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 mesopancreases, and contact/invasion of peri-pancreatic organs (ex. portal
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...
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 achieve 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.

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