



CONTINUING EDUCATION PROGRAM: FOCUS

Imaging in colonic cancer



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KEYWORDS

Colonic cancer;
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Abstract Whilst the diagnosis of colonic cancer is always based on visually guided flexible colonoscopy, which is the only technique that provides a histological diagnosis, the pre-treatment assessment of the cancer involves computed tomography. This can determine the exact site of the cancer in the colon, its dimensions and juxta-colonic extension and is used to investigate for liver, mesenteric or lung metastases.

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Colorectal cancer is a modern day public health problem: 42,152 new cases were recorded in 2012 [1] and the incidence of the disease has increased by more than 50% in thirty years. Five to 6% of the French population will develop colorectal cancer, 60% of this population before the age of 50 years old.

The diagnosis of colonic cancer is based on visually guided flexible colonoscopy, which both directly visualizes the tumor and enables biopsies to be taken which are required for histological diagnosis.

Imaging is useful if colonoscopy is impossible or incomplete, in emergency situations (obstruction or perforation) and for the staging assessment of a tumor.

Indications for imaging

Imaging is involved in three situations in colonic cancer. The central role of visually guided flexible colonoscopy should not however be forgotten.

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Investigating polyps: CT colonography

Screening for these premalignant lesions may be for personal reasons (in a population at high risk – past personal or family history – or those at very high risk – the inherited colonic cancers and polyposis) or by mass screening (general population over the age of 50 years old). The investigations which are currently proposed are stool testing using the hemoccult and visually guided flexible colonoscopy. CT colonography is indicated if visually guided flexible colonoscopy fails or is refused and can be offered more generally to patients at moderate risk who want more than a hemoccult test or for patients at high risk who do not wish to undergo colonoscopy. The technique uses gas (CO₂) as the method of colonic distension and is read on dedicated software.

Clinically suspected cancer: water enema CT

The clinical signs of colonic cancer are well known – alternating diarrhea and constipation, rectal bleeding, pain or the finding of an abdominal mass, deterioration in general health and iron deficiency anemia. Water enema CT is indicated if visually guided flexible colonoscopy is unsuccessful or is impossible and for the preoperative assessment of the tumor. The technique uses water as the means of distending the colon and can be performed routinely without dedicated software.

Acute complication of colonic cancer: “simple” abdominal and pelvic CT

In the event of obstruction or perforation, a “simple” (i.e. without colonic opacification) abdominal and pelvic CT can be used in an emergency to diagnose cancer and its complications.

New treatment approaches

The radiologist must be aware of these new approaches in order for the initial assessment to be complete and appropriate.

Surgically

Colectomies (left, right and total) are performed laparoscopically by most surgical teams [2].

Early rehabilitation (ERAS) [3] is increasingly used. This practice involves an overall “non-aggressive” approach to the patient in the perioperative period, in particular with no preoperative colonic preparation. This makes it impossible to carry out preoperative colonoscopy and requires accurate initial identification of small lesions.

Surgery for liver metastases is advancing rapidly and can be performed (depending on the surgical teams and number and sites of the lesions) in the same surgical stage as the colectomy or may be performed later.

Surgery for peritoneal carcinomatosis is also developing and involves a tumor resection stage, either combined or not combined with intra-peritoneal chemotherapy.

Chemotherapy

Neoadjuvant chemotherapy (in addition to adjuvant chemotherapy) can be offered for non-metastatic colonic cancer which is associated with poor prognostic indicators such as invasion of the muscularis (T3), peritoneum or a neighbouring organ (T4) [4].

Insertion of a colonic stent

This is an endoluminal technique (performed radiologically or endoscopically), which releases a colonic obstruction. The size of the prosthesis used depends on the length of the stenosed bowel. It does, however, carry well-known risks of long-term dissemination and perforation. If surgery is possible, it should be performed shortly after the stent has been inserted.

Questions asked by the surgeon to the radiologist

These are specific and all have an impact on treatment: the radiology report should therefore answer these questions point by point.

What is the precise site of the tumor in the colon?

Topographic errors may be made in visually guided flexible colonoscopy, particularly beyond the left colonic flexure in dolichocolon, and a small tumor may be difficult to identify laparoscopically.

What is the extension of the tumor?

Tumor extension to the peritoneum is a contraindication to laparoscopic surgery (a risk of dissemination into the peritoneal cavity).

Depending on the site of the tumor, certain organs should be assessed: the left ureter and bladder for a left colonic lesion, the duodenum for a right colonic lesion and the stomach and pancreas for a transverse colonic lesion.

