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A novel intestinal rotation method for digestive reconstruction after combined pancreaticoduodenectomy and extended right hemicolectomy: A case report and surgical technique

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ABSTRACT

INTRODUCTION: Pancreaticoduodenectomy (PD) combined with extended right hemicolectomy (RH) is a challenging procedure for locally advanced malignancies. However, information concerning the reconstruction method of the digestive system is limited. Here, we present a case and surgical technique of a novel intestinal rotation method for digestive reconstruction after PD combined with RH.
PRESENTATION OF CASE: A 62-year-old man with locally advanced pancreatic cancer received conversion surgery combined with PD and RH after preoperative chemotherapy. With respect to the reconstruction of the digestive system, the entire intestinal mesentery was rotated 180° forward counterclockwise around the axis of the superior mesenteric artery, and then the reconstruction, according to Child's method, was performed. The patient recovered without problems in gastroenterological functions after the operation.
DISCUSSION: With respect to the reconstruction of the digestive system in patients undergoing combined PD and RH, practitioners should pay close attention to twisting of the intestinal mesentery when bringing up the proximal jejunum for pancreatojejunostomy and hepatojejunostomy and the distal ileum for ileocolic anastomosis. This intestinal rotation method enables a smooth and uneventful reconstruction of the digestive system.
CONCLUSION: This is the first detailed description of an intestinal rotation method for digestive reconstruction after combined PD and extended RH. The intestinal rotation method can be an alternative and helpful technical option for digestive reconstruction in patients with combined PD and RH.

1. Introduction

Pancreaticoduodenectomy (PD) is recognized as the most complicated and technically complex procedure for treating tumors around the head of the pancreas. A tumor developing from the periampullary region often extends beyond the pancreas, directly invading adjacent organs, and infiltrating the transverse colon or its mesentery, resulting in major vascular encasement [1]. Combined multi-organ resection is considered the best therapeutic treatment for patients with locally advanced malignancies. In addition, PD combined with an en bloc extended right hemicolectomy (RH) is the best radical option to perform complete resection of various periampullary malignancies without distant metastasis.

Previous studies have shown the feasibility and safety of combined PD and RH for locally advanced tumors [1–6]. However, information concerning the reconstruction method of the digestive system is limited. In conventional PD, the proximal jejunum is brought up through a postcolic route to perform pancreatojejunostomy and hepatojejunostomy. The reconstruction of the gastrojejunostomy is then made through an antecolic route [7]. On the other hand, particularly in PD combined with RH, the conventional reconstruction method described by Child is difficult after the resection of the right hemicolon and its mesentery [8]. Major concerns include the locations and routes of the digestive reconstruction, including in ileocolic anastomosis.

In this case report, we describe a case of PD combined with RH for a locally advanced pancreatic cancer and the surgical technique of an intestinal rotation method for digestive reconstruction. This case report has been reported in line with the SCARE criteria [9].

