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Portal vein thrombosis after reconstruction in 270 consecutive patients with portal vein resections in hepatopancreatobiliary (HPB) surgery

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ABSTRACT

Backgrounds: This study was aimed to evaluate the occurrence of portal vein thrombosis after portal vein reconstruction.
Methods: The portal veins were repaired with venorrhaphy, end-to-end, patch graft, and segmental graft in consecutive 270 patients undergoing hepato-pancreto-biliary (HPB) surgery.
Results: Portal vein thrombosis was encountered in 20 of 163 of end-to-end, 2 of 56 of venorrhaphy, and 2 of 5 of patch graft groups, as compared with 0 of 46 of segmental graft group ($p < 0.05$, N.S., $p < 0001$, respectively). Portal vein thrombosis occurred more frequently after hepatectomy than after pancreatectomy ($p < 0.0001$). The restoration of portal vein blood flow was more sufficiently achieved in the early re-operation within 3 days after surgery than in the late re-operation over 5 days after surgery ($p < 0.05$).
Conclusions: The segmental graft might have to be more preferred in the portal vein reconstruction. The revision surgery for portal vein thrombosis should be performed within 3 days after surgery.

1. Introduction

Hepato-pancreato-biliary (HPB) malignancies are usually diagnosed as an advanced stage despite of recent improvement of diagnostic imaging devices. Major venous vasculatures surrounding tumors such as the portal vein (PV), hepatic vein (HV) and inferior vena cava (IVC) are often involved by direct invasion, and which makes surgical resection difficult even in the case of HPB malignancies without distant metastases. Recent surgical technical improvement could bring about rendering combined vascular resection of the PV and IVC feasible without an increased surgical mortality rate at high volume centers.[1–3] However there has been still reported to result in some amount of surgical morbidity such as liver failure, vascular thrombosis and intra-abdominal infectious complications after these combined venous resections.[4,5] Especially, the occurrence of PV thrombosis after the PV resection and reconstruction might be able to induce severe complications such as liver damage, intestinal congestion, intestinal bleeding and persistent portal hypertension.[6–8] Therefore, favorable post-operative outcome has to be assumed after combined vascular resection and reconstruction by appropriate surgical procedures in the patients with combined PV resection, venorrhaphy, end-to-end, segmental graft, and patch graft reconstructions. When a venous conduit is required for the reconstruction of the PV after combined PV resection, there have been reported various venous conduits to be applicable and feasible such as the iliac vein, femoral vein, left renal vein, jugular vein, umbilical vein, and synthetic graft.[1] We have previously reported the usefulness of the left renal vein graft for the PV and IVC reconstruction as an auto-vein graft, and has preferably utilized a left renal vein graft in HPB oncologic surgery.[9–11] In this study, it was aimed to assess the occurrence of post-operative PV thrombosis after the reconstruction with various options in consecutive 270 patients with combined PV resection for HPB malignancies in

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2. Materials and methods

2.1. Patients

From April 2001 to February 2015, two-hundred seventy patients underwent combined PV resections in 1648 patients who underwent surgical resections for HPB oncologic diseases at department of general surgery, Chiba University hospital. The utilized procedures in the PV reconstruction were venorrhaphy in 56, end-to-end in 163, left renal vein segmental graft in 46, and patch graft in 5 patients. The PV resection was performed in 71 of hepatectomy, 196 of pancreatectomy, and 3 patients of hepatopancreaticoduodenectomy. In 270 patients with PV resection, there were 111 male and 159 female patients. Their age ranged from 33 to 84 years with a median of 66 years. PV resection in HBP oncologic surgery were carried out various HPB diseases as shown in Tables 1 and 2. The utilized grafts in the PV reconstruction were left renal vein grafts in 46 and patch grafts with the inferior mesenteric vein in 3, umbilical vein in 1, and PV in 1 patients. The segmental grafts were utilized when reconstruction with an end-to-end fashion was judged to be difficult due to too much tension for end-to-end fashioned PV reconstruction during surgery. Median follow-up after surgery was 74 months (range 15–180 months) in all patients. The short-term outcome after PV reconstruction was assessed in comparison with various reconstructive procedures of the resected PV, especially concerning on the occurrence of the PV thrombosis.

