When Colorectal Surgery is Performed: What to Expect in CT Evaluation?

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Learning objectives

The purposes of this review are:

- To describe the surgical procedures commonly performed for treating benign and malignant colon diseases,
- To describe the Computed Tomography (CT) findings of normal postoperative anatomy changes.
- To analyze the imaging findings of early and late postoperative complications, including the radiological signs of local recurrence in cases of colorectal cancer.

Background

Surgery is the most commonly used treatment for several colon diseases. Benign disease (including inflammatory bowel disease, diverticula and intestinal polyposis) as well as colorectal cancer can be treated by colonic resection according to the severity of the disease and the affected intestinal segment.

Multidetector Computed Tomography (MDCT) provides anatomic details of the surgical altered intestine and has become an essential diagnostic tool in the evaluation of early and late postoperative complications.

An understanding of the surgical procedure is essential for a radiologist, who should be aware of the type of surgery performed and which anastomosis were created. The ability to recognize postoperative anatomy is critical to interpret imaging studies and to better differentiate complications from normal findings.

CT technique

Abdominal CT scanning is usually obtained following the administration of both orally diluted water soluble contrast material and intravenous injection of contrast medium with dynamically enhanced scanning of the entire abdomen.

Findings and procedure details
Colorectal procedures

Colonic resection procedures differentiate according to the underlying pathology and its location.

• **Segmental resections**

A segmental resection can include ileocecal, right, transverse and left colectomies. This term refers to the removal of a portion of the colon based on the location of the lesion.

Segmental resections for malignant neoplasm require an extended segmental colectomy, mesenteric and omental resections with excision of the lymphatic drainage of the tumor.

The intestinal continuity is established with an end-to-end or end-to-side anastomosis.

• **Total colectomy**

This is usually indicated for ulcerative colitis and familial polyposis, and consists on removal of the entire colon from the terminal ileum to the anus. The rectum is conserved to create an ileoanal anastomosis.

• **Anterior resection**

This is the surgery of choice for low sigmoid or rectosigmoid area cancers, occurring more than 8 cm proximal to the pectinate line.

It consists on the resection of distal portion of the left colon, sigma and distal rectum with a low rectal anastomosis.

There are three major types of anterior resection:

• **High anterior resection:** which involves the excision of the rectosigmoid and the upper and mid rectum above the peritoneal reflection.

• **Standard low anterior resection:** which includes the excision of the rectosigmoid and the upper and mid rectum below the peritoneal reflection.
• **Extended low anterior resection:** including the excision of the distal sigmoid colon and the distal rectum.

Intestinal continuity can be restored with a coloanal or colorectal end-to-end or end-to-side anastomosis or a colonic J pouch.

• **Abdominoperineal resection**

It is performed for low rectal malignancies that are less than 8 cm above the pectinate line. It is indicated in cases of anal malignancies and anorectal complications of inflammatory bowel disease.

The dissection requires an abdominal and perineal component:

• The abdominal component consists on excision of the distal colon and mobilization of the rectum, with creation of a permanent end-colostomy, usually in the left lower abdomen.

• The perineal component consists of excision of the anus and distal rectum with removal of the mobilized abdominal bowel.

• **Hartmann resection**

In a Hartmann procedure a partial colectomy or sigmoidectomy is performed with a diverting colostomy and a blind-ending rectal or colonic stump, closed by sutures. **Fig. 1 on page 9, Fig. 2 on page 9**

It is usually performed on an emergency, in cases of complicated acute diverticulitis, obstructing or perforated sigmoid carcinoma and penetrating trauma.

Bowel continuity can be reestablished at a later date once the inflammatory changes have resolved.

**Postoperative CT findings and anatomy**
Normally, in the immediate postoperative period there is a reactive peritoneal effusion and pneumoperitoneum, which usually disappears within days.

Normal CT findings after these surgeries include absence of bowel segments, anastomotic sutures and displacement of the adjacent viscera into the unoccupied postoperative spaces.

• **Following low anterior resection:** a presacral midline fluid collection may be seen in the early postoperative period. It can be distinguished from a leak by the absence of air or oral contrast material extravasation. The presacral space is usually larger, with the rectum usually displaced anteriorly > 2 cm from the sacrum, as it is commonly pulled away by the operation itself. Fig. 3 on page 10

Months later, in 30% of the cases, a small amount of soft tissue in the presacral space can be seen, that either decreases in size or does not change during subsequent examinations. Fig. 4 on page 11

• **Following abdominoperineal resection:** in the first 4-6 months after surgery, a presacral mass of fibrous tissue may be seen as a normal finding.

Because of the difficulty distinguishing this fibrous tissue from tumor recurrence, a baseline CT examination within 2-4 months after the surgery is recommended, with routine follow-up at about 6 months intervals.

