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Bachelier, D. Jaeck

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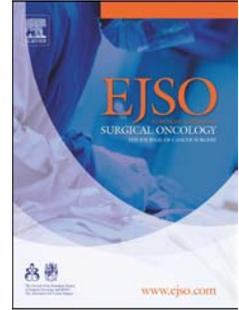
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Authors: P. Pessaux, E. Rosso, F. Panaro, E. Marzano, E. Oussoultzoglou, P. Bachellier, D. Jaeck



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Preliminary experience with the hanging maneuver for pancreaticoduodenectomy

PESSAUX P., MD, PhD, ROSSO E., MD, PANARO F., MD, PhD, MARZANO E., MD,
OUSSOULTZOGLOU E., MD, BACHELLIER P., MD, JAECK D., MD, PhD, FRCS
Centre de Chirurgie Viscérale et de Transplantation - Hôpital de Hautepierre, Hôpitaux
Universitaires de Strasbourg, Avenue Molière, 67098 STRASBOURG Cedex, France.

Conflict of interest

The authors declare that they have no conflict of interest.

Mailing address for correspondence:

Professeur Patrick PESSAUX

Centre de Chirurgie Viscérale et de Transplantation, Hôpital de Hautepierre

Hôpitaux Universitaires de Strasbourg – Université Louis Pasteur

Avenue Molière, 67200 Strasbourg, France.

Tel: +33 3 88 12 72 58, Fax: +33 3 88 12 72 86,

E-mail: patrick.pessaux@chru-strasbourg.fr

Abstract:

Background: Malignant periaampullary tumours often invade retroperitoneal peripancreatic tissues and a positive resection margin following pancreaticoduodenectomy (PD) is associated with a poor survival. The margin most frequently invaded is the retroperitoneal margin (RM). Among the different steps of PD one of the most difficult and less codified is the resection of the RM with high risk of bleeding. We have developed a surgical technique – “Hanging maneuver” – which allows at the same time a standardization of this step, a complete resection of the RM, and an optimal control of bleeding.

Patients/Methods: We described the surgical technique, and we reported our preliminary experience. Surgical data, postoperative outcome and pathological results of patients submitted to PD for pancreatic carcinoma using “Hanging maneuver” technique between January 2007 and December 2007 were reviewed.

Results: The Hanging maneuver was performed in 20 patients without any intra-operative complication and massive bleeding. No patient required blood transfusion. After had inked the surgical margins, retroperitoneal peripancreatic tissue was invaded in 12 out of 17 patients with malignant diseases (70.5%). In only one case (6%), the retroperitoneal margin was involved by the tumour (R1 resection).

Conclusion: The “hanging maneuver” is a useful and safe technical variant and should be considered in the armamentarium of the pancreatic surgeons in order to achieve negative retroperitoneal margins.

Key-words: pancreaticoduodenectomy, retroperitoneal margin, maneuver, Whipple, carcinoma, superior mesenteric artery.

Introduction

The poor prognosis associated with pancreatic carcinoma has been attributed to early lymph node involvement as well as to distant metastases [1,2]. In case of pancreatic head cancer, curative pancreaticoduodenectomy (PD) is still the only treatment offering a hope of longterm survival [1-3]. Malignant periampullary tumours often invade the retroperitoneal peripancreatic tissues and microscopic positive resection margin (R1 resection) following PD is associated with a poor survival [3,4]. The retroperitoneal margin is the most frequently invaded, resulting in R1 resection of PD in about 20% [3,5]. The retroperitoneal peripancreatic tissue surrounds the first 3 to 4 cm of the superior mesenteric artery (SMA) origin behind the superior mesenteric vein (SMV) [3-7]. Recently Gockel et al.[8] has defined this anatomical structure as “mesopancreas” similarly to the mesorectum. Therefore, PD with curative intent should include complete clearance of the peripancreatic retroperitoneal tissue which represents the most difficult and less codified step of PD with high risk of intraoperative bleeding. We here described a surgical technique called “Hanging maneuver” which allows a standardization and a complete resection of the retroperitoneal tissue, and an optimal control of bleeding.

