Colon Cancer: Multivisceral Resection

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15.1 Introduction

Up to 10% of primary colon cancers are attached to adjacent organs or other anatomical structures. True invasion, however, occurs in approximately 50%, with the remaining cases secondary to adhesions from tumour-related inflammation and contained tumour perforation. The most commonly involved organs and structures include small bowel, urinary bladder and abdominal wall. The sigmoid colon is the most common primary tumour site with advanced disease [1]. Organs less commonly involved with locally invasive colon cancer are the liver, spleen, pancreas, stomach and gallbladder. Nevertheless, when a structure in the abdomen is involved with the primary tumour, regardless of the anatomical site, it must be included *en bloc* with the primary specimen. Attempts to "reduce" radicality by shaving off adherent structures from the primary tumour are likely to result in a palliative situation. Situations involving an R1 (microscopically positive margins) resection, even when subsequent resection is planned, are associated with significantly higher risks of local recurrence including peritoneal carcinomatosis. Local residual cancer (R1, 2 resection) is a significant predictor of survival, with a median survival of 12 months [2–4]. This applies not only to local recurrence but also to distant metastases [5].

Apart from the role of multivisceral resection for primary colon tumours, these complex operations may also be needed to cure patients from local recurrences and occur in 5–20% of patients. Operative indications depend heavily on the stage and biology of the primary tumour [5]. All cases should be staged appropriately preoperatively with imaging and endoscopy and neoadjuvant treatment discussed whether it be chemotherapy or radiation.

15.2 Preoperative and Intraoperative Management

All patients are given mechanical bowel preparation. The use of oral antibiotics and perioperative intravenous antibiotic prophylaxis depends largely on local guideline parameters. All patients are marked preoperatively by a stoma nurse if faecal diversion is required.

The positioning of the patient depends on the site of the tumour. However, in cases of locally advanced, metastatic or recurrent cancer, the modified lithotomy position allows easy access for intraoperative colonoscopy, transanal stapling and positioning of the surgeon to evaluate the upper abdomen and diaphragms with relative ease.

15.3 Operative Procedure

A long midline incision provides ideal exposure for multivisceral resection in the setting of colon cancer. The role of diagnostic laparoscopy to assess the burden of metastatic disease should be discussed preoperatively to avoid the morbidity of a laparotomy incision. Upon entering the peritoneal cavity, the abdomen should be thoroughly inspected for metastatic disease. The liver is the most common site of distal spread and if the metastatic disease is resectable, this is not a contraindication to multivisceral resection. Peritoneal metastases need special considerations as they indicate poor prognosis. If multivisceral resection is to be performed, the options of hyperthermic intraperitoneal chemotherapy (HIPEC) and systemic chemotherapy have to be weighed against this deci-

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sion. Recent randomised prospective data have shown less of a role for HIPEC compared with adequate cytoreduction alone in the setting of peritoneal carcinomatosis of colorectal origin [6]. It should also be noted that patient age and invasion of the pancreas will increase the risk of postoperative complications and mortality [7]. Intraoperative incisional biopsies to prove invasion of adjacent structures in order to justify multivisceral resections must be strictly avoided.

Sharp dissection following the anatomical and embryological planes without blunt separation of any structures is key in multivisceral resections. Both medial-to-lateral and lateral-to-medial techniques are appropriate. During these procedures, gentle traction and counter-traction must be applied at all times to identify the correct incision line and to avoid tearing of the tumour itself (see Fig. 15.3). If one of these planes is suspected to be involved, the adjacent organ or structure must be included in the specimen (see Figs. 15.7 and 15.8). As a principle, if a multivisceral resection is needed, the primary tumour should not be approached initially. The surrounding uninvolved organs should be dis-

Figures. 15.1 and 15.2

Bulky tumour of the splenic flexure (1) invading the pancreas (2) and the stomach (3). Intraoperative exploration showed invasion of the duodenojejunal junction and anterior perirenal capsule as well

sected and isolated first (see Fig. 15.4). Subsequently, the relevant vessels supplying the organs involved or belonging to the regional lymphatic drainage are dissected and identified with vessel loops and divided as necessary (see Figs. 15.9, 15.10, 15.13). These measures reduce the risk of postoperative bleeding and delineate the blood supply of the organs to be resected but also of those to be preserved. Finally, this step is also crucial for assessing adequate blood supply to an anastomosis.

15.4 Case Presentation

The operative principles of multivisceral resection will be demonstrated by the following case involving a locally advanced carcinoma of the splenic flexure, invading the distal pancreas, stomach, duodeno-jejunal junction and renal capsule (Figs. 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8, 15.9, 15.10, 15.11, 15.12, 15.13, 15.14, 15.15, 15.16, 15.17, and 15.18).

Figure 15.1

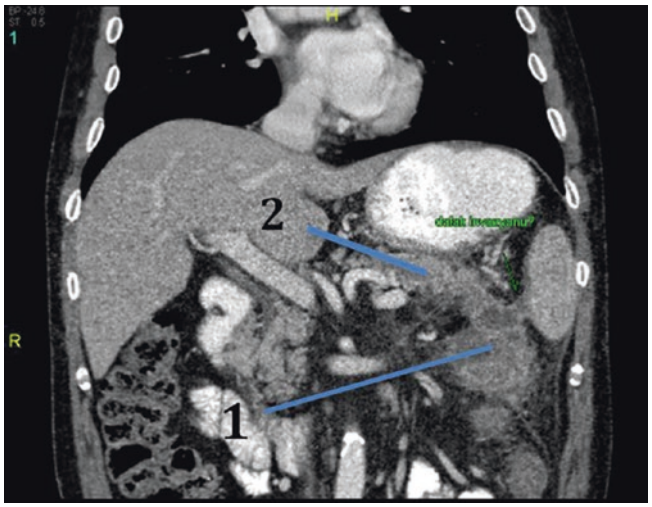


Figure 15.2

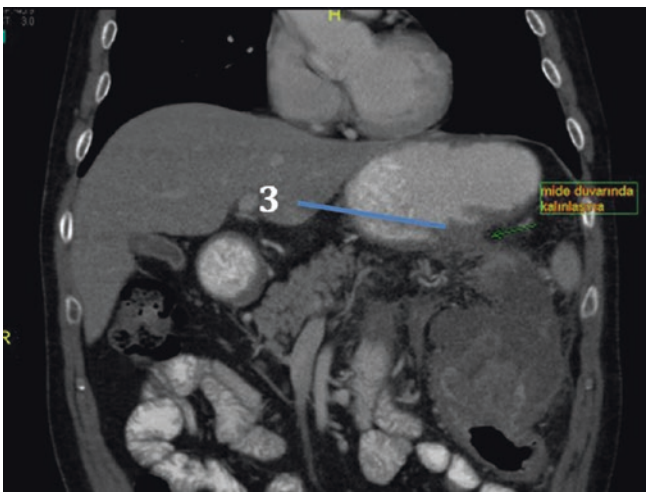
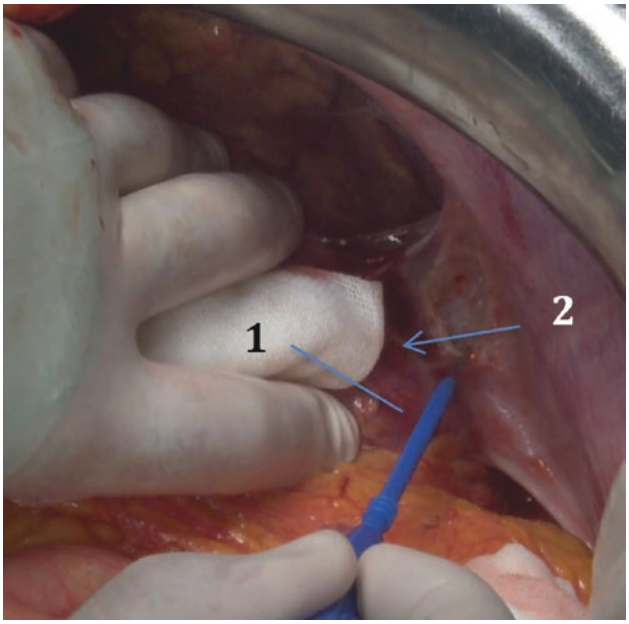


