Normal and abnormal findings after colorectal surgery

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1. Learning Objectives

To recognize the normal postoperative appearances of the abdomen and pelvis after colorectal surgery.

To recognize the most frequent and important complications after colorectal surgery.

2. Background

Colorectal surgery is an extremely common procedure, performed both for benign and malignant diseases, most frequently colorectal cancer, diverticulitis and inflammatory bowel disease.

Many radiologists find themselves in the difficult situation of having to differentiate normal findings from potentially fatal complications, both in fluoroscopic enemas and computed tomography.

In this pictorial essay we will review the expected findings of the most common procedures, such as abdominoperineal resection, anterior resection, Hartmann procedure, total proctocolectomy with ileal-anal pouch and segmental resection.

We will also discuss the most frequent complications after colorectal surgery, namely: anastomotic leak, fistulas, abscesses, wound dehiscence, parastomal hernias and obstruction.

3. Imaging Findings/Procedure Details

A- Most frequent procedures

- **There are five major types of colorectal procedures, namely:**

1. Abdominal perineal resection
2. Anterior resection
3. Hartmann procedure
4. Total proctocolectomy with ileo-anal pouch
5. Segmental resection

1. Abdominal perineal resection

- An abdominal perineal resection (APR) includes the resection of part of the sigmoid colon, rectum, and anus, and the construction of a permanent end colostomy (usually in the left lower quadrant), with an abdominal-perineal approach.

- It's mainly indicated for anorectal complications of inflammatory bowel disease (IBD) and low lying rectal or anal cancer involving the anal sphincter complex.

Fig 1 - Abdominal perineal resection

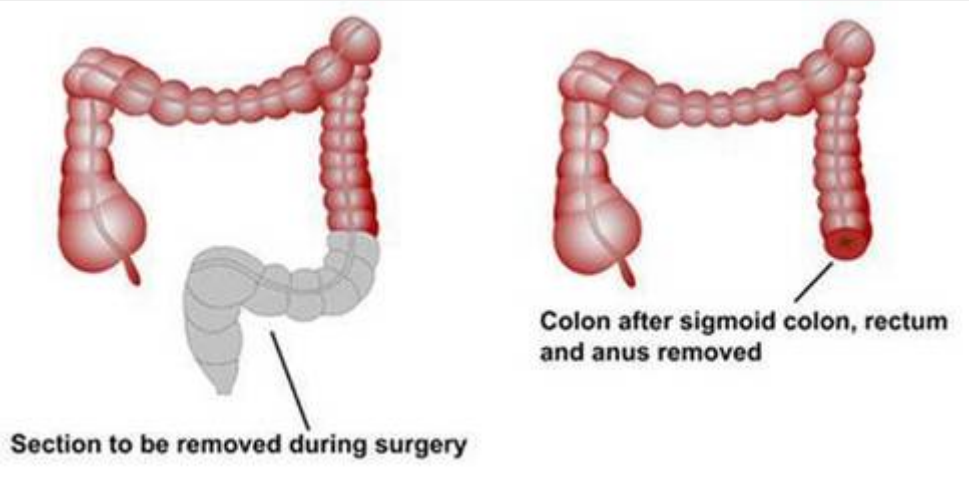

Fig 1 (http://www.cedars-sinai.edu/Patients/Programs-and-Services/Colorectal-Cancer-Center/Services-and-Treatments/Rectal-Cancer.aspx)

- Multidetector computed tomography (MDCT) demonstrates the repositioning of the pelvic organs. The bladder, seminal vesicles / uterus and small bowel tipically move posteriorly into a presacral location.
- A presacral mass, in this setting, can represent those displaced pelvic organs, postsurgical fibrosis / granulation tissue or tumor recurrence. Serial imaging and coronal and sagittal reformations are important factors in differentianting the three.
- Most patients will present an ill-defined presacral midline mass of 3-5 cm diameter, that decreases in size (or can persist indefinitely) and becomes progressively more distinct in serial imaging - fibrosis / granulation tissue.
- Tumor recurrence manifests as a well defined soft tissue mass that grows on serial imaging and becomes ill-defined as it becomes more infiltrative (cf tumor recurrence)

Fig 2 – Pelvic CT of a 83 year old patient who underwent abdominal perineal resection

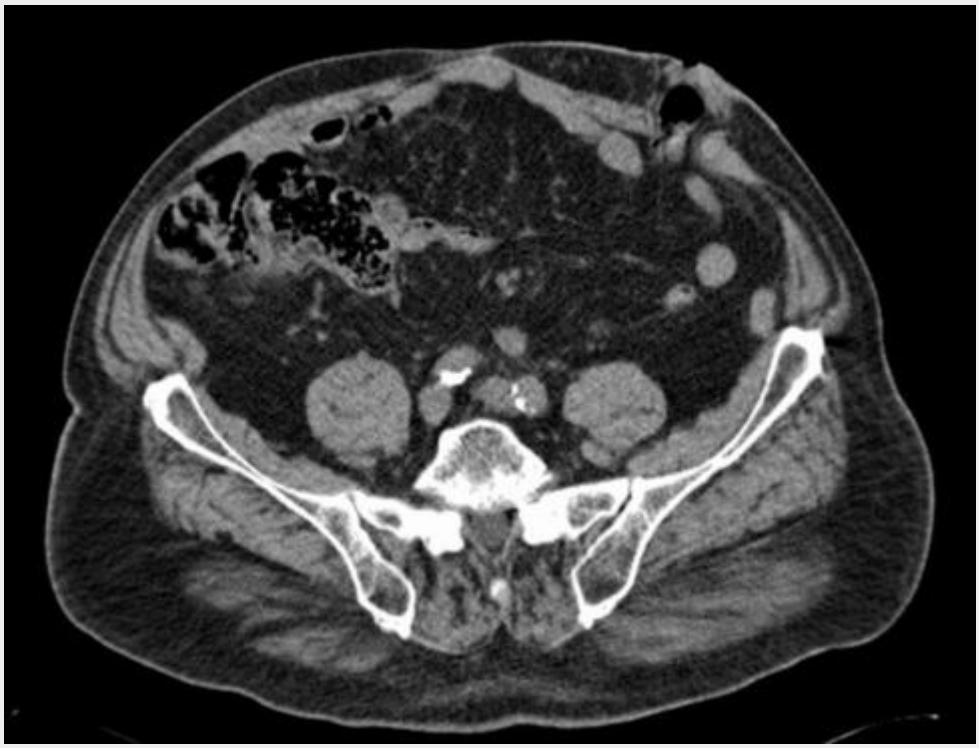

Fig 2 - End colostomy at the left flank.

Fig 3 – Pelvic CT of a 83 year old patient who underwent abdominal perineal resection (same patient of Fig 2)

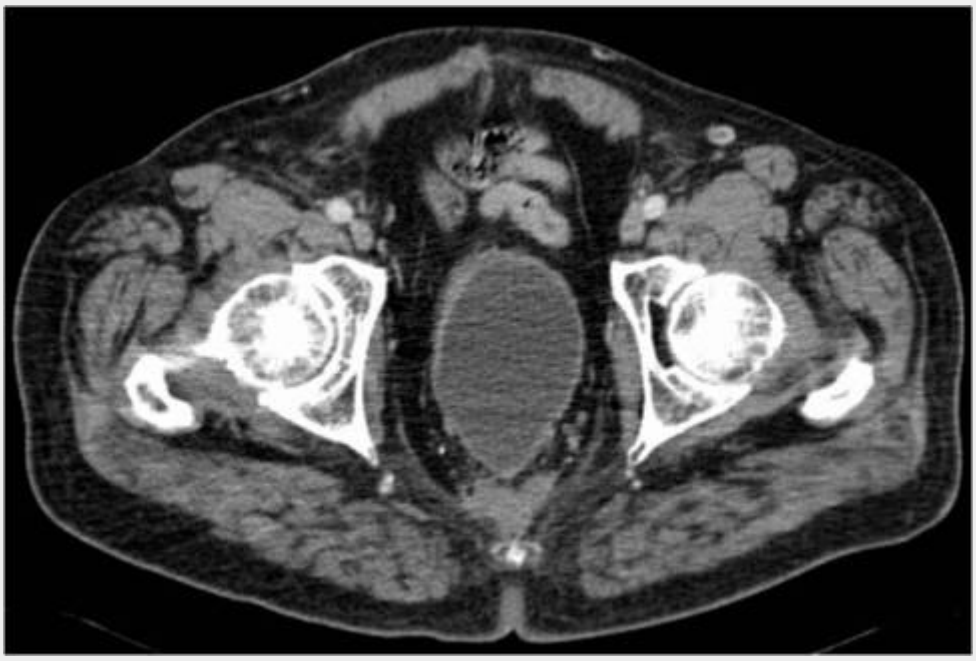

Fig 3 - Posterior to the bladder, there is an ill-defined irregular soft tissue mass - post surgical fibrosis. Note posterior displacement of the bladder into the presacral space.

2. Anterior resection

- An anterior resection (AR) includes resection of the rectosigmoid without perineal dissection and the construction of an anastomosis between the descending colon and rectum.
- The anastomosis can be performed in a end-to-end, end-to-side or colonic pouch fashion.
- It's mainly indicated for diverticulitis and cancer of the mid to upper rectum.

Fig 4 - Anterior resection

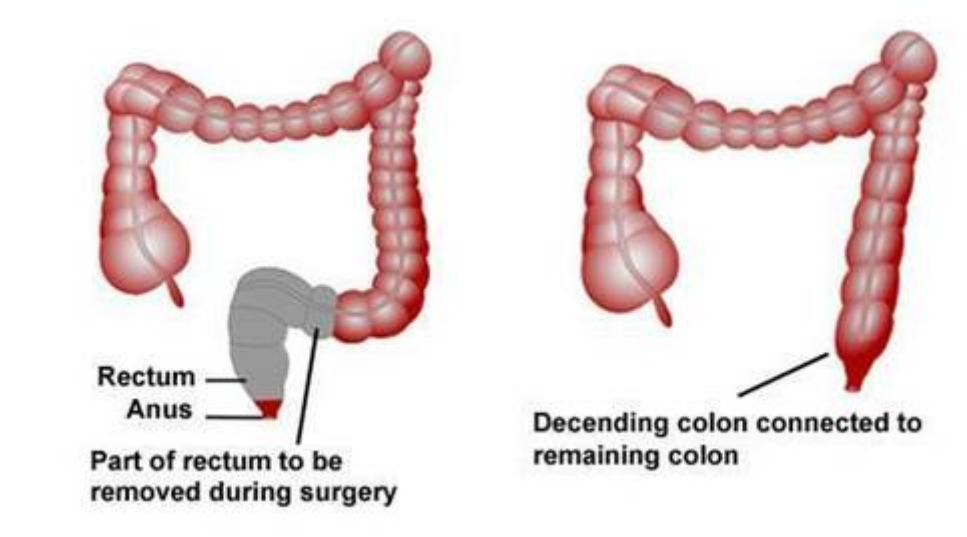

Fig 4 - http://www.cedars-sinai.edu/Patients/Programs-and-Services/Colorectal-Cancer-Center/Services-and-Treatments/Rectal-Cancer.aspx

- Frequent normal post-operative findings are a small fluid colection or small soft tissue mass in the midline of the presacral space, anterior displacement of the rectum (presacral space of 2 cm width), surgical clips and wall thickening due to anastomotic edema.
- Marked anterior displacement of the rectum (3-5 cm) or increased fluid / soft tissue mass should raise suspicion for anastomotic leak or tumor recurrence.

Fig 5 - Pelvic CTs of a patient who underwent anterior resection some years ago, with interval of 6 months between the two exams

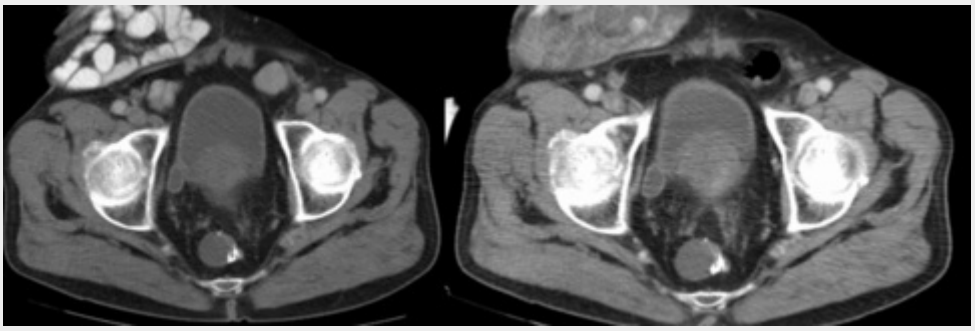

Fig 5 - Small liquid collection at the midline in the presacral space, near the anastomosis, with similar morphology and dimensions on both exams, without pathologic significance - granulation tissue. Note also a parastomal hernia at the right flank.

3. Hartmann procedure

- It is an operation to remove part of the sigmoid colon and/or the rectum.
- A temporary diverting colostomy is performed, with a sutured rectal or colonic stump left behind for an elective reanastomosis. Sometimes a mucous fistula is created by bringing up the stump to the abdominal wall.
- It is often performed in an emergency situation where there is bowel obstruction, bowel perforation or in septic patients, in the setting of cancer or diverticulitis.