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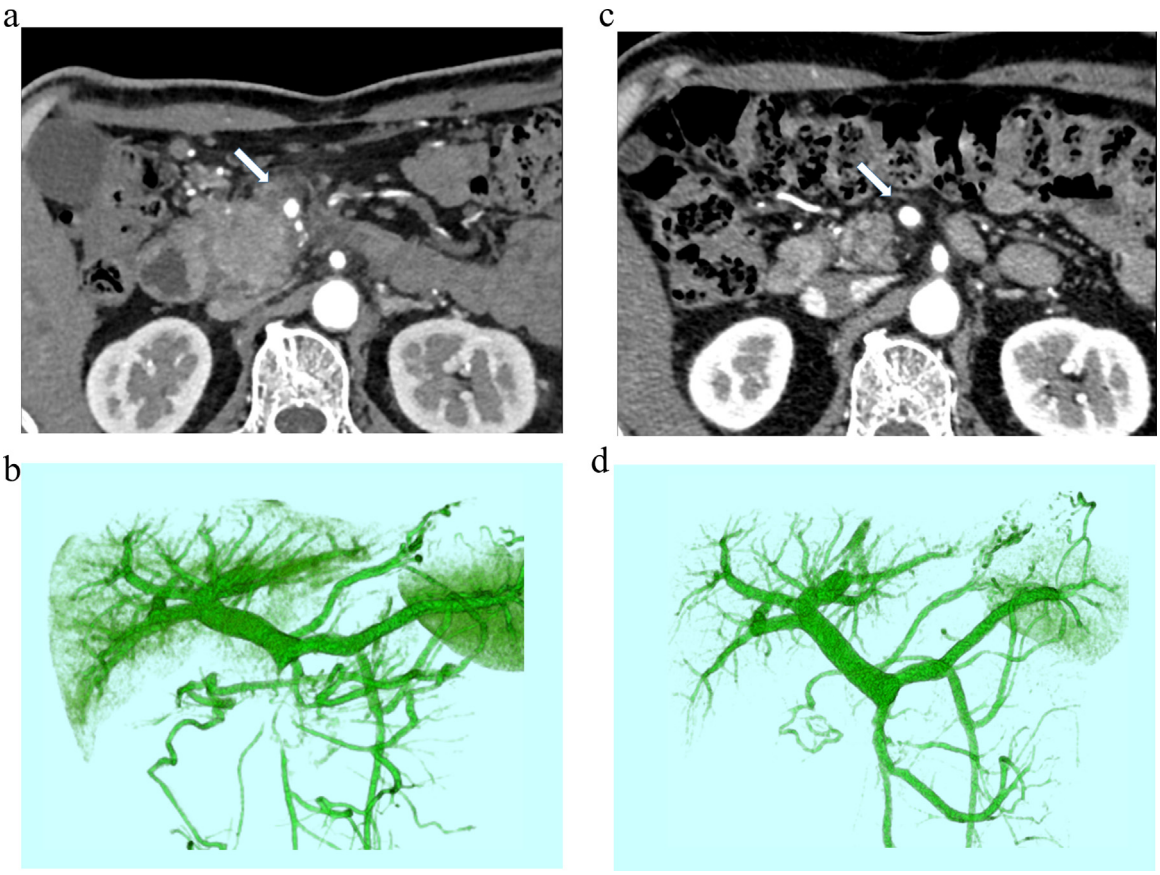

Fig. 1. Contrast-enhanced computed tomography images: **a**. A tumor of approximately 4.0 cm in the pancreatic head with invasion extending into the plexus nerve around the superior mesenteric artery (SMA) before chemotherapy (arrow); **b**. The tumor occluded the superior mesenteric vein (SMV) completely. The tumor was diagnosed as an unresectable locally advanced pancreatic head cancer; **c**. After chemotherapy, the tumor shrunk substantially, and the invasion into the plexus nerve around the SMA became unclear (arrow); **d**. The SMV became patent. The tumor was diagnosed as a borderline resectable pancreatic cancer.

2. Case report and surgical technique

A 62-year-old male with a previous history of diabetes was referred to our facility complaining of anemia and hyperglycemia. Abdominal contrast-enhanced computed tomography (CT) showed a tumor of approximately 4.0 cm in the pancreatic head with invasion extending into the plexus nerve around the superior mesenteric artery (SMA) (Fig. 1**a**). The tumor occluded the superior mesenteric vein (SMV) completely (Fig. 1**b**), but no distant metastasis was found. Endoscopic biopsy revealed adenocarcinoma. Accordingly, the tumor was diagnosed as an unresectable locally advanced pancreatic head cancer.

The patient received combination chemotherapy regimens of 2 courses of FOLFIRINOX (fluorouracil, leucovorin, irinotecan, and oxaliplatin), and 5 courses of gemcitabine plus *nab*-paclitaxel [10,11]. Due to side effects, continuing chemotherapy became difficult. However, these regimens were effective for this patient. The tumor shrunk extremely, and the invasion into the plexus nerve around the SMA became unclear (Fig. 1**c**). In addition, the SMV became patent (Fig. 1**d**). We diagnosed the tumor as borderline resectable pancreatic cancer, then decided to perform conversion surgery. Regarding surgical procedures, a CT revealed an invasion to the SMV, and the possibility of invasion to the plexus nerve around the SMA, and infiltration to the middle colic artery (MCA) and ileocecal artery (ICA). Therefore, we planned to perform a subtotal stomach-preserving PD combined with extended RH and SMV reconstruction.

