Review Article

Tips and tricks for complex minimal-invasive pancreatic resection

Edoardo Rosso, Vito De Blasi, Abdel Sanoussi, Beniamino Pascotto, Virginy Poulain, Martine Goergen, Juan Santiago Azagra

Department of General, Mini-Invasive and Robotic Surgery, Centre Hôspitalier du Luxembourg, Luxembourg City, Luxembourg

Contributions: (I) Conception and design: E Rosso, V De Blasi; (II) Administrative support: None; (III) Provision of study materials or patients: E Rosso; (IV) Collection and assembly of data: A Sanoussi, B Pascotto, V Poulain, M Goergen; (V) Data analysis and interpretation: E Rosso, JS Azagra; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Edoardo Rosso, MD. Department of General, Mini-Invasive and Robotic Surgery, Centre Hôspitalier du Luxembourg, Luxembourg City, Luxembourg. Email: rosso.edoardo@chl.lu.

Abstract: Mini-invasive pancreatic resections (MIPS) are moving from rarely performed interventions to standard of care. MIPS are complex interventions which require optimal pre-operative planning and advanced mini-invasive skills. Anatomical variations are common and they require specific modification of the resection technique in view to avoid major post-operative complications. The most common anatomical variation is constituted by the presence of a right hepatic artery (RHA) originating from the superior mesenteric artery (SMA), in case, it is not an accessory branch its injury may cause right hepatic ischemia, due to is anatomical position the risk of injury during pancreaticoduodenectomy (PD) is high. Tumoral invasion or tight contact with the porto-mesenteric venous axis are frequent findings during pancreatic resection for cancer, in most of the cases, the pre-operative computed tomography (CT) scan and/or magnetic resonance imaging (MRI) show clearly the suspicion of venous invasion, however, the exact location and the real extent still be an intra-operative appreciation. Such situations increase, significantly, the complexity of the intervention and they should be approached in step-by-step way. Indeed, it is pivotal to achieve a complete control of the venous axis, before to attempt any dissection or resection of the porto-mesenteric venous axis. This article will report some useful tips and tricks to approach the above quoted intra-operative findings.

Keywords: Minimally invasive pancreatic resection; robotic pancreatic resection; right hepatic artery (RHA)

Received: 24 December 2021; Accepted: 15 March 2022; Published: 30 June 2022.

doi: 10.21037/dmr-21-104

View this article at: https://dx.doi.org/10.21037/dmr-21-104

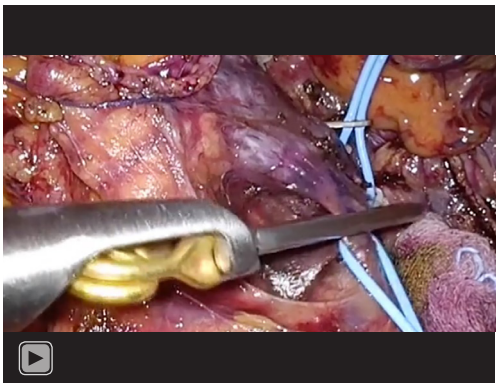
Background

Mini-invasive pancreatic resections (MIPS) are complex interventions due to several reasons such as: the frequent occurrence of arterial anatomical variations, the need for portal axis resection in case of venous invasion, the high risk of major bleeding during the resection phase, and the high level of suturing skills required in case a reconstruction phase is needed (1-5). The learning curve to safely achieve MIPS is long and difficult to achieve, however, a perfect planning of the intervention and the world-wide sharing of techniques through multimedia may allow to reduce the complexity of such type of interventions (1,2).

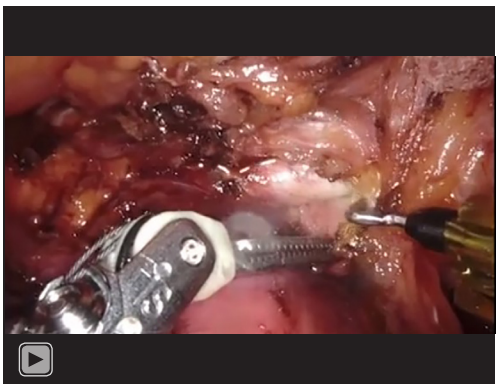
In the present manuscript we present different technical tips and tricks useful in some of the most difficult steps of resection phase during MIPS.

Pre-operative workout to plan the resection

The use of 3 phases angio computed tomography (CT) with vascular reconstructions and magnetic resonance (MR) are currently the basic standard investigations to detect anatomical variations, infiltration of the mesopancreas, and contact/invasion of peri-pancreatic organs (ex. portal



Video 1 Usefulness of pre-operative 3D reconstruction in case of rare venous anomaly.



