

Lateral cavo-caval shunt: an alternative veno-venous bypass in liver surgery

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Abstract: When inferior vena cava (IVC) resection is mandatory during liver surgery, use of a veno-venous bypass (VVB) is usually required despite its specific related adverse events. We describe a safe and alternative technique which allows both derivation of the portal and the caval blood flow by performing a lateral cavo-caval shunt using a prosthetic graft.

Keywords: Hepatic surgery; *ex-vivo*; liver transplantation (LT); major liver resection; cholangiocarcinoma

Received: 04 April 2018; Accepted: 09 April 2018; Published: 02 May 2018.

doi: 10.21037/tgh.2018.04.03

View this article at: <http://dx.doi.org/10.21037/tgh.2018.04.03>

Introduction

During liver transplantation (LT), inferior vena cava (IVC) conservation with “piggy-back” reconstruction (1) or latero-lateral anastomosis (2) has replaced the historic vena cava resection procedure (3) as it proved to be safer and provide better outcomes (4). Nevertheless, in some specific cases, the IVC must be resected. In those cases, especially if the complete caval clamping is not tolerate, an extra corporal veno-venous bypass (VVB) is mandatory. However, VVB could be responsible of severe adverse effects like pulmonary embolism, lung injury or coagulation disorder (5). Also, in extreme liver surgery cases the IVC may be resected.

Here we described an alternative method allowing the preservation of both IVC and portal blood flow without extracorporeal VVB, combining a cavo-caval shunt (with a prosthetic vascular graft) and a temporary porto-caval shunt (TPCS).

Case presentation

A 60-year-old woman presented with a huge intrahepatic cholangiocarcinoma. The tumor was considered unresectable due to infiltration of all vascular structures (i.e., the portal vein, the hepatic artery and the 3 hepatic veins).

The retrohepatic vena cava also had a very close contact with the tumor and was probably infiltrated (*Figure 1*). There was no extra hepatic tumoral localization and the patient’s clinical status was normal.

After discussion in multidisciplinary meeting, a neo-adjuvant treatment was decided associating systemic chemotherapy regimen (gemcitabine and cisplatin) and Yttrium-90 radioembolization (6). Despite a significant down staging, the tumor remained unresectable due to persistent vascular infiltration. Orthotropic liver transplantation (OLT) was then discussed as it may be the only potential curative treatment as we already reported (7). Due to persistent contact with IVC and as Yttrium-90 radioembolization is known to be responsible of inflammatory adherences between the retrohepatic IVC and the liver (8), the resection of the IVC was mandatory in order to achieve a safe R0 resection.

The OLT was performed with a graft discarded by all other transplantation team due to advanced donor’s age. The procedure started, like usual with liver pedicle dissection. A TPCS was then performed in order to preserve outflow of the splanchnic territory. The liver was partly mobilized with section of the right and left triangular ligament.

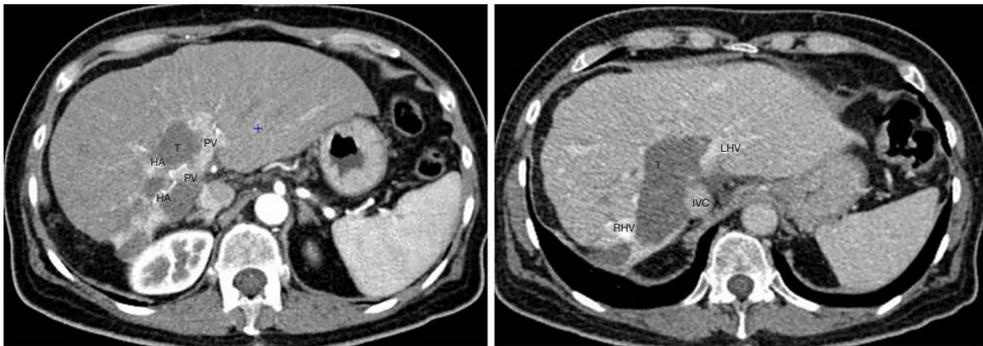


Figure 1 Unresectable cholangiocarcinoma infiltrating the hilar structures and the inferior vena cava. HA, hepatic artery; IVC, inferior vena cava; LHV, left hepatic vein; PV, portal vein; RHV, right hepatic vein; T, tumor.

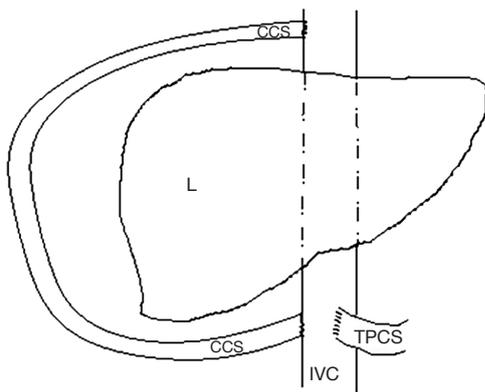


Figure 2 Derivation of the caval and portal blood flow using a latero-lateral cavo-caval shunt associated with a temporary porto-caval shunt. CCS, cavo-caval shunt; IVC, inferior vena cava; L, liver; TPCS, temporary porto-caval shunt.

