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Colorectal cancer mimics: a review of the usual suspects with pathology correlation

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Abstract

Colorectal cancer is the third most commonly diagnosed cancer in men and second most commonly diagnosed cancer in women worldwide. Initial diagnosis of colorectal malignancy is generally made on colonoscopy, sigmoidoscopy or digital rectal examination; however, with increased use of CT as primary investigation in patients with lower gastrointestinal symptoms, the diagnosis of colon cancer is often first apparent to a radiologist prior to more invasive tests. CT can demonstrate a discrete soft-tissue mass that narrows the colonic lumen or focal nodular wall thickening/stricture and a variety of pericolonic changes. Pattern of wall thickening has been described as an aid to differential diagnosis; however, significant overlap remains between primary colonic tumor and non-colonic tumors or benign conditions. Imaging is non-specific, and appropriate clinical history, direct inspection, histological analysis, and sometimes discussion at MDT are essential for accurate diagnosis and treatment planning. In this article, we will review the imaging features of some of these benign and malignant mimics of colorectal cancer, with accompanying histology slides where appropriate.

Key words: Colorectal—Cancer—Tumor—CT

Colorectal cancer is the third most commonly diagnosed cancer in men and second most commonly diagnosed cancer in women worldwide [1]. Initial diagnosis of colorectal malignancy is generally made on colonoscopy, sigmoidoscopy, or digital rectal examination; however, with increased use of CT as primary investigation in patients with lower gastrointestinal symptoms, the diagnosis of colon cancer is often first apparent to a radiologist prior to more invasive tests. The rate of accuracy of primary colon cancer diagnosis on CT varies between 48 and 77%, depending on the size and appearance of the tumor [2].

CT often demonstrates a discrete soft-tissue mass with narrowing of colonic lumen. Large colonic masses may undergo central necrosis with areas of central low attenuation; sometimes pockets of air can be seen which may suggest tumor perforation rather than an abscess. Some tumors appear as focal colonic wall thickening and stenosis; in particular, rectal and sigmoid cancers have been described to appear as asymmetric nodular wall thickening [2]. Pattern of wall thickening has been described as an aid to differential diagnosis, with heterogeneous and asymmetric focal thickening suggesting malignancies, while symmetric regular and homogeneous thickening suggests benign conditions or well-differentiated tumors. Disproportionate fat stranding and long/diffuse segmental involvement is more likely to be inflammatory [3].

Significant overlap remains and appearance on CT is often non-specific with several conditions mimicking primary colorectal cancer on imaging. Appropriate clinical history, direct inspection, histological analysis, and sometimes discussion at multidisciplinary team meetings (MDT) are often essential for accurate diagnosis and treatment planning in these cases. In this article, we will review the imaging features of some of these benign and malignant mimics of colorectal cancer, with accompanying histology slides where appropriate (Table 1).

Inflammatory bowel disease

Inflammatory bowel disease is a group of chronic idiopathic intestinal diseases characterized by inflammation of the bowel, most commonly ulcerative colitis and Crohn's disease. Crohn's disease is a chronic granulomatous disease of the GI tract, which can affect any part of the system from the mouth to anus (Fig. 1). Bowel involvement is usually discontinuous. The colon is af-

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Table 1. Mimics of colorectal cancer on CT

Inflammatory
Inflammatory Bowel disease (Crohn's disease or ulcerative colitis)
Diverticular disease
Other Inflammatory conditions (TB, LGV)
Reactive wall thickening (secondary to regional inflammation)
Neoplastic
Secondary involvement
Direct invasion—prostate, gynecological malignancy, etc.
Transcoelomic or transperitoneal spread (serosal metastasis)
Hematogenous metastasis
Primary lymphoma of bowel
Villous tumors of rectum (non-invasive)
Miscellaneous
Endometriosis
Chronic Radiation stricture
Short segment ischemic strictures

fected either with (50%) or without (15–20%) small intestine [4]. Peak age of involvement is between 15 and 25 years affecting both genders equally [4]; however, bimodal age presentation and late onset Crohn's (presenting in the 7th or 8th decade) can occur and may create confusion [5]. Ulcerative colitis exclusively affects the colon, progressing from distal to proximal; rectum is often involved, although rectal sparing is recognized [6].

Colonic thickening in Crohn's disease is often asymmetric and can therefore mimic colorectal cancer. Bowel wall thickening is caused by a combination of fibrosis and inflammatory infiltrates, bowel obstruction and strictures being common [4]. It is recognized that short segment focal thickening is more likely to be due to cancer, while more diffuse colonic thickening (length $>$ 10 cm) is more indicative of an inflammatory cause [7] (Fig. 2). Inflammatory imaging characteristics also point to a diagnosis of Crohn's disease, including hyperemic vascular engorgement (Comb sign) and fluid in the mesentery, pericolonic fat stranding, or fibrofatty proliferation with separation of bowel loops [5, 7].

Acute ulcerative colitis, when severe with large ulcers and transmural involvement, appears as wall thickening on CT. In chronic involvement, the appearance is indistinguishable from Crohn's disease with marked wall thickening, shortening and luminal narrowing, mimicking of colonic tumor, with or without submucosal fat deposition [6].

It is important to recognize that patients with inflammatory bowel disease (not only ulcerative colitis, but also Crohn's) are at an increased risk of developing colorectal cancer, particularly those with longstanding