2.2. Preoperative work-up

Preoperative evaluation included the usual work-up, contrast-enhanced multi-detector abdominal computed tomography (MDCT), gadoxetic acid-enhanced magnetic resonance imaging (EOB-MRI), and positron emission tomography (PET). The endoscopic ultrasonography (EUS) was utilized in pancreatic cancer, extrahepatic bile duct cancer, and gallbladder cancer. Preoperative judge of vascular involvement was mainly performed by the images of MDCT and also endoscopic ultrasonography (EUS). The presence of distant metastasis was assessed by MDCT, EOB-MRI, and PET. Preoperative diagnostic criteria for vascular involvement on imaging included vessel stenosis or occlusion, obvious contour deformity associated with tumor contact, or greater than 25% circumferential vessel wall contact with the tumor. The presence of extra-primary distant metastases resulted in a contra-indication to surgical resection with combined vascular resection of the PV in this series.

2.3. Portal vein resection

All surgical resections with PV resections were performed provided it was estimated that the macroscopic PV invasion might exist and tumor clearance could not be obtained otherwise by PV resection. The intraoperative judge about whether either partial resection of the circumference of the PV wall or segmental resection were done in each case according to the extent of PV wall invasion. The intraoperative judge about whether venorrhaphy or patch or segmental grafts for vascular reconstruction of the PV were performed by three senior surgeons. PV resections with various partial hepatectomy were performed, and PV reconstructions were carried out immediately after en-bloc resection of tumors under only clamping of the PV. PV resections with pancreatectomy were also performed similarly after en-bloc resection of tumors under only clamping of the PV. Portal venous bypass were not required except two cases during surgical resection and reconstruction of the PV in this series. In those 2 cases, an internal shunt tube (Anthron®, Toray Medical, Chiba, Japan) was utilized for avoiding long-standing portal congestion and hepatic ischemia. All segmental grafts utilized the left renal vein grafts that were harvested from same operative fields when it was judged intraoperatively that a segmental graft was required for PV reconstruction due to too much tension for end-to-end anastomosis. Umbilical, inferior mesenteric, and PV-branch veins were suitably utilized for the PV reconstruction as a patch graft in 5 patients. The left renal vein grafts were utilized in 46 patients for the PV reconstruction as a segmental graft as reported previously.[9–11]

Table 2
Surgical procedures in the 270 patients with portal vein resection.

	n
Hepatectomy	**71**
Right trisectionectomy	3
Left trisectionectomy	11
Right hemihepatectomy	35
Left hemihepatectomy	16
Central inferior hepatectomy	5
Other hepatectomies	1
Pancreatectomy	**196**
Pancreaticoduodenectomy	164
Distal pancreatectomy	20
Total pancreatectomy	12
Hepatopancreaticoduodenenctomy	**3**
Total	270

2.4. Post-operative management

Systemic heparinization (200–240 u/kg/day) was introduced from the first post-operative day to 7 post-operative days. The patency of the vascular reconstruction was assessed by daily Doppler ultrasonography until 2 weeks after surgery. Contrast-enhanced CT was undergone at the 7th post-operative day in all patients who underwent PV resection. Furthermore, when daily Doppler ultrasonography revealed a reduced blood flow, contrast-enhanced CT was immediately undergone to confirm the patency

Table 1
270 patients with portal vein resection in 1648 patients who underwent surgical resection for HPB diseases.

Diseases	Total resection	PV resection	Venorrhaphy	End-to-end	Patch graft	Segmental graft
Hepatic metastases	352	3	1	1	0	1
ICC	125	10	3	7	0	0
Bile duct cancer	396	59	9	44	2	4
Gallbladder cancer	130	13	3	7	0	3
Pancreas cancer	645	185	40	104	3	38
Total	1648	270	56	163	5	46

ICC: intrahepatic cholangiocarcinoma.