



Case Report

Evaluation of Gastric Perfusion by Intraoperative Indocyanine Green Fluorescence Imaging in Distal Pancreatectomy with Celiac Axis Resection with Left Gastric Artery Reconstruction in Pancreatic Cancer – A Case Report (with Video)

Kuei-Heng Chang, Shao-Bin Cheng, Cheng-Chung Wu, Shao-Ciao Luo*

Division of General Surgery, Department of Surgery, Taichung Veterans General Hospital, Taichung, Taiwan

Abstract

A 67-year-old man had suffered from persistent abdominal cramping pain for six months, with radiation to the back. Adenocarcinoma of pancreatic body with celiac encasement was diagnosed. Neoadjuvant chemotherapy was given and regressive tumor size was noted. Further operation of distal pancreatectomy with celiac axis resection (DP-CAR), including transection of the left gastric artery (LGA), was performed. The middle colic artery (MCA) was utilized for reconstruction of LGA, with LGA-MCA anastomosis. Intraoperative indocyanine green (ICG) fluorescence was used to confirm the blood supply. DP-CAR is a complicated procedure for tumor involving celiac axis but would bring benefit if en bloc resection was achieved. Reconstruction of the transected vessels was important to reduce further complications. Intraoperative indocyanine green (ICG) fluorescence imaging is a feasible method of evaluating the blood supply to the stomach and liver after the DP-CAR procedure.

Keywords: Distal pancreatectomy with celiac axis resection, indocyanine green fluorescence imaging, left gastric artery reconstruction

INTRODUCTION

Pancreatic cancer remains one of the most lethal malignancies. Vessel resection may be needed to achieve en bloc resection in resectable cases. Distal pancreatectomy with celiac axis resection (DP-CAR) is a procedure used for pancreatic tumors involving the celiac axis (CA). A transected left

gastric artery (LGA) can be reconstructed using the middle colic artery (MCA). Intraoperative indocyanine green (ICG) fluorescence imaging is useful to confirm the blood supply. Here, we present a case in whom gastric perfusion was

Address for correspondence: Dr. Shao-Ciao Luo,
Division of General Surgery, Department of Surgery, Taichung Veterans
General Hospital, No. 1650 Taiwan Boulevard Sect. 4, Taichung, Taiwan.
E-mail: ytpytp@hotmail.com

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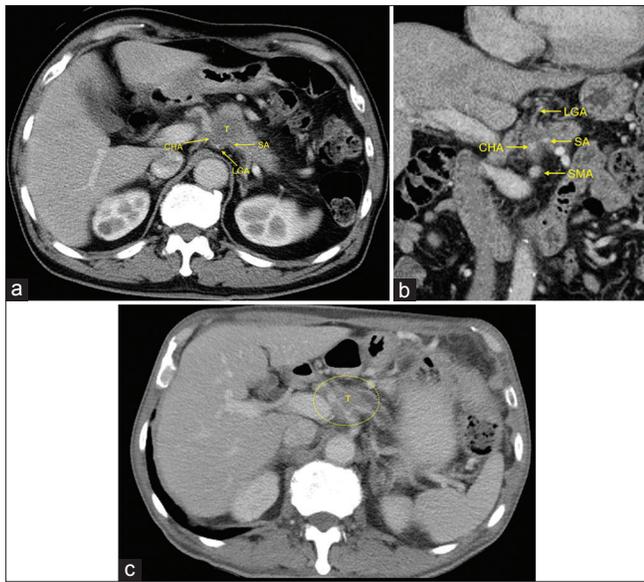


Figure 1: Abdominal CT (a) Pancreatic body tumor before neoadjuvant chemotherapy. (b) Celiac axis encasement of the tumor. (c) Tumor regression was noted after neoadjuvant chemotherapy. T: Tumor; CHA: Common hepatic artery; SA: Splenic artery; LGA: Left gastric artery; SMA: Superior mesenteric artery; CT: Computed tomography

evaluated using ICG fluorescence imaging after a DP-CAR procedure for pancreatic body cancer.