Intraoperative findings showed no liver metastasis and peritoneal dissemination. The first step was performed using the mesenteric approach [12]. The SMV and SMA were peeled off and the plexus nerve around the SMA was dissected, which showed no malignancy on the intraoperative pathological examination. Once resectability was confirmed, the ICA and MCA arising from the SMA were ligated because of the possibility of tumor invasion into the ICA and MCA. A right colon mobilization was also added, and then the distal ileum approximately 10 cm from the end of ileum and transverse colon were divided. The proximal jejunum was transected approximately 20 cm from the ligament of Trietz, and the stomach was divided at the oral side of the pyloric ring. Next, regarding the cholecystectomy, lymph node dissection, including hepatoduodenal ligament, and resection of the bile duct and gastroduodenal artery were performed. The pancreatic neck was then transected on the SMA, which showed negative margins. After the extended Kocher's maneuver, the portal vein and SMV were resected. Accordingly, resection of the specimen combined with PD, extended RH, SMV resection, and wide lymphadenectomy were completed.

With respect to the reconstruction of the digestive system, we developed an intestinal rotation method for digestive reconstruction. The overview of this technique is shown in Fig. 2. At first, the entire intestinal mesentery was rotated 180° forward counterclockwise around the axis of the SMA (Fig. 3). In conventional reconstruction after combined PD and RH, only the upper proximal jejunum mesentery is rotated around the axis of the SMA and brought up to perform pancreatojejunostomy and hepatojejunostomy reconstruction (Fig. 4). However, our entire intestinal rotation method can make the following reconstruction procedures, according to Child's method, easier: the pancreato-

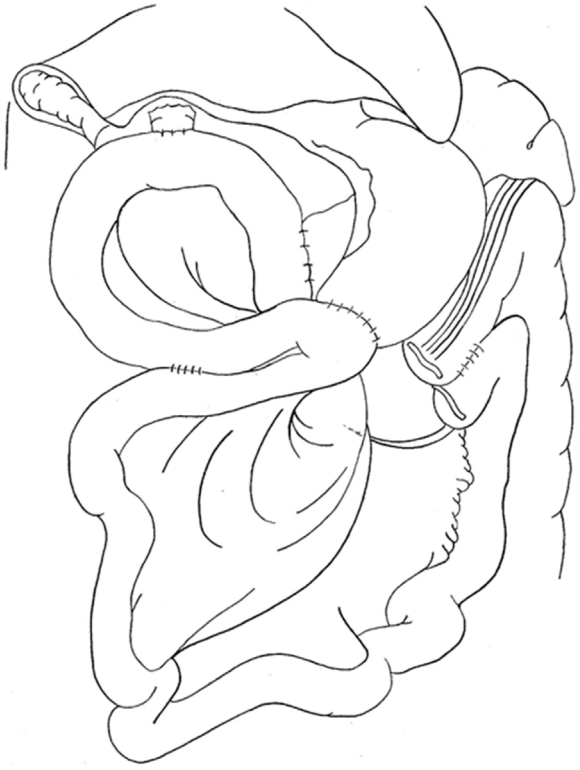

Fig. 2. Overview of an intestinal rotation method for digestive reconstruction after pancreaticoduodenectomy combined with an en bloc extended right hemicolectomy.

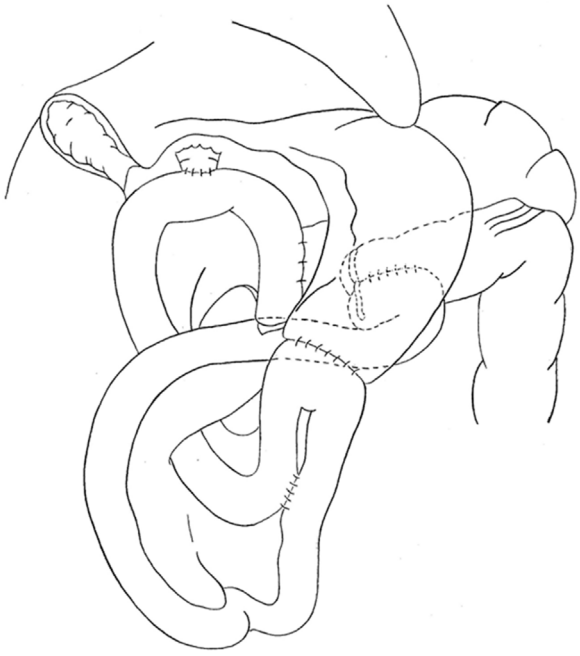

Fig. 4. Overview of conventional reconstruction after combined pancreaticoduodenectomy and right hemicolectomy.