Fig 6 - Hartmann procedure

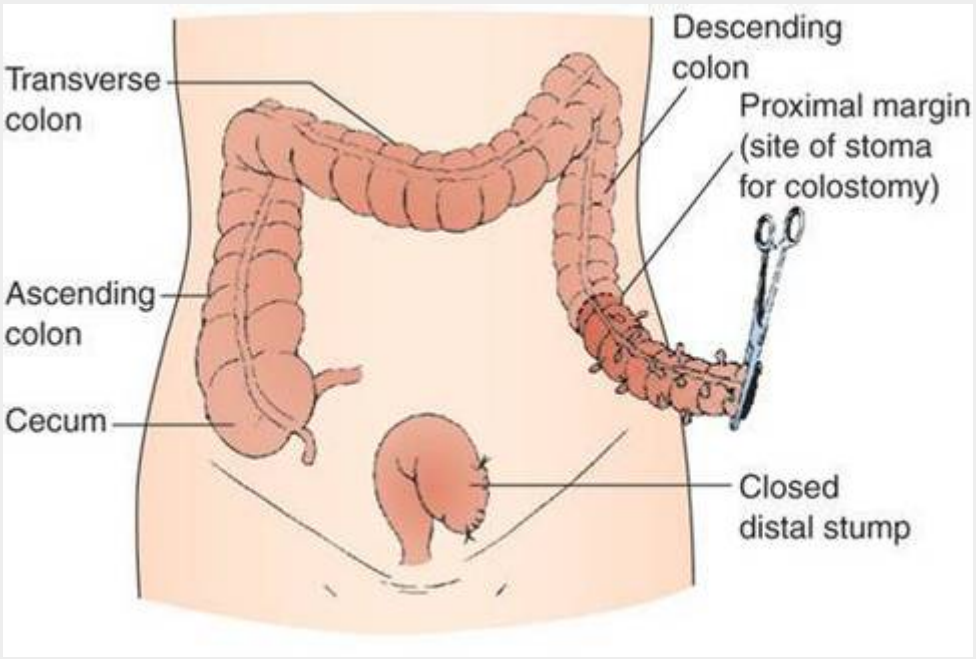

Fig 6 (http://5minuteconsult.com/ViewImage/2027820)

- A constrast enema is usually done right before reanastomosis of the colon to assess integrity of the rectal stump and anastomotic leak.
- A control film should be done to show the surgical staples.

Fig 7 - Gastrografin® enema of a 63 year old woman who underwent Hartmann procedure

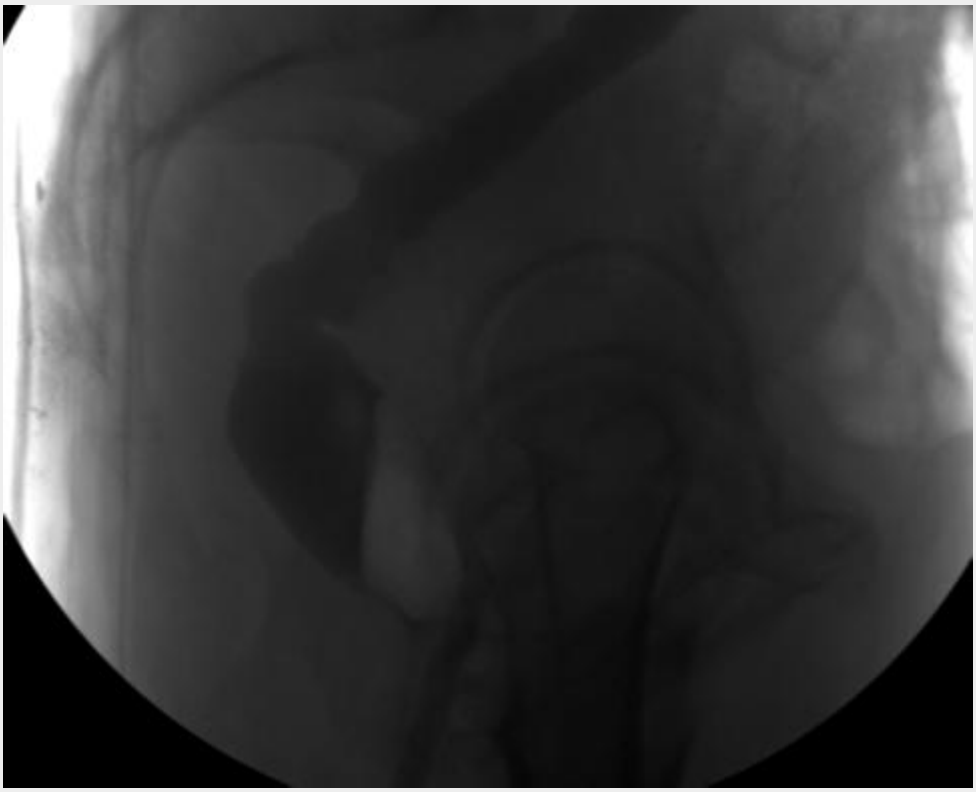

Fig 7 - No leakage from the rectal stump.

- CT also may play a part in this setting; it locates the stump and may demonstrate residual endoluminal fluid, air or debris, which are common normal findings.

Fig 8 - 65 year old patient who underwent an Hartmann procedure

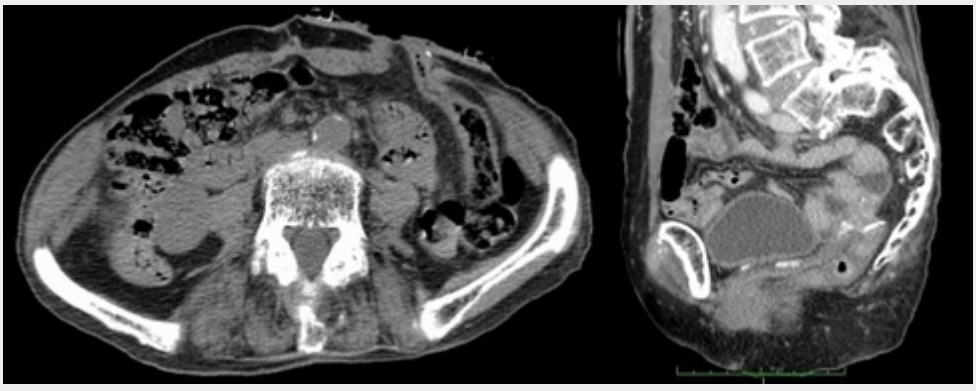

Fig 8 - CT findings of the Hartmann procedure include left flank colostomy and a closed rectal stump (note the surgical staples).

4- Restorative Proctocolectomy with Ileal pouch-anal anastomosis

- Restorative Proctocolectomy with IPAA involves a total proctocolectomy and creation of an ileal pouch with anal anastomosis.
- It can be performed as a single, 2-stage or 3-stage procedure. Three main types of ileal pouches can be fashioned – J type (the most common), S type and W type.
- It is done for definite surgical treatment of familial adenomatous polyposis, Lynch syndrome, ulcerative colitis or multiple colon cancers.

Fig 9 - Restorative Proctocolectomy with Ileal pouch-anal anastomosis

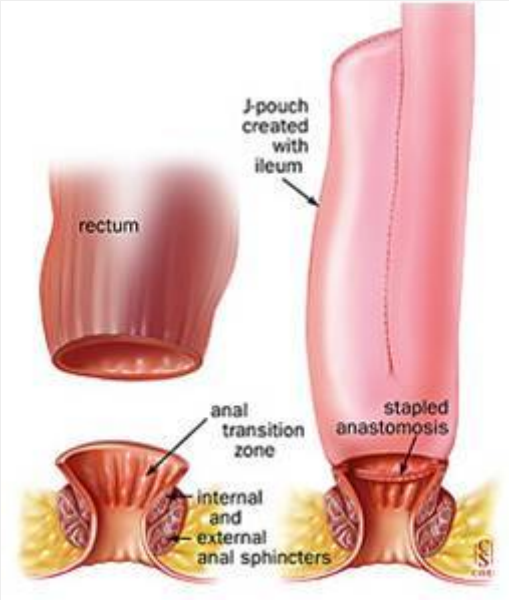

Fig 9

(https://gi.jhsps.org/GDL_Disease.aspx?CurrentUDV=31&GDL_Cat_ID=AF793A59-B736-42CB-9E1F-E79D2B9FC358&GDL_Disease_ID=5F8BA0A9-ACCC-

- A contrast enema with a water-soluble contrast should be performed at 2-3 months after surgery to exclude leakage and evaluate the integrity of the pouch.
- Prior control films are advised to visualize the surgical suture, to know which type of pouch we are dealing with and distinguish it from small leaks after rectal contrast administration.
- Anteroposterior, oblique and lateral spot radiographs of the pouch in full distention are obtained.
- Post evacuation anteroposterior and lateral views are also obtained so that an otherwise occult leakage may manifest itself.
- The J reservoir has a distinctive raphe separating the two limbs of the pouch.
- A small lenght of closed reflected ileum usually is not fully incorporated into the J pouch. When this J pouch appendage is long it can be mistaken for a leak.

Fig 10 - Gastrografin® enema of a patient who underwent restorative proctocolectomy with IPAA

Fig 10 - Normal anastomotic permeability and morphology of the J pouch.

Fig 11 - Gastrografin® enema of another patient who underwent restorative proctocolectomy with IPAA

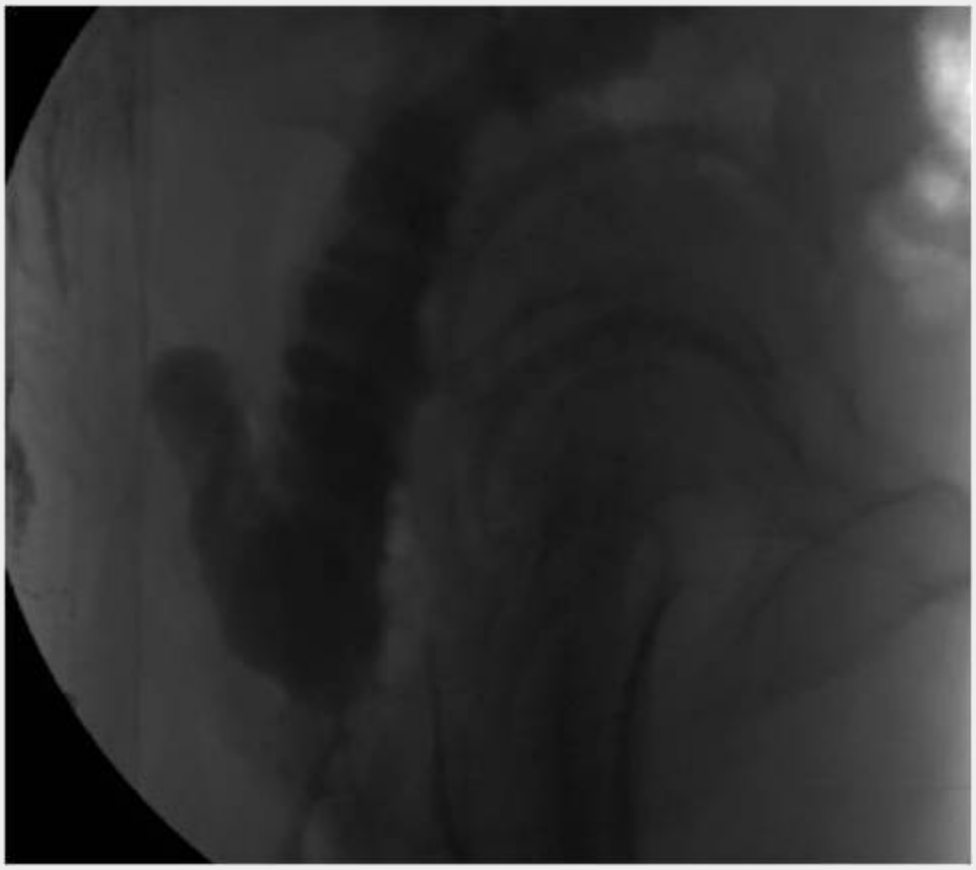

Fig 11 - Long J-pouch appendage located in the presacral space which could be mistaken for a fistulous tract.

- CT is the modality of choice in symptomatic patients for detection of infection or other complications
- Water-soluble rectal constrast may help distending the pouch for a better depiction.
- The typical postoperative findings of a J-pouch are of a fluid filled structure with a row of horizontal staples in the blind-ending ileum and a double row of staples at the vertical ileoileal anastomosis.
- The pouch has well defined margins and is in close proximity to the sacrum posteriorly and the bladder anteriorly.

Fig 12 - Pelvic CT of patient with an ileo-anal J pouch.

Fig 12 - The two limbs of the J-pouch are better appreciated in this sagittal reformation. The J-pouch is in close proximity with the bladder anteriorly and the sacrum posteriorly.

5. Segmental Resection

- It involves a localized resection of a portion of the colon.
- A straight anastomosis is most frequently done.
- Three types of anastomosis can be fashioned; end-to-end; end-to-side and side-to-side.
- End-to-side anastomosis can sometimes be mistaken for a leak.

Fig 13 - Segmental Resection

Fig 13 (http://www.st-joseph.org/LaparscopicColon)

- CT findings of this procedure are: absence of the excised part of the colon, anastomotic surgical clips and displacement of abdominal organs into the unoccupied postoperative spaces.