CASE REPORT

History and survey

This 67-year-old man had neither systemic disease nor operation history. He presented with persistent abdominal cramping pain for 6 months, with radiation to the back. Abdomen computed tomography (CT) [Figure 1a and b] disclosed a 3.5 cm tumor over the pancreatic body with celiac encasement and dilated pancreatic duct. The serum CEA level was 4.52 ng/ml, and the CA-199 level was 20.92 U/ml. Endoscopic ultrasound fine-needle aspiration biopsy revealed adenocarcinoma. Whole-body positron emission tomography showed a suspected paraaortic metastatic lymph node. Staging laparoscopy was performed, which showed no peritoneal carcinomatosis.

Strategy

Neoadjuvant chemotherapy with gemcitabine + TS-1 (q2w for four cycles) was given. A follow-up abdominal CT revealed that the tumor had regressed [Figure 1c] to 2.6 cm. Angiography showed no obvious encasement of the celiac vessels, and the main portal vein and its bilateral branches were patent.

Additional surgery was arranged. First, the paraaortic lymph nodes of groups 16a2 and 16b1 were sent for frozen section diagnosis and the result showed no macrometastasis. He then underwent the DP-CAR procedure. All of the arteries with tumor involvement, including the LGA, common hepatic artery (CHA), and bifurcation of the proper hepatic artery (PHA), and gastroduodenal artery (GDA) were transected

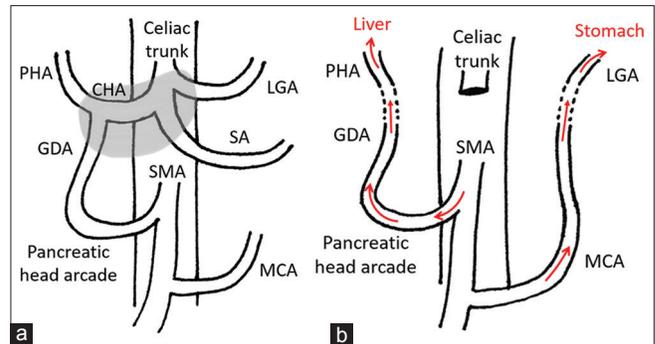


Figure 2: Sketches of the celiac axis (a) before resection, and (b) after reconstruction; blood flow to the liver and stomach was reserved. Gray region: tumor; CHA: Common hepatic artery; SA: Splenic artery; LGA: Left gastric artery; PHA: Proper hepatic artery; GDA: Gastroduodenal artery; MCA: Middle colic artery; SMA: Superior mesenteric artery

for en bloc resection. The cut ends of the PHA and GDA were reconstructed directly with end-to-end PHA-GDA anastomosis to preserve hepatic blood flow. The blood flow from the superior mesenteric artery (SMA) could be delivered to the GDA and PHA through the pancreatic head arcade. The MCA was used to reconstruct the LGA, with LGA-MCA anastomosis, which maintained the blood flow to the stomach. Figure 2 shows the sketches of the CA before resection and after reconstruction.

After reconstruction, 3 cm³ of ICG was given intravenously for fluorescence imaging. The blood flow was confirmed, as ICG fluorescence imaging showed positive fluorescence over part of the stomach 11 s after administering ICG. The liver and T-colon also showed positive fluorescence [Figure 3 and Video 1] https://drive.google.com/file/d/1sABoZBQR5kveYS39_zlQdDUtkxZVKIu/view?usp=sharing. The result showed acceptable blood flow to the liver and stomach.

No specific complication was noted except for grade A delayed gastric emptying. Postoperative care was smooth, and the patient was discharged on postoperative day 13.

Pathologic result

The final tumor size was 2.5 cm in length, and the free margin was 1 mm. The regional vessels were encased without tumor thrombi or invasion. Unfortunately, the permanent frozen section of the specimen showed metastatic adenocarcinoma over the group 16b1 lymph node. The final pathologic report was ypT2N0 (0/3) M1(lym), stage IV.

Follow-up

He received adjuvant chemotherapy with gemcitabine + TS-1 (a total of 12 cycles). Nine months later, an elevated CA-199 level was noted, so TS-1 was maintained. However, an abdominal CT at postoperative months 10 and 14 showed progressive disease with liver metastasis.