Methods

Surgical Technique

After a bilateral subcostal incision, the resectability of a periampullary tumour is confirmed by an examination of the abdominal cavity. A resection procedure will be contraindicated in case of liver metastases or peritoneal carcinomatosis. The duodenum is mobilized with an extensive Kocher maneuver starting superiorly from the inferior border of the Winslow foramen, and continuing downward along the posterior plane to the Treitz fascia in order to include all the tissues covering the inferior vena cava and the left renal vein. The Kocher maneuver is extended to the left border of the aorta allowing a good exposure of the aorto-caval area. The lymphadenectomy of the inter-aorto-caval space is performed and sent for frozen section. The presence of inter-aorto-caval lymph node metastases (group 15-16) constitutes a contra-indication to PD [9]. The origin of the SMA is exposed at the point where the left renal vein crosses the aorta as previously reported [10]. The dissection of SMA continues

along the plane of the adventitia up to the junction of the third and fourth parts of the duodenum. This dissection allows identifying and preserving a possible right hepatic artery (figure 1). The greater omentum is then separated from the transverse colon. The SMV is dissected free in the area where the SMV is crossing anteriorly the third part of the duodenum by ligating and dividing all the tributaries to the head of the pancreas. The SMV is retracted with a eyelid ophthalmic retractor and the SMA is identified. In case of SMA invasion the PD is not performed. A smooth right-angle dissector is passed along the SMA from its origin on the aorta up to its emergence in the mesentery (figure 2a). A tape is seized with the right-angle and passed around the retroperitoneal peripancreatic tissue (figure 2b-c). A regional lymphadenectomy is carried out including lymphatic and perineural tissues of the hepatoduodenal ligament, as well as around the common hepatic artery, the celiac axis, and the SMA. The gastroduodenal artery is double ligated and divided after a clamping test. The stomach and the proximal jejunum are divided as in a standard Whipple PD. At this time the assistant lifts upward the tape exposing the retro-portal lamina (so-called “Hanging maneuver”) facilitating the dissection of the retroperitoneal peripancreatic tissue from the SMA (figure 3). Bleeding may be easily controlled by further lifting of the tape leaving to the surgeon both hands free for selective and definitive haemostasis with fine sutures. At this stage, the posterior wall of the portal vein (PV) and the SMV are exposed and venous invasion can be easily recognized. In such case the neck of the pancreas is divided using a surgical blade leaving the specimen attached to the PV only. Venous resection can be achieved with a short clamping time and reconstructed with an end-to-end without any graft [11-12]. In absence of venous invasion the inferior pancreaticoduodenal veins and all the small tributaries to the PV are ligated individually and the neck of the pancreas is cut at the end of the procedure. The gastrointestinal continuity is reconstructed by a pancreatogastrostomy, an end-to-side hepaticojejunostomy, and an end-to-side gastrojejunostomy [13].

Results

Pathological findings

Between January 2007 and December 2007, twenty patients underwent PD with dissection of the retroperitoneal peripancreatic tissue using the Hanging maneuver for preoperative suspicion of carcinoma. At the definitive pathology, 17 patients had malignant diseases (adenocarcinoma in 15 patients, endocrine tumour in 2 patients), and the others 3 patients had non-invasive intraductal papillary and mucinous neoplasm. A right hepatic artery was identified and preserved in three patients. Three patients underwent PD with PV resection with an average clamping time of 19 minutes (ranges: 14 – 23 minutes). Definitive pathological reports showed lymph nodes metastases in 70.5% (12/17) of the patients. The average number of lymph nodes examined for each patient was 17 (ranges: 7 - 34). The average number of metastatic lymph nodes was 3 (ranges: 1 - 7). After had inked the surgical margins, retroperitoneal peripancreatic tissue was invaded in 12 out of 17 patients with malignant diseases (70.5%). In only one case (6%), the retroperitoneal margin was involved by the tumour (R1 resection). In Patients with retroperitoneal involvement (n=12), 3 had no lymph node involvement (pT2N0:n=1 and pT3N0:n=2). In contrast, in Patients without retroperitoneal involvement (n=5), 3 had lymph node involvement (pT2N1:n=1 and pT3N1:n=2). The mean lower distance between the border of the tumour invading the retroperitoneal peripancreatic tissue and the external resection margins was 2.75 mm (ranges: 0.5 mm to 7 mm). The duodenal, pancreatic, and bile duct cut edges were free from tumour in all specimens, therefore 94 % of the patients underwent a R0 resection.