Figure 15.3

The hand of the surgeon covers the tumour (1), which is protected by a gauze to avoid inadvertent injury. The splenic flexure is mobilised by incising the lateral attachments and parietal peritoneum approximately 1 cm lateral to Toldt's line (2), which is involved by the tumour. After full mobilisation of the tumour off the lateral abdominal wall, the perirenal invasion was further assessed. After preliminary assessment of the local extent of tumour invasion, extensive mobilisation of all organs involved by the primary tumour should be performed

Figure 15.3



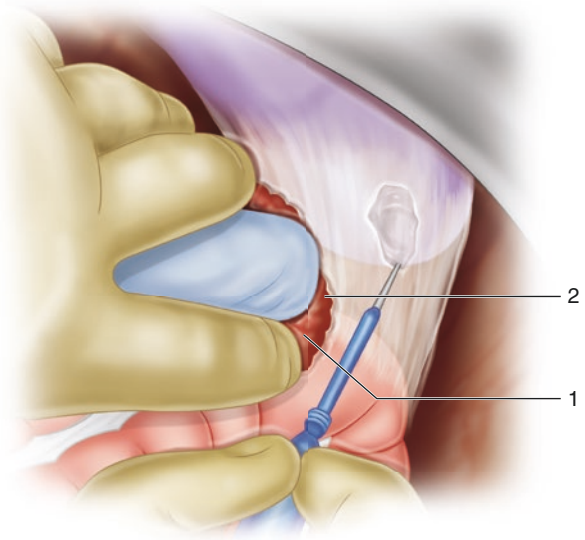


Figure 15.4

(**a**, **b**) The following operative steps in this case involved complete mobilisation of the ascending colon and full Kocherisation of the duodenum, including the pancreatic head. Constant traction (blue arrow) and counter-traction (red arrow) allows for sharp dissection in the correct anatomical plane. Thereby the organs fixed to the tumour are primarily not touched, to avoid any tearing of the tumour. Vena cava, covered by the parietal plane (1), pancreatic head (2) and ligament of Treitz (3) are also anatomically exposed

Figure 15.4

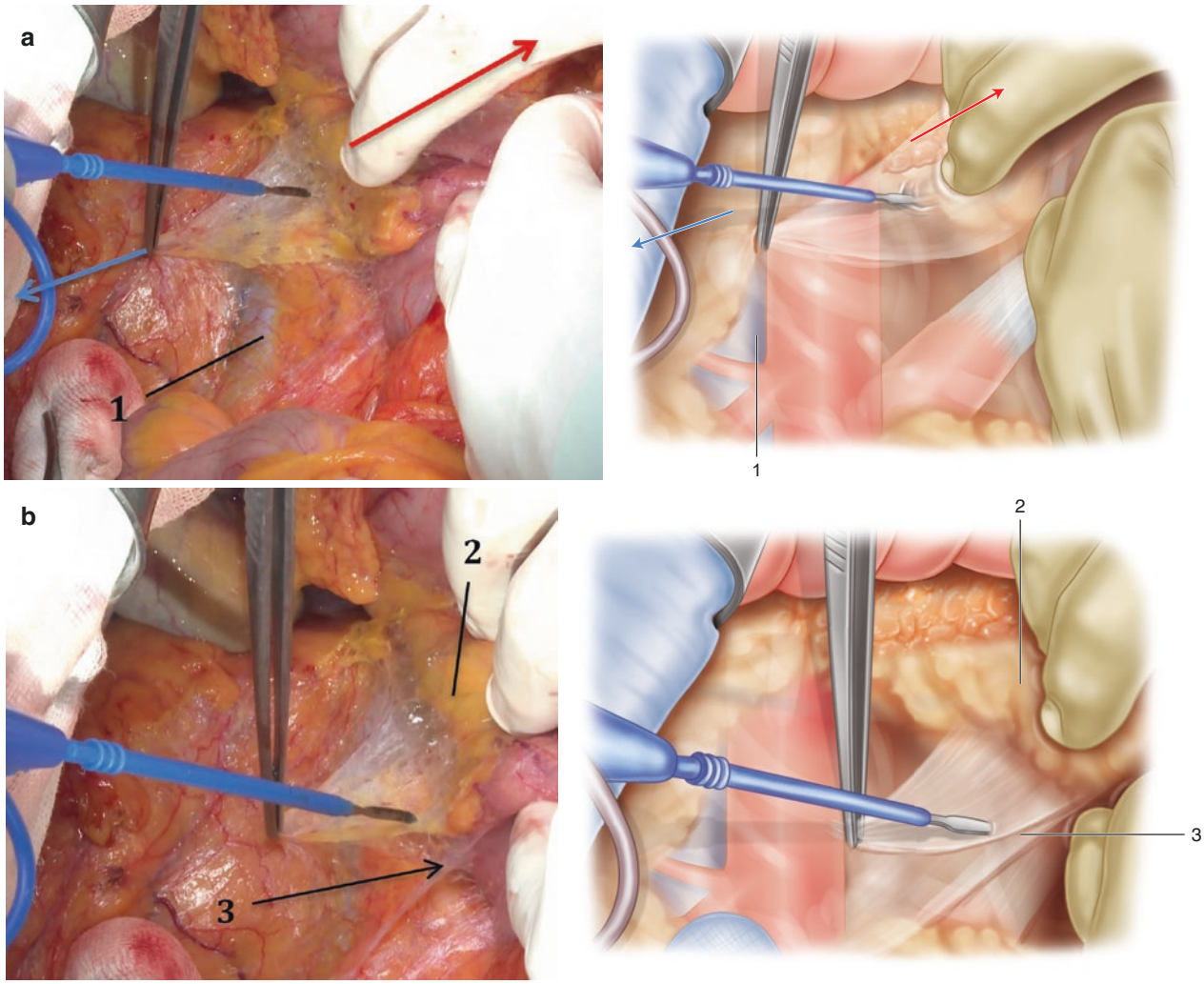


Figure 15.5

The greater omentum is dissected off the right transverse colon following the embryological attachments (dashed blue line), to access the lesser sac. This is followed by skeletonisation of the greater curvature of the stomach, transection of the left-sided omentum and exposure of the superior mesenteric vein (see Figs. 15.6, 15.7, and 15.8). Of importance, these steps are performed far from the primary tumour (arrow), in the left upper abdomen

