

LETTER TO THE EDITORS

Total hepatectomy, pancreatoduodenectomy, and living donor liver transplantation using innovative vascular reconstruction for unresectable cholangiocarcinoma

doi:10.1111/tri.12401

Dear Sirs,

In patients with diffuse-type bile duct cancer with extensive hilar invasion, bilateral liver involvement, and vascular encasement, en bloc resection using a 'no touch' technique, a process involving extended bile duct resection combined with total hepatectomy, pancreatoduodenectomy, and deceased donor whole liver transplantation (HPD-LT), has been proposed to eradicate the entire biliary tract and pancreas head, along with their lymphatic system and nerves, and improve curability [1,2]. A study at the Mayo Clinic found that strict preoperative staging and neoadjuvant chemoradiation followed by deceased donor whole liver transplantation yielded encouraging outcomes in patients with unresectable hilar cholangiocarcinoma (CCA) [3].

The scarcity of deceased organ donations has led us to perform HPD and living donor liver transplantation (HPD-LDLT), following neoadjuvant chemoirradiation in patients with unresectable hilar CCA. The absence of fresh vascular conduit from deceased donors, however, has been a huge obstacle for timely and successful HPD-LDLT because preoperative irradiation of a recipient's portal vein (PV) and hepatic artery (HA) at the hilum frequently results in postoperative radiation-injury-induced stenosis and thrombosis; these patients subsequently require resection of these injured vessels and replacement with new healthy vascular conduit [3]. Here, we describe the successful performance of HPD-LDLT after neoadjuvant chemoirradiation using innovative methods.

A 59-year-old Korean female patient presented with Bismuth type IV hilar CCA with right HA and left PV invasion but no lymph node metastasis (Fig. 1). Initially, her total bilirubin and CA 19-9 concentrations were 6.5 mg/dl and 984 U/ml, respectively. A biliary dynamic computed tomography (CT) scan showed that the intrapancreatic bile duct had thickened walls with enhancement although tumor mass was localized to the suprapancreatic bile duct,

suggesting diffuse bile duct involvement of the hilar CCA. We planned curative resection, consisting of neoadjuvant chemoirradiation and 'no-touch en bloc' resection of the tumor, along with hepatectomy and bile duct resection, followed by HPD-LDLT.

The donor was the patient's 29-year-old daughter; preoperative evaluation showed she was acceptable as a right lobe donor.

The patient underwent endoscopic retrograde biliary drainage followed by neoadjuvant chemoirradiation. Her CA 19-9 concentration decreased from 984 to 36.1 U/ml. Laparoscopic staging laparotomy performed 7 days before HPD-LDLT showed no evidence of metastasis to the regional lymph node and peritoneum. She underwent surgery on November 30, 2010, with no evidence of metastasis after laparotomy. This was followed by the donor operation to harvest a modified right lobe graft as previously described [4].

Hepatectomy, pancreatoduodenectomy, and deceased donor whole liver transplantation was performed using the same extent of dissection as previously described [5]. To avoid radiation-injury-related vascular complications such as thrombosis and stenosis, the far distal gastroduodenal artery, which was located in a non-irradiated area, was dissected to prepare the HA inflow. The proper HA was divided at the origin, and the PV was divided proximal to the splenomesenteric junction. Venovenous bypass was not performed.

To reconstruct the PV in the absence of an interposing freshly deceased donor vessel graft, a spiral-shaped vascular tube graft ≥ 1 cm in diameter, made by wrapping and suturing of the autogenous bisected great saphenous vein (GSV) over a 10-ml plastic syringe, was used as an alternative interposition graft to fill the gap between the donor and recipient PVs. One end of the vascular tube graft was anastomosed to the donor's PV at the bench. In addition, hepatic vein venoplasty and middle hepatic vein reconstruction were performed as described [6,7].