Fig 14 - Abdominal CT of a patient who underwent right hemicolectomy

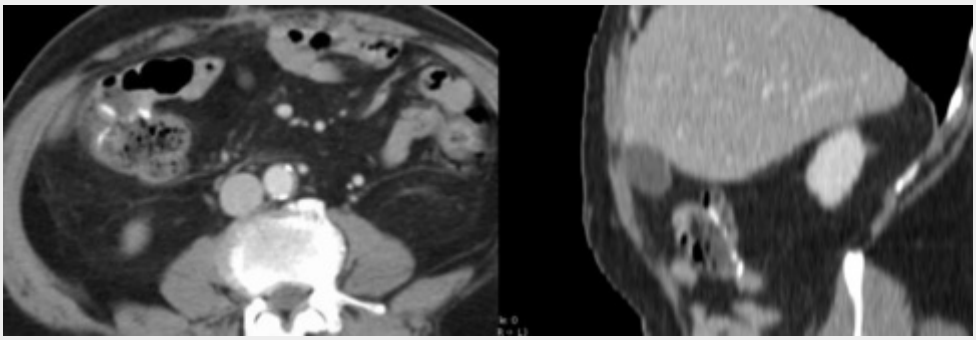

Fig 14 - End-to-side anastomosis between the terminal ileum and the transverse colon.

Fig 15 - Abdominal CT of a patient who underwent left colectomy

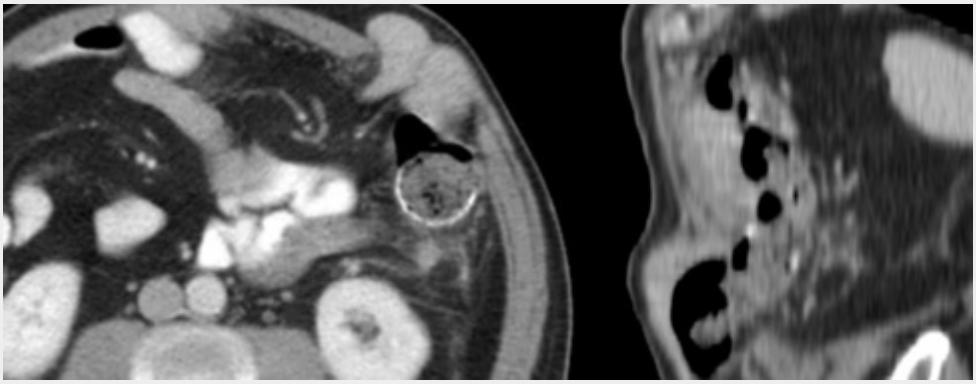

Fig 15 - End-to-end anastomosis between the transverse colon and the sigmoid colon.

B- Postsurgical complications

- **Postoperative complications may either be general or specific to the type of surgery undertaken and should be managed with the patient's history in mind.**
- **The most frequent complications of colo-rectal surgery are anastomotic leaks, fistulas, abscesses, wound dehiscence, incisional hernias and obstruction.**
- **Contrast enemas may be the best technique for some clinical situations, but MDCT allows better evaluation of the location, type and extent of the complication on most occasions.**

1. Anastomotic leaks

- Leakage most commonly occurs at the pouch-anal anastomosis, although it may also occur from the pouch itself at the staple line.
- Contrast enema's typical finding is of a contrast leak, at the level of the anastomosis, tracking to the presacral space. Anastomotic leaks are most commonly posterior in location, so lateral views are advised.

Fig 16 - 53 year old man who underwent anterior resection 3 months before. Now with fever and abdominal pain.

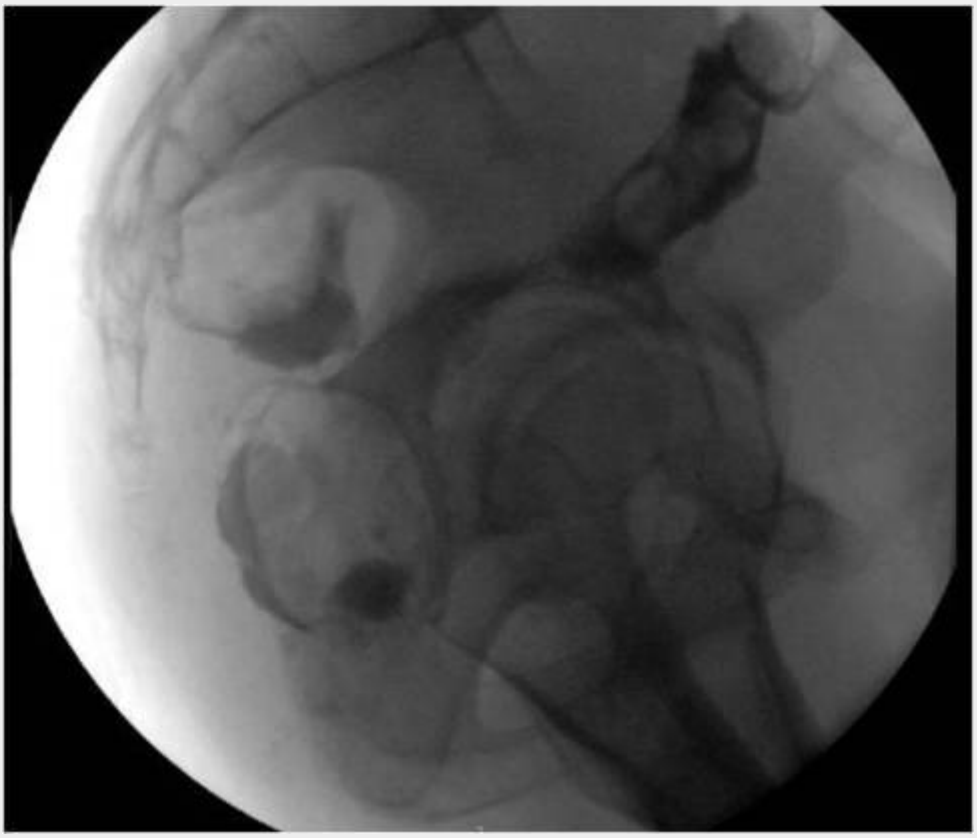

Fig 16 - Double contrast enema revealed contrast extravasation at the level of the anastomosis into the presacral space, which is widened due to a collection.

- CT is increasingly the modality of choice to evaluate for suspected anastomotic leak. It should be performed with oral, intravenous and rectal contrast. Multiplanar reformations are of paramount importance in this setting.

- Suggestive signs of anastomotic leak at CT are frank extravasation of contrast material; peri-anastomotic fluid or air collection, anterior displacement of the rectum of more than 5 cm from the sacrum, extraluminal air in higher proportion relative to fluid.

- Nevertheless, most postoperative CT features overlap between patients with and without important anastomotic leak. The only feature seen statistically more frequently is peri-anastomotic loculated fluid containing air.

Fig 17 - Abdominal CT of the same patient in Fig 16

Fig 17 - An air-fluid collection is seen right next to the colo-rectal anastomosis – an inespecific sign of anastomotic leak.

Fig 18 - 52 year old patient with fever and malaise after an anterior resection.

Fig 18 - Disruption of the suture line, an indirect sign of anastomotic leak.

2. Fistulas

- Fistulas can involve the ileal or Hartmann pouch and the vagina, bladder, uterus, other intestinal loops or the skin. They may occur secundary to an anastomotic leak or as a late complication.
- A small tract outlined with contrast material communicating with another organ makes the diagnosis on contrast enemas or fistulography.
- A potential problem in demonstrating a fistula between the anastomosis and anteriorly located structures like the vagina and bladder arises when the patient is only examined in the supine position, preventing the contrast material from reaching the anterior wall of the intestinal lumen. This is why the patient's position should be changed to a prone or 45º upright position.

Fig 19 - Fistulography through a cutaneous orifice at the left lower flank in a patient who had had a sigmoidectomy five years prior.

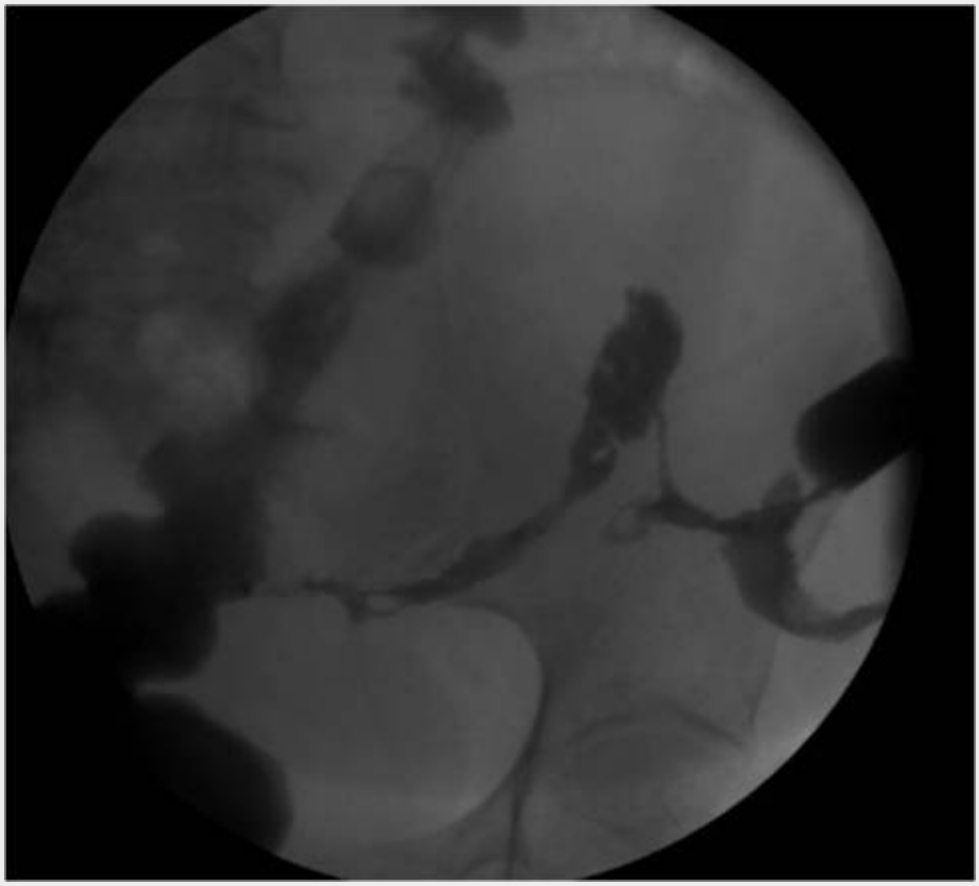

Fig 19 - Two fistulous tracts are opacified; one between the skin and a small bowel loop and another between the same small bowel loop and the colo-anal anastomosis.

Fig 20 - 40 year old woman who underwent anterior resection. Now with stool passing through the vagina.

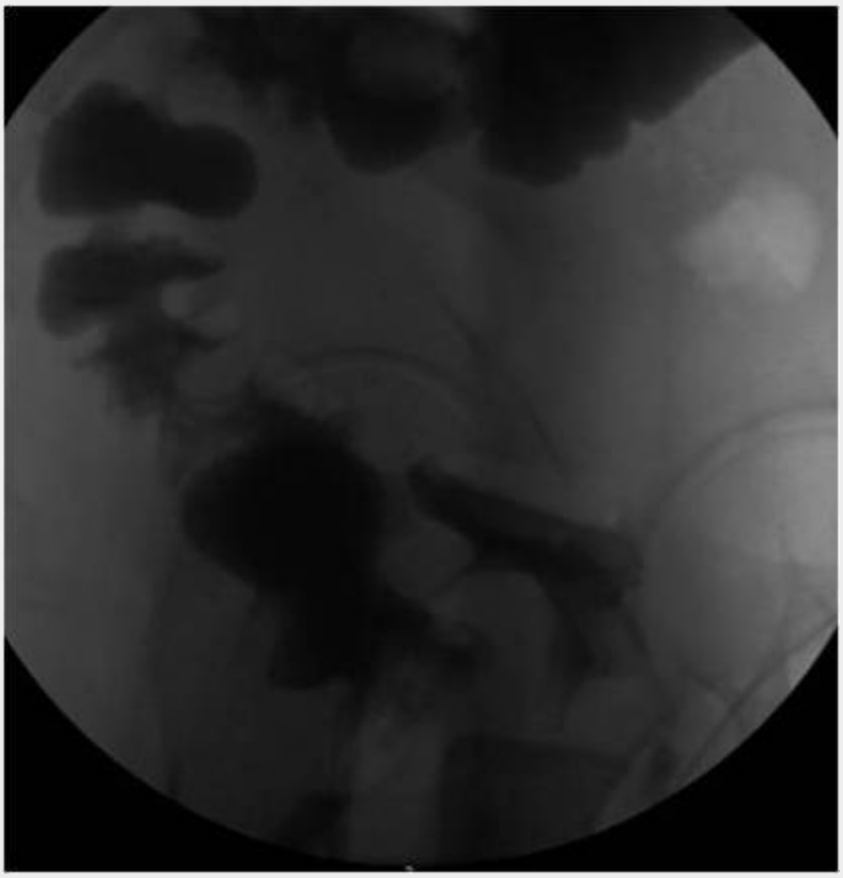

Fig 20 - Gastrografin® enema revealed a small tract of contrast between the anterior wall of the rectum and the posterior and superior wall of the vagina – rectovaginal fistula.