Are metastases present (liver or lung)?

If they are, initial surgery is carried out. The metastases need to be precisely located and measured to monitor their change and decide on any subsequent surgery.

Is peritoneal carcinomatosis present?

If this is shown on imaging (CT, PET CT or MR), initial chemotherapy is started before any subsequent consideration of peritoneal surgery, whether or not combined with intra-peritoneal chemotherapy with hyperthermia (IPCH).

If any questions remain about the imaging assessment, an exploratory laparoscopy should be planned.

If carcinomatosis is found preoperatively, the procedure combined with tumor reduction depends on the location and number of tumor sites.

Is the colon pre-perforated?

In this case, surgery should be performed without delay. A decision may be taken to insert a colonic stent depending on the patient's general health, pending surgery under optimal conditions.

The radiologist's answers in the non-emergency situation: water CT

In this situation, the answers are provided by water enema CT [5–7].

Technique

This investigation involves a simple technique: after introducing a cannula connected to an enema bag containing 2 litres of warm water, an image recorded under normal contrast conditions is used to confirm that severe stercoral impaction is not present and to investigate the liver before contrast injection. The enema is then started and is passed quickly (three minutes) without mobilizing the patient, who remains in the decubitus position. A second acquisition is performed after IV iodinated contrast enhancement injection in the portal phase. The enema is evacuated as soon as the acquisition is finished by tipping the enema bag downwards. The investigation lasts a total of ten minutes.

If a tumor lesion is found, the chest is examined during the same investigation.

The water enema CT is read on a standard viewing console by examining axial reconstructions and both coronal and sagittal reconstructions.

Appearances

Normally the colonic wall appears as a regular thin line (less than 3 mm thick), enhancing homogeneously in the portal phase. The haustrations and folds are followed easily by scrolling through the axial sections and multi-planar

reconstructions. The bowel lumen is open and the pericolic fat is homogeneous in appearance.

A colonic cancer appears as local wall thickening with pronounced heterogeneous enhancement. The lesion may be budding and sessile in the lumen of the colon or may be more or less circumferential. It may or may not be associated with stenosis of the lumen of the bowel and infiltration of the adjacent fat. Its location within the bowel should be described.

Staging assessment

Any enlarged lymph nodes or metastases (liver, mesenteric or lung) should be identified.

In a recent work (unpublished data), we have proposed an assessment of tumor stage (stage T of the international TNM classification) by examining the appearances of the peritoneal edge of the tumor: convex for T1 or T2 lesions (the distinction between the 2 stages is impossible on imaging) (Fig. 1) and concave and "stiff" for a T3 lesion (breaching the muscularis) (Fig. 2). Invasion of a neighbouring organ (abdominal wall, liver, bladder, pancreas, stomach, duodenum or fascia) indicates a stage T4 lesion (Fig. 3) and infiltration of the adjacent fat should be deemed to be a poor prognostic indicator [8].

The site of the tumor in the colon is identified from the various reconstructed planes (Fig. 4).

The N stage is more difficult to establish. In our study we considered peri-tumor lymph nodes over 5 mm in size, enhancing to more than 100 UH, to be invaded (specificity 77.4%; sensitivity 77.3%) (Fig. 5). Surgical lymph node curettage removes several nodes and when histological examination cannot identify the node believed to be positive we define a tumor as N+ when at least one lymph node meets these criteria.

Pitfalls and differential diagnoses

Some situations can make the diagnosis more difficult. These include chronic sigmoid diverticulitis lesions which cause thickening of the wall or a small tumor located in a fold (Fig. 6). A second tumor site must not be missed (Fig. 7).