Figure 15.6

The greater curvature of the stomach is skeletonised by resecting the arcade of gastroepiploic vessels (dashed blue line) for two reasons: (1) Maximise the resection margin of the primary tumour and (2) Include potential regional lymph node metastases, which are found at this region in approximately 10% of cases (see also Fig. 15.7)

Figure 15.5

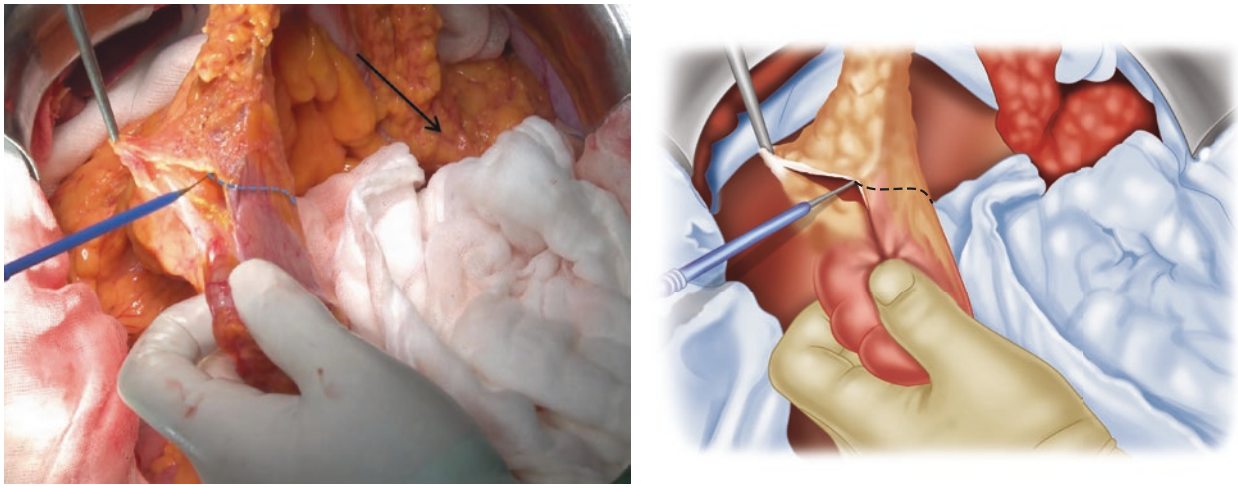


Figure 15.6

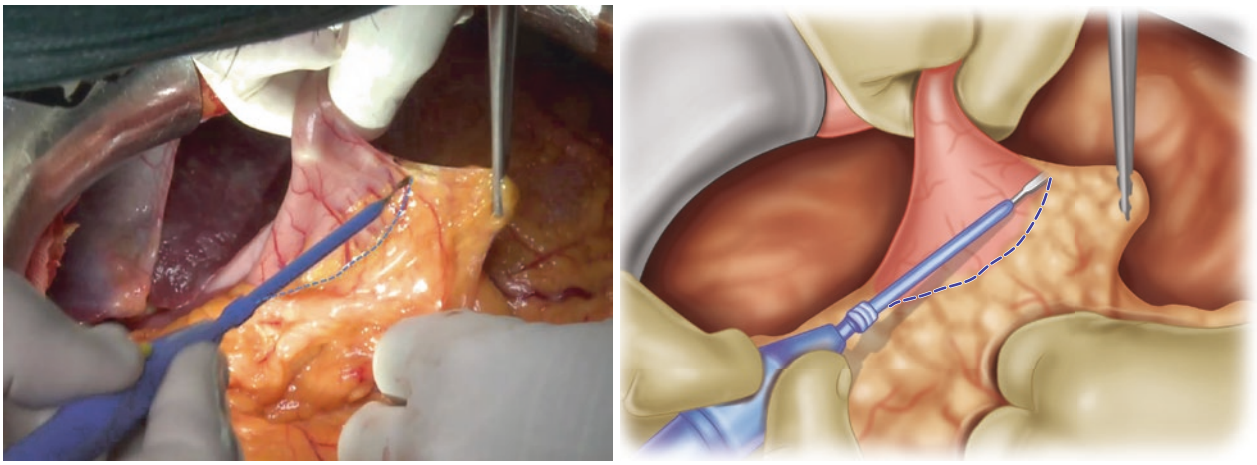


Figure 15.7

The greater curvature of the stomach (1) is skeletonised by dividing the radial vessels originating from the right gastroepiploic vessel. The lesser sac (2) is accessible on its right side but occluded by the primary tumour and peritumoural inflammation on the left side (3) which invades the posterior wall of the stomach

Figure 15.8

The greater curvature including the tumour invasion is resected with a stapler (4 fires). The distance to the tumour is approximately 2–3 cm