Fig 21 - 60 year old man who underwent restorative proctocolectomy with ileal pouch-anal anastomosis. Now with stool coming out of the urethra.

Fig 21 - Retrograde urethrocystography revealed communication of prostatic urethra with the anterior wall of the ileal pouch. There is also a large vesical diverticulum.

- CT is a better technique to demonstrate complex fistulas. They are seen as enhancing tracts of contrast material extending into the peripouch soft tissues with associated surrounding fat stranding.

Fig 22 - Abdominal CT of the same patient of Fig 21

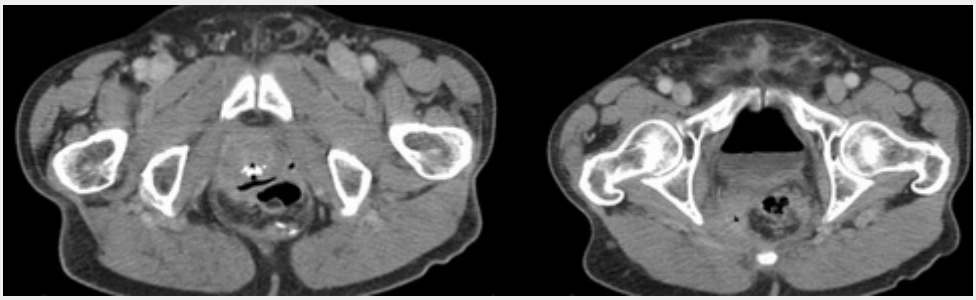

Fig 22 - Collections of air arising from the ileal pouch and communicating with the prostatic urethra (note prostatic calcifications). Air inside the vesical lumen and densification of the presacral fat on the right side of the J-pouch - the fistulous tract itself.

3. Abscesses

- Although abscess formation may be associated with anastomotic leakage it is most frequently caused by pelvic contamination during surgery.
- Anterior displacement of the pouch on contrast enema may be an indirect sign of an abscess at the presacral space.
- CT is the modality of choice when there is suspicion of an abscess. It demonstrates fat inflammatory changes associated with discrete abscesses which typically present as a gas and/or fluid collection with a peripheral enhancing rim.
- CT may also serve to guide percutaneous management of the collections.

Fig 23 - Abdominal CT of a 60 year old patient with fever a month after restorative proctocolectomy with ileal pouch-anal anastomosis

Fig 23 - An air-fluid collection, with thick enhancing wall is seen on the presacral space, with anterior displacement of the rectum – an abscess.

Fig 24 - Pelvic CT of a 55 year old woman with a few days after restorative proctocolectomy with ileal pouch-anal anastomosis

Fig 24 - Fluid collection with a small air-fluid level and a thick enhancing wall at the widened presacral space - an abcess.

4. Wound dehiscence

- Wound dehiscence is an uncommon but troublesome complication of all abdominal surgeries. While most of the cases present in a readily recognizable way, some are clinically unapparent.
- It occurs as a consequence of inflammation, infection and necrosis at or adjacent to the wound, and may evolve to hernia if not treated either medically or surgically.
- CT findings of wound dehiscence include separation between the layers of the abdominal wall and a fluid collection with or without associated air within the wound site and adjacent tissues.
- Secondary intention wound closure may mimic wound dehiscence, but in this case there will not be an associated fluid collection.

Fig 25 - Abdominal CT of a 54 year old male who underwent Hartmann procedure 2 months before

Fig 25 - Separation of the layers of the abdominal wall associated with a fluid collection with small air bubbles near the suture – wound dehiscence. Note colostomy at the right flank.

Fig 26 - Abdominal CT of a 60 year old male who underwent abdominal surgery some weeks before

Fig 26 - There is separation between the layers of the abdominal wall but no associated fluid or air collections - secondary intention wound closure.

5. Incisional hernia

- An incisional hernia is a type of hernia caused by an incompletely-healed surgical wound; most will develop during the first 4 months after surgery, a critical period for the healing of transected muscular and fibrous layers of the abdominal wall.
- The diagnosis is usually based on clinical palpation. Radiologic studies are used to visualize the extent of the herniated segments (which can be bowel loops or only mesenteric fat) and to evaluate associated complications.
- A stomal or parastomal hernia is a frequent type of incisional hernia that occurs at the site or adjacent to the stoma.
- It does not have pathological significance unless incarceration ensues (fluid accumulation, intestinal wall thickening and fat stranding at the stoma).
- Many of the symptomatic patients after colorectal surgery undergo CT, primarily to exclude intraadominal processes. However, the CT appearance of the abdominal wall must also be carefully assessed as a clinically occult incisional hernia may be the unsuspected cause of the patient's symptoms.

Fig 27 - Abdominal CT of a 67 year-old man who underwent Hartmann procedure, with right flank colostomy

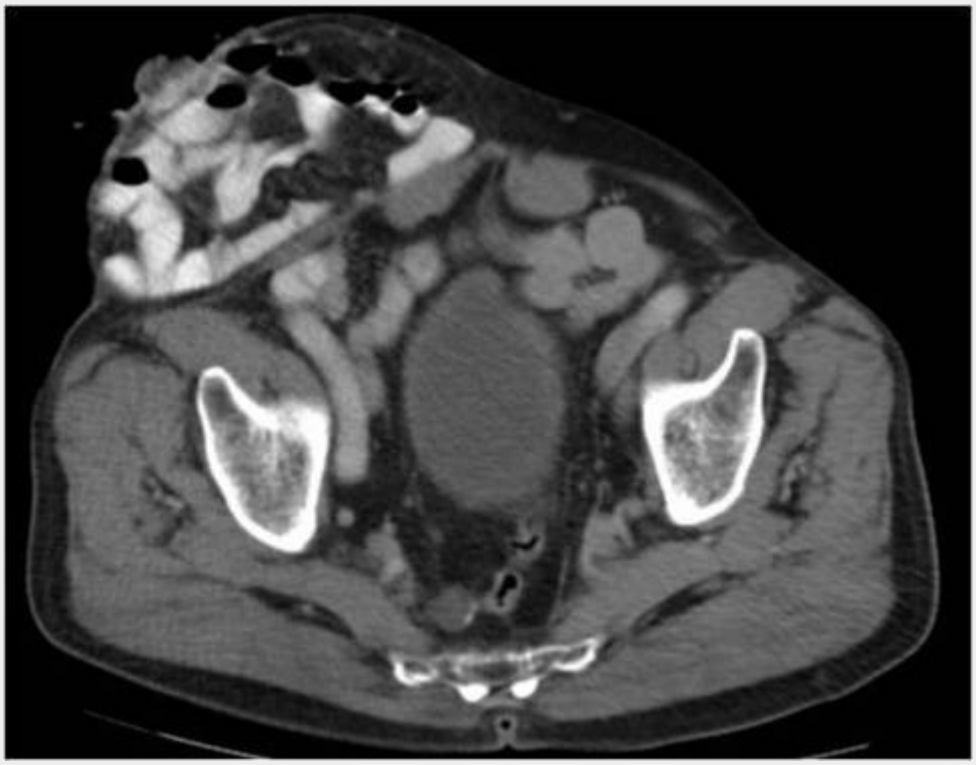

Fig 27 - Large parastomal hernia on the right flank with bowel loops and mesenteric fat, with no signs of incarceration. Note also small fluid collection near the colonic stump at the presacral space – probable fibrosis / granulation tissue.

Fig 28 - Abdominal CT of patient with a colostomy

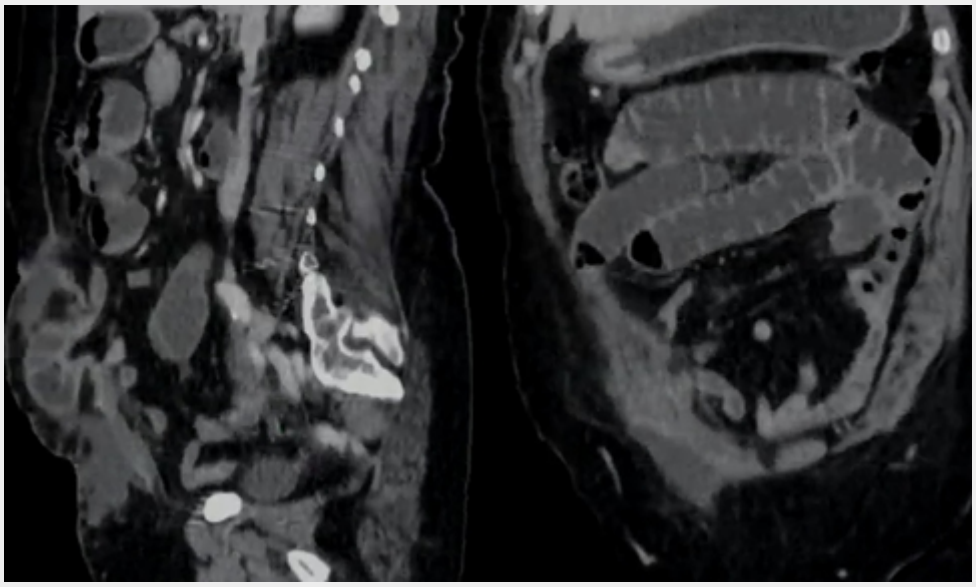

Fig 28 - Small bowel obstruction due to parastomal hernia with bowel and mesenteric contents, associated with moderate amount of fluid - indicative of incarcerated hernia.

6. Pseudo-obstruction and obstruction

- Postoperative ileus (**pseudo-obstruction**) is the most common cause of bowel dilatation in the immediate postoperative period. This condition lasts typically only for the first 48 hours and CT will not show any identifiable cause for the obstruction.

- If symptoms persist after 48 hours then other causes must be considered. CT usually is the initial test at this point in time.

Fig 29 - Abdominal CT in a patient with abdominal pain 36 hours after surgery

Fig 29 - Diffuse colon distension with no identifiable mechanical cause - pseudo-obstruction.

- Typical CT findings of **obstruction** are distended bowel loops proximal to a transition point.
- Adhesions, strictures and tumour recurrence are some of the most frequent causes for mechanical obstruction after colorectal surgery.

6a. Adhesions

- Adhesions are the most common cause of delayed bowel obstruction after colo-rectal surgery.
- The diagnosis of adhesion-related small-bowel obstruction is presumed on CT if there is a narrow zone of transition without an identifiable obstructive lesion. Other CT findings that suggest adhesions are an acute angulation of the small bowel, traction deformities, stretching of loops, small bowel loops closely applied to the anterior abdominal wall and in a very small percentage of cases a “fat –bridging” sign of the adhesive band itself.
- Low-grade and partial high-grade obstructions are treated by enteric decompression.
- Those with complete, closed-loop, or strangulating obstruction require emergent surgery.

Fig 30 - Abdominal CT of a patient with obstruction who had colorectal surgery some years ago

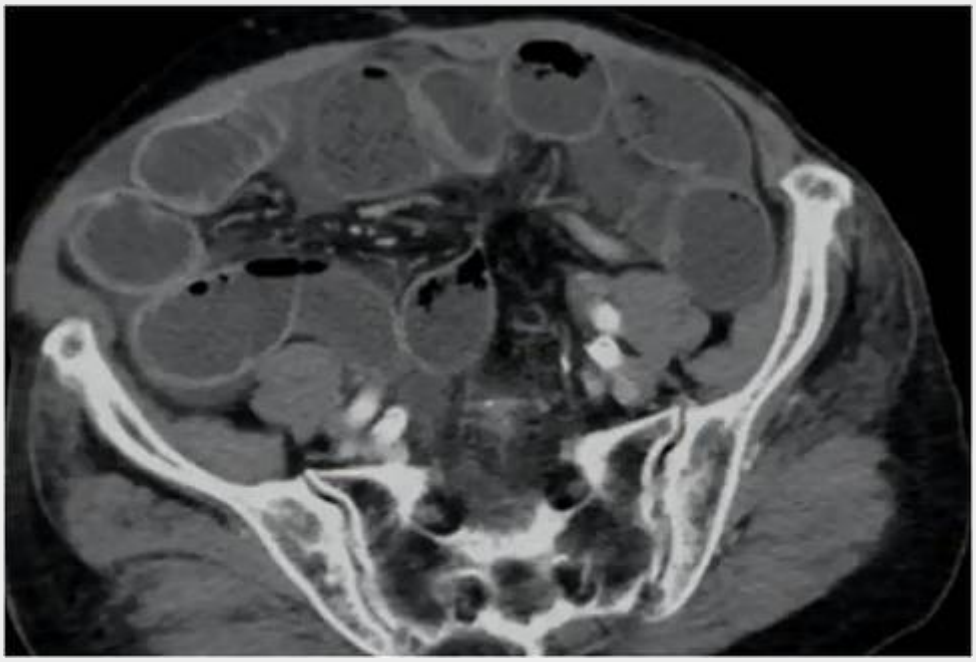

Fig 30 - Small bowel distension proximal to a narrow point of transition where there is an acute angulation, with traction deformities of the mesenteric vessels. There is no identifiable lesion at the transition point. Note small bowel loops closely applied to the anterior abdominal wall and ascites - adhesion related obstruction.