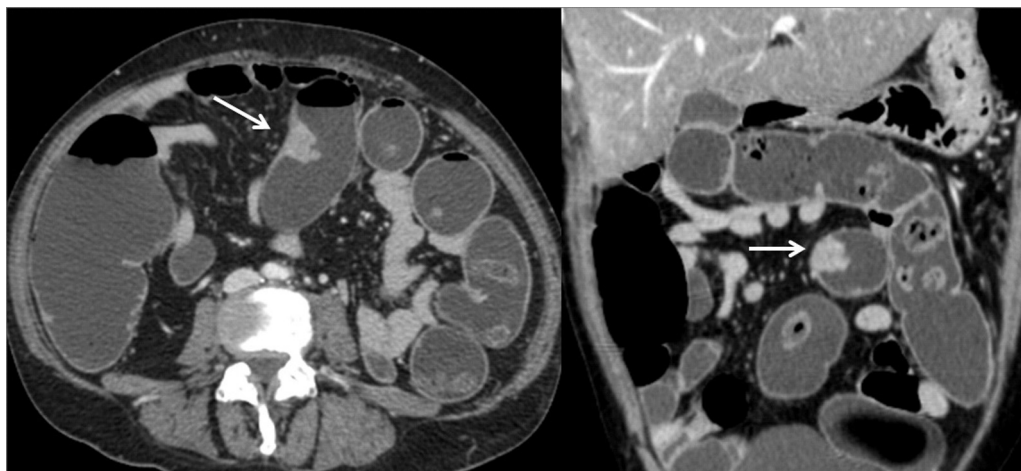


Figure 1. Water enema CT: stage T2 adenocarcinoma in the sigmoid colon: exophytic lesion with convex regular peritoneal outline (arrows).

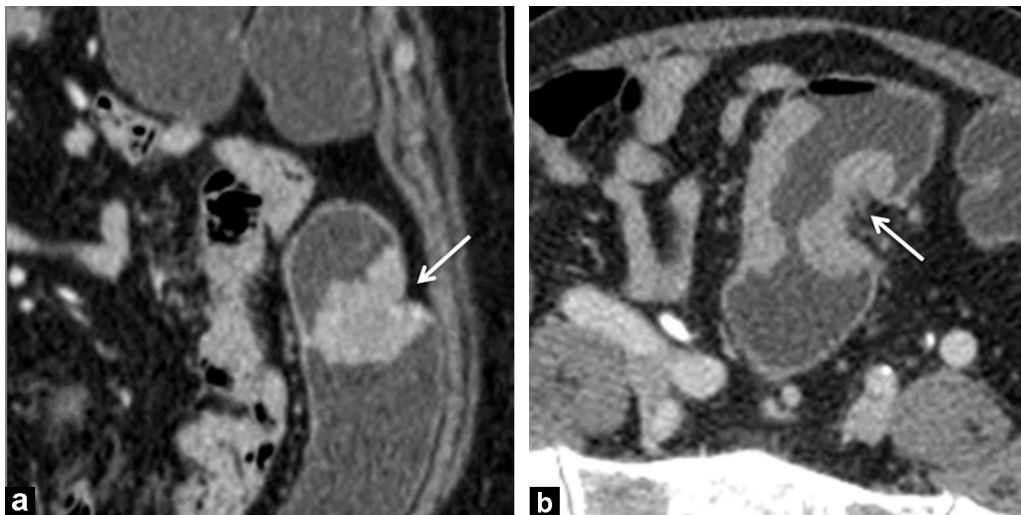


Figure 2. Water enema CT: stage T3 adenocarcinomas: "stiff" concave lesions at the peripheral edge: exophytic shaped tumor (a) and circumferential stenotic tumor (b) (arrows).

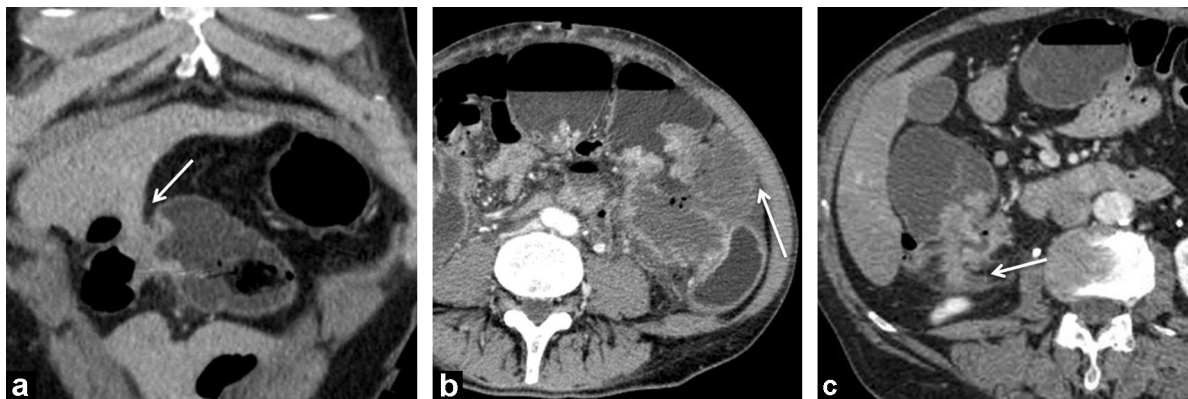


Figure 3. Water enema CT: stage T4 adenocarcinomas: tumors invading a neighbouring organ: the liver (a), abdominal wall (b), right posterior wall fascia (c) (arrows).