Figure 15.7

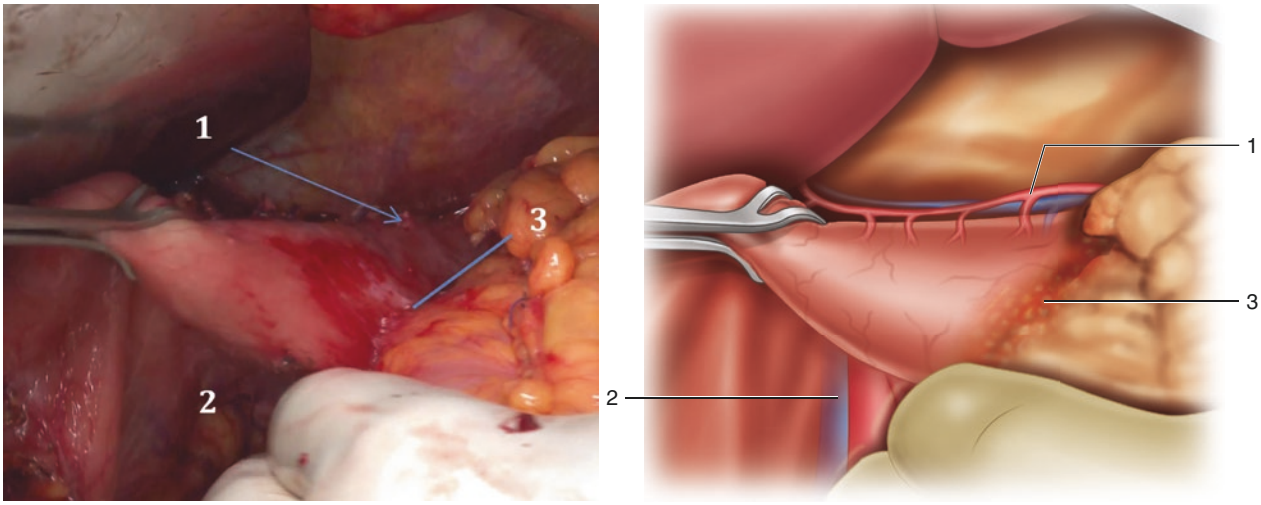


Figure 15.8

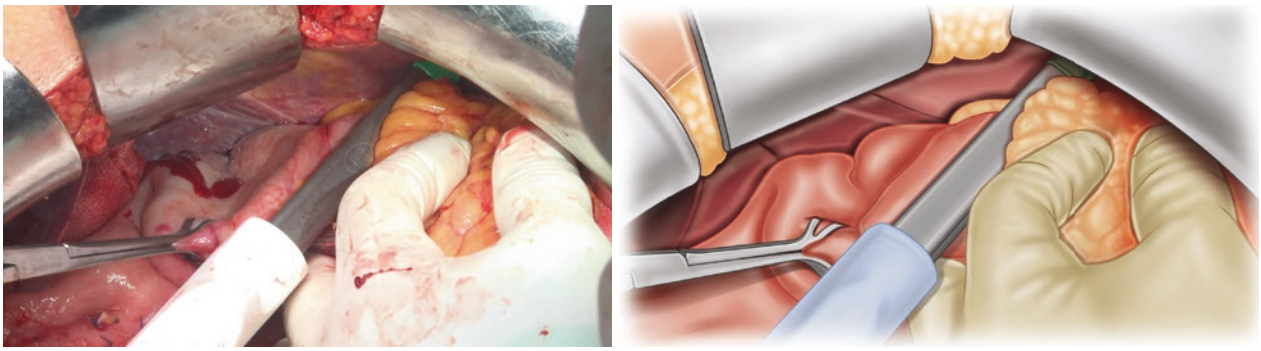


Figure 15.9

The superior mesenteric vein (1) is exposed including its course below the isthmus of the pancreas (2), the right gastroepiploic vein (3) and middle colic vein (4). The gastrocolic venous trunk was missing in this patient but is typically the most commonly encountered vascular anatomy

Figure 15.9

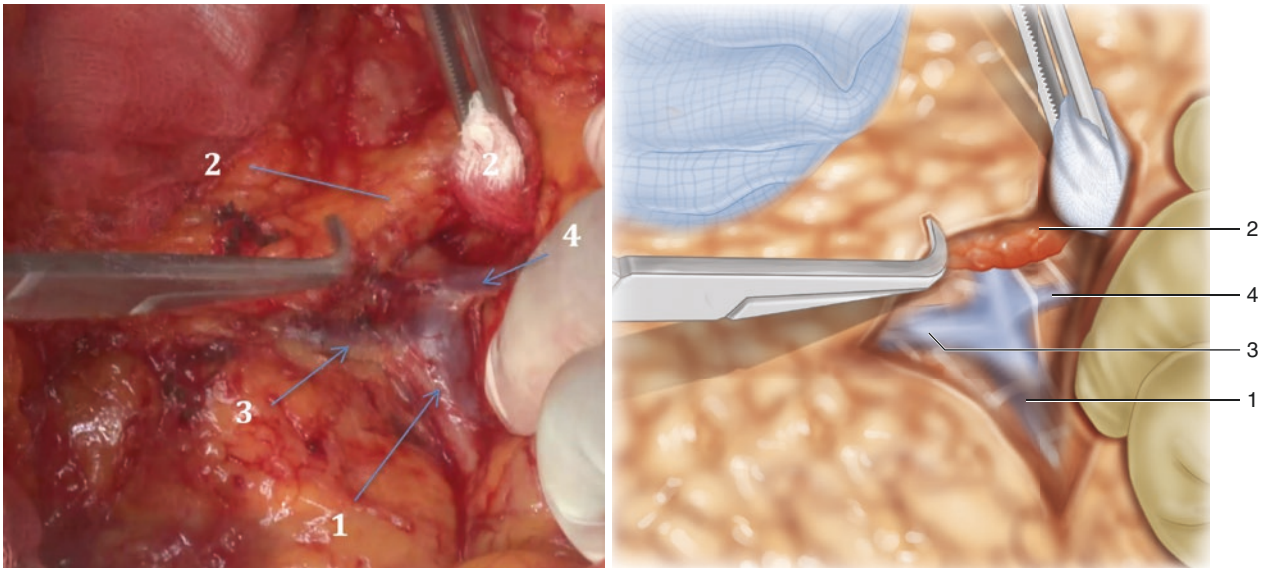


Figure 15.10

(**a**, **b**) The middle colic vein (1) and artery (2) are divided to expose the inferior border of the pancreatic body, which is also mobilised from the root of the superior mesenteric artery and subsequently transected (see Fig. 15.11)

