

# Technique of “mini-invasive radical antegrade modular pancreateosplenectomy” for pancreatic cancer

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**Abstract:** Pancreatic cancer spreads preferentially into the retroportal lamina that is frequently invaded at the celiac trunk (CT) and/or superior mesenteric artery (SMA) margins. In 2007, for the first time, it has been proposed by the team of Prof. Strasberg SM an innovative surgical technique for open surgery called radical antegrade modular pancreateosplenectomy (RAMPS) which allows to increase the circumferential resection margins in case of pancreatic cancer of the body of the pancreas and it is associated to a high rate of R0 resection. Currently, it is possible to perform such intervention mini-invasively. The present manuscript reports our technique.

**Keywords:** Pancreatic cancer; laparoscopic; radical antegrade modular pancreateosplenectomy (RAMPS); pancreateosplenectomy

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## Introduction

The main purpose of surgical resection for pancreatic cancer is to obtain an R0 resection at each pancreatic surgical margin (1-5). Only recently, it has been shown by Verbaicke (1-5) that the most frequently invaded margin is the retro-portal one, therefore to surgeons need to concentrate their efforts on peri-adventitial dissection around the superior mesenteric artery (SMA) and celiac trunk (CT) in order to remove *en-block* with the pancreatic cancer the retro-portal lamina.

In case of pancreas cancer located in the body and the tail of the pancreas, Prof. Strasberg described in 2007 (6) an original technique, for open surgery, called radical antegrade modular pancreateosplenectomy (RAMPS). Such technique, differently from the standard left spleno pancreatectomy, includes: (I) an extensive dissection around the CT and SMA, (II) and the extension of the poster pancreatic margin at the Gerota fascia increasing the circumferential margin. Several studies confirmed that RAMPS allows to obtain a high rate of R0 resection (7,8).

Currently, it is possible to perform RAMPS laparoscopically

or robotically, hereby you we reported our technique described step by step with the assistance of shorts videos (9-12).

## Step by step approach to RAMPS

During laparoscopic RAMPS, we usually use 6 to 7 trocars: the camera is inserted in the abdomen through a supraumbilical 10 mm trocar, further 10 mm trocars are inserted para-rectal right and left, slightly higher than the previous one. Additional 5 mm trocars are inserted in the right and left abdomen, lateral to the previous ones, and below the xiphoid process. A final 10 mm trocar is inserted between the two left trocars previously placed.

Following abdominal cavity exploration, after the presence of peritoneal carcinosis or metastases at the glissonean surface have been excluded, the operation starts with the dissection of the gastrocolic ligament, keeping the omentum attached to the transverse colon and carefully preserving the gastroepiploic vessels on the greater curvature. Retrogastric adhesions with the pancreas are dissected, from left to right, moving towards the posterior wall of the gastric antrum.



**Figure 1** Standard laparoscopic anterior RAMPS (13). RAMPS, radical antegrade modular pancreatectomy.

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**Figure 2** Venous resection in case of posterior RAMPS (14). RAMPS, radical antegrade modular pancreatectomy.

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At this point the gastroduodenal artery is identified on the left side of the duodenum and dissected upwards until its origin from the common hepatic artery (CHA). When the anterior wall of the pancreatic isthmus is fully exposed, a laparoscopic ultrasound is performed in order to better identify the tumor, assess its relation with close structures, and identify peritumoral lymphadenopathies or tumor infiltration of the retropancreatic fat tissue.

The operation continues with careful dissection of the caudal border of the pancreas from the transverse mesocolic root, at the pancreatic isthmus, until identifying the superior mesenteric vein (SMV). At this point, the CHA is identified, dissected, and encircled with an elastic tape at the superior margin of the pancreatic isthmus. Such dissection is extended to right, with dissection and elastic tape encircling of the proper hepatic artery (PHA), behind

which the portal vein (PV) is identified.

Once the retropancreatic space is carefully dissected and the pancreas is encircled at the isthmus, the tissue at the left side of the hepatic pedicle is dissected free from the PHA and from the PV and pulled to the left. The dissection continues left, until identification and transection of the left gastric vein and identification, dissection, and encircling of the left gastric artery and splenic artery (SA) at the origin from the CT. The SA is then ligated but not transected.

The dissection moves now below the transverse mesocolon: the Treitz ligament is identified and dissected below the inferior mesenteric vein (IMV), until fully mobilization of the first jejunal loop and exposure of the anterior aortic wall. The dissection continues inframesocolic, above the IMV, until the left renal vein (LRV) is identified. The IMV transection allows now a complete exposure of the anterior wall of the LRV at its origin: it represents an important landmark for the identification of the left side of the SMA. Here, the SMA is encircled with an elastic tape and dissected free, upwards and downwards, from the surrounding tissue which will be removed *en-bloc* with the specimen.

The dissection of the inferior pancreatic margin is then continued to the left and deep, in order to remove the perirenal fat, with the exposure of the left renal capsule of the superior renal half. According to the tumor posterior extension, the left adrenal gland can be left in place (anterior RAMPS) (*Figure 1*) or, in case of tumor contact/infiltration, removed (posterior RAMPS) (*Figure 2*), following left adrenal vein closure and transection. The operation continues with the transection of the short gastric vessels and the complete separation of the stomach from the spleen.

The dissection moves back to the CT, whose left side is dissected upwards until its origin from the aorta. The SA, previously ligated, is now transected. Completing the dissection of the CHA from the pancreas, the presence of a dorsal pancreatic artery needs to be sought: its ligation and transection are mandatory, in order to achieve a complete lymphadenectomy of left side of the hepatic pedicle. The dissection moves now at the inferior pancreatic margin, where the SMA, while pulled to the left, is carefully dissected free at its anterior-right side from the retropancreatic lamina. During this maneuver, the retropancreatic tissue is dissected upward from the origin of the SMA, until the anterior aortic wall between the CT and the SMA is fully exposed.

The pancreas is then transected at the isthmus through an Endo Gia black reload tri-staple reload: prefiring pancreatic compression is used during transection, in order to minimize traumatism to pancreatic capsule and

parenchyma. The splenic vein transection at the confluence with the SMV is performed with an Endo GIA vascular reload and is followed by the pancreatic body and tail mobilization from the posterior plane and the dissection of the splenic peritoneal connections. Finally, the mobilized specimen is extracted with an endobag through a Pfannenstiel incision, the hemostasis checked, and two drains are placed: one close to the pancreatic stump and the other in splenic space.

### Post-operative care

Patients are allowed to drink from the first post-operative day (POD), oral re-alimentation is introduced gradually from the POD 2. Amylase are measured in the drains on POD 1, 3 and 5, which are removed on POD 5 in absence of pancreatic fistula (PF), however, if PF occurs, the drains are kept in place and eventually replaced by percutaneous pig tail according to the finding of post-operative CT scan, and they are gradually removed in outpatient clinics.

Oral pancreatic enzymes are administered systematically for at least 3 months. Post-operative persistent diarrhea occurs frequently and is treated with oral loperamide at escalating doses, the patients are closely monitored in combination with a nutritionist to prevent malnutrition till the improvement of diarrhea (usually between for 4 to 8 weeks).

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### Footnote

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manuscript and any accompanying images.

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