Postoperative outcome

The Hanging maneuver was feasible in all 20 patients without any intra-operative complication and massive bleeding (mean blood loss: 760 ml). No patient required blood transfusion. Five patients developed a transitory (< 3 months) postoperative diarrhoea controlled by medical treatment (< 4 bowel movements per day).

Discussion

The Hanging maneuver is feasible, safe, and provides a complete retroperitoneal tissue resection. The retroperitoneal peripancreatic tissues is often invaded at the time of PD resulting in R1 resection with dismal survival [3,6,7]. It is of utmost importance to remove “enbloc” together with the

head of the pancreas all the retroperitoneal peripancreatic tissue, anterior to the inferior vena cava and the left renal vein, in order to increase the number of R0 resections to extend the circumferential resection margins [4,7,14].

R0 resection

Identification and complete resection of the retroperitoneal tissue is difficult due to its anatomical localization behind the mesenterico-portal confluence, and the occurrence of bleeding from small branches of the SMA during dissection. Such conditions may lead to incomplete resection and bleeding. The Hanging maneuver, completely different from an extended lymphadenectomy, is a simple technique achieving an optimal resection of the retroperitoneal tissue. Indeed, randomized studies comparing standard versus extended lymphadenectomy PD showed no difference in patient overall survival [5,15]. However, such conclusion should be cautiously regarded as they showed following an extended lymphadenectomy a trend toward an improved survival mainly explained by the lower rate of positive resection margins (5% versus 21%) [5]. The present approach provides a definitive control of the retroperitoneal margin along the SMA to reduce the R1 resection rate without increase the operative time and the postoperative morbidity. In our experience, this approach decreased the rate of positive retroperitoneal margin (6%) compared with our previous series where the rate of R1 resection was about 18% [12,16]. Up to date, we have no data about the long-term survival.

Technical advantages

The hanging maneuver, described by Belghiti et al [17]. for liver resection, offers during the PD several advantages over the classical technique which consists to keep the left hand behind the pancreatic head to feel the SMA and to control bleeding. These advantages include: 1) first, early dissection of the SMA over 2 to 3 cm from its origin on the aorta identifying immediately an arterial invasion which contraindicate a non curative resection (R1 or R2 resection); moreover, it allows the identification and preservation of a right hepatic artery. 2) Second, the “hanging maneuver” allows a complete resection of the retroperitoneal peripancreatic tissue. In fact, the traction on the tape pulls the retroperitoneal peripancreatic tissue on the side resulting in a better exposure of the SMA facilitating the dissection of the origin of all the small proximal arterial branches of the SMA. 3) Third, in case of

bleeding a temporary haemostasis can be achieved by asking to the assistant to lift up the tape: in such way both hands of the surgeon are free to achieve a selective and definitive haemostasis. 4) Fourth, in the presence of a venous invasion the combination of the hanging maneuver, early section of the pancreatic neck, stomach, jejunum, and biliary duct leaves the tumour attached exclusively to the invaded vein performing a short clamping time and an easier resection/reconstruction of the mesenterico-portal confluence without any need for mesenterico-caval shunt. 5) Finally, the “hanging maneuver” provides a combined anterior and posterior approach of the SMA which is particularly useful in obese patient in whom a retroperitoneal tissue resection could be very difficult by a posterior approach alone [10].

Conclusions

This approach should be considered as an alternative to a routine procedure during PD. In our practice, we recommend particularly this approach in patients presenting preoperative suspicion of SMA involvement, those receiving neoadjuvant therapies for locally advanced disease, and in patients with a right hepatic artery arising from the SMA. Finally, this technique can be applied to train surgeons and help to standardize the resection procedure. These arguments constitute a clear justification to promote in selected patients this approach in order to achieve negative retroperitoneal margins. The “hanging maneuver” is a useful and safe technical variant and should be considered in the armamentarium of the pancreatic surgeons.

Conflict of interest

The authors state that they have no conflict of interest.