Figure 15.10

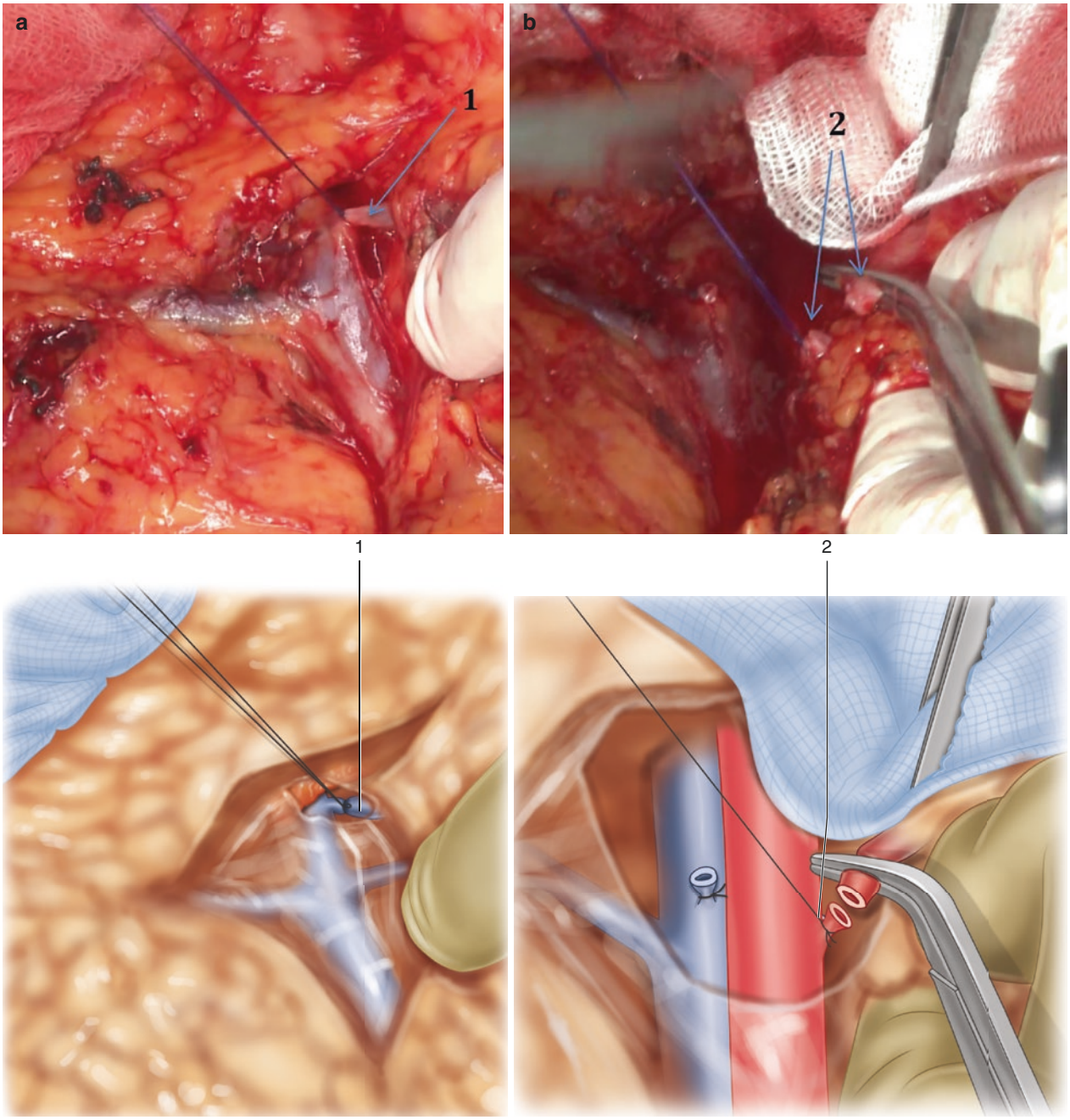


Figure 15.11

Residual branches of the mesenteric root are divided. It is important to not skeletonise these arteries in the same manner as with the veins to preserve the surrounding autonomic nerves (1); otherwise severe diarrhoea may result. Afterwards, the body of the pancreas is mobilised off the root of the superior mesenteric artery and transected. Incision line (dashed blue line), stump of the middle colic artery (2) and vein (3), superior mesenteric vein (4), right gastroepiploic vein (5)

Figure 15.12

Once the blood supply to the right colon is clearly identified, the large bowel is divided with a stapler. Afterwards, the transverse mesocolon is incised vertically

Figure 15.11

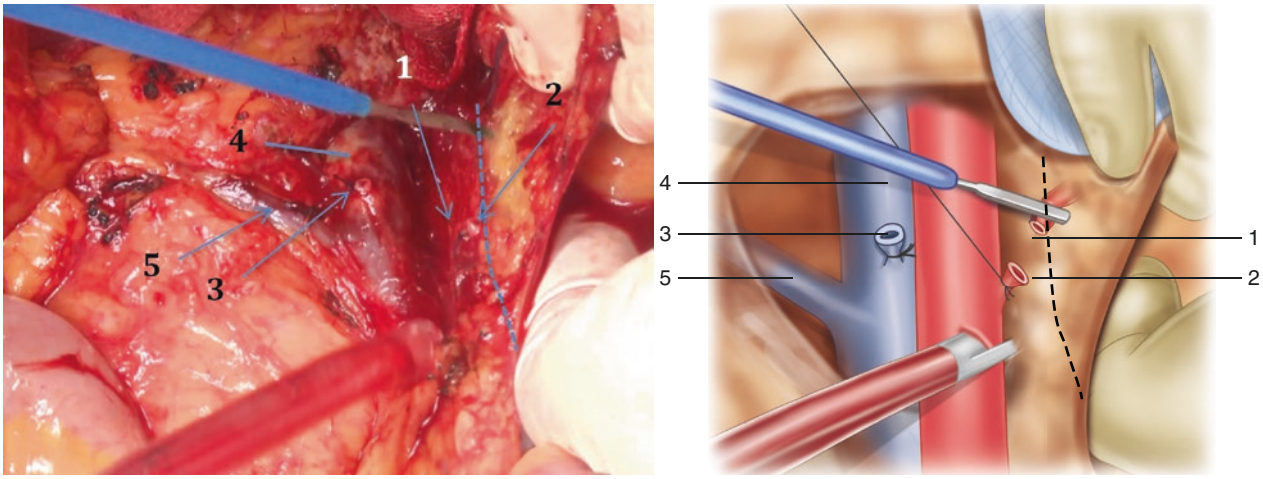


Figure 15.12

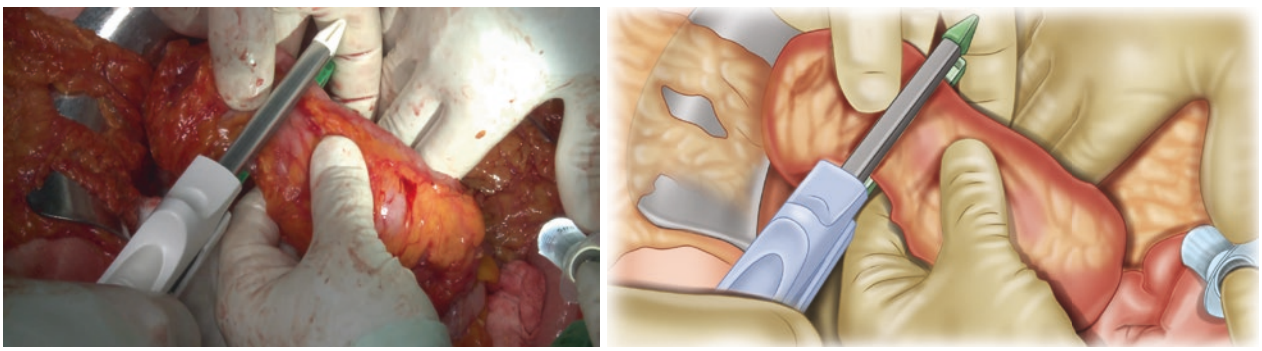


Figure 15.13

(**a**, **b**) Before transecting the pancreas, the splenic artery (1) and vein (2) are looped and divided. Pancreatic body (3)