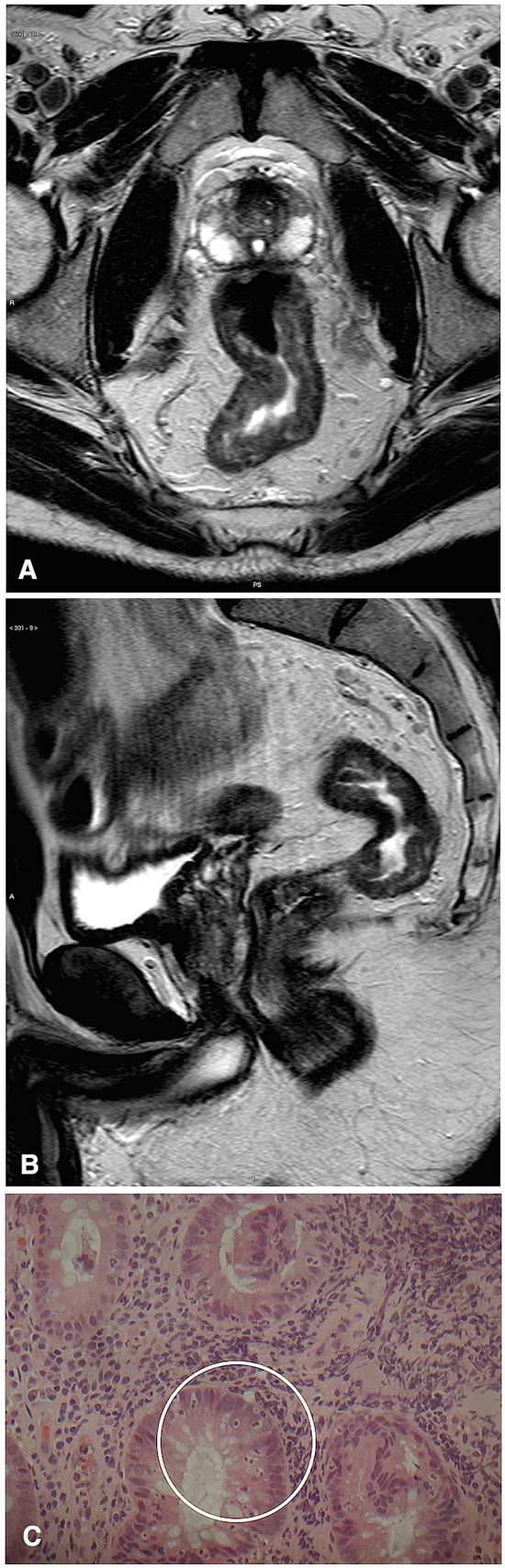


Fig. 1. Crohn's proctitis. Axial T2W (**A**) and sagittal T2W (**B**) MR images, showing irregular intermediate signal wall thickening with shouldered margins, but preserved outer muscle coat. No significant mesorectal fat stranding is evident. (**C**) Photomicrograph (original magnification $\times$40; hematoxylin-eosin [H-E] stain) shows large bowel mucosa with neutrophils within glands in keeping with cryptitis (*circle*).

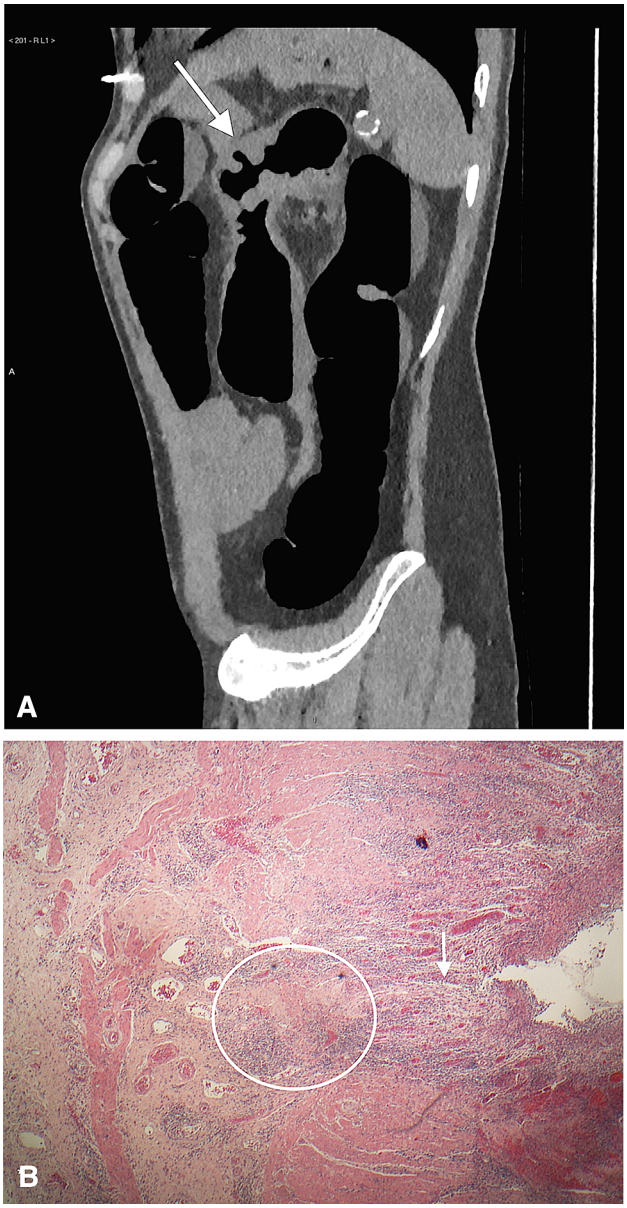


Fig. 2. Crohns stricture of splenic flexure. Sagittal (**A**) image from a CT Colonography, showing irregular stricture with elevated margins. (**B**) Photomicrograph (original magnification ×4; hematoxylin-eosin [H-E] stain) shows ulcerated large bowel mucosa with deep fissure (*arrow*), ill-defined granuloma (*circle*), and subserosal fibrosis (*).