6b. Anastomotic strictures

- Anastomotic strictures are not an infrequent postsurgical finding. Benign anastomotic strictures can be caused by fibrosis, haemorrhage, ischaemia or leakage at the suture line.
- In the first days following surgery it is most probably caused by haemorrhage or edema.
- In delayed cases it can be caused by fibrosis or recurrence of the primary disease (IBD or tumor).
- Some early anastomotic strictures resolve spontaneously; in others, balloon dilatation or surgery is needed.

Fig 31 - Gastrografin® enema of a patient who underwent anterior resection a week before.

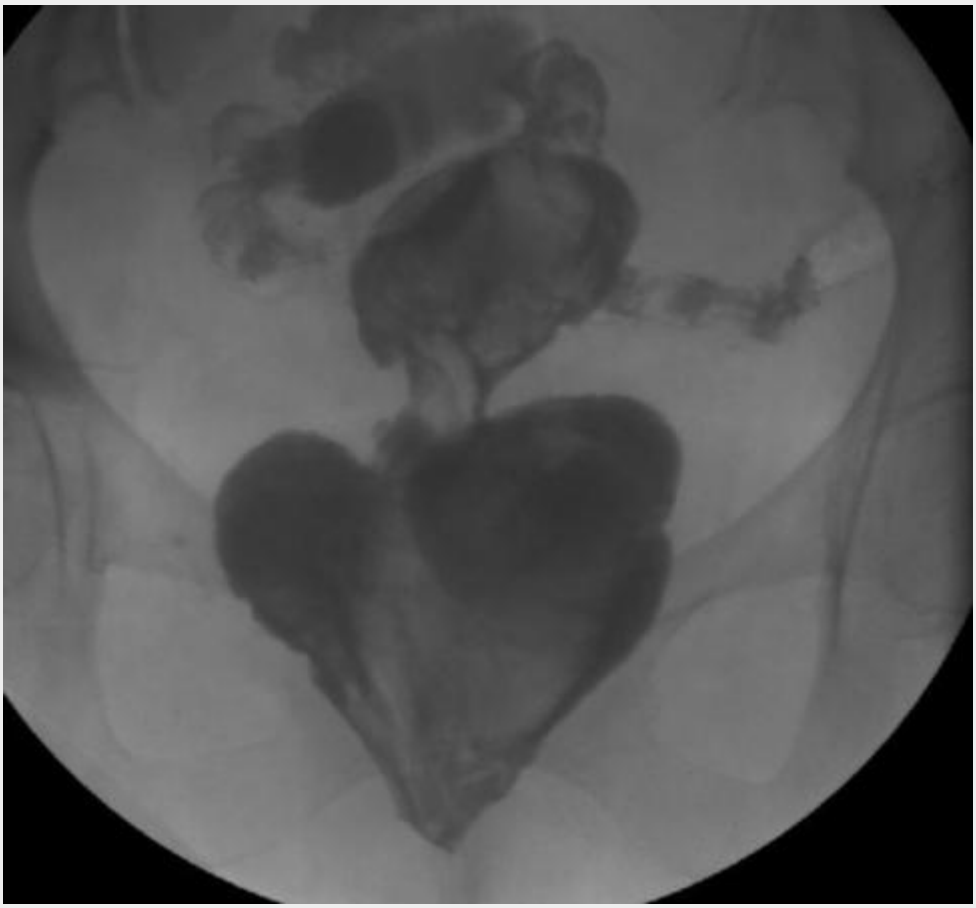

Fig 31 - Short anastomotic stricture that resolved spontaneously some days after - probable haemorrhagic / edematous stenosis.

Fig 32 - Gastrografin® enema of a patient who had had an anterior resection some years before.

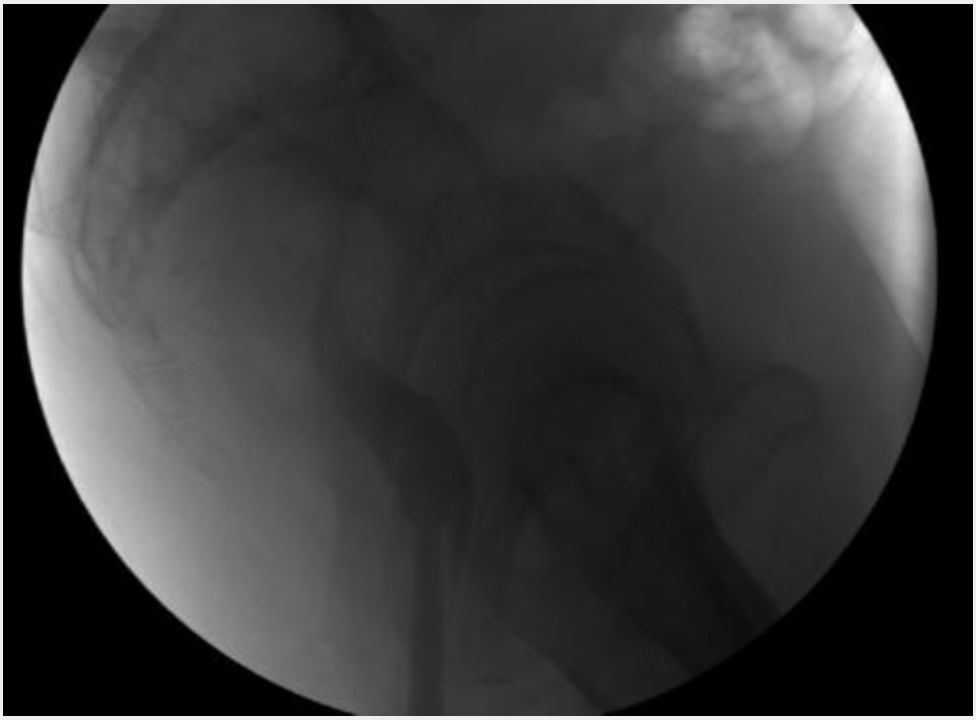

Fig 32 - No progression of rectal contrast beyond the colo-anal anastomosis. There is also widening of the presacral space.

Fig 33 - Pelvic CT of the same patient of Fig 32

Fig 33 - Large soft tissue mass completely surrounding the colo-anal anastomosis (note the suture clips), as the cause for the obstruction - fibrotic stricture.

6c. Tumor recurrence

- Tumor recurrence may be the cause of obstruction several months or years after colo-rectal surgery.
- The imaging findings are of an enhancing mass or assymetric wall-thickening, near the site of the resected tumor, that was not present on prior exams or increased in size.
- As said before, tumor recurrence needs to be diferentiated from the midline mass present in most patients who underwent abdominal perineal resection.

Fig 34 - Enhanced pelvic CT of a 79-year old woman who underwent sigmoidectomy for colon adenocarcinoma one year ago. Now with obstructive symptoms.

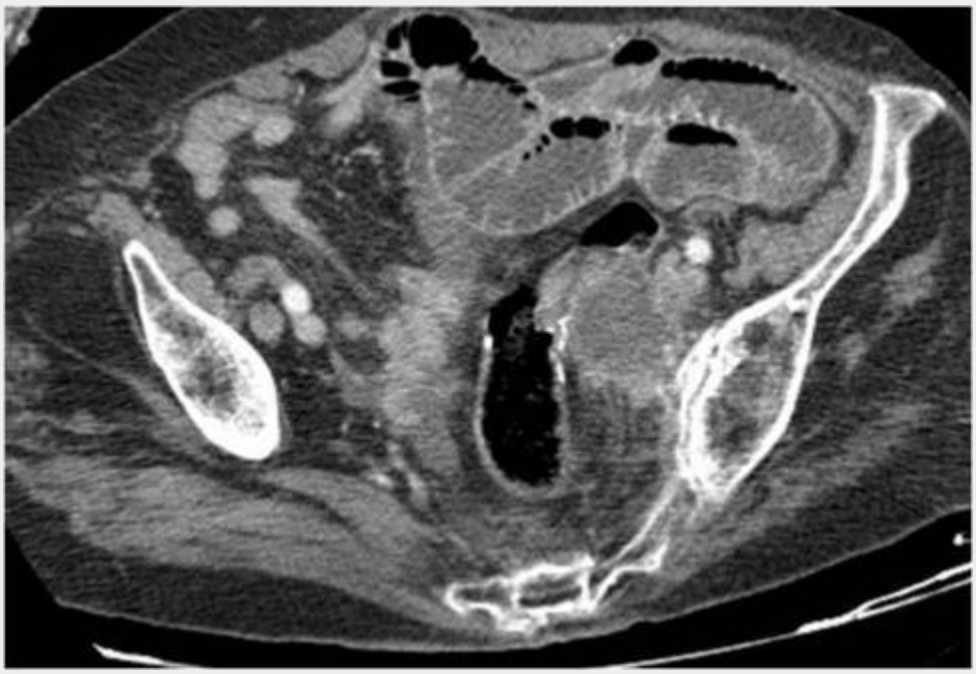

Fig 34 - Asymmetric thickening of the bowel wall and hypodense mass adjacent to the colo-rectal anastomosis, that caused proximal bowel distension - later confirmed as tumor recurrence.

4. Conclusion

Communication with the referring surgeon is advised before performing a diagnostic examination. Nevertheless, a familiarity with the types of surgery, most common anastomosis and most frequent complications are of paramount importance for every diagnostic radiologist, so that potentially life-threatening situations can be promptly diagnosed.

5. References

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6. Author Information

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7. Mediafiles

Fig 1 - Abdominal perineal resection

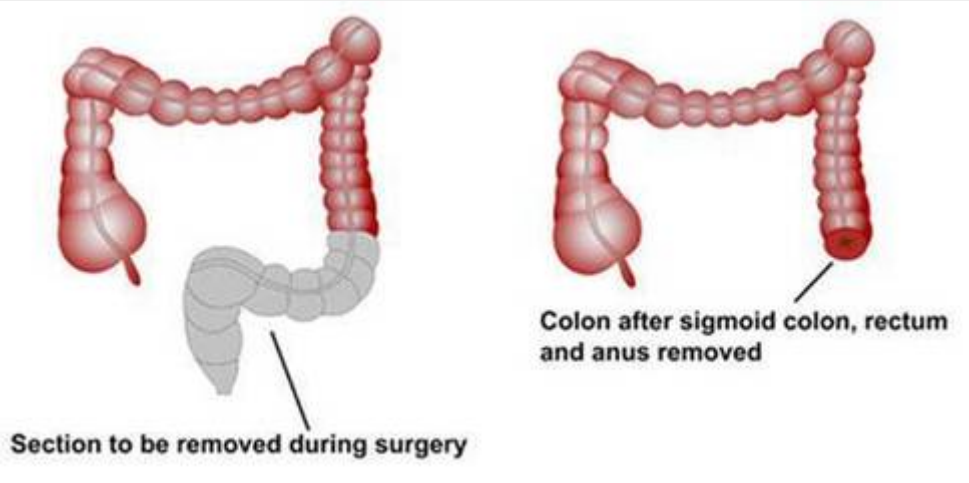

Fig 2 – Pelvic CT of a 83 year old patient who underwent abdominal perineal resection

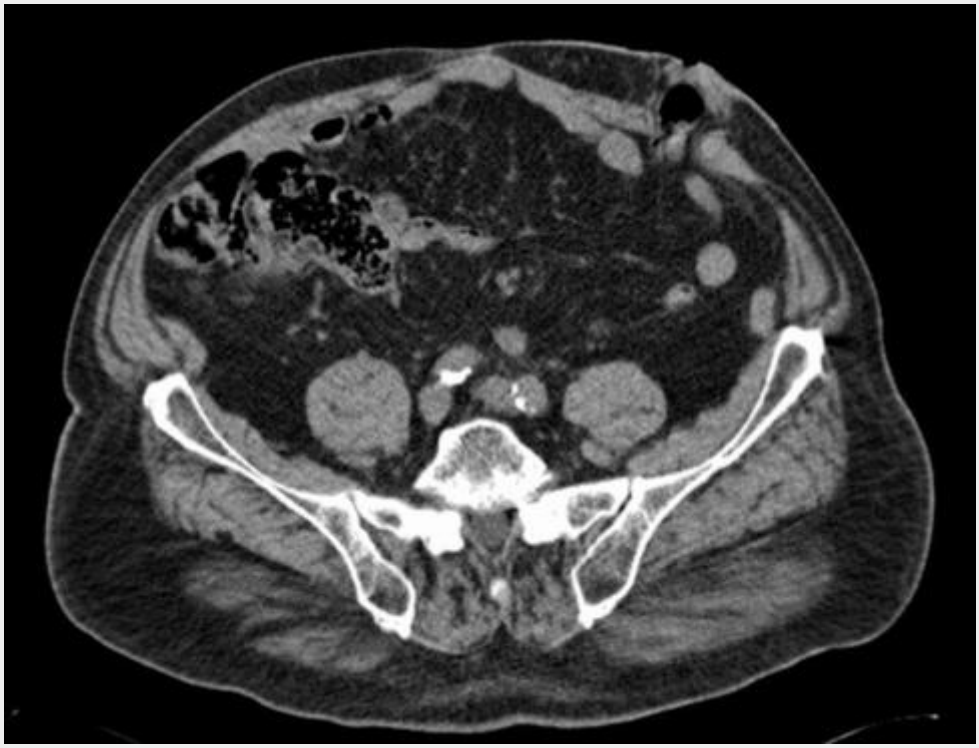

Fig 3 – Pelvic CT of a 83 year old patient who underwent abdominal perineal resection (same patient of Fig 2)