Figure 15.13

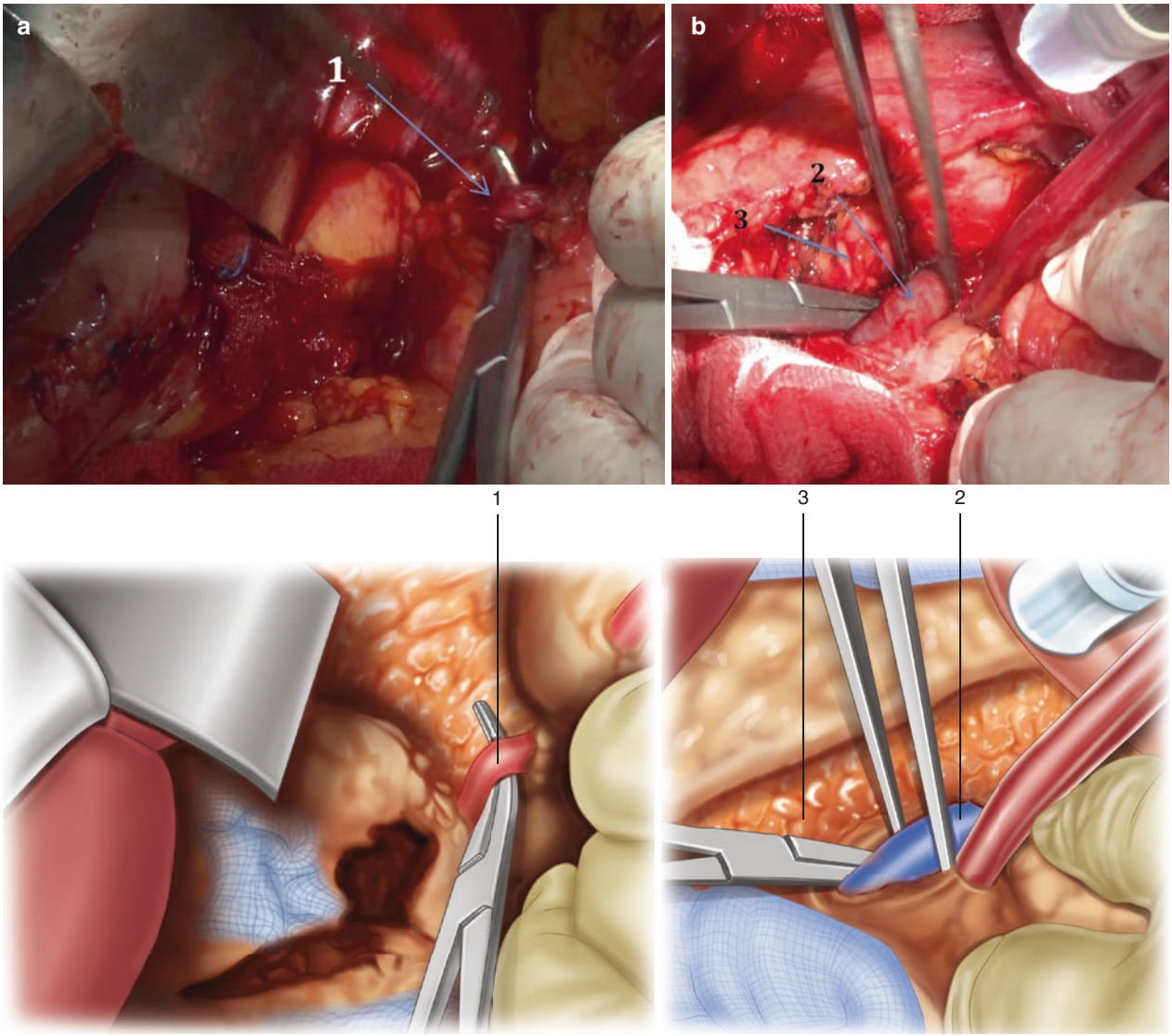


Figure 15.14

A linear stapler is used to transect the pancreatic body. If the pancreas is thick or fibrotic, sharp transection followed by suture closure of the pancreatic duct and pancreatic stump is preferred. Gallbladder (1), left colon staple line (2)

Figure 15.15

The root of the inferior mesenteric artery (1) is isolated and divided. For oncological reasons, it could also be preserved and ligated more distally, at the level of the take-off of the ascending branch of the left colic artery (for details refer to chapter on left hemicolectomy and sigmoid resection)