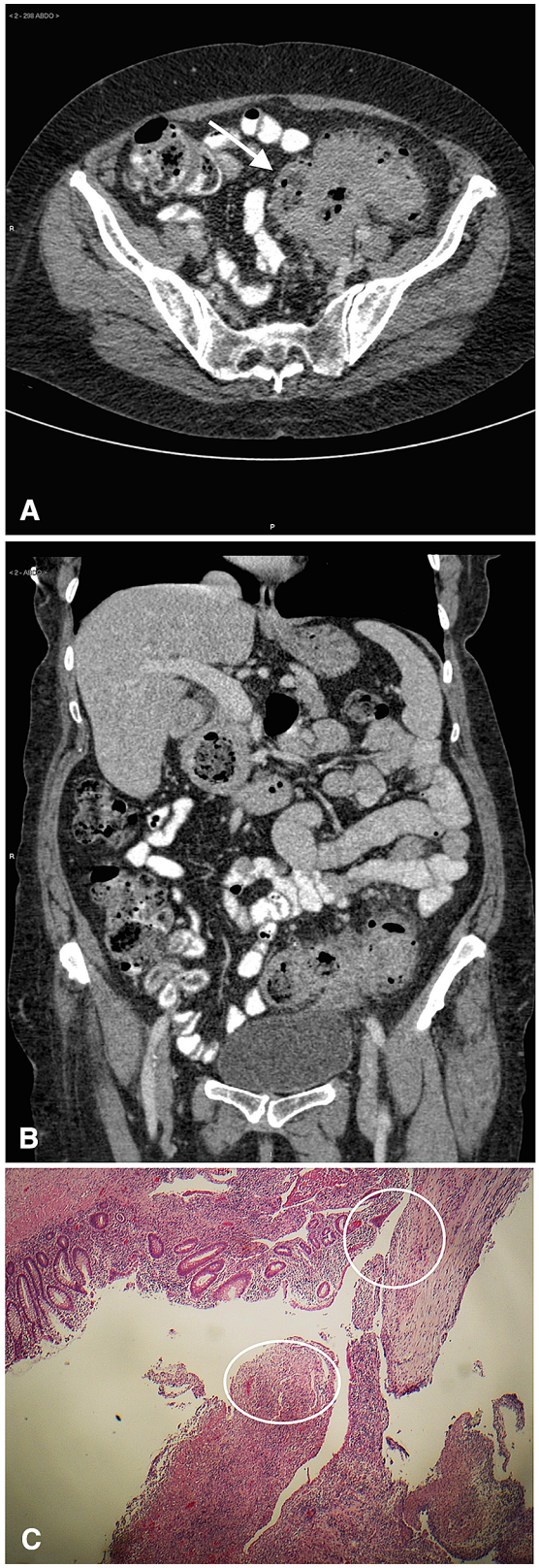
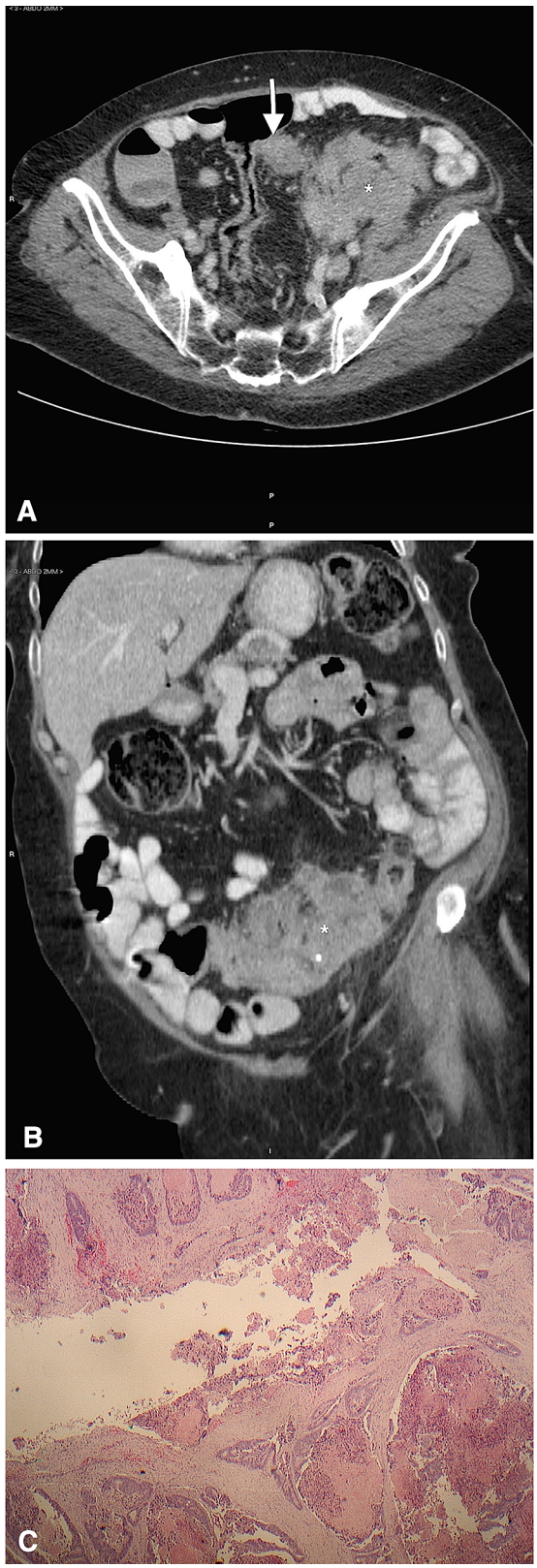


Fig. 3. Acute diverticulitis with localized perforation. Axial (**A**) and coronal (**B**) CT images showing marked thickening of the sigmoid colon, with diverticular change, surrounding inflammatory changes and a localized perforation (*arrow*). (**C**) Photomicrograph (original magnification ×4; hematoxylin-eosin [H-E] stain) shows inflamed and perforated diverticulum with formation of fistulous tract surrounded by areas of fibrosis (*circle*) and granulation tissue formation (*oval*).



◀**Fig. 4.** Sigmoid adenocarcinoma. Axial (**A**) and coronal (**B**) CT images showing marked thickening of the sigmoid (*), pericolonic fat stranding and a pathological pericolonic lymph node (*arrow*). (**C**) Photomicrograph (original magnification ×4; hematoxylin-eosin [H-E] stain) shows sigmoid adenocarcinoma perforating through the visceral peritoneum (pT4b).

colitis, strictures, fistulae, and right-sided colonic disease [8, 9]. Ultimately, distinguishing benign from malignant strictures may not be possible on imaging, and colonoscopic evaluation with biopsy is often required for a definitive diagnosis; this is particularly important for any new strictures, and surgery may be considered if colonoscopic evaluation cannot be achieved [5, 8, 9].

Diverticular disease

Diverticular disease is common in Western populations and, like colorectal cancer, is a disease predominantly affecting older people and with a predilection for the left-sided colon. (Pseudo)-diverticula, outpouchings of colonic mucosa protrude through areas of weakness in the mesenteric border of bowel wall, and can occur anywhere throughout the colon but are particularly common in the sigmoid colon [10, 11].

Imaging findings in support of diverticulitis include associated inflammatory changes, such as pericolonic fat stranding and fluid in the mesentery, a long (>10 cm) segment of involved bowel with symmetric wall thickening, or signs of associated complication, i.e., abscess or fistula [7, 10, 12] (Fig. 3). However, if a colorectal cancer breaches the bowel wall and infiltrates the pericolonic fat, it can mimic an 'inflammatory appearance' of fat stranding, leading to the cancer being misdiagnosed as a benign inflammatory lesion such as diverticulitis (Fig. 4). Also, since colorectal cancer and diverticular disease are both common in the elderly population and can co-exist, the presence of diverticula around a focal colonic lesion may not be helpful in differentiating benign from malignant disease.