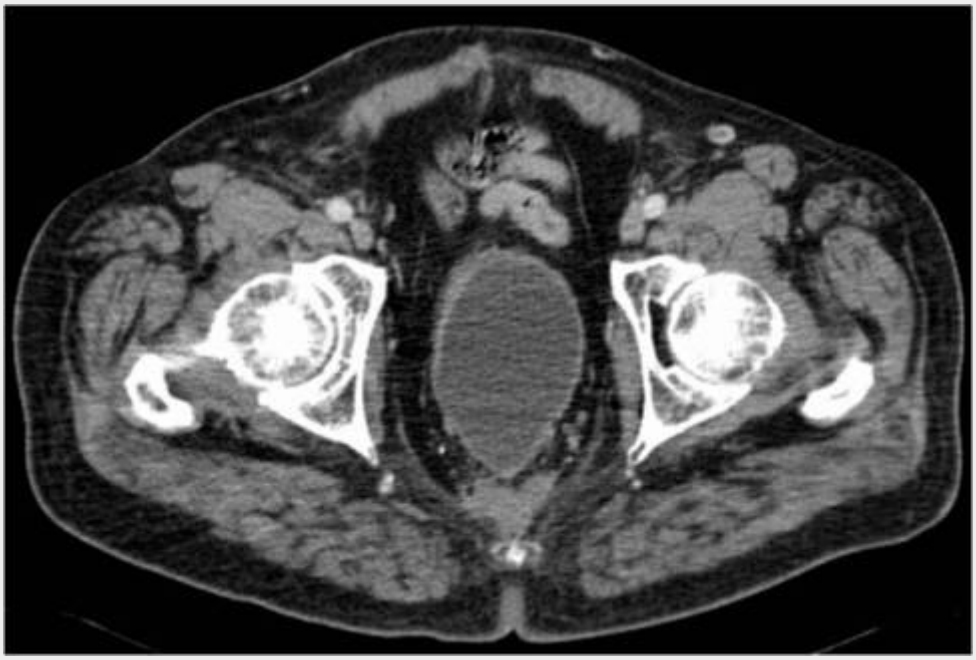

Fig 4 - Anterior resection

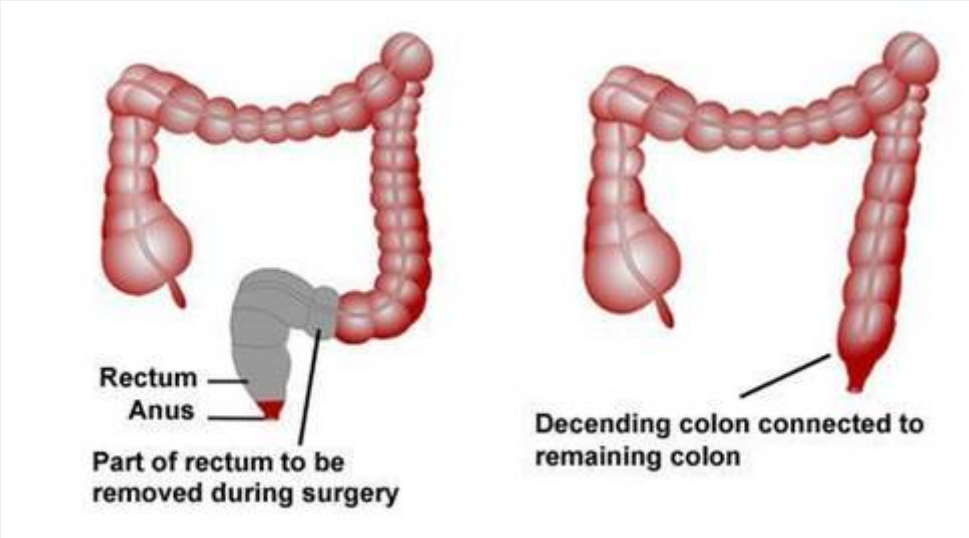

Fig 5 - Pelvic CTs of a patient who underwent anterior resection some years ago, with interval of 6 months between the two exams

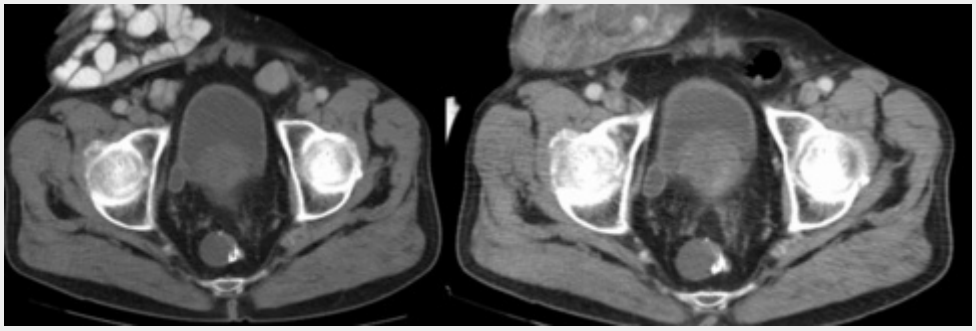

Fig 6 - Hartmann procedure

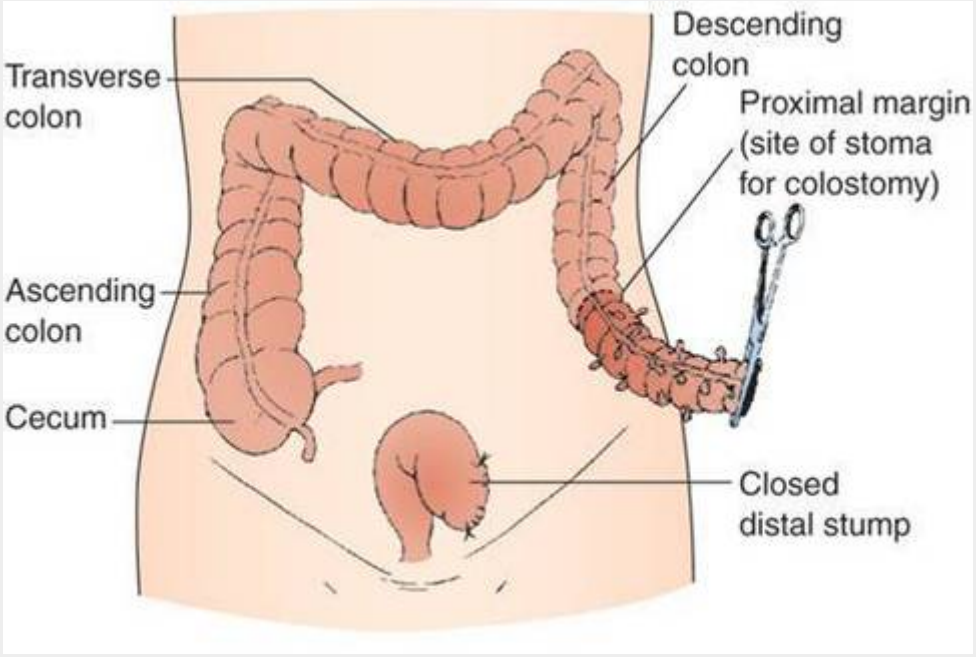

Fig 7 - Gastrografin® enema of a 63 year old woman who underwent Hartmann procedure

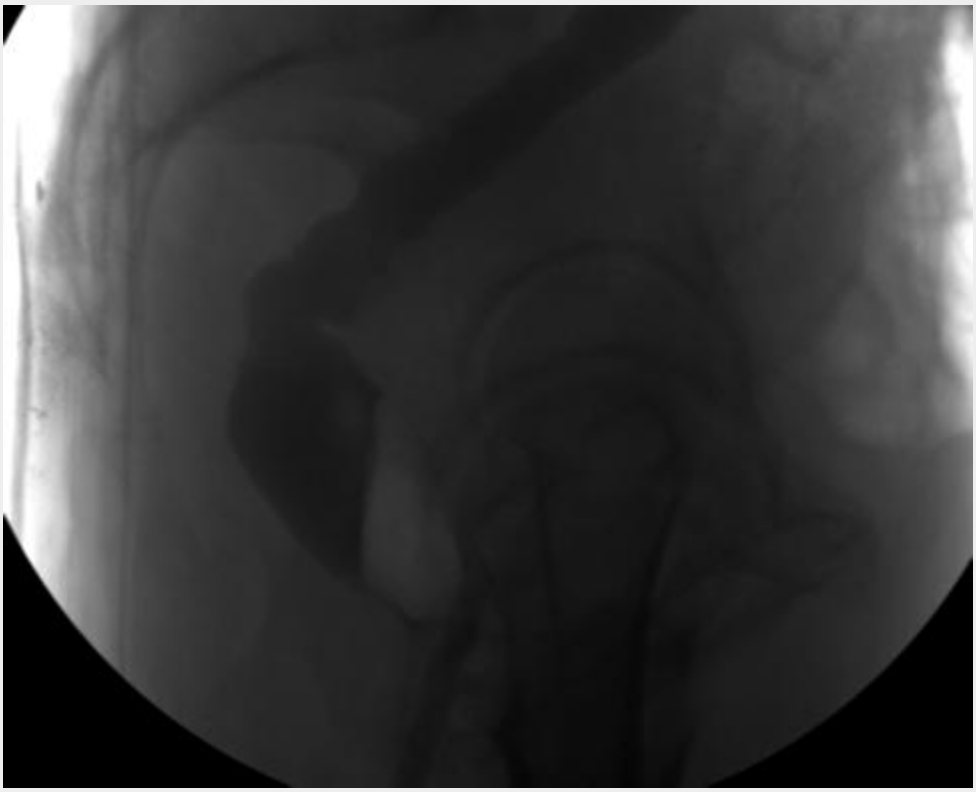

Fig 8 - 65 year old patient who underwent an Hartmann procedure

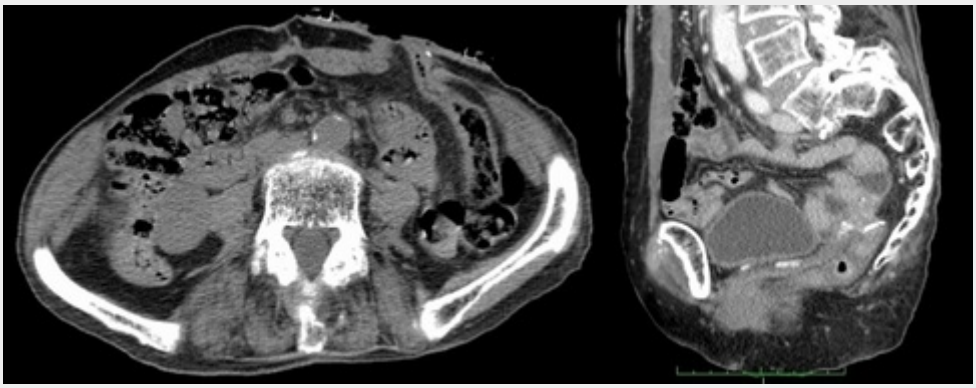

Fig 9 - Restorative Proctocolectomy with Ileal pouch-anal anastomosis

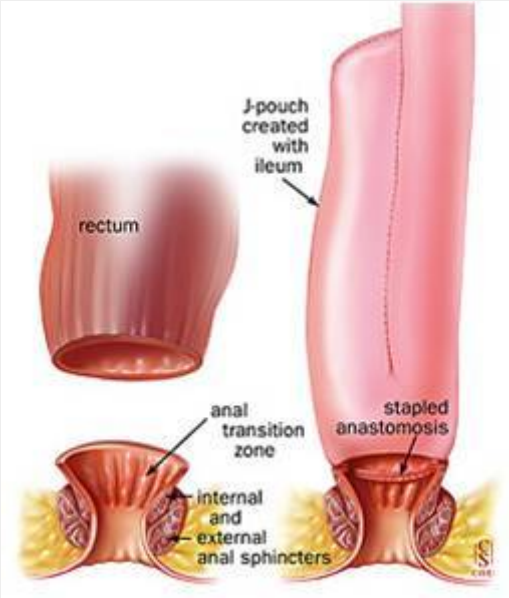

Fig 10 - Gastrografin® enema of a patient who underwent restorative proctocolectomy with IPAA

Fig 11 - Gastrografin® enema of another patient who underwent restorative proctocolectomy with IPAA