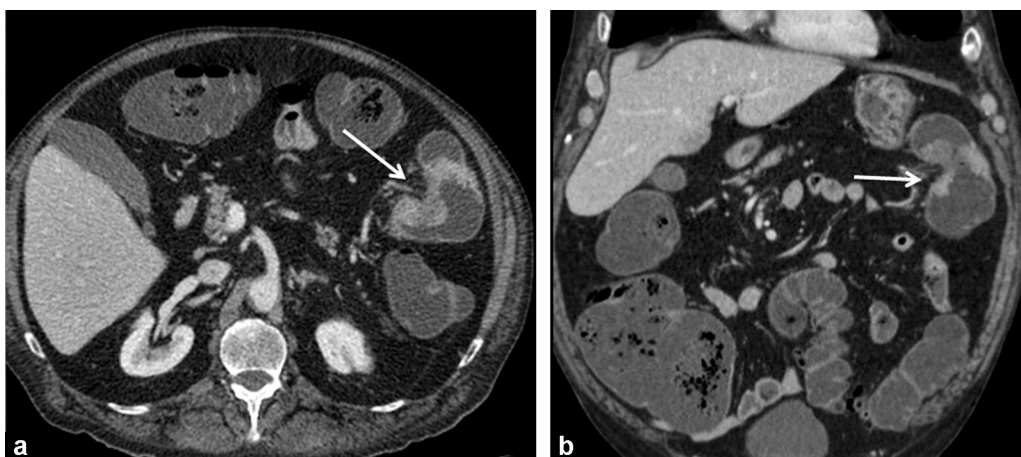


Figure 4. Location of the cancer in the colon: adenocarcinoma located by visually guided flexible colonoscopy in the right transverse colon: water enema CT refines the site to the left angle on axial section (a) and coronal reconstruction (b) (arrows).



Figure 5. Peri-tumor lymph node, 5 mm in its smaller diameter with 103 UH enhancement (arrow), deemed to be invaded by tumor.

Not all tumors are adenocarcinomas. Lymphomas are particularly recognizable by their very homogeneous appearance and extremely regular external outlines (Fig. 8).

Not all thickening of the wall represents tumor and target shaped lesions of the wall (enhancement of the mucosa

and sub-mucosal edema often combined with a “comb sign”) (infiltration with the appearance of the teeth of a comb) (Fig. 9) suggests an inflammatory Crohn’s disease-type lesion.

Peritoneal carcinomatosis

The diagnosis of peritoneal carcinomatosis is straightforward when a peritoneal effusion is present and combined with tumor implants. If any doubt is present, this can be confirmed by PET CT (Fig. 10) or MR (diffusion and T2 weighted sequences), which provide an accurate pre-treatment assessment [9,10].

The radiologist’s response in the emergency situation: abdominal and a pelvic CT

The answers in the situation of an acute complication are provided by abdominal and pelvic CT with IV iodine enhancement but without opacification of the bowel lumen. This enables one of the following two diagnoses to be made.

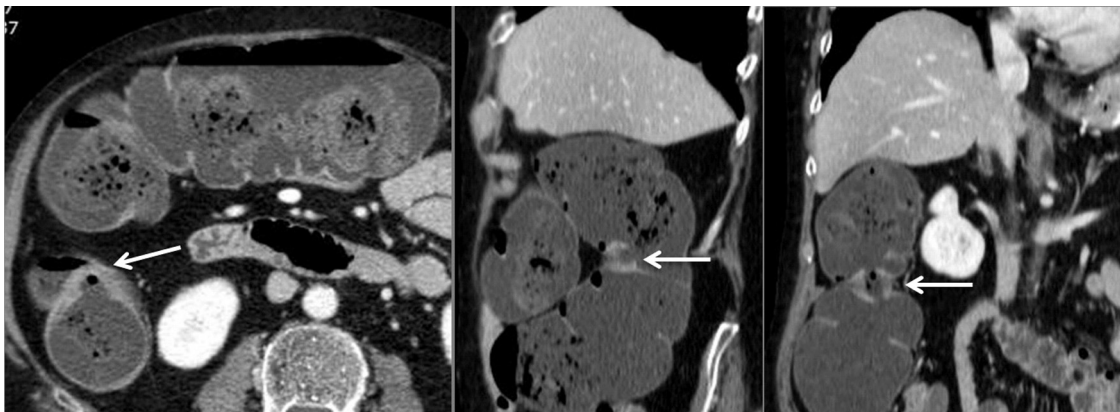


Figure 6. Small lesion estimated to be T1/T2 (the distinction between these 2 stages is not possible on imaging) located in a fold. This is difficult to identify on axial sections (a), but clearly seen in sagittal (b) and coronal (c) reconstructions (arrows).