Diverticular disease and colorectal cancer may present as strictures causing luminal narrowing, although there is no specific difference in clinical symptoms between the two [9]. Imaging features that suggest an inflammatory stricture include a long affected segment, associated signs of inflammation and smooth tapered margins. Features of a malignant stricture include short segment involvement, asymmetric wall thickening, an enhancing luminal soft-tissue mass, and 'shouldering' of stricture margins [7].

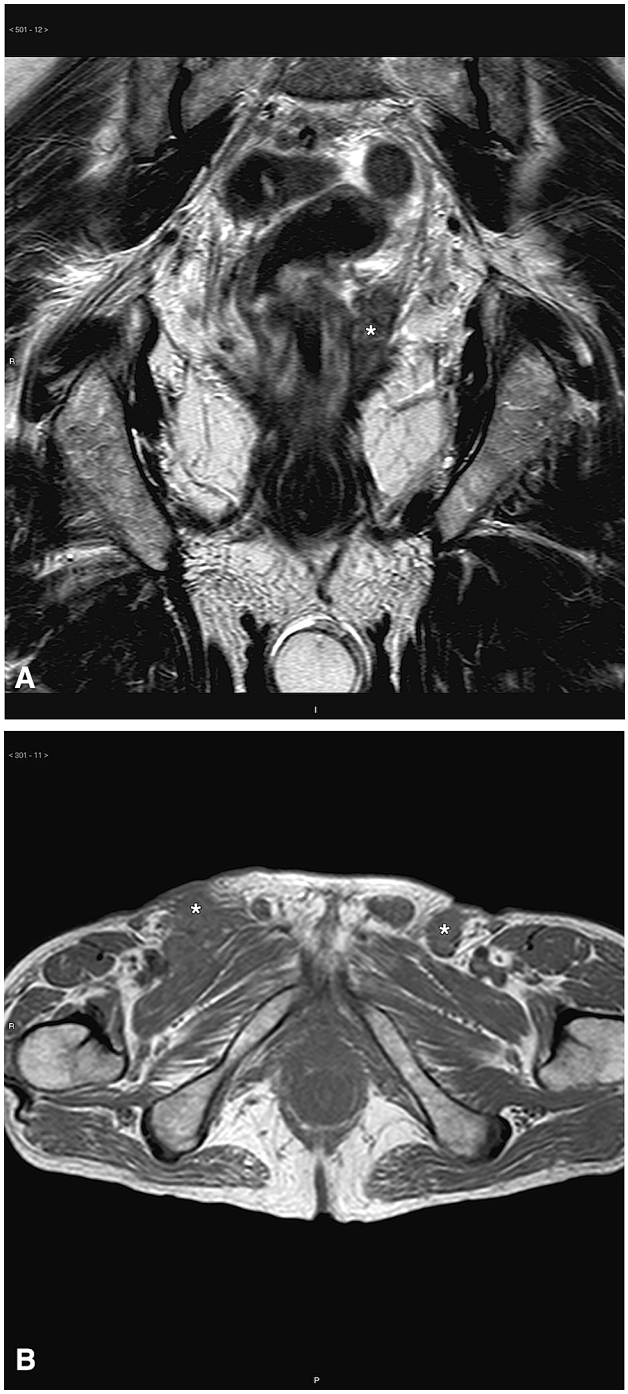


Fig. 5. Lymphogranuloma Venereum (LGV). Coronal T2W (**A**) MR image showing irregular edematous rectal wall thickening with extensive perirectal inflammatory high signal and abnormal mesorectal soft-tissue thickening (*). (**B**) Axial large FOV T1W MR image shows bilateral enlarged inguinal nodes with inflammatory change in the surrounding fat (*). Histology was non-specific, but the patient responded to appropriate antibiotic therapy.

Pericolic lymph nodes greater than 1 cm in short axis diameter raise a greater suspicion for malignancy; however, a cancerous lesion may also present with normal