Figure 15.14

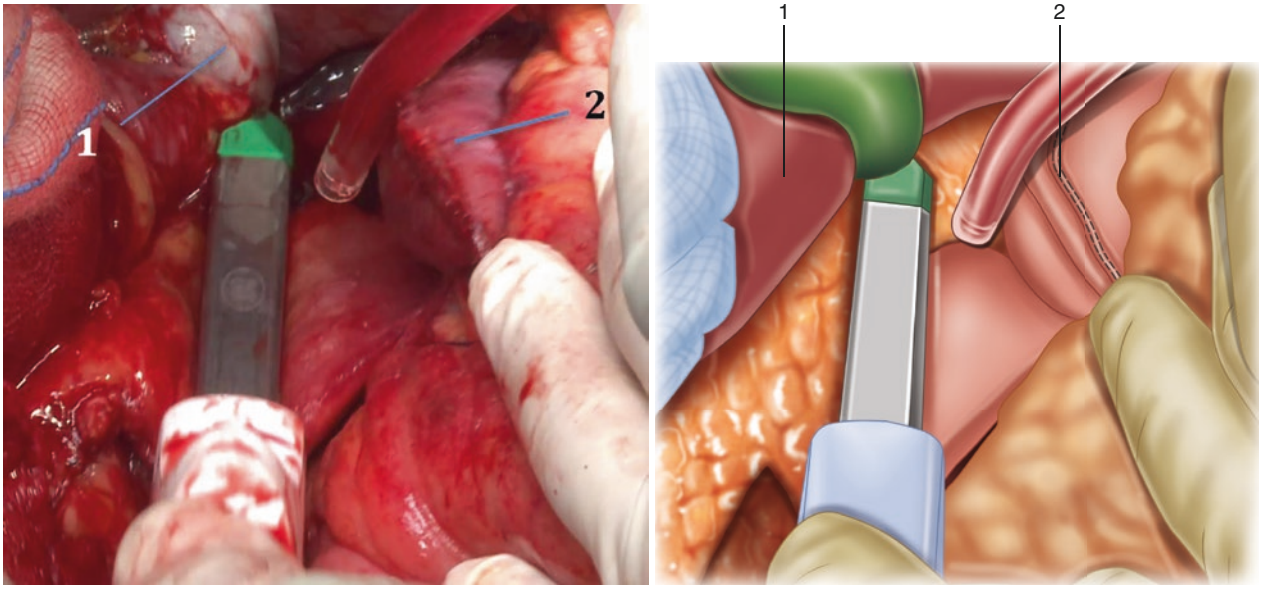


Figure 15.15

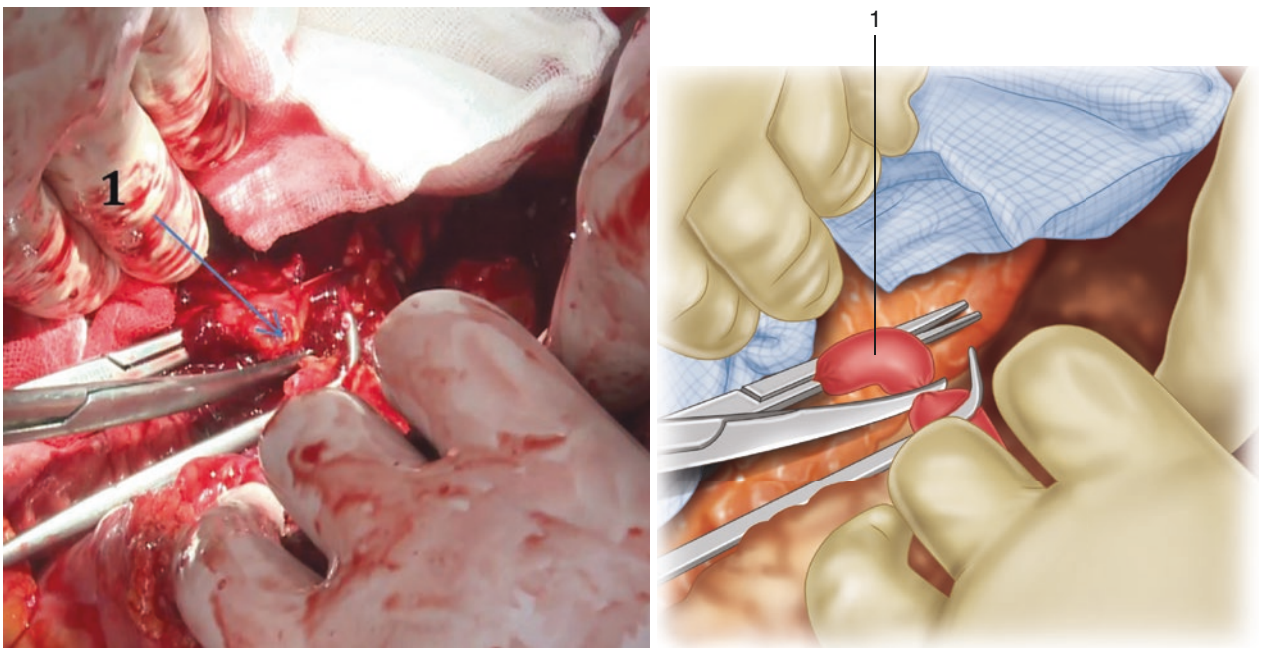


Figure 15.16

The distal sigmoid colon is divided by a stapler, followed by transection of the mesosigmoid. Afterwards, the tumour is still fixed to the duodeno-jejunal junction (Fig. 15.17) and the perirenal capsule (Fig. 15.18), which will be divided next

Figure 15.17

As the primary tumour is still adherent to the duodeno-jejunal junction, this will be excised en bloc in a disk-like fashion

Figure 15.16

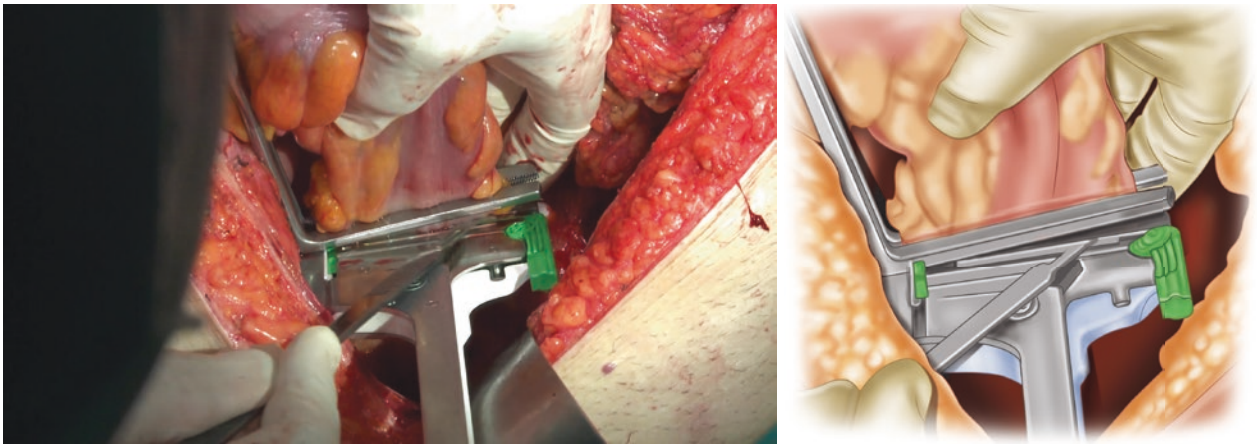


Figure 15.17

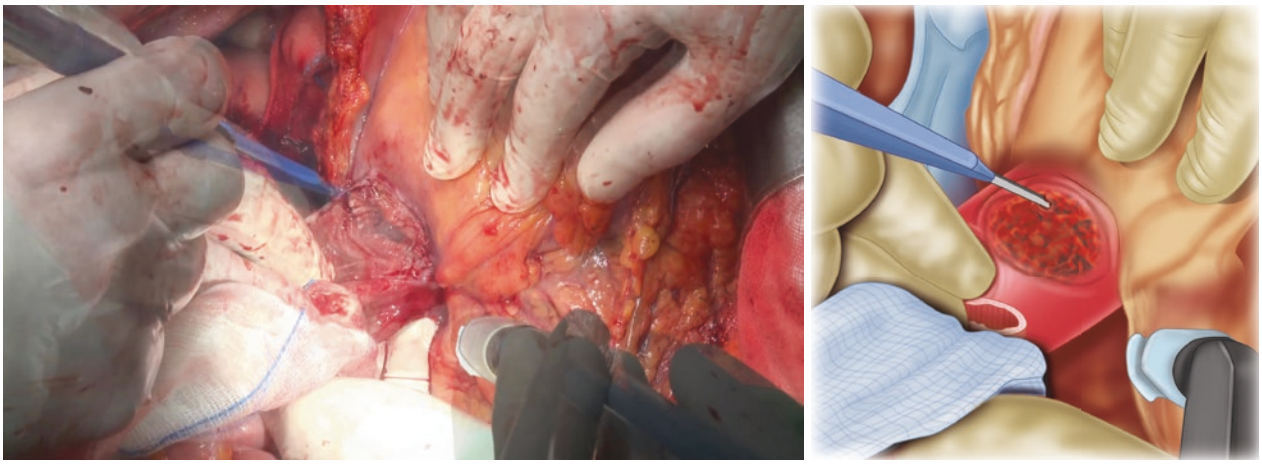
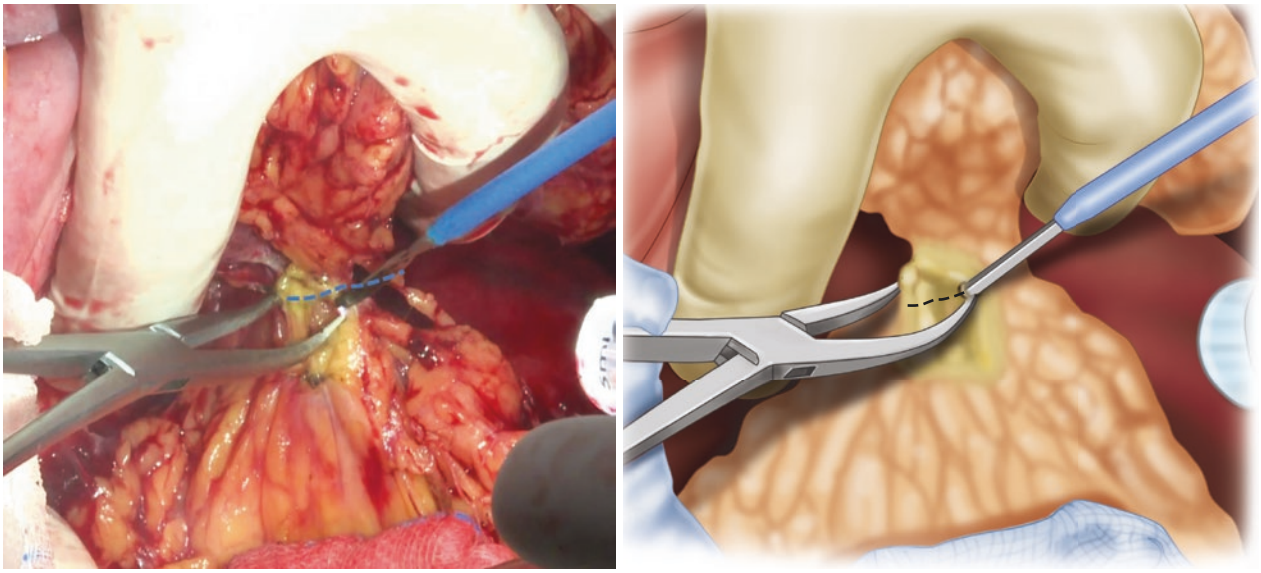