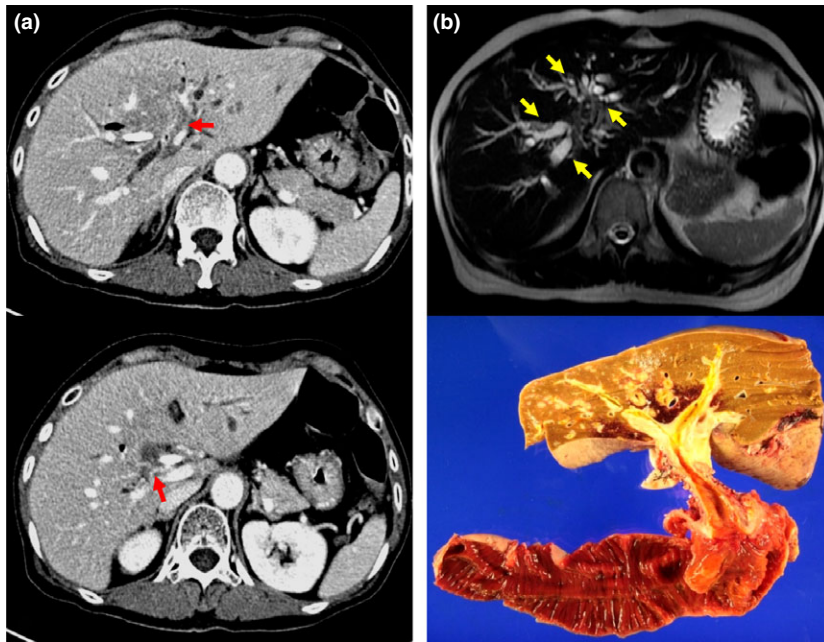


Figure 1 Preoperative image of the patient with Bismuth type IV hilar cholangiocarcinoma (CCA). Computed tomography (CT) scan revealed invasion of left portal vein and right hepatic artery without lymph node metastasis indicated by red arrows (a). The extent of Hilar CCA on magnetic resonance cholangiogram and resected specimen showed that the upper intrapancreatic bile duct was involved by tumor (b).

During engraftment, the recipient's main PV (immediately above splenomesenteric junction) was anastomosed to the spiral tube vascular graft connected to the donor's PV (Fig. 2a). An arterial anastomosis between the right HA of the donor and the gastroduodenal artery of the recipient was constructed under surgical microscopy. For gastrointestinal continuity, duct-to-mucosal pancreaticojejunostomy and hepaticojejunostomy were performed. Both anastomoses were externally stented, followed by gastrojejunostomy (Fig. 2b).

Pathologic examination of the resected tumor revealed a moderately differentiated hilar CCA extending along the common bile duct down to the intrapancreatic portion, as well as lymphovascular and perineural sheath invasion. Lymph nodes sent for frozen section during the operation showed perinodal fibrosis without tumor involvement. Lymph nodes were absent from the irradiated hepatoduodenal ligament, and only severe fibrosis present at the perihilar tissue. However, one metastasis of peripancreatic lymph nodes was found on permanent biopsy of the resected specimen.

Follow-up CT 21 days after transplantation revealed patent vascular structures without stenosis. The patient was discharged from the hospital 28 days after transplantation (Fig. 3). She survived for 6 months without recurrence; however, she later died from a ruptured cerebral aneurysm.

Early outcomes of LT for unresectable hilar CCA are poor due to unrecognized distant metastases, intra- or preoperative tumor seeding, and peripancreatic tumor extensions in lymphatic vessels or perineural sheaths along the distal residual bile duct [1,5].

We found that in the absence of an available deceased whole liver, we can perform HPD-LDLT after neoadjuvant chemoradiation using the described procedures to avoid radiation-related vascular stenosis or thrombosis of HA and PV. To the best of our knowledge, this is the first description of the use of these innovative techniques for timely HPD-LDLT, thereby avoiding the necessity of fresh vessel grafts from deceased donors. However, several reports have described HPD-LDLT using interposed deceased donor vessels [8,9].

Relatively high post-operative morbidity rates are expected because of these complicated procedures. Leakage of pancreatic juice through the anastomosis is a particularly dangerous complication and may be a fatal. Therefore, some centers prefer a sequential pancreatoduodenectomy following LDLT in patient with hilar CCA complicated by primary sclerosing cholangitis [10]. We did not prescribe steroid as an immunosuppressant to avoid delayed wound healing and leakage through the pancreatic anastomosis.

In conclusion, a combination of neoadjuvant chemoradiation and HPD-LDLT may be a valid approach to the

