


Fig. 4. Tumor mapping on the divided surface of specimens. The resected specimen showed a solid tumor with a 21-mm diameter in the pancreatic head-body, and unclear boundaries with the CHA and PV. The solid tumor (filled red area) in the pancreatic parenchyma showed unclear boundaries with the artery (red dotted line) and PV (purple dotted line) on the divided surface.

during combined celiac arterial system resection with PD. The resected artery was of a length that in principle would be difficult to anastomose in an end-to-end anatomical manner. In addition, reconstruction of the distal SA enabled preservation of the subtotal stomach, even when the root of the CA was resected.

Patients with initially unresectable PC who respond to long-term non-surgical treatment might be good candidates for radical surgery, as a R0 resection would improve oncological outcomes in

such situations [2]. Nowadays, this treatment approach is termed conversion surgery and often requires combined major arterial resection and reconstruction [10,11]. When grafting is required to replace long-segment defects after resection, there are autologous vessels that can be used as transposition grafts. The SA can be used as an autologous graft in many situations after concomitant HA resection, as can the LGA, GDA, MCA, and JA [12–15]. The JA is one of the alternative conduits available for use in HA recon-

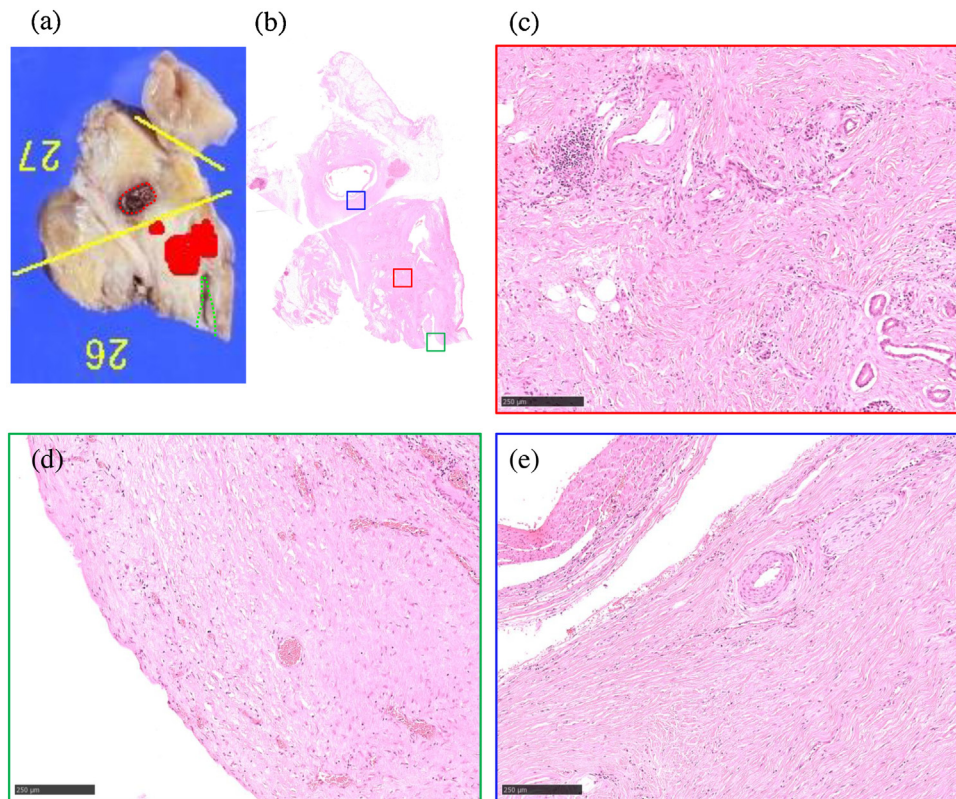


Fig. 5. Tumor mapping on the divided surface (a) and histopathological findings from hematoxylin/eosin staining (b, c, d, e). Histopathological examination revealed degenerated cancer cells (red square, b; c) and massive fibrosis or hyaluronate tissue (d, e), which were considered to be a former tumorous lesion.

struction. Several authors demonstrated its utility in extended radical pancreatobiliary surgeries [14,15]. However, mismatches in vascular diameter between the extra-anatomical conduit and reconstructing arteries, as well as insufficiency of blood flow for maintenance of targeted organ function, limit the availability of these conduits [16–18].