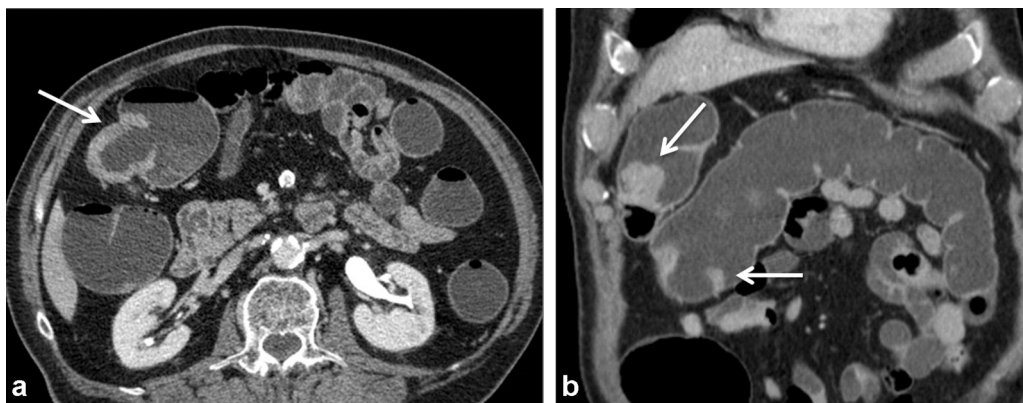


Figure 7. Dual lesion cancer: circumferential lesion of the right transverse colon seen on axial section (a), combined with an exophytic lesion in the right colonic flexure seen on coronal reconstruction (b) (arrows).



Figure 8. Typical appearances of a colonic lymphoma: circumferential thickening enhancing homogeneously with distinct margins not infiltrating the adjacent fat (arrow).

Colonic obstruction

Colonic cancer should be the primary diagnosis suspected in any case of colonic obstruction; the tumor is located at the junction between the dilated and flat colon (**Fig. 11**).

Colonic distress proximal to the tumor should be assessed in order to decide whether immediate surgery or possibly stenting is required (**Fig. 12**).

The peritoneal effusion may be reactive to the obstruction and is not necessarily synonymous of peritoneal carcinomatosis.

Colonic perforation

This usually occurs proximal to the cancer (diastatic perforation of the caecum) rather than through the tumor itself (**Fig. 13**).

In both of these circumstances, when colonic cancer is discovered, further investigation of the thorax is required at

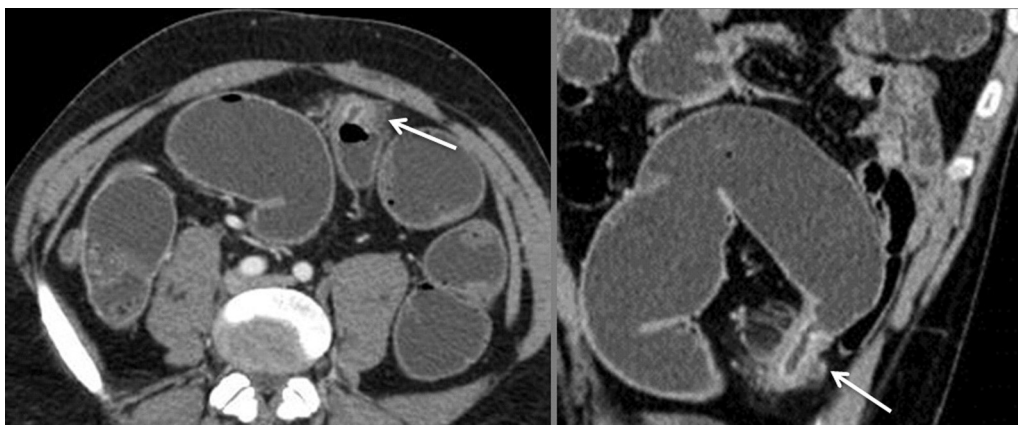


Figure 9. Colonic Crohn's disease: circumferential thickening of the wall with target shaped enhancement (increased density mucosa and reduced density sub-mucosa) combined with a "comb sign" (infiltration looking like the teeth of a comb) (arrows). Water enema CT was performed to investigate the colon beyond a sigmoid stenosis which could not be crossed on visually guided flexible colonoscopy.