Video 2 Robotic artery first management of a right hepatic artery coming from superior mesenteric artery.

system, stomach, colon, adrenal gland, etc.). Recently, 3D reconstruction and 3D printed models of the duodenal-pancreatic tract (6) are on the way to became a major advancement in preoperative planning of MIPS, indeed, they allow to obtain an improved visualization of the anatomical relationships between the organs and to "test" pre-operatively the best surgical strategy in details. Moreover, 3D reconstruction is useful in case of rare anatomical variations (*Video 1*).

Tips and tricks

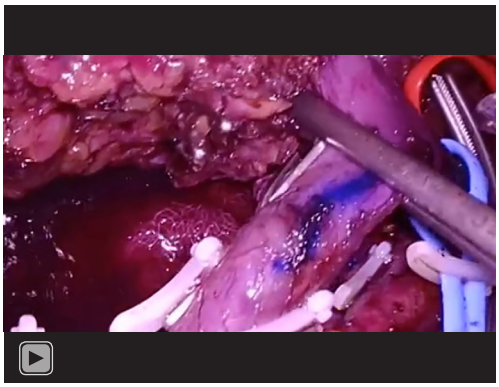
Sharing of technical experience through multimedia seems to be a modern and effective educational tool to reduce the length of learning curve and to push further the limits of MIPS giving to surgeons several different approaches to solve similar technical issues.

Artery first for right hepatic artery (RHA) from superior mesenteric artery (SMA) and common hepatic artery (CHA) from SMA

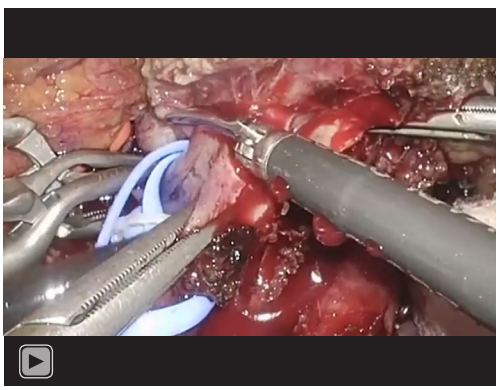
RHA is a common anatomical variation occurring between 14% and 34% of the cases, while CHA is rare variant, however, both of them share the same anatomical disposition and should be approached similarly (3). The first tip is to exclude, pre-operatively, tumoral invasion, indeed, due to the fact that they pass through the head of the pancreas along the way from the SMA to hepatic pedicle, they are frequently invaded in case of cancer of the head of the pancreas. In case of tumoral invasion, arterial resection and/or pre-operative embolization (for RHA) are required and in most of the case a simultaneous venous resection is needed; for such cases it should be considered to perform the pancreatic resection by laparotomy instead of MIPS. In absence of vascular invasion our trick is to approach the RHA and CHA using an artery first approach (7). The origin of SMA is identified at upper border of the left kidney vein and dissected on the adventitial plan from the aorta toward the mesentery till the origin of the RHA or CHA is visualized. Then the distal part of the RHA or CHA is identified and encircled with a vessel loop at the level of the right border of the hepatic pedicle. Finally, the RHA and CHA are completely freed from the surrounding tissue at the level of the posterior side of the head of the pancreas, the superior pancreatic artery (and gastro-duodenal artery in case of CHA) are divided between clips or ligature at their origins on the RHA or CHA (*Video 2*).

"Tumoral suspension" on the vein in case of venous invasion during pancreaticoduodenectomy (PD)

Clamping time, length and site (portal vein, mesenteric vein, porto-mesenteric vein junction) of venous resection and type of reconstruction are the main technical issues to be considered during venous resection during PD-MIPS. Our strategy for safe resection and to reduce the clamping time is to perform all the resection including the mesopancreas before clamping, the tumor is "suspended" on the vein consequently when the vein is divided the specimen is freed leaving a large field for easier and faster reconstruction (4,8-11). Practically an extended Kocher manoeuvre with complete mobilization of the colonic mesentery up to the Treitz is performed. The SMA is dissected as far as possible. Then all the lymphadenectomy is completed as well as



Video 3 An example of dissection of the portal vein after suspension of the area of tumoral contact.



Video 4 An example of "pancreatic Pringle maneuver" during a distal pancreatectomy with venous resection.

the division of the stomach, the jejunum at the Treitz, the gastroduodenal artery, the pancreatic neck and the bile duct are performed. Finally the mesopancreas is resected en-block using an anterior approach and following the SMA and the veins are encircled with vessel loops. At this stage of the intervention the venous axis can be clamped with bulldogs and the area of tumoral invasion can be freed (*Video 3*) or resected safely.