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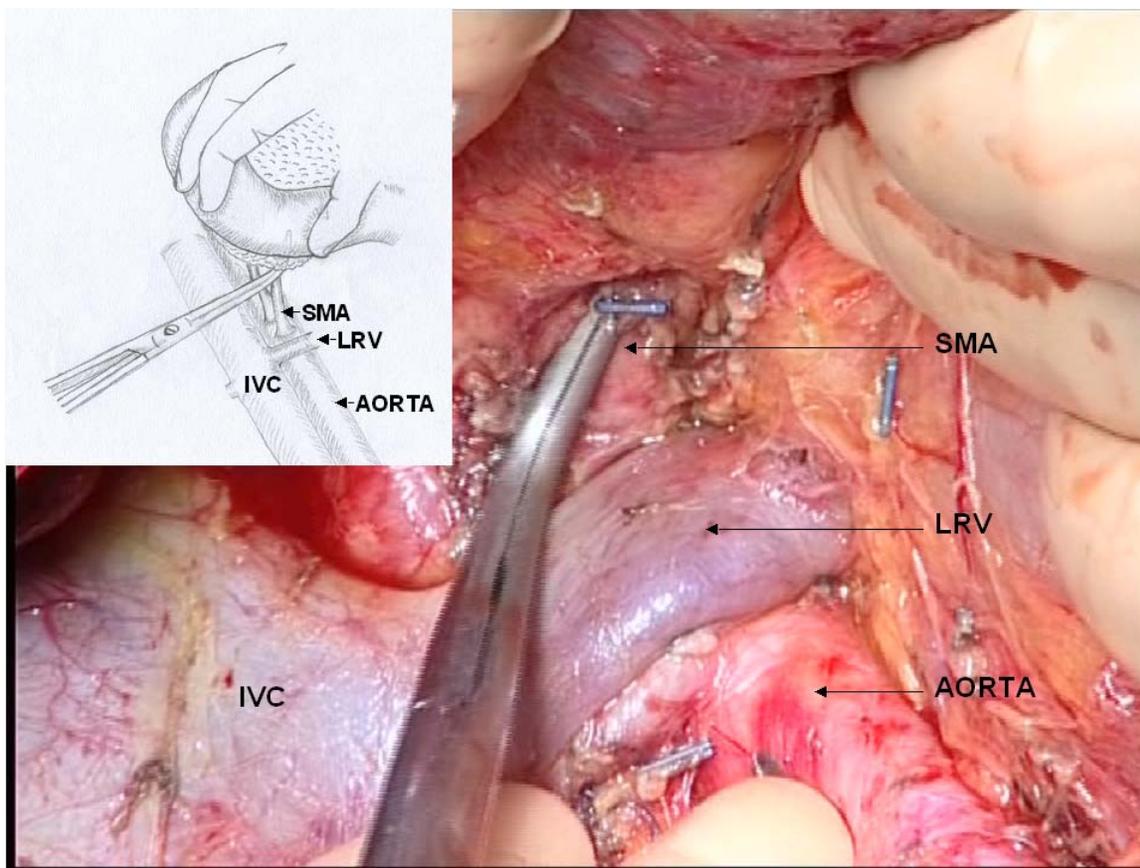
Figure 1. Intraoperative view of the origin of the SMA above the Left Renal Vein. A large right angle is passed along plane of the SMA. In the upper left corner a schematic representation of the manoeuvre. SMA: superior mesenteric artery, SMV: superior mesenteric vein, IVC: inferior vena cava, LRV: Left Renal Vein

Figure 2. 2a Creation of a tunnel along the SMA from its origin up to its exist in the mesentery.