Lack of growth over 2 years, clinical stability and normal Carcinoembryonic antigen (CEA) levels are additional evidence that the mass represents normal postoperative changes. Fig. 5 on page 11

The Fluorodeoxyglucose Positron-Emission Tomography (FDG-PET/CT) has an increasing role in detecting pelvic recurrence in patients after removal of a colorectal cancer.

It provides metabolic information and helps to differentiate tumor tissue from fibrosis in residual masses seen on CT.

**Complications**
Colonic resection is considered a major abdominal surgery and various abdominal complications may occur in the early or delayed postoperative period. CT is the imaging modality of choice for the diagnosis of postsurgical complications.

The common early complications include: wound infections, anastomotic leak and intraperitoneal abscess.

Delayed complications include: incisional hernia, bowel obstruction and tumor recurrence.

**Wound complications**

Wound infections is common due to the high risk of wound contamination from the resected bowel. Risk factors associated with wound complications include the patients’ chronic medical conditions, malnutrition and steroid use.

On CT it appears as a small fluid or gas collection within the abdominal wall incision and adjacent tissues. Untreated, can lead to wound dehiscence and incisional hernia. Fig. 6 on page 12

**Anastomotic leak**

It is a major complication associated with high morbidity and mortality.

The clinical symptoms that suggest the presence of an anastomotic leak usually present within 2 weeks after surgery, and include fever, as the predominant feature, often associated with abdominal pain and tachycardia.

On CT, it can lead to a large hydropneumoperitoneum or to a localized fluid collection containing air, which has been reported to be the most common indicator of an anastomotic leak. Fig. 7 on page 13, Fig. 8 on page 13

Administration of rectal contrast material will better define a presacral collection and depict areas of leakage.

The CT findings due to anastomotic leak in the context of an anterior resection include large air-fluid collections located in the presacral space, anterior displacement of the rectum and extravasation of the enterally inserted contrast material mimicking the normal...
rectum, called the "double rectum sign", which, is highly suggestive of an anastomotic leak. Fig. 9 on page 14

Sometimes, if the patient is stable without signs of sepsis or peritonitis, initial treatment may be conservative with administration of antibiotic and percutaneous drainage guided by MDCT. Fig. 10 on page 15

**Intraperitoneal abscess**

Intra-abdominal abscess remains the leading cause of morbidity in the postoperative patient.

CT features of an abscess include a well circumscribed fluid collection or air-fluid level that may enhance peripherically. Fig. 11 on page 16

CT allows guided percutaneous drainage with a high success rate over surgical drainage.

**Late complications**

**Incisional hernias**

It consists on a protrusion of abdominal viscera at the site of a surgical incision. Predisposing factors include obesity and wound infection.

CT findings in cases of incisional hernias include an abdominal wall defect with protrusion of abdominal contents (usually mesenteric fat and bowel loops) through it.

In cases of complicated hernias, CT is useful to evaluate signs of bowel ischemia caused by obstruction and strangulation, like bowel wall thickening, mesenteric fat stranding and fluid in the herniated sac. Fig. 12 on page 17

**Bowell obstruction**

In the immediate postoperative period, paralytic ileus is a common cause of bowel dilatation. This condition usually does not last more than 48 hours, otherwise persistent symptoms should raise suspicion for other causes.
Benign causes of bowel obstruction include adhesion, incarcerated incisional hernia, strictures and volvulus. The diagnosis of adhesion is often diagnosed by the absence of a lesion at the point of the obstruction.

In patients who have been treated surgically for malignancy, an important cause of obstruction is a recurrent malignant process, often metastatic disease. Fig. 13 on page 18

**Tumor recurrence**

Tumor recurrence has been reported in up to 40% of patients undergoing curative resection. The risk of recurrence varies according to the preoperative stage, histology and surgical technique.

Imaging may show enlargement of a soft-tissue mass over time, increase in the size of regional lymphadenopathies, invasion of contiguous structures and peritoneal spread. Fig. 14 on page 19

The liver is the predominant organ involved with metastases. At CT, hepatic metastases usually appear as hypoattenuating masses visualized during portal venous phase. Fig. 15 on page 20

Mucinous colorectal cancer can produce cystic or calcified hepatic metastases. Other common sites of metastases include the lungs, adrenal glands and bones.

In patients undergoing colorectal surgery, the MRI is not usually considered the method of choice for the follow-up period. However, as it has a high contrast resolution, it could be used to differentiate recurrent tumor from fibrosis in conflicted cases.

The Fluorodeoxyglucose Positron-Emission Tomography-CT (FDG-PET/CT) has an increasing role in detecting pelvic recurrence in patients after removal of a colorectal cancer.

PET-CT precisely localizes malignant tissue and delineate its boundaries, helps identifying peritoneal metastases and neoplastic involvement in normal-sized lymph nodes. Fig. 16 on page 21, Fig. 17 on page 22
Fig. 1: Axial CT enhanced image that depicts the location of the end colostomy in left lower quadrant (arrow) after a Hartmann procedure.
Fig. 2: Axial CT image (same patient as Fig. 1) shows the normal appearance of a Hartmann pouch (arrow) and the suture staple line.
Fig. 3: Axial CT image on a patient who had undergone low anterior resection. It shows a presacral left fluid collection as a normal early postoperative finding (arrow). It also shows the rectum (R) displaced 2 cm anteriorly from the coccix.