Pancreatic Pringle for portal vein resection during distal pancreatectomy (DP)

MIPS venous resection are more rare and complex in case of DP for three main raisons: (I) the persistence of the head of the pancreas after the resection reduce the length of vein that can be resected without using interposition graft for reconstruction (9); (II) not always is possible to suspend the tumor on the vein as for PD-MIPS due to the inaccessibility of the splenic artery in case of bulky tumor (12), and the difficult to manage the back bleeding from the splenic vein (SpV). A new useful trick to control the back bleeding after division of the portal axis is the pancreatic "Pringle": a tourniquet is passed at the level of the body of the pancreas in a way to include the pancreas and both the splenic artery and the SpV; at the time of the section of the pancreatic neck and of the portal vein, the Pringle is tight, such maneuver reduce dramatically the back bleeding allowing to complete the venous resection/reconstruction and to achive splenic artery division (*Video 4*).

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from all the patients for publication of this manuscript and accompanying videos. A copy of the written consent is available for review by the editorial office of this journal.

Conclusions

MIPS are gradually becoming the standard of care (2), however, they still be complex interventions. To reduce the complexity a perfect pre-operative planning of the intervention, including 3D reconstruction (and maybe 3D printing) seems necessary, moreover, each step of the operation should be planned and tips and tricks seems useful in case of difficult technical issue.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Digestive Medicine Research* for the series "Focus on Technical Advancement in Mini-invasive HPB Surgery". The article has undergone external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://dmr.amegroups.com/article/view/10.21037/dmr-21-104/coif). The series "Focus on Technical Advancement in Mini-invasive HPB Surgery" was commissioned by the editorial office without any funding or sponsorship. ER and JSA served as the unpaid Guest Editors of the series. ER serves

as an unpaid editorial board member of *Digestive Medicine Research* from September 2020 to August 2022. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are 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. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from all the patients for publication of this manuscript and accompanying videos. A copy of the written consent is available for review by the editorial office of this journal.

References

1. Miyasaka Y, Ohtsuka T, Nakamura M. Minimally invasive surgery for pancreatic cancer. Surg Today 2021;51:194-203.
2. Schwarz JL, Hogg ME. Current state of minimally invasive pancreatic surgery. J Surg Oncol 2021;123:1370-86.
3. El Amrani M, Pruvot FR, Truant S. Management of the right hepatic artery in pancreaticoduodenectomy: a systematic review. J Gastrointest Oncol 2016;7:298-305.
4. Rosso E, Zimmitti G, Iannelli A, et al. The 'TRIANGLE Operation' by Laparoscopy: Radical Pancreaticoduodenectomy with Major Vascular Resection for Borderline Resectable Pancreatic Head Cancer. Ann Surg Oncol 2020;27:1613-4.
5. Morales E, Zimmitti G, Codignola C, et al. Follow "the superior mesenteric artery": laparoscopic approach for total mesopancreas excision during pancreaticoduodenectomy. Surg Endosc 2019;33:4186-91.
6. Templin R, Tabriz N, Hoffmann M, et al. Case Report: Virtual and Interactive 3D Vascular Reconstruction Before Planned Pancreatic Head Resection and Complex Vascular Anatomy: A Bench-To-Bedside Transfer of New Visualization Techniques in Pancreatic Surgery. Front Surg 2020;7:38.
7. Zimmitti G, Manzoni A, Codignola C, et al. How to deal with replaced common hepatic artery during laparoscopic pancreaticoduodenectomy. Dig Med Res 2019;2:4.
8. Geers J, Topal H, Jaekers J, et al. 3D-laparoscopic pancreaticoduodenectomy with superior mesenteric or portal vein resection for pancreatic cancer. Surg Endosc 2020;34:5616-24.
9. Rosso E, Langella S, Addeo P, et al. A safe technique for radical antegrade modular pancreatosplenectomy with venous resection for pancreatic cancer. J Am Coll Surg 2013;217:e35-9.
10. Azagra JS, Rosso E, Pascotto B, et al. Real robotic total mesopancreas excision (TMpE) assisted by hanging manoeuver (HM): Standardised technique. Int J Med Robot 2021;17:e2259.
11. Addeo P, Rosso E, Fuchshuber P, et al. Resection of Borderline Resectable and Locally Advanced Pancreatic Adenocarcinomas after Neoadjuvant Chemotherapy. Oncology 2015;89:37-46.
12. Rosso E, Frey S, Zimmitti G, et al. Laparoscopic Radical Antegrade Modular Pancreatosplenectomy with Vascular Resection for Pancreatic Cancer: Tips and Tricks. J Gastrointest Surg 2020;24:2896-902.

doi: 10.21037/dmr-21-104
Cite this article as: Rosso E, De Blasi V, Sanoussi A, Pascotto B, Poulain V, Goergen M, Azagra JS. Tips and tricks for complex minimal-invasive pancreatic resection. Dig Med Res 2022;5:36.