Maintenance of good nutritional status in patients with pancreatic cancer allows a high relative dose intensity of adjuvant chemotherapy [19]. Sufficient capacity in the remnant stomach seems to be particularly important for supporting dietary intake. Based on this perspective, we performed non-anatomical arterial reconstruction using GSVG and a second JA conduit as a method for ensuring blood flow to the remnant stomach and HA after PD. The inflow artery for HA and gastric arterial perfusion is extremely limited after transection of CA. Autologous venous grafts, namely those of the saphenous vein and internal jugular vein, have been described as suitable alternatives for arterial replacement, although the number of reported cases employing these techniques remains small [6,13,20].

In this case, the entire stomach was preserved, but serum transaminases were significantly elevated, and the patient developed patchy peripheral infarctions in the liver. Our postoperative management protocol included routine contrast enhanced-computed tomography (CE-CT) performed on the sixth postoperative day, and the patency of reconstructed arteries was confirmed during the early post-operative period. Serial CT scans revealed hypoperfusion areas mimicking hepatic infarction in the lateral segment and anterior sector of the liver, within one week postoperatively. These areas developed a hepatic infarction, and the resultant sustained liver abscess required percutaneous drainage. The causative factors were assumed to be as follows: first, a microthromboembolus might have formed during the hepatic

artery/portal vein reconstruction that might have induced these transient infarctions. Secondly, perfusion imbalance could occur in the liver, even though good arterial anastomotic flow was secured, taking several moments to resolve, whereas sustained arterial flow insufficiency often results in development of an intractable abscess rather than temporary hypoperfusion. Thirdly, grafted vessels are denervated and considered less able to regulate blood flow in response to systemic blood pressure, whether the grafted vessels are transposed or interposed. These liver-related morbidities during her postoperative course suggested that the mode of HA reconstruction requires further reconsideration including the reconstruction of the remaining left HA microscopically as well as by GSVG.

In cases with PC involving with the root of the CA, total pancreatectomy coupled with subtotal gastrectomy must be theoretically justified [2]; however, great difficulty in controlling post-operative blood glucose level is expected to cause a significant loss of quality of life and is therefore unacceptable in daily clinical practice. To overcome this situation in this case, we conducted dual arterial reconstruction involving extended pancreaticoduodenectomy. A comprehensive literature search identified no published report on preservation of the remnant stomach by reconstructing the splenic artery instead of the left gastric artery. This patient suffered from several surgical morbidities, although her oral dietary intake was maintained without any pancreatic endocrine insufficiency. Even though the technical details of arterial reconstruction have to be reconsidered, such a concept should be utilized in future conversion surgery to assure radicality while avoiding loss of QOL after total pancreatectomy and subtotal gastrectomy.

Reconstruction of the distal splenic artery with GSVG in extended PD enabled preservation of the subtotal stomach and dis-

tal pancreas, even when the root of the CA was transected. GSVG might offer sufficient blood flow and enable multi-branch reconstruction, even if an additional incision is required.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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Ethical approval

The institutional review board of Sapporo Medical University Hospital approved the study protocol (302–16). Due to the retrospective study of this type, the applicable legal and ethical principles pertaining to the protection of human subjects provide for a waiver of approval from a research ethics committee.

Consent

Written informed consent was obtained from the patient's guardian 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

YK (Expert hepatobiliary-pancreatic surgeon certified by the Japanese Society of Hepatobiliary Pancreatic Surgery), NK, and YT performed the surgery on this patient. YK and MI had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the analysis. Study concept and design: YK, MI. Acquisition or interpretation of data: YK, MI, TI. Drafting of the manuscript: YK, IT. Critical revision of the manuscript for important intellectual content: IT, TY, NK. Technical or material support: NK, TY. Study supervision: IT.