DISCUSSION

DP-CAR is a surgical procedure for locally advanced pancreatic body/tail carcinoma with CA involvement. It was

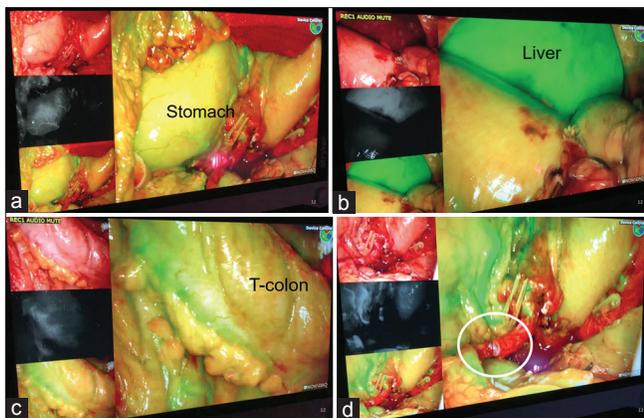


Figure 3: Blood supply was confirmed through ICG fluorescence imaging after vessel reconstruction and showed positive results. (a) Stomach, 11 seconds after administering indocyanine green. (b) Liver. (c) T-colon. (d) Anastomosis of the LGA-MCA (white circle). LGA: Left gastric artery; MCA: Middle colic artery; ICG: Intraoperative indocyanine green

modified from the Appleby procedure,^[1] which was used initially for locally advanced gastric cancer involving the CA.

The DP-CAR procedure is a complicated operation with a pooled morbidity rate of 49% and perioperative mortality rate of 3–16%.^[2] En bloc resection has been shown to be related to long-term survival. A pooled en bloc resection rate of 74% has been reported.^[2]

Common complications include pancreatic fistula, ischemic gastropathy (IG), delayed gastric emptying (DGE), and elevated liver enzymes. Pancreatic fistula is the most common complication after pancreatic operation, with a reported frequency of grade B and C pancreatic fistula after DP-CAR being 31% (10%–62%). IG and DGE are related to the inadequate blood supply to the stomach after LGA resection, with reported rates of 13% (13%–33%) and 13–30%, respectively.^[2] Without the CHA, the blood supply to the liver relies on perfusion through the GDA, which is connected to the pancreatic head arcade from the SMA. If perfusion through the GDA is insufficient, postoperative liver enzymes may be elevated, although most are transient.

Compared with palliative care, the DP-CAR procedure appears to provide better survival benefits (median survival interval: 13.7–38.6 months vs. 5–9.8 months).^[3,4] In our case, staging laparoscopy and frozen resection diagnosis were performed first to exclude peritoneal seeding and lymph node involvement. DP-CAR was then arranged for possible en bloc resection and further survival benefits.

During the DP-CAR procedure, LGA resection with reconstruction should be considered if the length from the LGA origin to the bifurcation of the splenic artery and CHA is less than 1 cm.^[5] Complications related to the stomach include IG and DGE. LGA resection has been shown to be a predictor of IG and DGE, and IG has been reported to be an independent predictor of survival.^[6,7] One method of LGA reconstruction involves using the branch of the MCA.^[8] Intraoperative ICG

fluorescence imaging helps to evaluate the flow quality of LGA-MCA anastomosis and blood supply to the stomach.^[9]

In our case, the positive fluorescence at the stomach indicated patency and adequate flow of LGA-MCA anastomosis. Blood supply to the liver through the PHA-GDA anastomosis was also confirmed by ICG fluorescence from the SMA. No significant complications of the stomach or liver were noted. To the best of our knowledge, this is the first reported case in which the blood supply was confirmed after the DP-CAR procedure using ICG fluorescence. The results seemed acceptable. In future cases, for greater objectivity, the blood flow could also be confirmed by Doppler ultrasonography.^[10]

CONCLUSION

For patients with locally advanced pancreatic cancer receiving the DP-CAR procedure, intraoperative ICG fluorescence imaging is a feasible method of evaluating the blood supply to the stomach and liver, with LGA-MCA anastomosis and pancreatic head arcade.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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