jejunostomy, hepatojejunostomy, gastrojejunostomy and Braun anastomosis. Furthermore, the ileocolic anastomosis was performed more smoothly without complex orientation of intestinal mesentery and left colon mobilization.

Concerning the postoperative course, the patient received interventional radiology for pseudoaneurysm of the splenic artery related to pancreatic fistula on day 11 after the surgery. He did not have any trouble with gastroenterological functions, which allowed hospital discharge on day 43.

3. Discussion

To our knowledge, this is the first detailed description of an intestinal rotation method for digestive reconstruction after combined PD and extended RH. This report highlights the surgical technique of an intestinal rotation method after PD combined with RH.

In conventional PD, the pancreatojejunostomy and hepatojejunostomy are performed through a postcolic route of the proximal jejunum. Then gastrojejunostomy reconstruction is performed through an antecolic route [7]. However, in PD combined with RH, the distal ileum must also be brought up to perform the ileocolic anastomosis. Fig. 4 shows an overview of conventional reconstruction after combined PD and RH. Fig. 5 focuses on the small intestine and its mesentery in the usual method. The upper proximal jejunum is first brought up accompanied with an intestinal mesenteric rotation of 180° forward counterclockwise around the axis of the SMA (Fig. 5**b**). After pancreatojejunostomy and hepatojejunostomy reconstruction, the distal ileum is brought up to perform ileocolic anastomosis through an antecolic route of the proximal jejunum (Fig. 5**c**). At that time, orientation of intestinal rotation is different at the proximal and distal sides, which might cause twisting of the mesentery. In addition, mobilization of the left colon might be needed for ileocolic anastomosis when the remnant transverse colon is short. Finally, a gastrojejunostomy was performed 50 cm

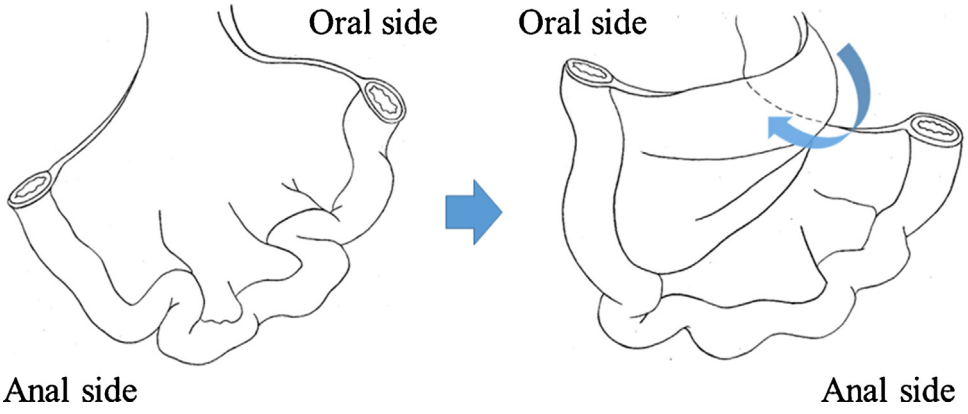

Fig. 3. After transection of the proximal jejunum and the distal ileum, the entire intestinal mesentery was rotated 180° forward counterclockwise around the axis of superior mesenteric artery.