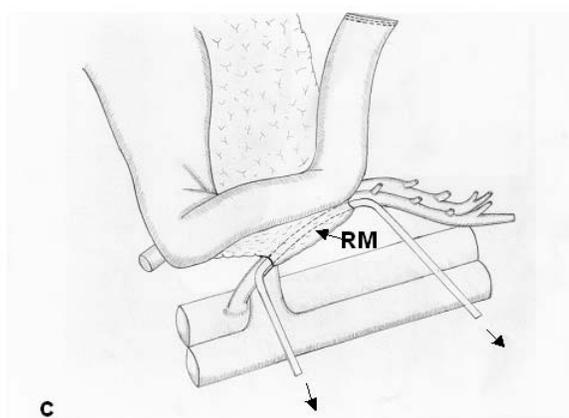
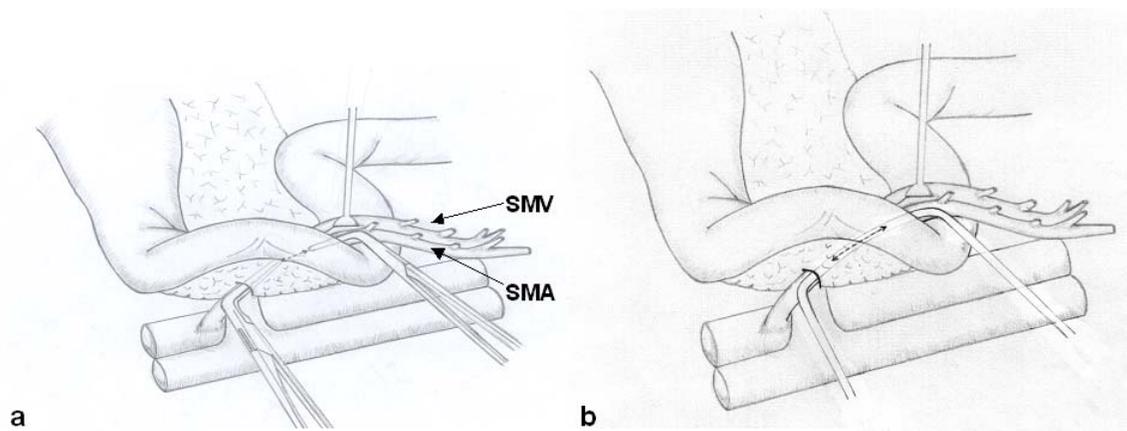
2b A tape is seized with the right-angled and passed around the RM. 2c Final view of the RM after division of the proximal jejunum by performing the hanging maneuver lifting up the tape. SMA: superior mesenteric artery, SMV: superior mesenteric vein, RM: retroperitoneal margin.

Figure 3. Intraoperative view of the dissection of the RM adopting the hanging maneuver. In lower right corner a schematic representation of the above photo. RM: retroperitoneal margin, SMA: superior mesenteric artery, SMV: superior mesenteric vein.

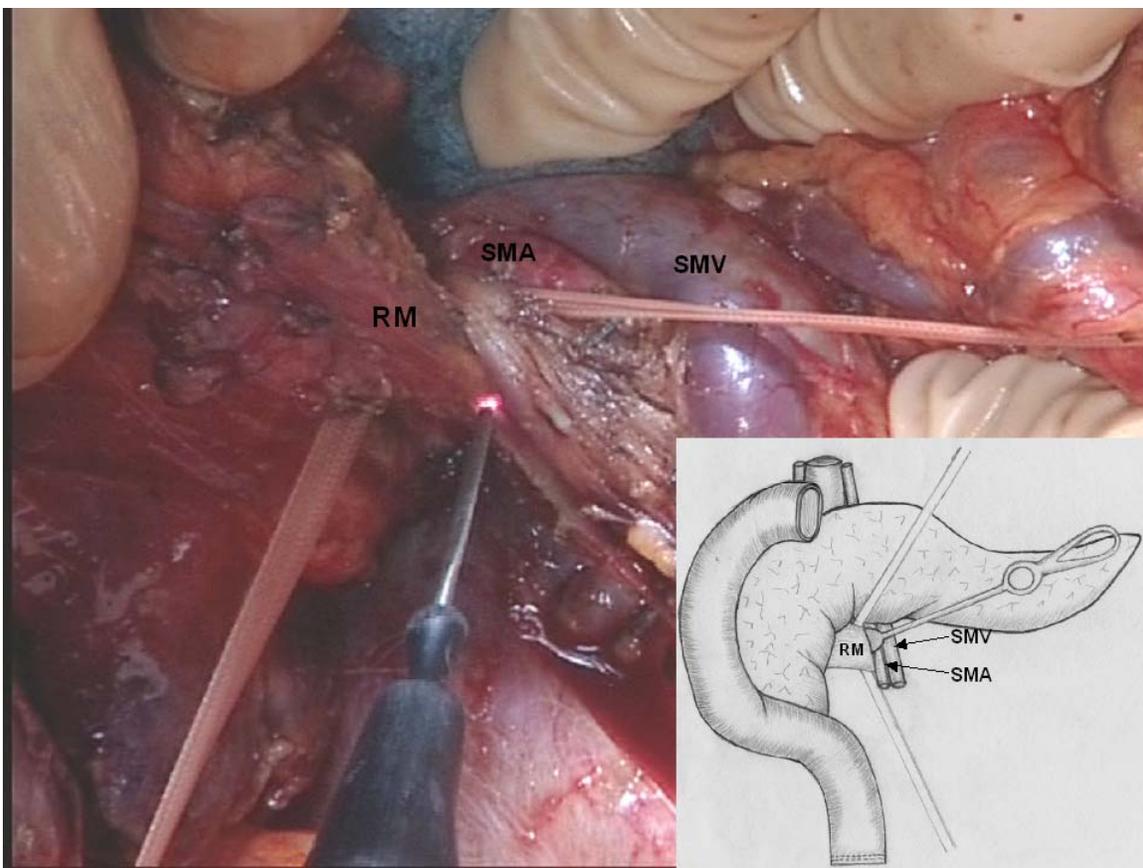
Figure 4. Intraoperative view after the specimen resection. SMA: superior mesenteric artery, SMV: superior mesenteric vein, CT: celiac trunk, IVC: inferior vena cava, LRV: Left Renal Vein