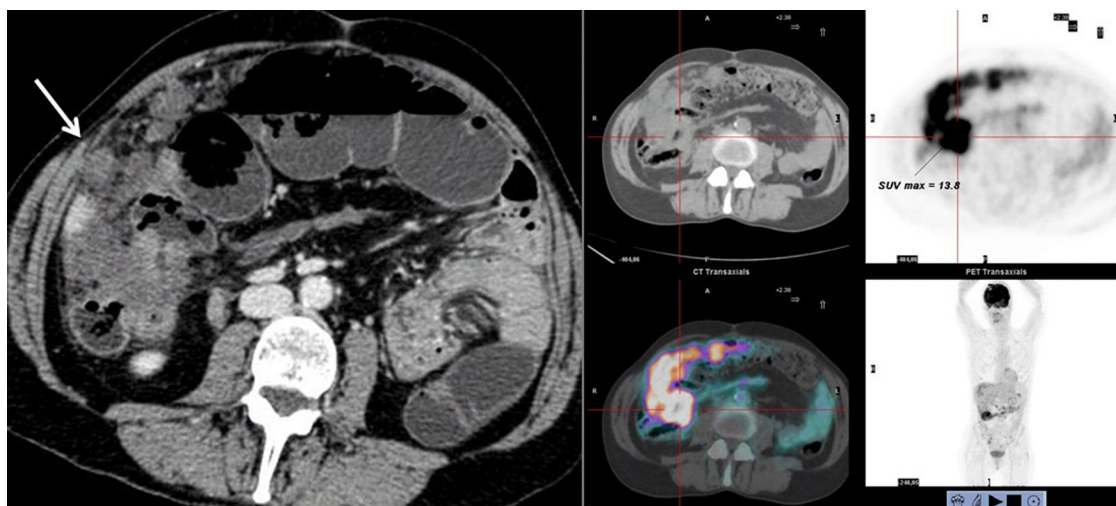


Figure 10. Right colonic tumor estimated at grade T4 (invasion of the posterior parietal peritoneal fascia) with multiple mesenteric tumor sites (arrow), seen on water enema CT; assessment supplemented with PET CT before treatment (initial chemotherapy then peritoneal surgery).

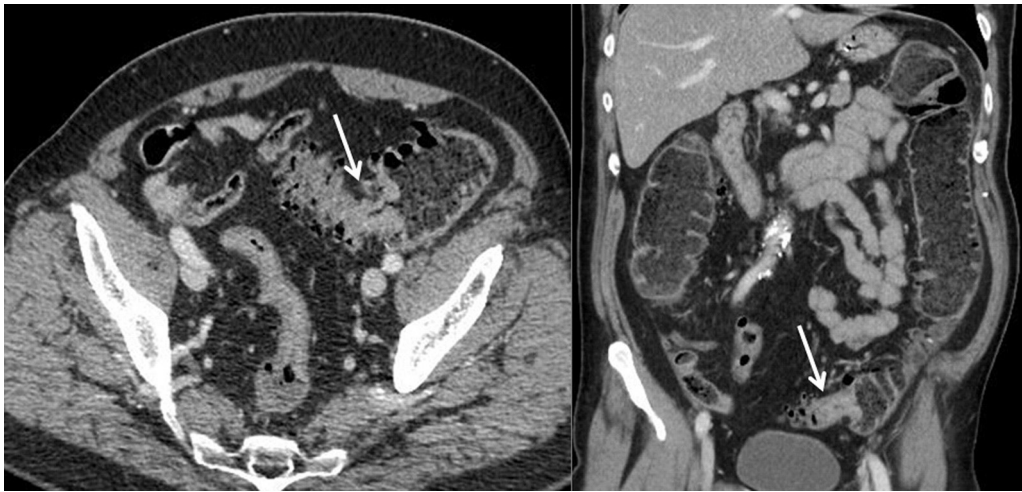


Figure 11. Emergency abdominal and pelvic CT: colonic obstruction due to stenotic sigmoid colon cancer: the lesion is located at the junctional area between the dilated colon and flat colon (arrows).