Registration of research studies

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References

- [1] Y. Kimura, T. Nakamura, T. Hayashi, M. Kuwatani, M. Motoya, M. Yoshida, M. Imamura, M. Nagayama, H. Yamaguchi, K. Yamakita, T. Goto, Y. Sakuhara, K. Takahashi, H. Maguchi, S. Hirano, I. Takemasa, Clinical usefulness of conversion surgery for unresectable pancreatic cancer diagnosed on multidetector computed tomography imaging: results from a multicenter observational cohort study by the Hokkaido Pancreatic Cancer Study Group (HOPS UR-01), *Ann. Gastroenterol. Surg.* 3 (5) (2019) 523–533, <http://dx.doi.org/10.1002/ags3.12272>, PMID: 31549012 eCollection 2019 Sep.
- [2] W. Hartwig, T. Hackert, U. Hinz, M. Hassenpflug, O. Strobel, M.W. Büchler, J. Werner, Multivisceral resection for pancreatic malignancies: risk-analysis and long-term outcome, *Ann. Surg.* 250 (1) (2009) 81–87, <http://dx.doi.org/10.1097/SLA.0b013e3181ad657b>, PMID: 19561478.
- [3] T. Sato, A. Saiura, Y. Inoue, Y. Takahashi, J. Arita, N. Takemura, Distal pancreatectomy with en bloc resection of the celiac axis with preservation or reconstruction of the left gastric artery in patients with pancreatic body cancer, *World J. Surg.* 40 (9) (2016) 2245–2253, <http://dx.doi.org/10.1007/s00268-016-3550-x>, PMID: 27198999.
- [4] K.I. Okada, S. Hirono, M. Kawai, S. Hayami, S. Asamura, Y. Wada, M. Ueno, M. Miyazawa, S. Shimizu, Y. Kitahata, H. Yamaue, Left gastric artery reconstruction after distal pancreatectomy with celiac axis en-bloc resection: how we do it, *Gastrointest. Tumors* 4 (1–2) (2017) 28–35, <http://dx.doi.org/10.1159/000469660>, PMID: 29071262.
- [5] A. Oba, Y. Inoue, T. Sato, Y. Ono, Y. Mise, H. Ito, T. Ishizawa, Y. Takahashi, A. Saiura, Impact of indocyanine green-fluorescence imaging on distal pancreatectomy with celiac axis resection combined with reconstruction of the left gastric artery, *HPB (Oxford)* 21 (5) (2019) 619–625, <http://dx.doi.org/10.1016/j.hpb.2018.09.023>, PMID: 30401519.
- [6] P. Bachellier, P. Addeo, F. Faitot, G. Nappo, P. Dufour, Pancreatectomy with arterial resection for pancreatic adenocarcinoma: how can it be done safely and with which outcomes?: a single institution's experience with 118 patients, *Ann. Surg.* 271 (5) (2020) 932–940, <http://dx.doi.org/10.1097/SLA.0000000000003010>, PMID: 30188399.
- [7] Y. Kimura, M. Imamura, Y. Kuroda, M. Nagayama, T. Itoh, S. Oota, M. Murakami, H. Yamaguchi, T. Nobuoka, N. Kawaharada, I. Takemasa, Clinical usefulness of saphenous vein graft in major arterial reconstruction during extended pancreatectomy, *Langenbecks Arch. Surg.* 405 (7) (2020) 1051–1059, <http://dx.doi.org/10.1007/s00423-020-01947-3>, PMID: 32737589.
- [8] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, For the SCARE Group, The SCARE 2020 Guideline: Updating Consensus Surgical Case Report (SCARE) Guidelines, *Int. J. Surg.* 84 (2020) 226–230, <http://dx.doi.org/10.1016/j.ijsu.2020.10.034>, PMID: 33181358.
- [9] M. Miyazaki, H. Ito, K. Nakagawa, S. Ambiru, H. Shimizu, M. Ohtuka, Y. Shimizu, N. Nakajima, F. Kimura, Vascular reconstruction using left renal vein graft in advanced hepatobiliary malignancy, *Hepatogastroenterology* 44 (18) (1997) 1619–1623, PMID: 9427033.