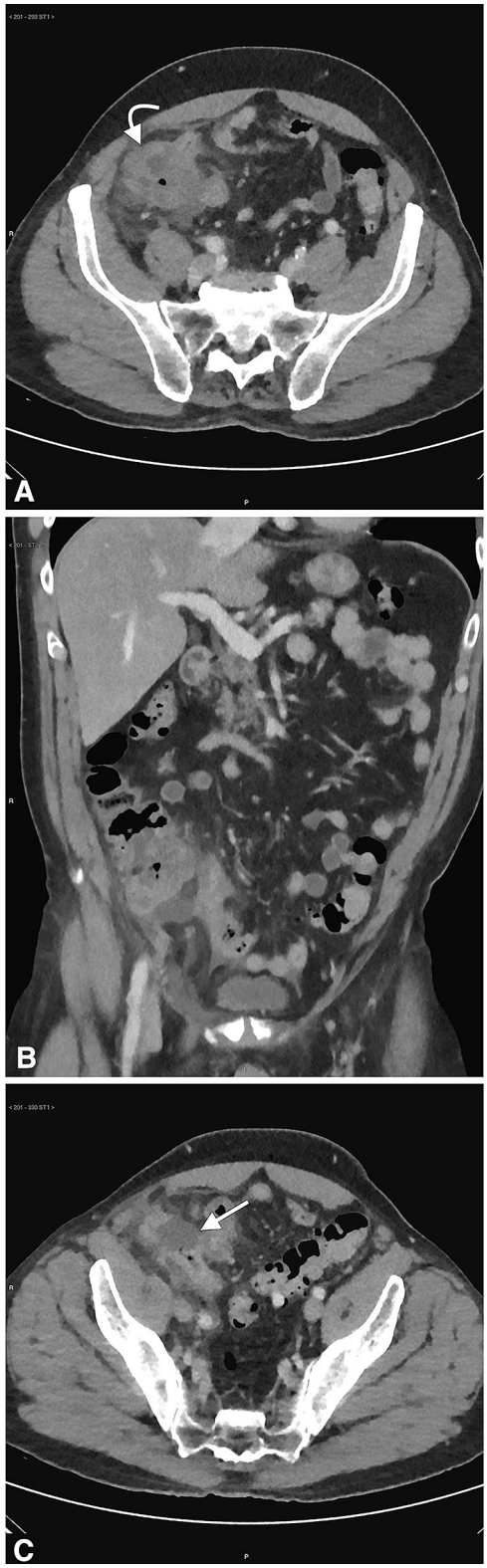
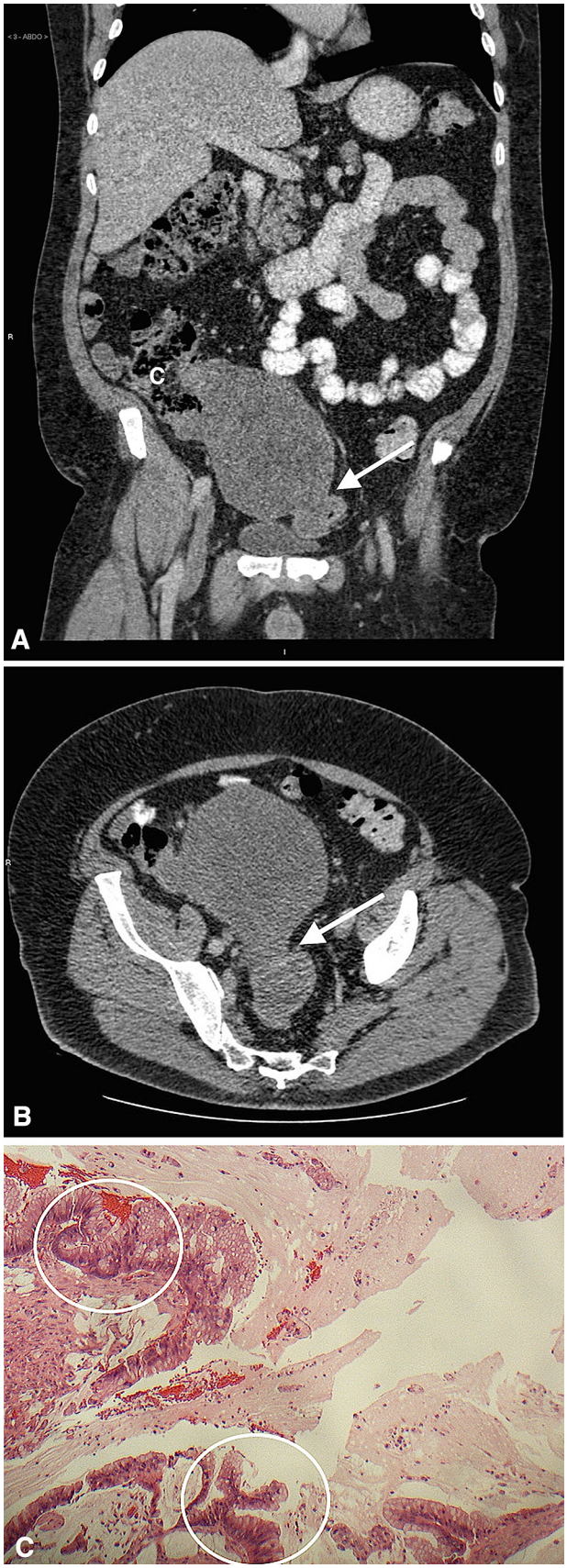


Fig. 6. Caecal pole thickening from appendicitis. Axial (**A**) and coronal (**B**) CT images showing marked edema and thickening of the caecal pole (*curved arrow*) with surrounding inflammatory fluid and fat stranding. (**C**) Axial CT images, inferior to the previous level, showing an inflamed thickened appendix with deficiency to the anterior wall at the base, consistent with perforation (*arrow*).



◀**Fig. 7.** Mucinous adenocarcinoma of the appendix extending into sigmoid colon. Coronal (**A**) and axial (**B**) CT images showing a large well-defined lobulated soft-tissue density mass arising from the caecal pole (C); distally the mass extends into the sigmoid colon (*arrow*). (**C**) Photomicrograph (original magnification ×20; hematoxylin-eosin [H-E] stain) shows mucus-secreting adenocarcinoma (*circles*).

Fig. 8. Prostatic carcinoma directly invading rectum. Axial▶ T2W (**A**) and sagittal T2W (**B**) MR images, showing large irregular low signal mass replacing most of the prostate (P), extending directly into the rectum (R) involving the anterior and lateral walls. (**C**) Photomicrograph (original magnification ×4) of immunohistochemical staining with PSA reveals negative reaction in large bowel mucosa (*arrow*) and positive reaction in tumor cells (*).

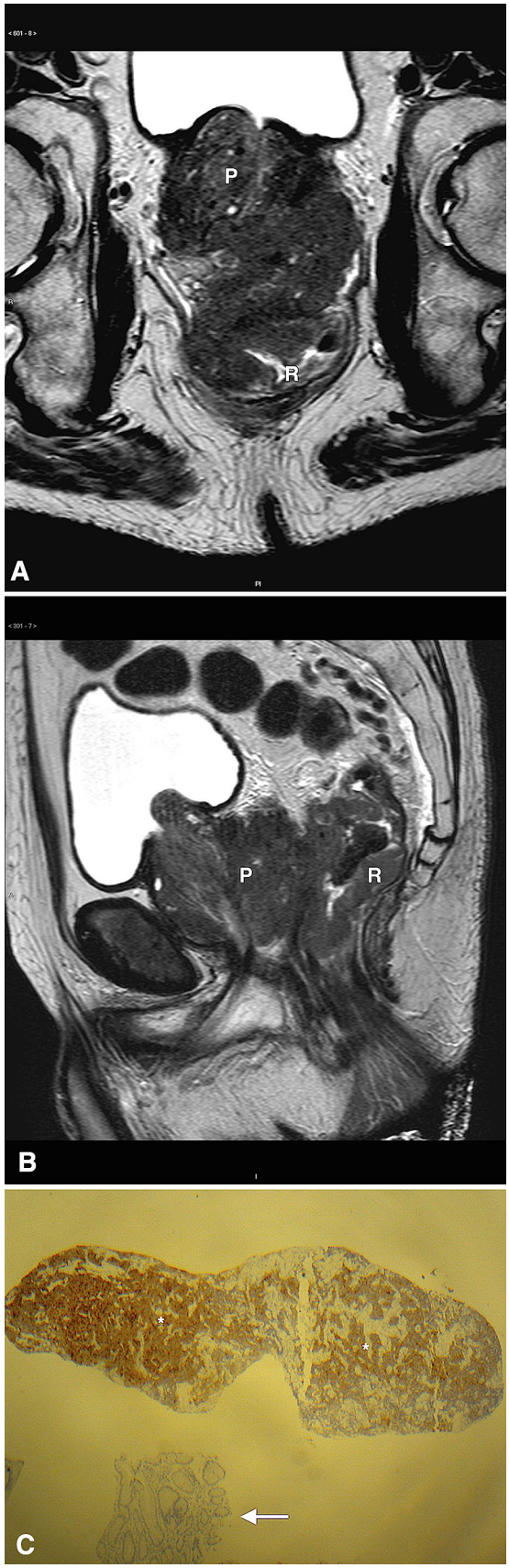
sized nodes [5, 7, 13, 14]. In some cases, it is impossible to distinguish between diverticulitis and a colonic malignancy without colonoscopy with biopsy [7].