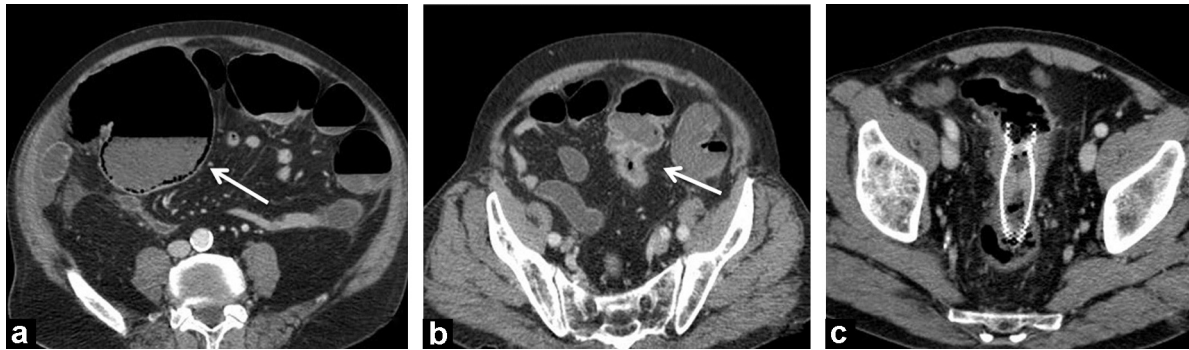


Figure 12. Colonic obstruction with severe dilation and air present in the caecal wall (a) proximal to a stenotic cancer in the sigmoid colon (b); endoscopic management by colonic stenting releasing the obstruction in the emergency stage (c) (arrows).

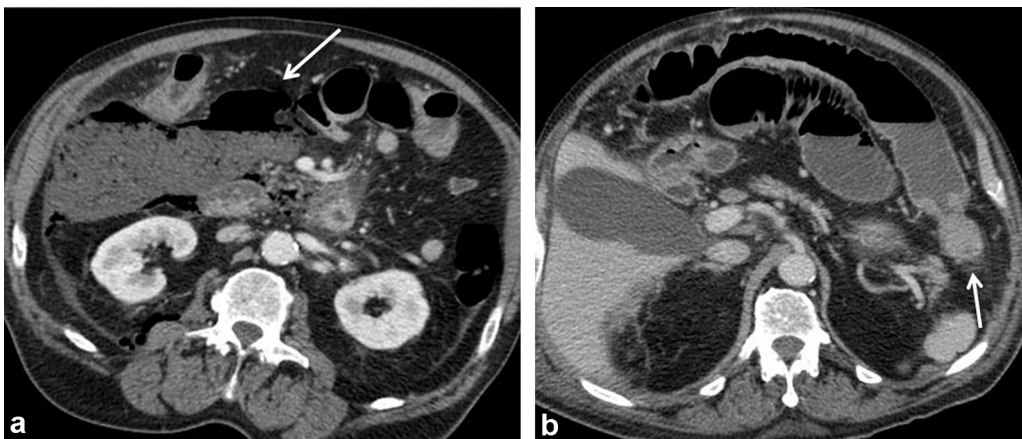


Figure 13. Diastatic perforation of the caecum (a) proximal to a stenotic left colonic cancer (b) (arrows).

the same time as the investigation for a full primary oncology assessment.

Conclusion

The specific site of the cancer in the colon, assessment of the T stage of the tumor (particularly T4) and the presence of metastases (liver or lung) or peritoneal carcinomatosis are useful findings for the management of colonic cancer. These are best provided by water enema CT, except in emergency situations.

TAKE-HOME MESSAGES

- Imaging is indicated for colonic cancer when optical colonoscopy is not possible or incomplete and in emergency situations (obstruction or perforation).
- The pre-treatment assessment for colonic cancer is based on water enema CT.
- The treatment strategy for colonic cancers depends on the site of the tumor, stage of colonic wall extension and the presence of metastases.
- A presumed T4 stage cancer is a contraindication to laparoscopic surgery.
- If the metastases or peritoneal carcinomatosis is present, chemotherapy is given prior to surgery.

Clinical case

This 79-year-old male patient with a past history of a cerebrovascular accident resulting in right hemiplegia was admitted for assessment of iron deficiency anemia. The colonoscopy was incomplete and stopped at the transverse colon.