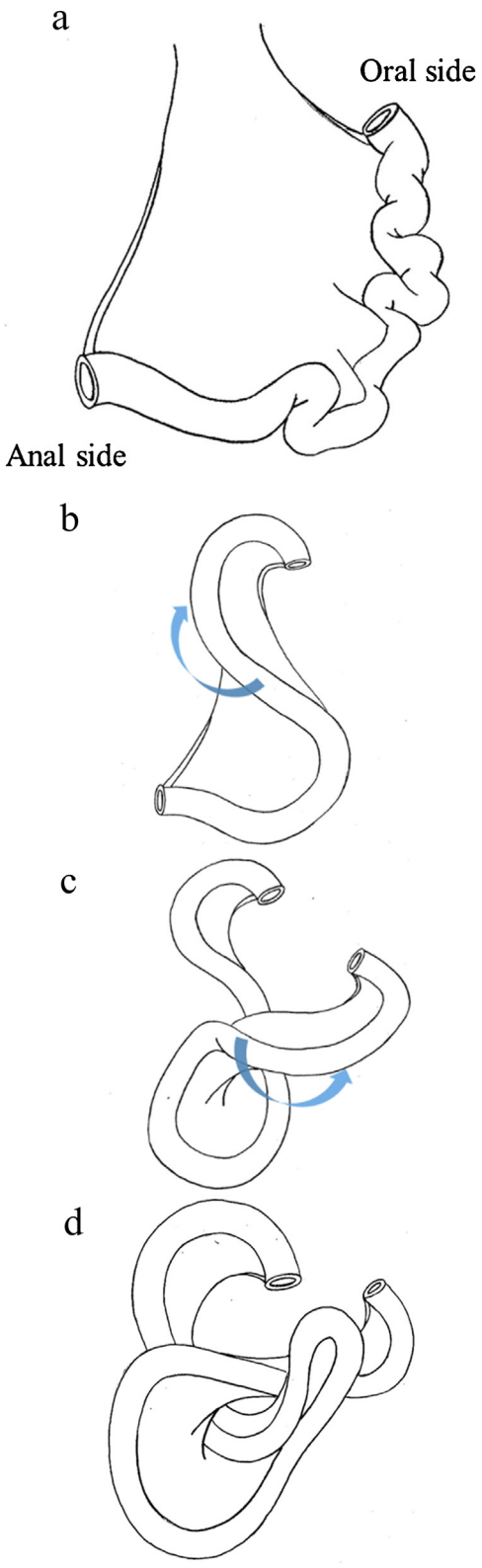

Fig. 5. The conventional reconstruction method: **a**. The small intestine and its mesentery; **b**. The upper proximal jejunum is first brought up accompanied with an intestinal mesenteric rotation of 180° forward counterclockwise around the axis of superior mesenteric artery; **c**. After reconstruction of pancreatojejunostomy and hepatojejunostomy, the distal ileum is brought up to perform ileocolic anastomosis through an antecolic route of the proximal jejunum; **d**. A gastrojejunostomy was performed through an antecolic route of ileocolic anastomosis. A Braun anastomosis was added, if necessary.

distal to the hepatojejunostomy through antecolic route of ileocolic anastomosis (Fig. 5**d**). A Braun anastomosis was added, if necessary. Accordingly, in PD combined with RH, the reconstruction of the digestive system has a more complex orientation involving different intestinal rotation than that of a conventional PD.

With respect to the intestinal rotation method, the difference between this method and the usual method, described above, is whether the entire intestinal mesentery or only the upper proximal jejunum mesentery is rotated around the axis of the SMA. Through the intestinal rotation method, pancreatojejunostomy, hepatojejunostomy, and gastrojejunostomy can be performed without a postcolic or antecolic route (Fig. 2). In PD combined with RH, further counterclockwise rotation of the entire intestinal mesentery around the axis of the SMA is possible after right colon resection. Moreover, there are some advantages of this method. First, reconstruction of the digestive system can be performed smoothly, especially in ileocolic anastomosis. Second, various complex intestinal rotations are not needed, unlike in the conventional method. Third, left colon mobilization is not needed because the distal ileum is easily brought up to perform ileocolic anastomosis.

Despite our important findings, there are a few limitations to the present report. First, no comparison has been conducted between the conventional reconstruction method and the intestinal rotation method in patients with combined PD and RH. The number of cases of PD combined with RH is limited, so investigating the efficacy of each method is challenging. Second, when partial colectomy is performed, the conventional reconstruction method should be performed, because twisting the mesentery to the degree performed in the intestinal rotation method is not necessary in a partial colectomy. Third, the long-term outcomes of this surgical technique have yet to be examined. We performed the intestinal rotation method for three patients, including the patient described in this report, after combined PD and RH. After a median follow-up of 29 months, no patient has had any gastroenterological function complications after surgery. However, further follow-up is needed.