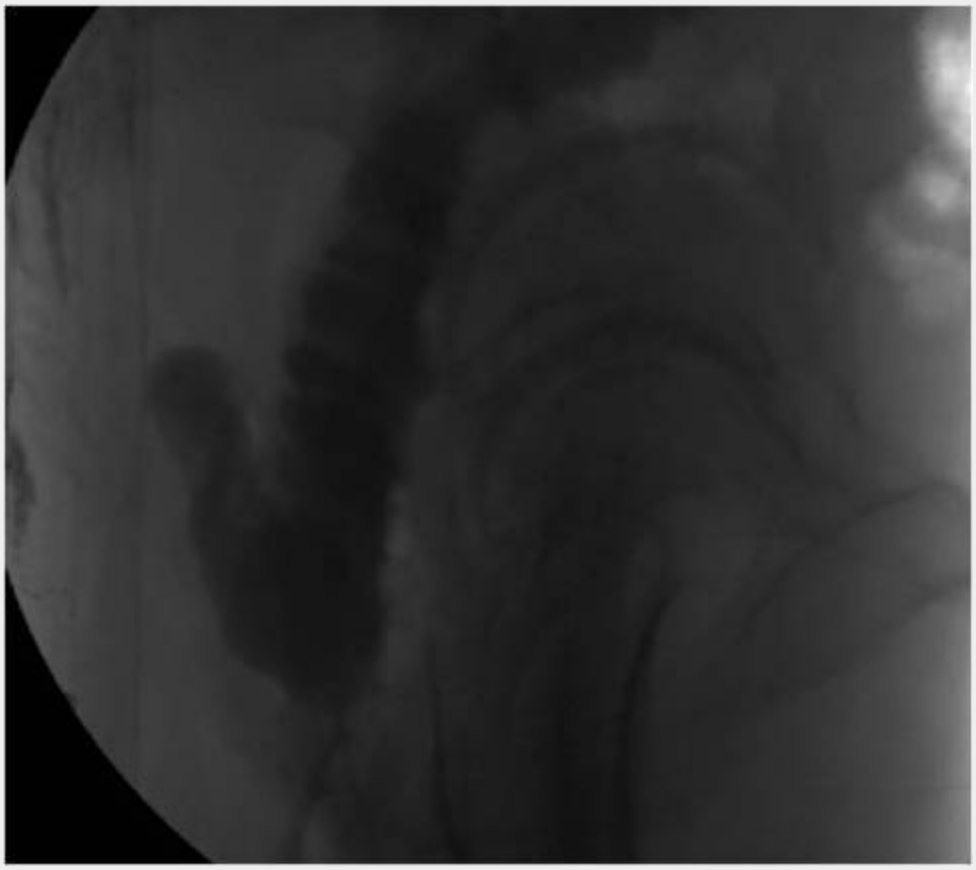

Fig 12 - Pelvic CT of patient with an ileo-anal J pouch.

Fig 13 - Segmental Resection

Fig 14 - Abdominal CT of a patient who underwent right hemicolectomy

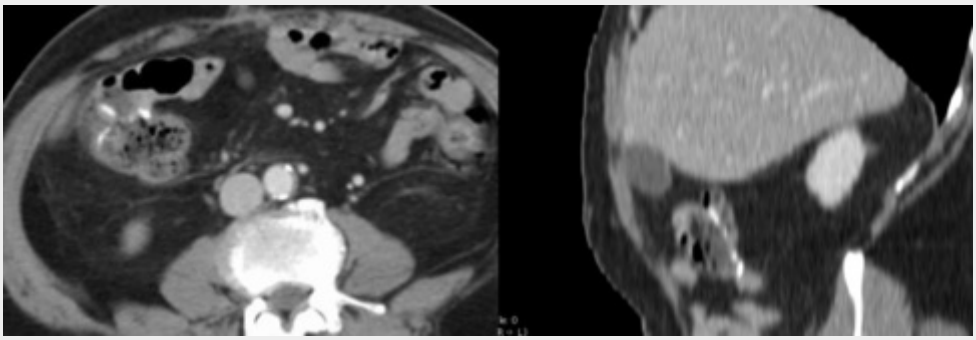

Fig 15 - Abdominal CT of a patient who underwent left colectomy

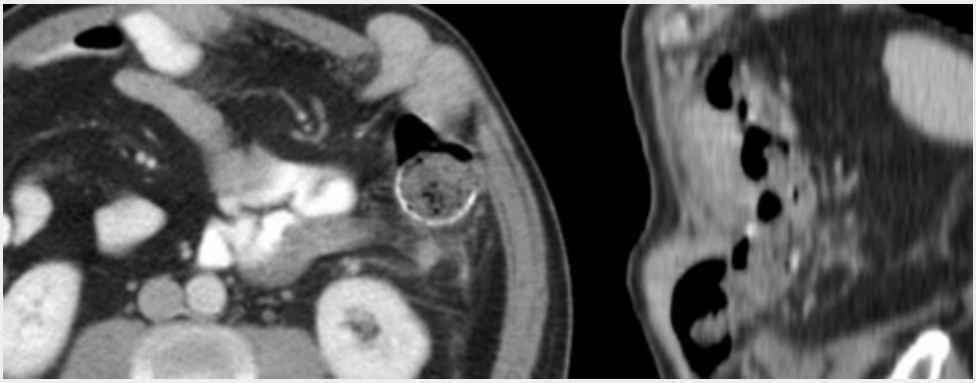

Fig 16 - 53 year old man who underwent anterior resection 3 months before. Now with fever and abdominal pain.

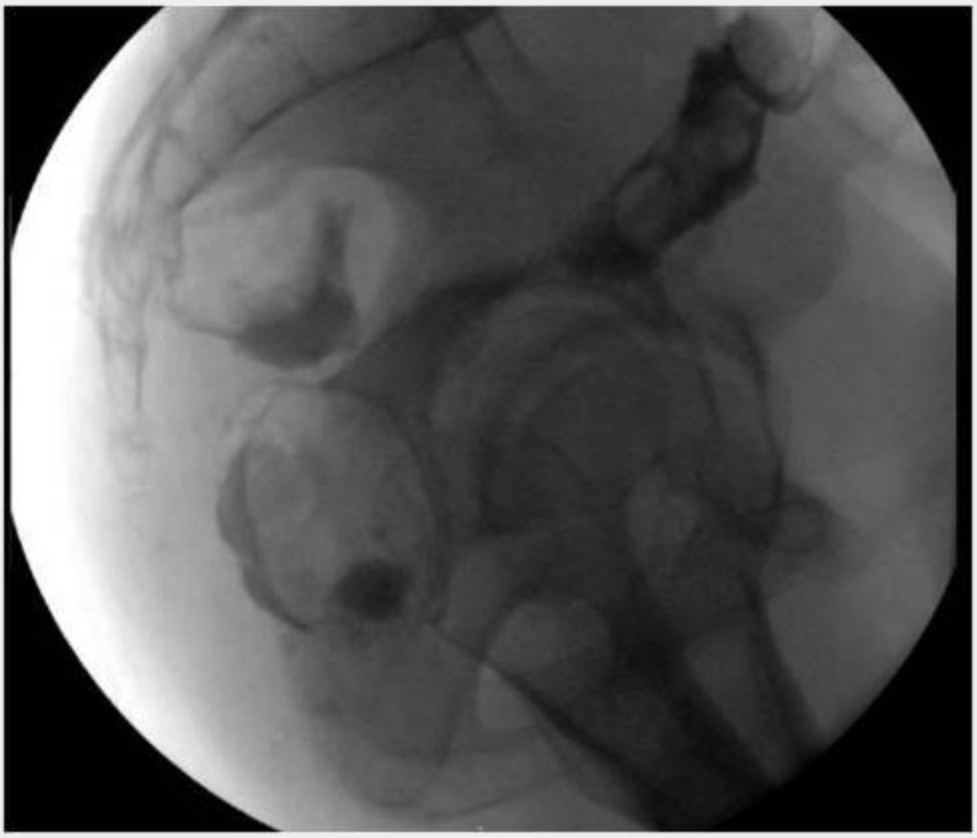

Fig 17 - Abdominal CT of the same patient in Fig 16

Fig 18 - 52 year old patient with fever and malaise after an anterior resection.

Fig 19 - Fistulography through a cutaneous orifice at the left lower flank in a patient who had had a sigmoidectomy five years prior.

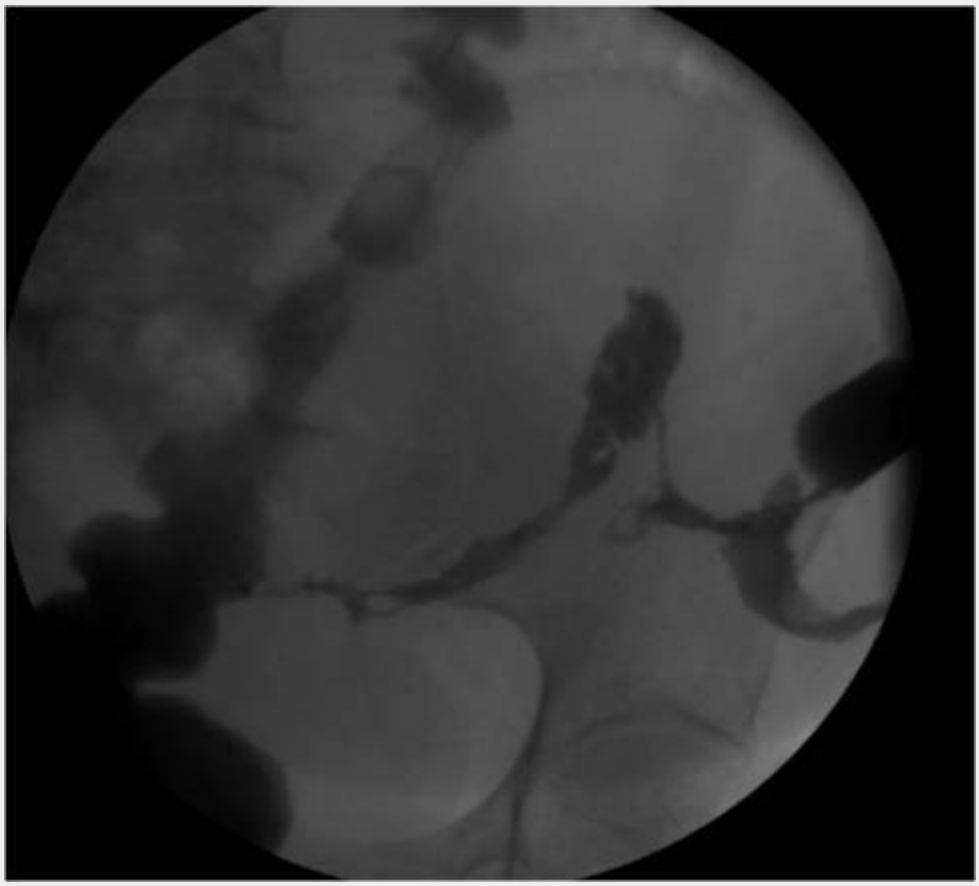

Fig 20 - 40 year old woman who underwent anterior resection. Now with stool passing through the vagina.

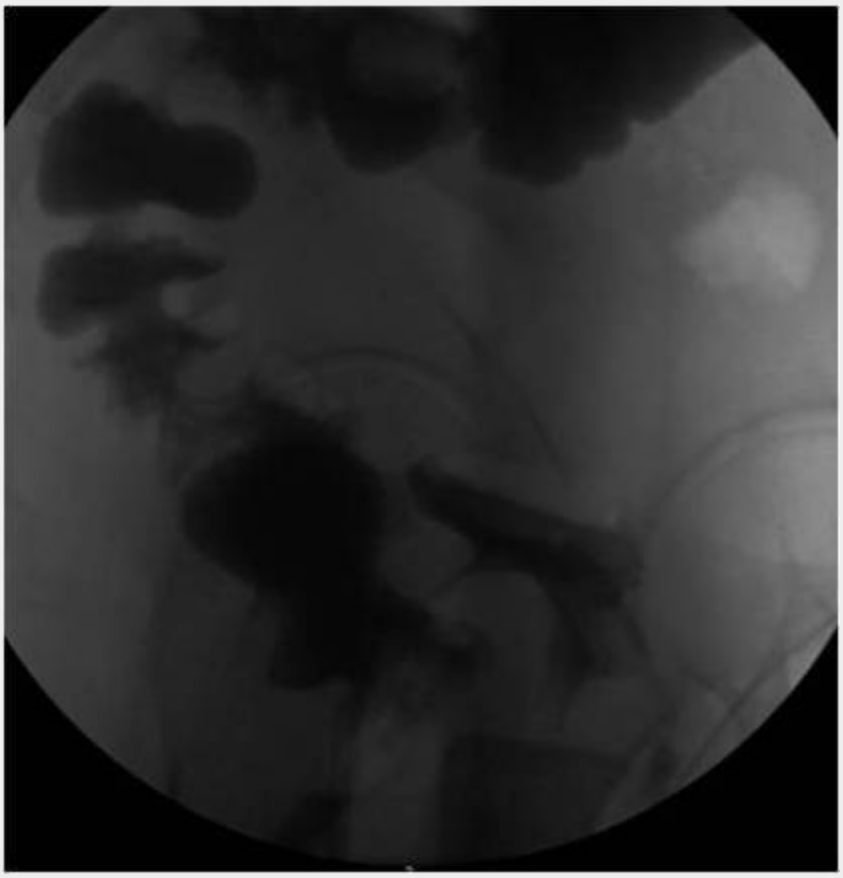

Fig 21 - 60 year old man who underwent restorative proctocolectomy with ileal pouch-anal anastomosis. Now with stool coming out of the urethra.