Questions

- 1) Which investigation would you suggest?
- 2) What anomalies can you describe from Fig. 14?
- 3) What treatment strategy would you propose?

Answers

- 1) Water enema CT.
- 2) The water enema CT showed thickening of the wall of the right colon representing a tumor. The lesion is circumferential with irregular external outlines and is invading the anterior abdominal wall. The tumor is graded T4 (Fig. 15a, arrow). It is located in the right colon. Nodules of peritoneal carcinomatosis are present (Fig. 15b, arrow).
- 3) Another colonoscopy after better digestive preparation of the patient to obtain histological confirmation of the tumor (adenocarcinoma) before initiating first-line chemotherapy.

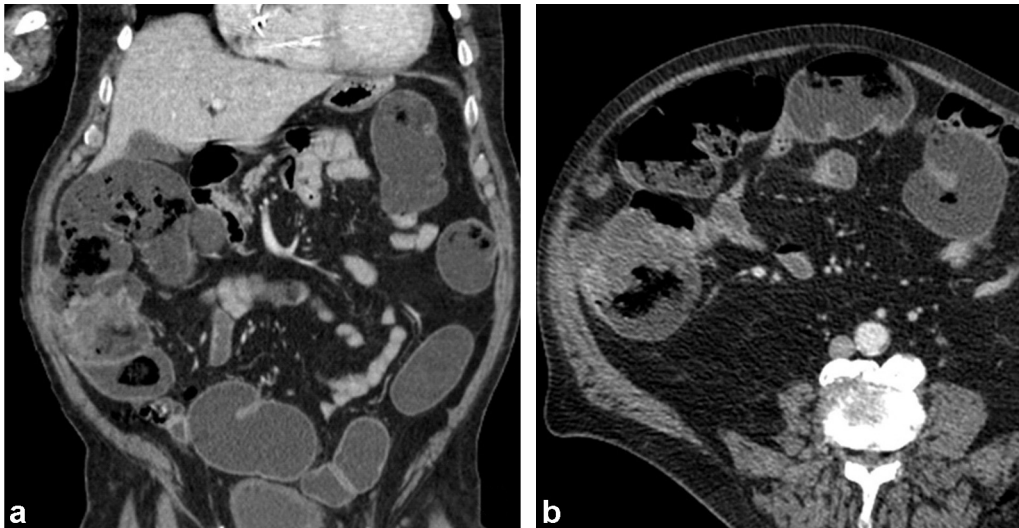


Figure 14. Water enema CT, coronal (a) and axial (b) sections.

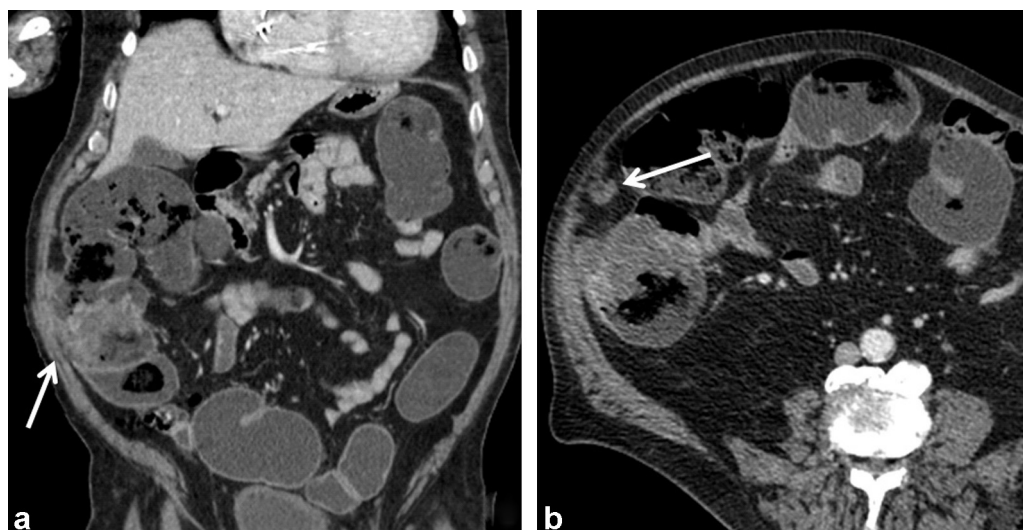


Figure 15. The water enema CT shows a circumferential right colonic tumor invading the abdominal wall (15a, arrow) and nodules of peritoneal carcinosis (15b, arrow).

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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