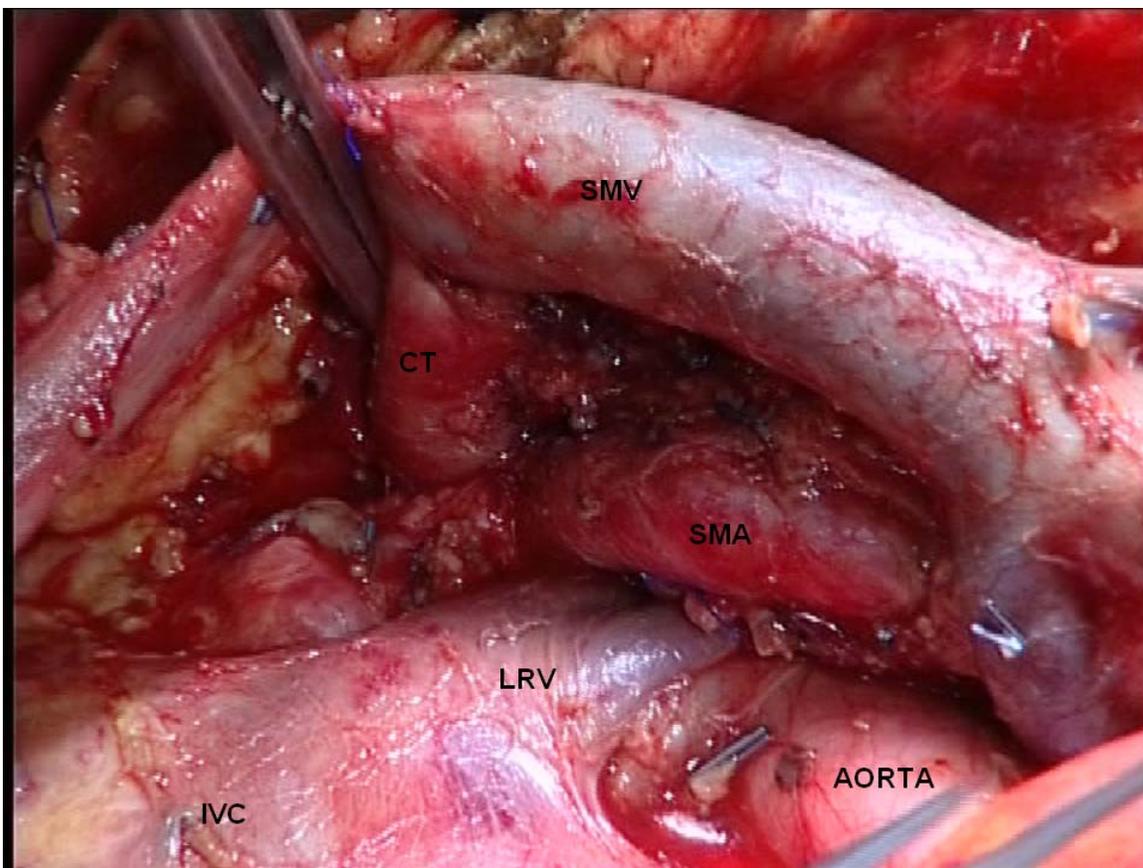
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