- [10] J.R. Delperio, A. Sauvanet, Vascular resection for pancreatic cancer: 2019 French recommendations based on a literature review from 2008 to 6–2019, *Front. Oncol.* 10 (40) (2020), <http://dx.doi.org/10.3389/fonc.2020.00040>.
- [11] A. Oba, Q.R. Bao, C.C. Barnett, M.H. Ai-Musawi, C. Croce, R.D. Schulick, M. Del Chiaro, Vascular resections for pancreatic ductal adenocarcinoma: vascular resections for PDAC, *Scand. J. Surg.* 109 (1) (2020) 18–28, <http://dx.doi.org/10.1177/1457496919900413>, PMID: 31960765.
- [12] U. Klaiher, A. Mihaljevic, T. Hackert, Radical pancreatic cancer surgery-with arterial resection, *Transl. Gastroenterol. Hepatol.* 4 (2019) 8, <http://dx.doi.org/10.21037/tgh.2019.01.07>.
- [13] F. Yang, X. Wang, C. Jin, H. He, D. Fu, Pancreatectomy with hepatic artery resection for pancreatic head cancer, *World J. Surg.* 43 (11) (2019) 2909–2919, <http://dx.doi.org/10.1007/s00268-019-05106-8>, PMID: 30976711.
- [14] S. Otsuka, Y. Kaneoka, A. Maeda, Y. Takayama, Y. Fukami, S. Onoe, Hepatic artery reconstruction with a continuous suture method for hepato-biliary-pancreatic surgery, *World J. Surg.* 40 (4) (2016) 951–957, <http://dx.doi.org/10.1007/s00268-015-3310-3>, PMID: 26546188.
- [15] B. Aryal, T. Komokata, J. Kadono, H. Motodaka, T. Ueno, A. Furoi, Y. Imoto, First jejunal artery, an alternative graft for right hepatic artery reconstruction, *World J. Hepatol.* 7 (4) (2015) 721–724, <http://dx.doi.org/10.4254/wjh.v7.i4.721>, PMID: 25866610.
- [16] P.C. Li, A. Thorat, L.B. Jeng, H.R. Yang, M.L. Li, C.C. Yeh, T.H. Chen, S.C. Hsu, K.S. Poon, Successful application of supraceliac aortohepatic conduit using saphenous venous graft in right lobe living donor liver transplantation, *Liver Transpl.* 23 (7) (2017) 976–980, <http://dx.doi.org/10.1002/lt.24720>, PMID: 28073174.
- [17] P. Muiresan, Nodari F. Relam, H.V. Melendez, V. Smyrniotis, V. Vougas, N. Heaton, Use of infra renal conduits for arterial revascularization in orthotopic liver transplantation, *Liver Transpl. Surg.* 4 (3) (1998) 232–235, <http://dx.doi.org/10.1002/lt.500040314>, PMID: 9563963.
- [18] P.T. Kim, H. Fernandez, A. Gupta, G. Saracino, M. Ramsay, G.J. McKenna, G. Testa, T. Anthony, N. Onaca, R.M. Ruiz, G.B. Klintmalm, Low measured hepatic artery flow increases rate of biliary strictures in deceased donor liver transplantation: an age-dependent phenomenon, *Transplantation* 101 (2) (2017) 332–340, <http://dx.doi.org/10.1097/TP.0000000000001564>, PMID: 27941438.
- [19] M. Tashiro, S. Yamada, F. Sonohara, H. Takami, M. Suenaga, M. Hayashi, Y. Niwa, C. Tanaka, D. Kobayashi, G. Nakayama, M. Koike, M. Fujiwara, T. Fujii, Y.

Kodera, Clinical impact of neoadjuvant therapy on nutritional status in pancreatic cancer, *Ann. Surg. Oncol.* 25 (11) (2018) 3365–3371, <http://dx.doi.org/10.1245/s10434-018-6699-8>, PMID: 30097739.

- [20] B.P.T. Loveday, N. Zilbert, P.E. Serrano, K. Tomiyama, A. Tremblay, A.M. Fox, M. Segedi, M. O'Malley, A. Borgida, T. Bianco, S. Creighton, A. Dodd, A. Fraser, M. Moore, J. Kim, S. Cleary, C.A. Moulton, P. Greig, A.C. Wei, S. Gallinger, N. Dhani,

I.D. McGilvray, Neoadjuvant therapy and major arterial resection for potentially reconstructable arterial involvement by stage 3 adenocarcinoma of the pancreas, *HPB (Oxford)* 21 (6) (2019) 643–652, <http://dx.doi.org/10.1016/j.hpb.2018.10.004>, PMID: 30471960.

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