Fig. 4: Axial CT scan image that shows the normal postsurgical findings in a patient who had undergone low anterior resection for colon polyps 2 years before. The rectum is displaced anteriorly from the sacrum (R) and a small amount of soft tissue is seen in the presacral space, suggestive of fibrotic material (white arrow). Surgical suture lines (yellow arrow).
Fig. 5: 18F-fluorodeoxyglucose PET/ contrast enhanced CT (FDG-PET/ceCT) of a 30 year-old woman who had undergone abdominoperineal resection for colorectal carcinoma one year before. ceCT (left) and fused FDG PET/CT (right) images show an irregular presacral mass (arrow) without metabolic activity, probably attributable to granulation tissue or fibrosis.

Fig. 6: Wound infection. Axial contrast enhanced CT image of a patient who presented redness, swelling and induration of the skin around the abdominal incision, associated
with tenderness in the affected area, 19 days after a left hemicolectomy. The CT image shows a hypodense collection within the abdominal wall incision (arrow).

Fig. 7: Anastomotic leak. Axial contrast enhanced CT obtained 7 days after a left hemicolectomy. It shows pneumoperitoneum distributed in the peritoneal cavity (*). A retroperitoneal collection of fluid and air compatible with an abscess formation in the context of an anastomotic leak (arrow).
Fig. 8: Anastomotic leak. Axial contrast-enhanced CT image of a 64 year-old man who 7 days after a left hemicolectomy for colon cancer presented septic shock and peritonitis. It shows a large heterogeneous fluid-air collection occupying the left gutter (arrow), compatible with an abscess due to an anastomotic leak.
Fig. 9: A 67 year-old man who presented fever and abdominal pain 10 days after a low anterior resection surgery. Axial contrast-enhanced CT image obtained after the administration of rectal contrast material, shows a presacral collection with air and frank extravasations of bowel contrast material (arrow), which produces a displacement of the rectum (R) anteriorly (called the "double rectum sign"), that confirmed the presence of anastomotic leak.
Fig. 10: Axial CT image of patient in Fig. 9, obtained in prone position. The patient received a conservative treatment with antibiotics and percutaneous drainage guided by MDCT of the presacral abscess. (arrow).
**Fig. 11:** Postoperative abscess after a right hemicolecction. Axial contrast-enhanced CT image shows mesenteric fat stranding and an abscess, (red arrow) consisting on a fluid collection with enhancing walls and extraluminal air inside, adyacent to the anastomotic surgical sutures (yellow arrow).
**Fig. 12:** Incisional hernia. 73 year-old woman who presented abdominal pain and vomiting 3 years after a left hemicolecotomy. Axial contrast-enhanced CT image shows a separation of rectus abdominis muscles with protrusion of bowel loops into the ventral abdominal wall (arrow) with mesenteric fat stranding and fluid (*) in the hernial sac as subtle signs of strangulations that was proven on surgery.
Fig. 13: Patient who presented 3 years after having undergone right hemicolectomy for colon cancer, with unexplained weight loss and malaise. Axial contrast-enhanced CT image shows a mass adjacent to the ileocolic anastomosis (arrow) that is causing duodenal obstruction (*), bile duct dilatation and infiltrates the pancreatic head (not shown).
**Fig. 14:** 73 year-old man who underwent right hemicolecctomy for colon cancer. Axial contrast-enhanced CT image, one year later, shows a mesenteric mass with irregular margin and fat stranding (arrow), suspicious of malignancy. Posteriorly it was proven to be recurrent disease.
Fig. 15: A 66 year-old woman with sigmoid cancer. Axial contrast-enhanced CT image of the abdomen shows hypodense liver lesions, proven to be liver metastases (*).
Fig. 16: One year after surgical removal of colon cancer, a patient was assessed for tumor recurrence. Axial contrast-enhanced CT (Fig. 16) shows a soft tissue mass, at the level of the rectal stump, with linear bands radiating in the mesenteric fat, that could be related to postsurgical changes of fibrosis or tumor recurrence. Fused FDG PET/CT (Fig. 17) performed to evaluate the metabolic activity, demonstrated areas of intense FDG uptake in the presacral area, subsequently proven to be recurrent disease. It also shows hypermetabolic perirectal adenopathy.
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Conclusion

CT with the use of multiplanar reformation allows to evaluate the normal postoperative anatomy and describe the location, extent and type of postsurgical complication following colon resection.

A previous knowledge of the surgical technique and its potential complications, in conjunction with an adequate communication with the surgical team, will help to interpretate the radiological findings and to establish a correct diagnosis.

Personal information

References