The suprahepatic IVC was dissected and controlled below and above the liver. This step required a dissection of the cavo-atrial junction in order to get approximately 5 cm of free supra-hepatic IVC. A prosthetic vascular graft (GORE-TEX®) was then sutured on the lateral right flank of the IVC in order to perform a cavo-caval shunt between the infra-hepatic and the supra-hepatic IVC. The upper anastomosis was performed firstly, approximately 2 cm above the confluence of the hepatic veins with a partial lateral-clamping of the right flank of the IVC. The lower anastomosis was performed approximately 1 cm above the TPCS with a partial lateral-clamping of the right flank of the IVC (*Figure 2*).

The shunt was opened and the retrohepatic IVC could be safely cross-clamped and resected with the attached

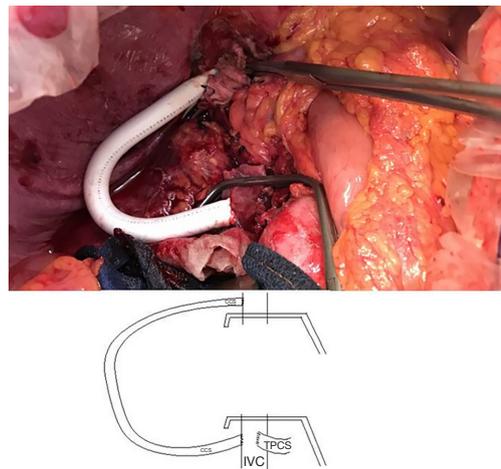


Figure 3 Latero-lateral cavo-caval shunt combined with temporary porto-caval shunt after native liver removal. CCS, cavo-caval shunt; IVC, inferior vena cava; TPCS, temporary porto-caval shunt.

liver (*Figure 3*). The liver graft could then be implanted orthotopically with an end-to-end caval anastomosis between the graft's and the recipient's IVC. After removing the TPCS, an end-to-end portal anastomosis was performed. The caval anastomosis was then unclamped and after ensuring of the absence of blood leakage, the shunt was sectioned with vascular stapler. After a total cold ischemic time of 7 hours, the liver was revascularized. No reperfusion syndrome was observed. The procedure was pursued with the arterial and the biliary anastomosis. Eventually, no transfusion was required.

The postoperative outcome was uneventful with normal graft function recovery. The length of stay in ICU lasted

3 days and the patient was discharged from the hospital at postoperative day 12 and is still doing well.

Discussion

During LT with IVC resection, a VVB is usually required in order to maintain hemodynamic stability (9) as well as abdominal organs function (10) and result in decreasing the early postoperative mortality (9). Here, we present a simple alternative procedure which avoids the use of an extracorporeal VVB while never interrupting the caval flow. Indeed, the association of a TPCS and a cavo-caval shunt using a prosthetic graft implanted laterally on the right flank of the IVC above and below the native liver allow both caval and portal blood flow to be maintained. No complications were observed during the procedure and no transfusion was required. Moreover, the flexibility of the prosthetic graft and its lateral implantation allow easy graft implantation and revascularization while maintaining the shunt. When it is no longer necessary, the shunt could be easily removed with a vascular stapler.

To our knowledge, this technique has never been reported and, in our opinion, could present several advantages compared to the classical VVB. Firstly, it avoids the necessity of a pump which is a costly procedure and usually required a specialized nurse for machine manipulation and surveillance. Secondly, it theoretically avoids occurrence of VVB related adverse events like acute pulmonary embolism (11,12), coagulation disorders or postoperative renal failure (13). Thirdly, it avoids potential additional incision required for cannulation of the femoral and axillary veins which could be responsible of wound infection or neurological damage (14). In our case, we did not observed specific adverse effects related to this procedure, however we must remain cautious as we only performed this procedure once.

Conclusions

In conclusion, when IVC resection is mandatory during liver surgery or transplantation, a temporary lateral cavo-caval shunt seem to be a safe method allowing maintenance of the caval flow and could be an alternative of the classical extracorporeal VVB.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent: Written informed consent was obtained from the patient for publication of this case report, accompanying images and any additional related information.

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doi: 10.21037/tgh.2018.04.03

Cite this article as: Rayar M, Levi Sandri GB, Blondeau M, Lakehal M, Desfourneaux V, Sulpice L, Meunier B, Boudjema K. Lateral cavo-caval shunt: an alternative veno-venous bypass in liver surgery. *Transl Gastroenterol Hepatol* 2018;3:23.