

Vascular Graft Bridged *En Bloc* Resection for Biliopancreatic Cancer Invading the Portal System

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To meet the requirement of extensive resection of pancreatic cancer with portal or mesenteric venous invasion, the innovation of Vascular Graft Bridged *En Bloc* Resection (VGBEBR) has been adopted to treat advanced biliopancreatic cancer in the Department of Hepatobiliary Surgery of the PLA Rocket Force General Hospital since 2013. This attempt could not only broaden surgical indications of radical resection and lymphadenectomy but also increase R0 resection rate, especially for the case with severe invasion in the portal and mesenteric venous system.^[1]

Thirteen patients (five males and eight females; age: 28–70 years) received “VGBEBR” from December 2013 to January 2015. All patients were diagnosed with locally advanced biliopancreatic cancer without systemic metastases confirmed by computed tomography and magnetic resonance imaging, and vascular grafts 8 mm long were prepared preoperatively. The extent of the invasion abutting or invading to the portal vein (PV) was >5 cm, which was unavailable to end-to-end anastomoses; thus, the following efforts were attempted: (1) The gallbladder was removed and the hepatoduodenal ligament was dissected to expose the PV measuring approximately 3 cm. (2) The 2-cm trunk section of the superior mesenteric vein (SMV) was anatomized for the anastomoses after the exposure, rather than the branches far down. (3) Vascular graft 40 cm long was used to perform the end-to-end anastomoses between the PV and SMV, followed by the ligation and transaction of PV and SMV 0.5 cm below and above the anastomoses, respectively, with the purpose of obstructing the PV and preventing the intrahepatic metastases caused by extrusion of tumors. PV obstruction should be controlled within 30 min. (4) The 40-cm graft was drawn to the right to

make space for the following manipulations in the surgical field. Whether to perform total pancreatectomy (TP) or head resection was determined by the location of the tumors. In case of the hepatic artery (HA) invasion, the reconstruction was needed after the removal of the tumors. The overlong graft had better be shortened to 10–12 cm. (5) After the anastomoses, the reconstructions were accomplished in turn, with pancreatic, biliary, and gastrointestinal procedures.

All the cases were successfully completed and no operative mortality occurred. All the cases were diagnosed as Stage III according to the modified UICC-3 TNM classification^[2] and were performed with R0 resection, except for one with R1 resection. The R0 rate was remarkably promoted to 92.3% (12/13). The intraoperative results and the postoperative pathology are shown in Supplementary Table 1. The complications included postoperative bleeding in three patients and gastrointestinal obstruction and anastomotic and lymphatic fistula in three patients, and the complication rate was 46.2%. Death happened in two cases (survived more than 300 days): one related to hemorrhage (day 4) and the other due to uncontrolled diarrhea secondary to electrolyte imbalance. The overall survival rate was 84.6%.

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The main indications for this surgery were as follows: (1) presented with the PV invasion and the gap between the pancreas and the PV disappeared; (2) the range of the invasion was usually >5 cm and unavailable to the direct end-to-end anastomoses; (3) the invasion was severe, expanding to the whole pancreas; (4) shallow and moderate invasion occurred in the HA; (5) the PV invasion resulted in regional portal hypertension. TP was performed in nine patients, and this procedure was determined by the following aspects: (1) Pancreatic cancer was mostly located in the neck and body, which was prone to the development to the head and tail. The procedure of TP should not be abandoned concerning its potentials in the achievements of negative margin and R0 resection.^[3,4] (2) In terms of postoperative complications, pancreatic fistula should be given more concern.

For this approach, there are four highlights, namely B-NET: B stands for the bridge; N means no touch; E represents *en bloc* resection; and T signifies the TP. Postoperatively, complications only occurred in three patients and were cured after conservative treatment. In view of these surgical benefits, we are convinced that this approach is safe and feasible and worth attempting. Although the long-term survival rate has not been confirmed yet, it is worthwhile to explore further to maximize its potentials in the improvement of the survival rate for the advanced pancreatic cancer.

Supplementary information is linked to the online version of the paper on the Chinese Medical Journal website.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. The patients understand that their names and initials will not be published in the journal and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Intraoperative results and the postoperative pathology of 13 patients with biliopancreatic cancer

Patient number	Scope of resection	OR bleeding (ml)	Duration of operation (h)	Artery reconstruction	Surgical margin	Pathology	TNM staging
1	Whole pancreas, duodenum, spleen, segmental PV, SMV, and HA	4000	7.5	HA reconstruction	R1 negative	Pancreatic poorly/moderately differentiated adenocarcinoma	T4N1M0
2	Pancreatic head, duodenum, gallbladder, distal CBD, distal stomach, proximal jejunum, segmental SMV	1600	9.0	No	R0 negative	Pleomorphic leiomyosarcoma	TXN1M1
3	Pancreatic head, duodenum, gallbladder, distal CBD, distal stomach, proximal jejunum, segmental SMV	6000	9.0	No	R0 negative	Duodenum poorly/moderately differentiated adenocarcinoma	T3N1M0
4	Hepatic right trilobectomy, distal CBD, distal stomach, pancreatic head, duodenum, proximal jejunum, segmental SMV	8000	11.0	No	R0 negative	Cholecyst poorly/moderately differentiated adenocarcinoma	T3N1M0
5	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	3100	11.0	No	R0 negative	Pancreas well-differentiated papillary squamous cell carcinoma	T3N0M0
6	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	4000	10.5	No	R0 negative	Pancreatic acinar adenocarcinoma	T3N1M0
7	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	4000	7.5	No	R0 negative	Pancreas multiple serous cystic adenoma	Benign*
8	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	800	5.5	No	R0 negative	Pancreatic moderately differentiated adenocarcinoma	T3N1M0
9	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	350	7.0	No	R0 negative	Pancreatic moderately/poorly differentiated adenocarcinoma	T3N1M0
10	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	2000	8.0	No	R0 negative	Pancreatic moderately/poorly differentiated adenocarcinoma	T3N1M0
11	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	380	6.5	No	R0 negative	Pancreatic moderately/poorly differentiated adenocarcinoma	T3N1M0
12	Whole pancreas, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	3500	7.0	No	R0 negative	Pancreatic highly/moderately differentiated adenocarcinoma	T3N0M0

Contd...

Supplementary Table 1: Contd...

Patient number	Scope of resection	OR bleeding (ml)	Duration of operation (h)	Artery reconstruction	Surgical margin	Pathology	TNM staging
13	Pancreatic head, duodenum, spleen, segmental PV, SMV, distal stomach, distal CBD, proximal jejunum	1000	7.5	No	R0 negative	Pancreatic moderately differentiated adenocarcinoma	T3N0M1

*Serous cystic adenoma is generally defined as pathological “benign,” but its biological behavior is very invasive, and such disease was clinically treated under malignant protocol. CBD: Common bile duct; PV: Portal vein; SMV: Superior mesenteric vein; HA: Hepatic artery; OR: Operation; TNM: Tumor, node, metastasis.