Fig 22 - Abdominal CT of the same patient of Fig 21

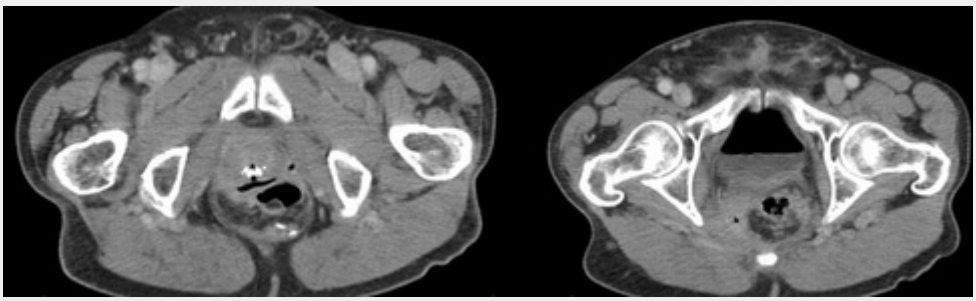

Fig 23 - Abdominal CT of a 60 year old patient with fever a month after restorative proctocolectomy with ileal pouch-anal anastomosis

Fig 24 - Pelvic CT of a 55 year old woman with a few days after restorative proctocolectomy with ileal pouch-anal anastomosis

Fig 25 - Abdominal CT of a 54 year old male who underwent Hartmann procedure 2 months before

Fig 26 - Abdominal CT of a 60 year old male who underwent abdominal surgery some weeks before

Fig 27 - Abdominal CT of a 67 year-old man who underwent Hartmann procedure, with right flank colostomy

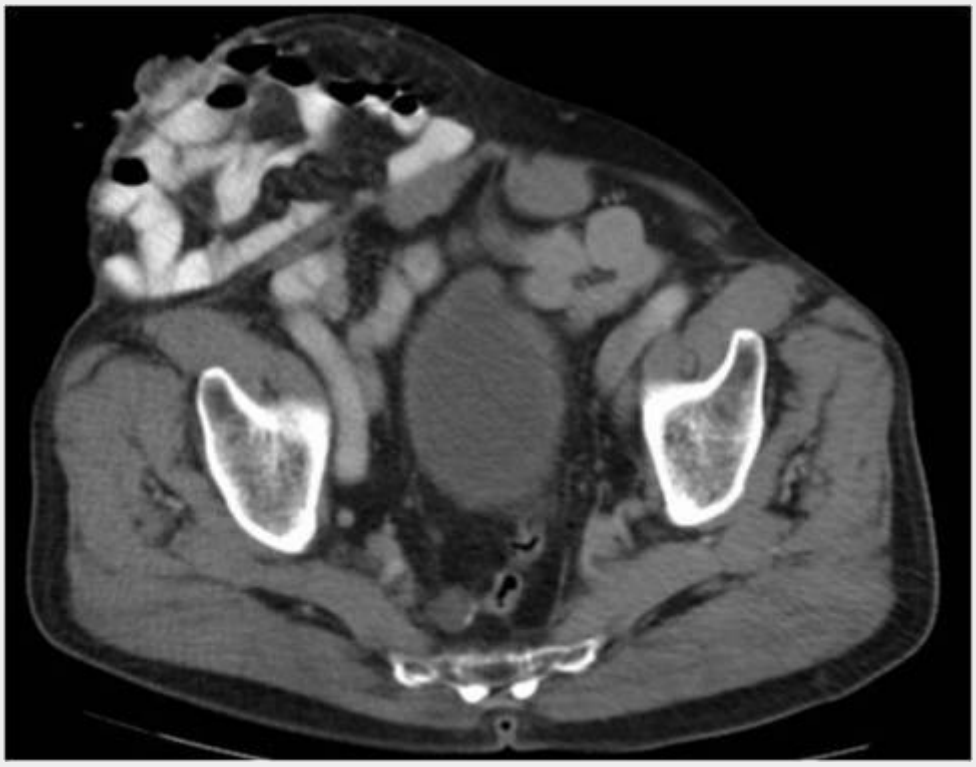

Fig 28 - Abdominal CT of patient with a colostomy

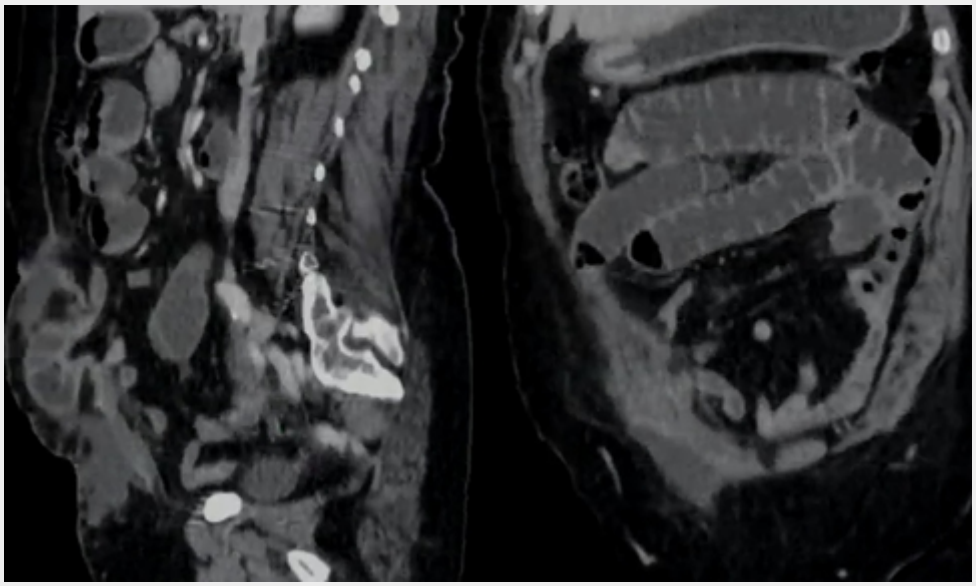

Fig 29 - Abdominal CT in a patient with abdominal pain 36 hours after surgery

Fig 30 - Abdominal CT of a patient with obstruction who had colorectal surgery some years ago

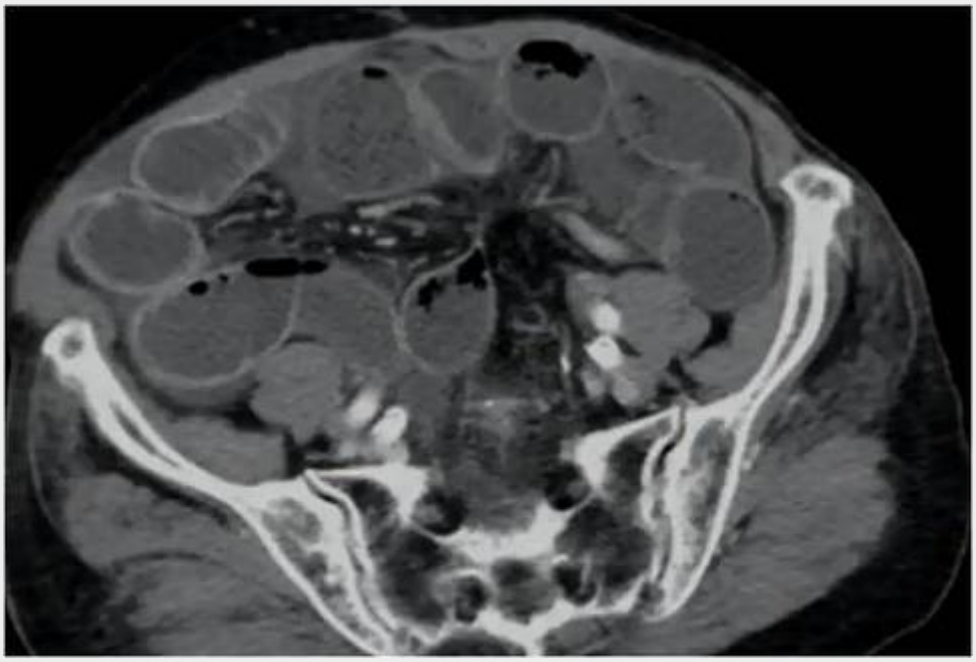

Fig 31 - Gastrografin® enema of a patient who underwent anterior resection a week before.

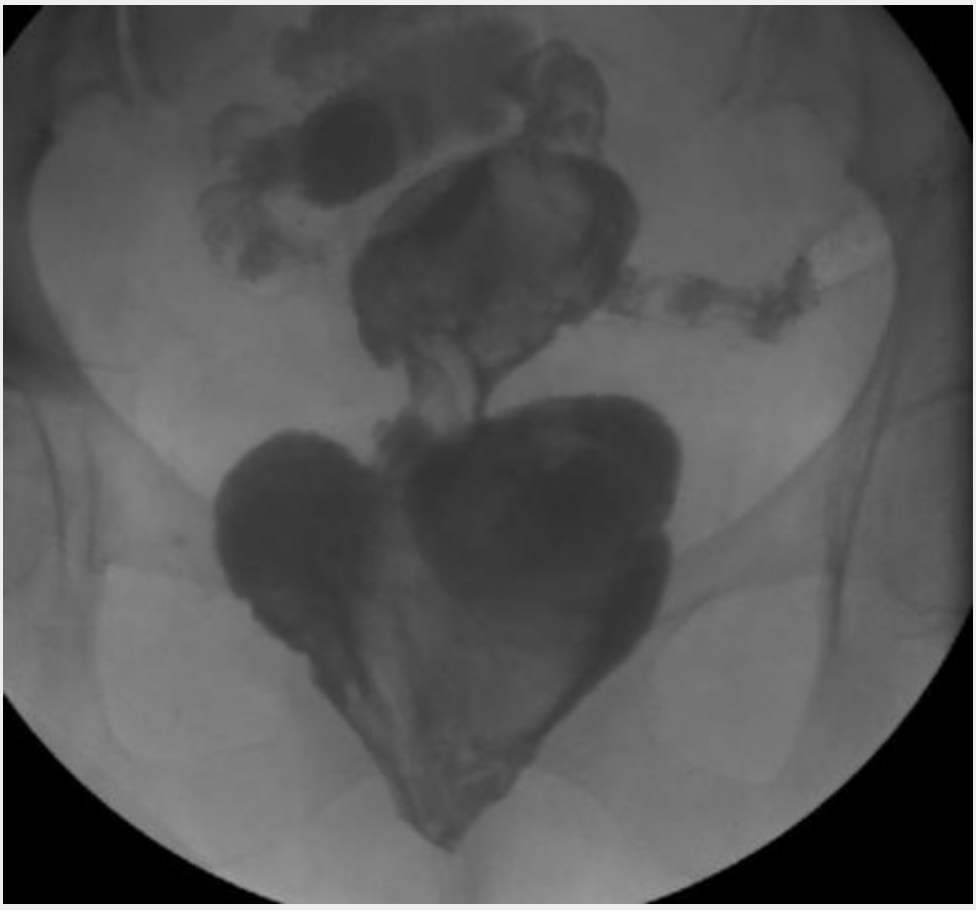

Fig 32 - Gastrografin® enema of a patient who had had an anterior resection some years before.

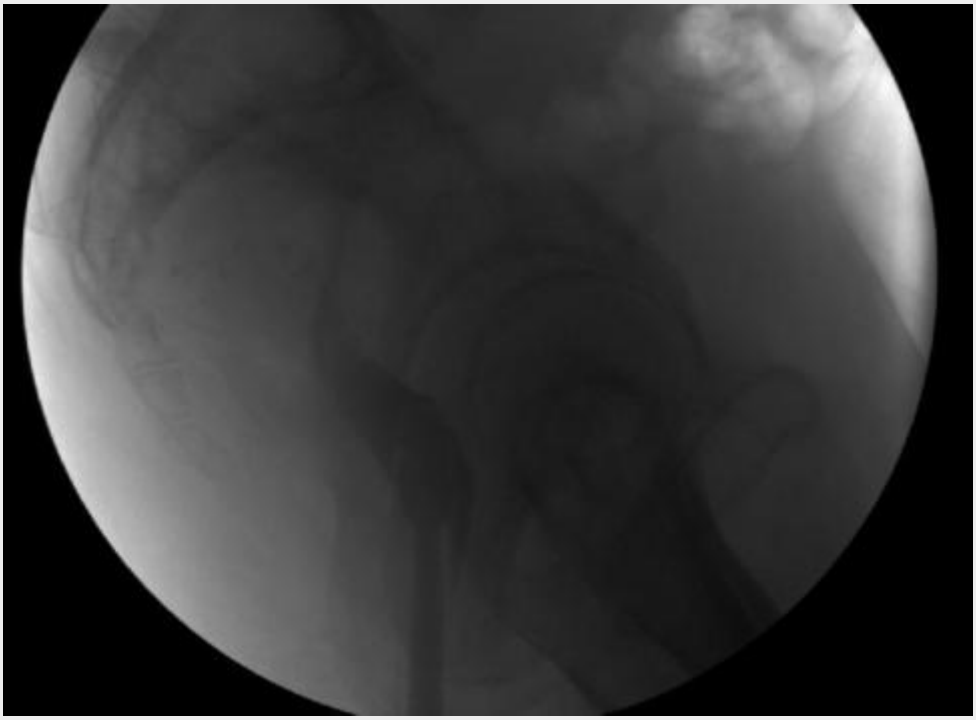

Fig 33 - Pelvic CT of the same patient of Fig 32

Fig 34 - Enhanced pelvic CT of a 79-year old woman who underwent sigmoidectomy for colon adenocarcinoma one year ago. Now with obstructive symptoms.