Take a deep dive into the business of transplantation!

2021 Digital Liver & Kidney Transplant Financial Bootcamp

February 26 - March 19, 2021

Access Online!

Register at ASTS.org/bootcamps

ASTS
American Society of Transplant Surgeons®

DOI: 10.1111/ajt.16301

Two surgical techniques are better than one: RAVAS and RAPID are answers for the same issue

To the Editor:

We thank the authors for their interest in our latest publication.[1,2] Liver transplantation (LT) for unresectable colorectal liver metastases (CRLM) has recently gained enthusiastic interest, as well as the RAPID technique proposed by Line et al.[3] RAPID and RAVAS techniques, although conceived to address unconventional indications for LT, are meant to be applied in different settings. RAVAS was conceived for patients with previous major liver surgery. In these patients, left lobectomy was deemed either not possible or unsafe, setting up the need for an alternative graft implantation site. Optimal venous outflow is paramount for liver regeneration in LT and the issue was addressed since the initial conception of the RAVAS technique.[4]

Our patient had undergone previous right hepatectomy (not suitable for RAPID) and he faced an initial graft dysfunction, related in our opinion to premature native hepatectomy, although we considered outflow impairment as a possible cause. Nevertheless, percutaneous liver biopsy performed after graft dysfunction diagnosis showed no signs of sinusoid congestion (Figure 1), and since the graft has progressively increased in size and improved in function, the hypothesis of suboptimal suprahepatic outflow was ruled out. Furthermore, Doppler ultrasound examination (Figure 1) showed optimal venous outflow during all the postoperative course. Nevertheless, measurement of hepatic venous pressure will be considered for the future cases.

We would like to add some considerations regarding the graft's venous outflow:

1. Although it is true that the IVC pressure slightly increases along with the distance from the right atrium, it is also true that IVC pressure is commonly considered to be lower in orthostatism compared to clinostatism, even if noninvasive measurements of the IVC metrics do not report significant changes;[5]

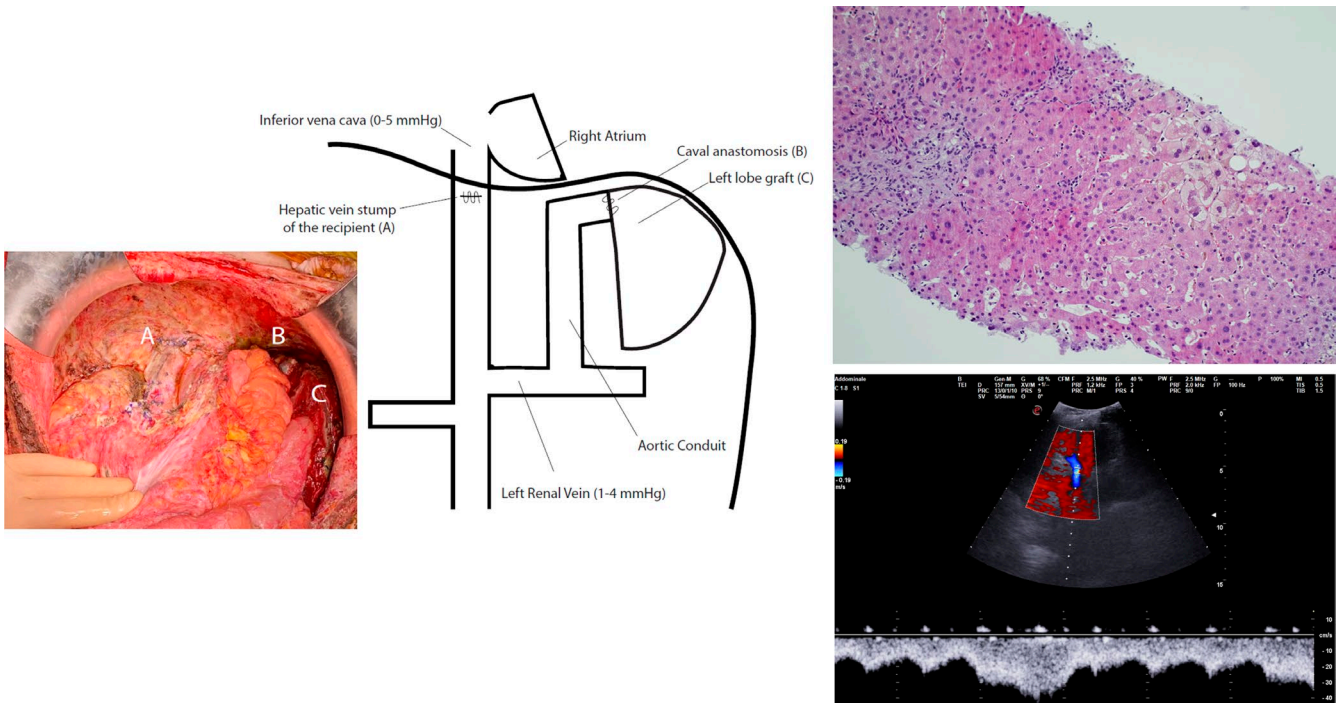

FIGURE 1 Theoretical hepatic venous pressure gradient; percutaneous large needle biopsy performed after graft impairment diagnosis, hematoxylin and eosin (H&E) stain liver biopsy shows a portal tract with mild inflammatory infiltration, and Doppler ultrasound of the suprahepatic vein. [Colour figure can be viewed at wileyonlinelibrary.com]

2. In heterotopic LT rodent models, no differences have been pointed out both in cases of suprahepatic or infrahepatic outflow reconstruction, and no signs of vascular congestion have been reported in cases where the infrahepatic IVC was used as the efferent vessel instead of the suprahepatic IVC;[6]
3. While it is true that the left renal vein is at a greater distance from the right atrium, the hydrostatic pressure within the graft efferent vessel itself needs also to be considered and the distance graft-to-renal vein subtracted from the atrium-to-renal vein distance; for this reason, the efferent vessel can be considered as if it was entering the IVC closer to the atrium (at spleen level), at a lower IVC pressure (Figure 1).

