



Placement of vein grafting in liver surgery at the time of the R1 vascular concept and the communicating veins

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Comment on: Terasaki F, Kaneoka Y, Maeda A, *et al.* The impact of standardized methods of hepatic vein reconstruction with an external iliac vein graft. *Hepatobiliary Surg Nutr* 2021;10:163-71.

Submitted May 25, 2022. Accepted for publication Jun 27, 2022.

doi: 10.21037/hbsn-2022-15

View this article at: <https://dx.doi.org/10.21037/hbsn-2022-15>

In the recent years, several development in liver surgery have contributed in increasing resectability while maintaining safety. Particularly parenchyma-sparing techniques are progressively gaining higher relevance as alternative to major hepatectomy for complex cases (1). Proceeding in this direction the provocative concept of parenchyma sparing major hepatectomies has been introduced (2). Sparing parenchyma in complex conditions means sparing liver tissue with adequate in- and outflow despite the disease involvement of the major intrahepatic vessel. Makuuchi *et al.* were the first who challenged the complexity in a parenchyma sparing perspective by profiting of the occasional presence of some anatomical favorable conditions as the accessory hepatic veins (3). Hemming *et al.* have shown that grafting an infiltrated hepatic vein to spare the parenchyma and expand the future liver remnant could be the solution: however, safety resulted inadequate (4). More recently Urbani *et al.* have reissued this modality showing more advanced solutions and better results in term of short-term outcome (5). Terasaki *et al.* have recently tried to standardize hepatic vein reconstruction utilizing external iliac vein (6). The authors reported 17 patients who underwent hepatic vein replacement in this modality. Long-term patency resulted exceeding 80%, no perioperative deaths were observed, and 24% major morbidity was reported with one reoperation due to graft acute occlusion. Mean blood loss exceeded 1,150 mL per patient with a third of them suffering a blood loss of more than 1,500 mL. For

sure patients received complex and sophisticated surgery and then these short-term results could be expected, as it was in the past. However, despite vein replacement, anyway still 24% (4/17) of patients had R1 surgery at pathology. Furthermore, just 24% had pathologically infiltrated hepatic vein wall: this means that the 3/4 of these patients could have potentially received a tumor-vessel detachment. On the other hand, Terasaki *et al.*, although never mentioning the tumor-vessel detachment as an option, left the reader with the doubt that tumor-vessel detachment was the solution in case of contact inferior to 50% of the vessel circumference and without vein compression. In the previous decade the R1vasc concept has been introduced (7,8), hypothesizing the oncological suitability of tumor vessel detachment. Long-term results were more than encouraging in terms of oncological suitability both for hepatocellular carcinoma (HCC) (9) and colorectal liver metastases (CLMs) (10). Focusing the attention to the liver out-flow R1vasc surgery for HCC at caval confluence was proposed as suitable in 2006 (7). More recently R1vasc surgery resulted suitable in most patients with CLM at caval confluence (11). However, another important actor playing a fundamental role for allowing advanced parenchyma sparing hepatectomies must be discussed. In 2010 we reported the first series showing that in case of tumor compressing or invading hepatic vein at caval confluence most patients showed communicating vein (CV) connecting the compressed or invaded vein with the adjacent one (12). The series recently reported

confirmed that CV together with r1vasc approach made possible to treat 99.3% of the patients with CLM at caval confluence in a parenchyma sparing approach (11).

Then from major hepatectomy, surgeons are resolutely moving to parenchyma sparing surgery also for complex tumor presentations. A path which started with the accessory veins, then moved to vein removal and grafting, and finally has arrived to R1vasc and CV. An armamentarium of findings, concepts and techniques developed with the common intent to spare parenchyma, maximize resectability, and improve safety. Cultural and technical background of resective and transplant surgery offer their solution aiming to keep the scaffold the first and grafting it the second. For sure rather than competing each other, the different attitude works better if assembled in a portfolio of choices to be adapted case by case. Personally, I think surgeon's priority should be to preserve, profiting of the oncological suitability of R1vasc and of the proven adaptation of the liver once the outflow is partially obstructed. Indeed, preserving the organ scaffold, other than featuring a higher safety, also increases the chance of salvageability in case of tumor relapse (13). From that, from ruling out the organ amputation, the intriguing chapter of the parenchyma sparing major hepatectomies has given birth (2). Parenchyma sparing since the architecture of the organ is maintained; major hepatectomy since anyway a consistent portion of liver tissue results removed. Conversely, in the event of conditions unsuitable for a parenchyma sparing approach grafting the vein could play the role of the last technical alternative to organ amputation. Terasaki *et al.* has had the merit to return visibility to this last approach and to try its standardization. However, the authors in their remarkable effort omit to disclose to the reader the remaining part of the herein recalled technical solutions, with the exception of the accessory vein, namely the inferior right hepatic vein. Inversely, debating on the different approaches would have provided to the manuscript that completeness of which is lacking. Indeed, the standardization of a modality, anyway not the only one, should benefit of a discussion of the pros & cons versus the alternatives. That, other than strengthening the reliability of the message itself, could have given to the reader the possibility of building his own opinion. An opinion that arguing on parenchyma sparing liver surgery could not neglect the progressively enlarging panorama of technical solutions, which, rather than amputating or replacing part of the liver scaffold, use this last as driver for providing interventions at least successful as the conventional major

hepatectomies or the vein grafting are.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Hepatobiliary Surgery and Nutrition*. The article did not undergo external peer review.

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at <https://hbsn.amegroups.com/article/view/10.21037/hbsn-2022-15/coif>). GT serves as an unpaid editorial board member of *Hepatobiliary Surgery and Nutrition*. The author has no other conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Torzilli G. Placement of vein grafting in liver surgery at the time of the R1 vascular concept and the communicating veins. *HepatoBiliary Surg Nutr* 2022;11(4):608-610. doi: 10.21037/hbsn-2022-15