Other inflammatory conditions

Involvement of GI tract by tuberculosis is rare, commonest site of involvement being ileocaecal region. CT often shows, irregular eccentric wall thickening or a mass-like lesion, which can mimic a caecal tumor. Discontinuous areas of bowel wall thickening and stricture, particularly with ileocaecal involvement, in appropriate clinical setting, should also suggest the diagnosis. Large local mesenteric lymph nodes of low attenuation due to caseous necrosis are also recognized as characteristic [3].

Occasionally, unusual inflammatory conditions are encountered like Lymphogranuloma Venereum (LGV), which is a sexually transmitted disease (causative organism *chlamydia trachomatis*), rare in the Western world. The usual early presentation of LGV is characterized by acute inguinal lymphadenitis with bubo formation. The other clinical presentation of LGV, the anogenitorectal syndrome, causes moderate to severe ulcerative proctocolitis, which can clinically and histologically resemble Crohn's disease [15]. MRI findings in these patients show diffuse mucosal wall thickening with submucosal edema and perirectal halo of infiltration and adenopathy. Enlarged iliac chain and inguinal lymph nodes may also be present, hence nodal involvement does not help in differentiating these from anorectal cancer [15] (Fig. 5).

Secondary colonic wall thickening from local inflammatory processes like acute appendicitis affecting caecum or sigmoid colon, acute cholecystitis (particularly



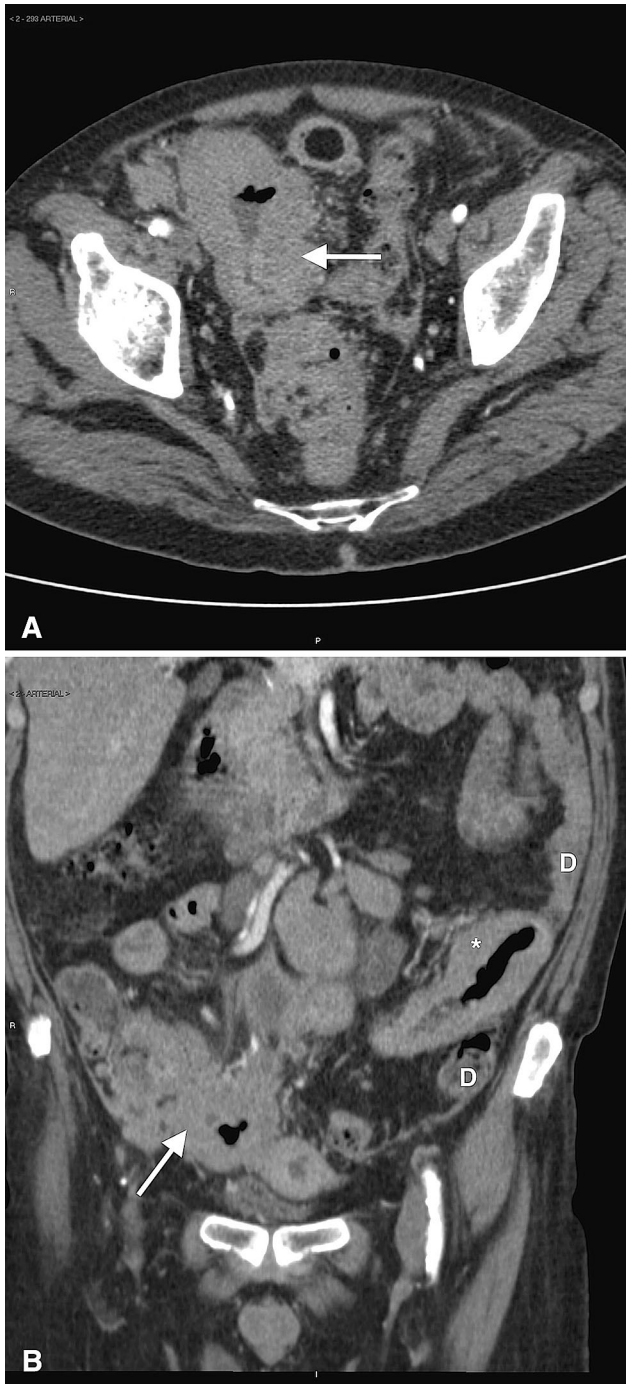
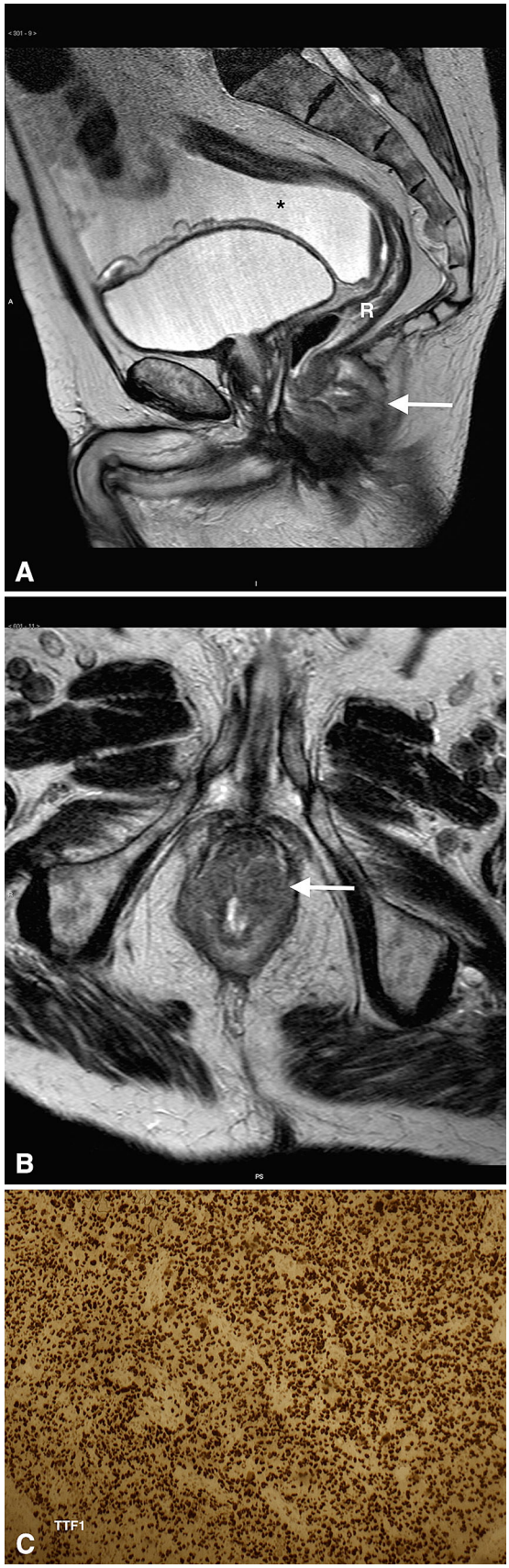