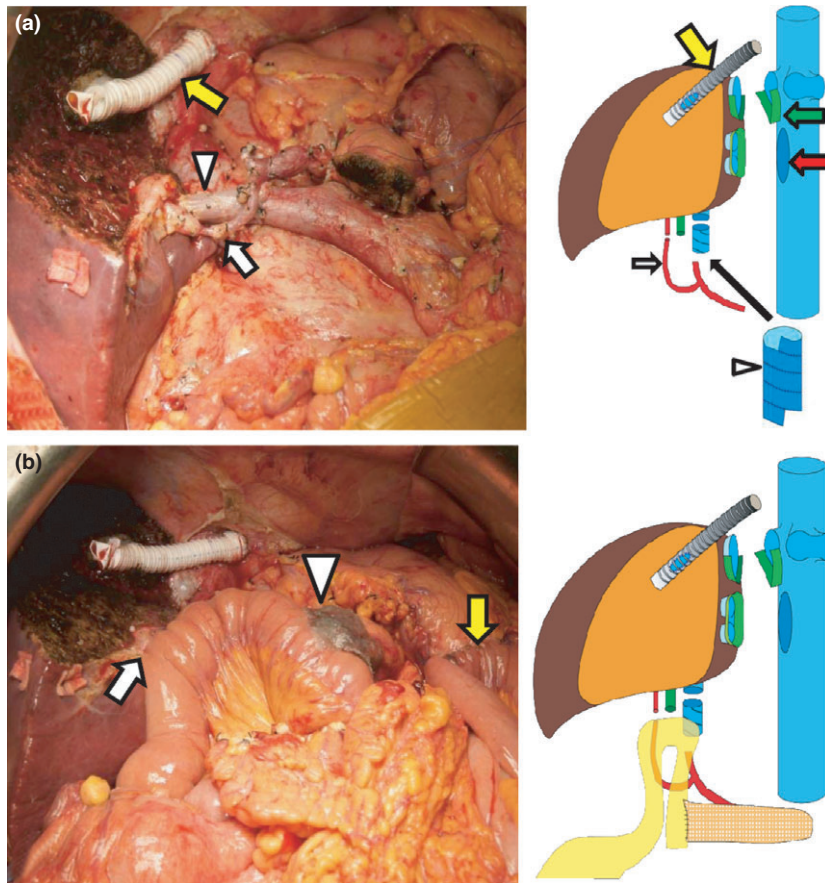


Figure 2 Intraoperative views with schema for engraftment and reconstruction of gastrointestinal continuity. (a) Shows enlarged right hepatic vein anastomosis after patch venoplasty (green arrow), inferior right hepatic vein anastomosis with a large common cuff (red arrow), bisected great sphenous vein spiral tube (white arrowhead) used for portal vein reconstruction, gastroduodenal artery (white arrow), and ringed polyterafuoroethylene graft (yellow arrow) used for segment eight middle hepatic vein reconstruction. (b) Shows pancreatojejunostomy (white arrowhead), hepaticojejunostomy (white arrow), and gastrojejunostomy (yellow arrow).

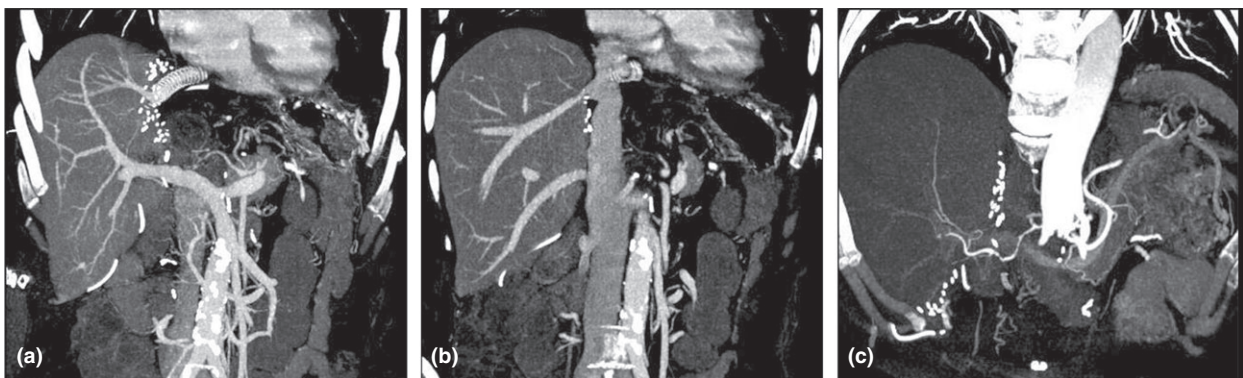


Figure 3 Follow-up computed tomography (CT) scan on post-transplantation day 21. The photographs showed good patency of reconstructed vascular structures including portal vein (a), right hepatic vein and inferior hepatic vein (b), and hepatic artery (c).

treatment of early stage but unresectable hilar CCA in the absence of deceased donor organs. Our innovative techniques using autogenous vessels including the gastroduode-

nal artery and bisected GSV allow timely HPD-LDLT in the absence of fresh vessels from deceased donors, which are usually used for vascular interposition grafts.

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Conflicts of interest

The authors have declared no conflicts of interest.

Funding

The authors have declared no conflicts of interest and funding.

Acknowledgement

The authors would like to acknowledge the efforts of Jung-Man Nam-goong, Tae-Yong Ha, Shin Hwang, Chul-Soo Ahn, Gi-Won Song, Dong-Hwan Jung, Gil-Chun Park, Bo-Hyun Jung, Sung-Hwa Kang.

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