4. Conclusion

The intestinal rotation method can be an alternative and helpful technical option for the digestive reconstruction in patients with combined PD and RH. In PD combined with RH, practitioners should pay close attention to the twisting of the mesentery caused by bringing up the proximal jejunum for pancreatojejunostomy and hepatojejunostomy, and the distal ileum for ileocolic anastomosis.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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Ethical approval

Not applicable.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Author contributions

All authors contributed to this work, and approved the final manuscript.

Guarantor

Takahito Yagi.

References

[1] E.T. Kimchi, M. Nikfarjam, N.J. Gusani, D.M. Avella, K.F. Stavely-O'Carroll, Combined pancreaticoduodenectomy and extended right hemicolectomy: outcomes and indications, HPB (Oxford) 11 (2009) 559–564.
[2] Y. Suzuki, Y. Fujino, Y. Tanioka, T. Sakai, T. Ajiki, T. Ueda, et al., Resection of the colon simultaneously with pancreaticoduodenectomy for tumors of the pancreas and periampullary region: short-term and long-term results, World J. Surg. 28 (2004) 1007–1010.
[3] A. Saiura, J. Yamamoto, M. Ueno, R. Koga, M. Seki, N. Kokudo, Long-term survival in patients with locally advanced colon cancer after en bloc pancreaticoduodenectomy and colectomy, Dis. Colon Rectum 51 (2008) 1548–1551.
[4] S.R.P. Costa, A.C. Henriques, S.H.C. Horta, J. Waisburg, M.B. Speranzini, En-bloc pancreatoduodenectomy and right hemicolectomy for treating locally advanced right colon cancer (T4): a series of five patients, Arq. Gastroenterol. 46 (2009) 151–153.
[5] I.M. Paquette, B.R. Swenson, M.R. Kwaan, A.F. Mellgren, R.D. Madoff, Thirty-day outcomes in patients treated with en bloc colectomy and pancreatectomy for locally advanced carcinoma of the colon, J. Gastrointest. Surg. 16 (2012) 581–586.
[6] Q.S. Sheng, W.B. Chen, M.J. Li, X.B. Cheng, W.B. Wang, J.J. Lin, Combined right hemicolectomy and pancreaticoduodenectomy for locally advanced right hemicolon cancer, Hepatobiliary Pancreat. Dis. Int. 14 (2015) 320–324.
[7] K. Takagi, T. Yagi, R. Yoshida, S. Shinoura, Y. Umeda, D. Nobuoka, et al., Surgical outcome of patients undergoing pancreaticoduodenectomy: analysis of a 17-year experience at a single center, Acta Med. Okayama 70 (2016) 197–203.
[8] C.G. Child, Pancreaticojejunostomy and other problems associated with the surgical management of carcinoma involving the head of the pancreas: report of five additional cases of radical pancreaticoduodenectomy, Ann. Surg. 119 (1944) 845–855.
[9] R.A. Agha, A.J. Fowler, A. Saetta, I. Barai, S. Rajmohan, D.P. Orgill, the SCARE Group, The SCARE statement: consensus-based surgical case report guidelines, Int. J. Surg. 34 (2016) 180–186.
[10] T. Conroy, F. Desseigne, M. Ychou, O. Bouche, R. Buimbaud, Y. Becouarn, et al., FOLFIRINOX versus gemcitabine for metastatic pancreatic cancer, N. Engl. J. Med. 364 (2011) 1817–1825.
[11] D.D. Von Hoff, T. Ervin, F.P. Arena, G. Chiorean, J. Infante, M. Moore, et al., Increased survival in pancreatic cancer with nab-paclitaxel plus gemcitabine, N. Engl. J. Med. 369 (2013) 1691–1703.
[12] A. Nakao, The mesenteric approach in pancreatoduodenectomy, Dig. Surg. 33 (2016) 308–313.