Figure 15.18

Finally, a tissue bridge attached to the perirenal capsule is divided (dashed blue line) and the specimen is retrieved

Figure 15.18



15.5 Peritoneal Carcinomatosis

In patients with established peritoneal carcinomatosis and a peritoneal index below 20 (Fig. 15.19), cytoreduction and possible HIPEC should be considered [8]. If feasible, these patients should receive neoadjuvant chemotherapy, as most patients require multivisceral resection. Per definition, these resections always result in R1 resections. Therefore, excision of all macroscopic disease should be performed. The extent of organ resec-

Figure 15.19

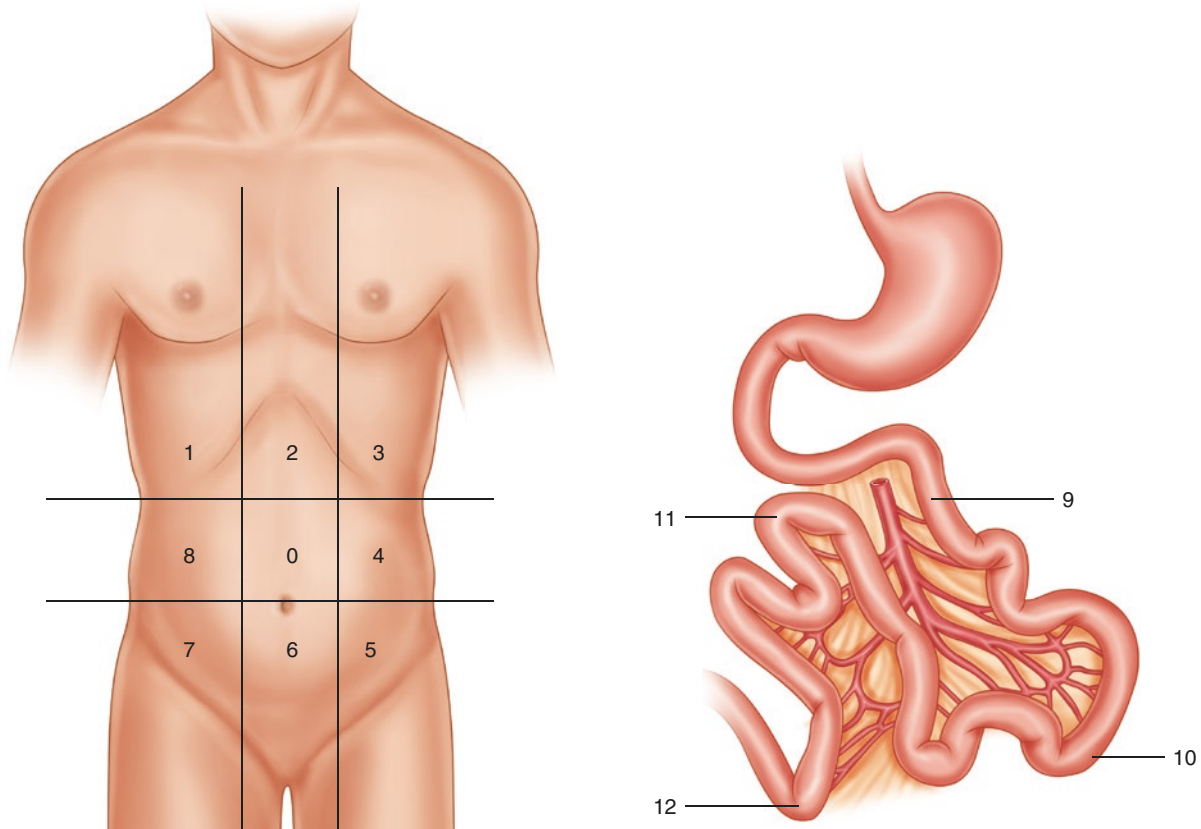
Peritoneal cancer index calculation chart [7]

tion is mainly influenced by the remaining intact arterial blood supply. However, the rules of regional lymph node excision and of removal of adjacent organs must also be followed, if the primary tumour has not already been removed.

15.6 Reconstruction

Re-establishment of the continuity of the gastrointestinal tract after multivisceral resection is challenging. The decision of a hand-sewn or stapled anastomosis will depend on

Figure 15.19



Regions	Lesion Size	Lesion Size Score
0 Central		LS 0 No tumour seen
1 Right Upper		LS 1 Tumour up to 0.5 cm
2 Epigastrium		LS 2 Tumour up to 5 cm
3 Left Upper		LS 3 Tumour > 5 cm
4 Left Flank		Or confluence
5 Left Lower		
6 Pelvis		
7 Right Lower		
8 Right Flank		
9 Upper Jejunum		
10 Lower Jejunum		
11 Upper Ileum		
12 Lower Ileum		
PCI		

surgeon preference. Small bowel reconstructions can be performed end-to-end or side-to-side with sutures or a stapler. In the case presented here, the defect at the duodeno-jejunal junction was closed with a running single layer suture. Right colon resections commonly involve a stapled side-to-side anastomosis. In this case, an end-to-end colo-colonic ascending-sigmoidostomy was performed with a circular stapler.

Anastomosis after proctectomy will be discussed elsewhere; however, colorectal anastomosis after sigmoidectomy with multivisceral resection is a common scenario with locally invasive tumours and frequently involves en bloc resection of urinary bladder, as well as abdominal wall and pelvic sidewall structures (*i.e.*, ureter, external iliac vein and artery and spermatic cord or round ligament). When primary colorectal anastomosis is performed with extensive multivisceral resection, a diverting loop ileostomy should typically be considered.

If patients are haemodynamically stable and are extubated postoperatively, they are transferred to a surgical ward. Diet is initiated on postoperative day one. If surgical drains are placed, they are usually removed early in the postoperative course, depending on the quality and amount of output. In patients who undergo pancreatic resection and are suspected to have a pancreatic leak, surgical drains are left longer.

15.7 Conclusion

In the setting of locally invasive and metastatic colon cancer, it is of paramount importance to assess the locoregional tumour burden, both in quality and quantity, to therefore plan the extent of resection needed to achieve an R0 resection. Appropriate patient selection and multidisciplinary treatment results in improved postoperative outcomes.

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