Fig. 9. Serosal and peritoneal deposits from small bowel Diffuse Large B Cell Lymphoma (DLBCL). Axial (**A**) and coronal (**B**) CT images, showing an abnormal thickened and irregular loop of sigmoid colon to the right of midline (*arrow*); coronal image shows abnormal thickened loop of small bowel on the left (*), with normal retroperitoneal descending colon (D). Histology showed infiltration of peritoneal fat by large cells with pleomorphic nuclei and were BC16 and CD20 positive (not shown).



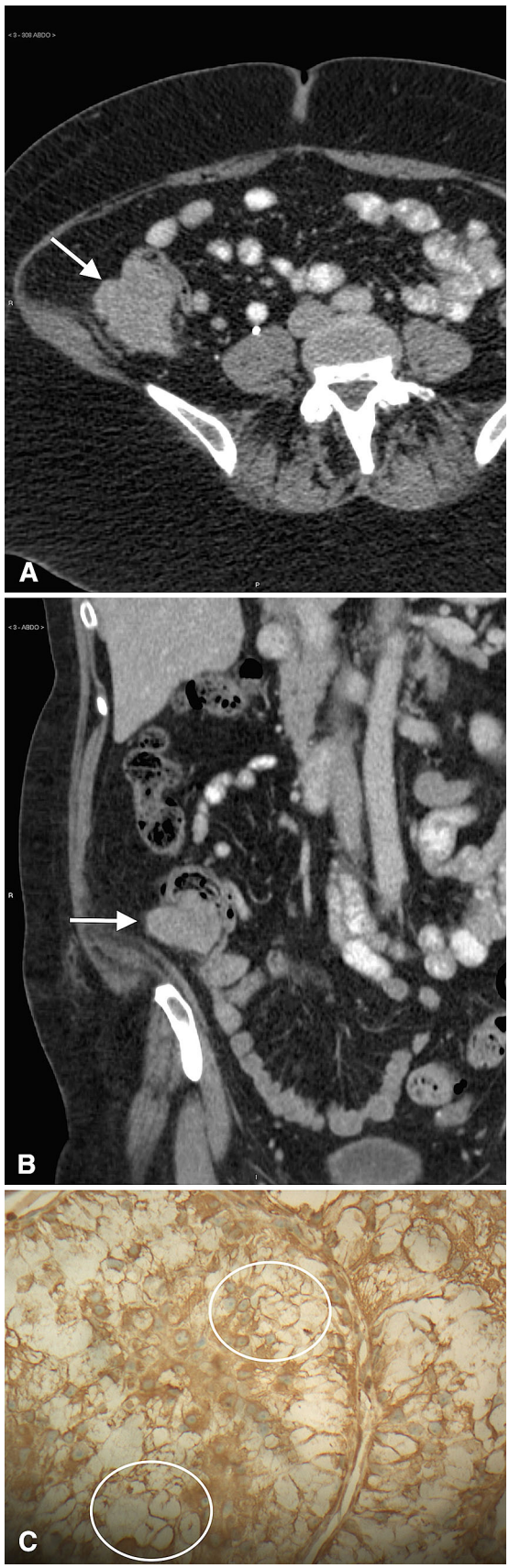
◀**Fig. 10.** Metastatic non-small cell lung carcinoma in anal canal. Sagittal T2W (**A**) and axial T2W (**B**) MR images, showing a locally advanced circumferential anal mass with diffuse irregular low signal wall thickening (*arrow*) with a normal looking rectum (R); Hemorrhagic ascites (*) and irregular nodular peritoneal deposits are also evident on sagittal image. (**C**) Photomicrograph (original magnification ×20) shows tumor cells positive for TTF1 & CK7 (not shown) consistent with poorly differentiated non-small cell carcinoma of primary lung origin.

xanthogranulomatous type) affecting hepatic flexure is also recognized and generally more easily differentiated from primary colonic tumor on the basis of typical clinical features and imaging appearances of the primary inflamed organ (Fig. 6) [16].

Secondary malignant involvement

The colon can be secondarily involved by a primary tumor arising elsewhere by direct invasion from adjacent tumors, spread along peritoneal surface, ligaments and omentum, or by hematogenous spread. Direct invasion can occur with tumors in prostate, malignancies of female pelvis (vault recurrence is elaborated below), gall bladder, pancreas, stomach, kidney, or appendix. The location of colonic involvement depends on the location of the primary tumor. Gastric tumor can involve transverse colon via omentum, pancreatic tumor can involve transverse colon directly or via transverse mesocolon, tumor in appendix can directly involve right or sigmoid colon, malignant tumor involving gall bladder or liver can involve the hepatic flexure, while renal tumor involves the left colon [17] (Fig. 7). The area of involvement may appear as an extrinsic irregular enhancing or necrotic mass inseparable from the colon, displacing it or as direct infiltration of the wall, when differentiation from a locally invasive primary colonic tumor may be difficult. Although direct colonic invasion is more commonly encountered on CT, it is better assessed on MRI owing to its superior soft-tissue contrast.