The reply argues that the long-term outcome will be unfavorable in case of Budd-Chiari syndrome development. However, our patient never developed ascites and is in good clinical condition one year after the procedure; also, other cases of heterotopic transplantation have been reported with favorable outcome and with a longer follow-up.[7]

Although this preliminary experience needs further refinements, we consider the RAVAS technique as a reasonable option in cases where the RAPID technique is not feasible due to previous surgery, expanding the possibility to transplant patients without disadvantage for other LT candidates.

KEYWORDS

clinical research/practice, liver (native) function/dysfunction, liver allograft function/dysfunction, liver disease, liver transplantation/hepatology, liver transplantation: auxiliary

DISCLOSURE

The authors of this manuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation*.

Matteo Ravaioli[1,2]
Guido Fallani[2]
Matteo Cerri[3]
Enrico Prosperi[2]
Carla Serra[1]
Antonia D'Errico[4]
Matteo Serenari[1]
Giuliana Germinario[1]
Matteo Renzulli[5]
Federico Contedini[6]
Federica Odaldi[1,2]
Lorenzo Maroni[1,2]
Antonio Siniscalchi[1]
Matteo Cescon[1,2]
Daniel Azoulay[7]

[1]*Department of General Surgery and Transplantation, Azienda Ospedaliero-Universitaria di Bologna, Bologna, Italy*
[2]*Department of General Surgery and Transplantation, Alma Mater, Bologna, Italy*
[3]*Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy*
[4]*Department of Pathology, S.Orsola-Malpighi Hospital, University of Bologna, Bologna, Italy*
[5]*Department of Experimental, Diagnostic and Specialty Medicine, S. Orsola-Malpighi University Hospital, Bologna, Italy*
[6]*Department of Plastic Surgery, S.Orsola- Malpighi Hospital, Bologna, Italy*
[7]*Department of Hepato-Biliary and Pancreatic Surgery and Liver Transplantation, AP-HP Paul Brousse Hospital, Villejuif, France*

Correspondence
Matteo Ravaioli
Emails: matteo.ravaioli@aosp.bo.it;matteo.ravaioli6@unibo.it

ORCID

Matteo Ravaioli https://orcid.org/0000-0001-5862-6151
Guido Fallani https://orcid.org/0000-0002-5774-7696
Matteo Cerri https://orcid.org/0000-0003-3556-305X
Enrico Prosperi https://orcid.org/0000-0002-9389-1812
Carla Serra https://orcid.org/0000-0001-5555-0745
Antonia D'Errico https://orcid.org/0000-0003-2747-3732
Matteo Serenari https://orcid.org/0000-0003-1471-8585
Giuliana Germinario https://orcid.org/0000-0002-8019-1956
Matteo Renzulli https://orcid.org/0000-0002-1311-5670
Federica Odaldi https://orcid.org/0000-0003-2910-2273
Lorenzo Maroni https://orcid.org/0000-0003-4195-3580
Antonio Siniscalchi https://orcid.org/0000-0002-2014-4680
Matteo Cescon https://orcid.org/0000-0003-1715-3794

REFERENCES

1. Rammohan A, Reddy MS, Line PD, et al. Heterotopic liver transplantation: temporary solution, permanent problem? [published online ahead of print August 17, 2020]. *Am J Transplant*. https://doi.org/10.1111/ajt.16271
2. Ravaioli M, Brandi G, Siniscalchi A, et al. Heterotopic segmental liver transplantation on splenic vessels after splenectomy with delayed native hepatectomy after graft regeneration: a new technique to enhance liver transplantation [published online ahead of print July 26, 2020]. *Am J Transplant*. https://doi.org/10.1111/ajt.16222
3. Line P-D, Hagness M, Berstad AE, et al. A novel concept for partial liver transplantation in nonresectable colorectal liver metastases: the RAPID concept. *Ann Surg*. 2015;262(1):e5–e9.
4. Ravaioli M, Fallani G, Cescon M, et al. Heterotopic auxiliary segment 2–3 liver transplantation with delayed total hepatectomy: new strategies for nonresectable colorectal liver metastases. *Surgery*. 2018;164(3):601–603.
5. Panebianco NL, Shofer F, Cheng A, et al. The effect of supine versus upright patient positioning on inferior vena cava metrics. *Am J Emerg Med*. 2014;32(11):1326–1329.
6. Kort WJ, Wolff ED, Eastham WN. Heterotopic auxiliary liver transplantation in rats. Use of the infrahepatic vena cava as the efferent vessel. *Transplantation*. 1971;12(6):415–420.
7. Azoulay D, Lahat E, Salloum C, et al. Heterotopic liver retransplantation for impossible former graft explantation. *Hepatology*. 2017;66(2):655–657.