Prostate and rectal cancers are staged according to the TNM classification and the difficulty in differentiating a locally invasive prostate tumor from a colorectal tumor arises when there is T4 disease in either on MRI. (AJCC Prostate cancer staging 7th edition) (Fig. 8). The pattern of disease spread may help to suggest one diagnosis over the other. Anal and rectal cancers commonly metastasize to the liver and/or lungs due to their venous drainage via the internal iliac veins or inferior mesenteric vein, a tributary of the portal



◀**Fig. 11.** Renal metastasis to caecum. Axial (**A**) and coronal CT (**B**) showing a large exophytic caecal mass (*arrow*). (**C**) Photomicrograph (original magnification ×40) shows tumor cells positive for Vimentin (*circles*); the cells were negative for CK7 and CK20 (not shown).

vein [18]. Prostate cancers commonly spread to the lymph nodes, bones with sclerotic metastases, and less commonly lung and liver [19].

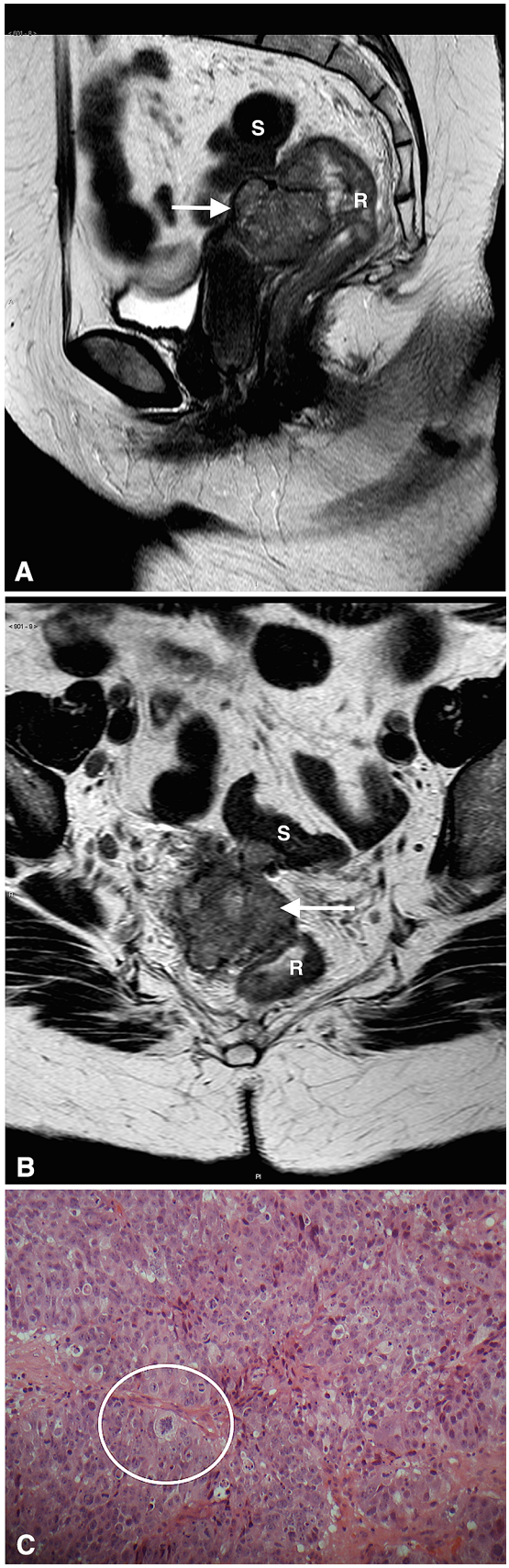
Serosal involvement from transperitoneal spread can occur from small bowel primary, peritoneal primary, gastric, pancreatic primary, or lymphoma and appear as eccentric wall thickening, nodular serosal deposits or frank mass with breech of colonic wall and architecture [17] (Fig. 9).

Colonic metastatic disease from an extra-colonic primary malignancy is usually rare and may be picked up at post mortem. Examples of such primary malignancies, which could metastasize to large bowel, include lung, breast, renal, and ovarian cancer (Figs. 10, 11). The metastatic deposits may be intraluminal or serosal. Availability of adequate clinical history and prior imaging is useful in reaching the correct diagnosis. Tissue biopsy and histology will usually be required in all these cases for confirmation and treatment planning, since they are indistinguishable from primary colonic malignancy.

Vault recurrence

Vaginal vault is located posterior to the bladder and anterior to the rectum. The vaginal vault may be the first site of recurrence of cervical, endometrial, or vaginal malignancy [20]. The most common CT and MR imaging feature of recurrent tumor of the primary site is an irregular mass with central necrosis and irregular enhancement. If CT reveals loss of the fat plane between the tumor and the rectum, invasion is suspected, although an obvious mass extending into the rectum is often seen (Fig. 12). MR imaging provides better soft-tissue contrast, and it is more accurate at demonstrating invasion of adjacent viscera like rectum or bladder by a recurrent lesion at the vault. MRI shows loss of the normal low signal intensity of the rectal wall on T2W images, which is inseparable or in continuity with the irregular mass [21].

In advanced cases with macroscopic involvement of rectum or sigmoid colon, definitive differentiation from colonic primary may be impossible without histological analysis. Unfortunately, the nodal distribution and pattern of metastatic spread do not help to distinguish between the two cancers. Nodal distri-



◀**Fig. 12.** Vault recurrence of endometrial carcinoma affecting rectum: Sagittal T2W (**A**) and axial T2W (**B**) MR images, showing an irregular low signal mass with pelvic fat infiltration (*arrow*), directly invading the upper rectum (R) and a loop of sigmoid colon (S). (**C**) Photomicrograph (original magnification ×20; hematoxylin-eosin [H-E] stain) shows poorly differentiated carcinoma consisting of pleomorphic cells with hyperchromatic, pleomorphic, and occasional bizarre-shaped nuclei (*circle*).

bution in both can be pelvic and then para-aortic, while metastatic spread will be primarily to liver and lungs [22].

Primary colonic lymphoma

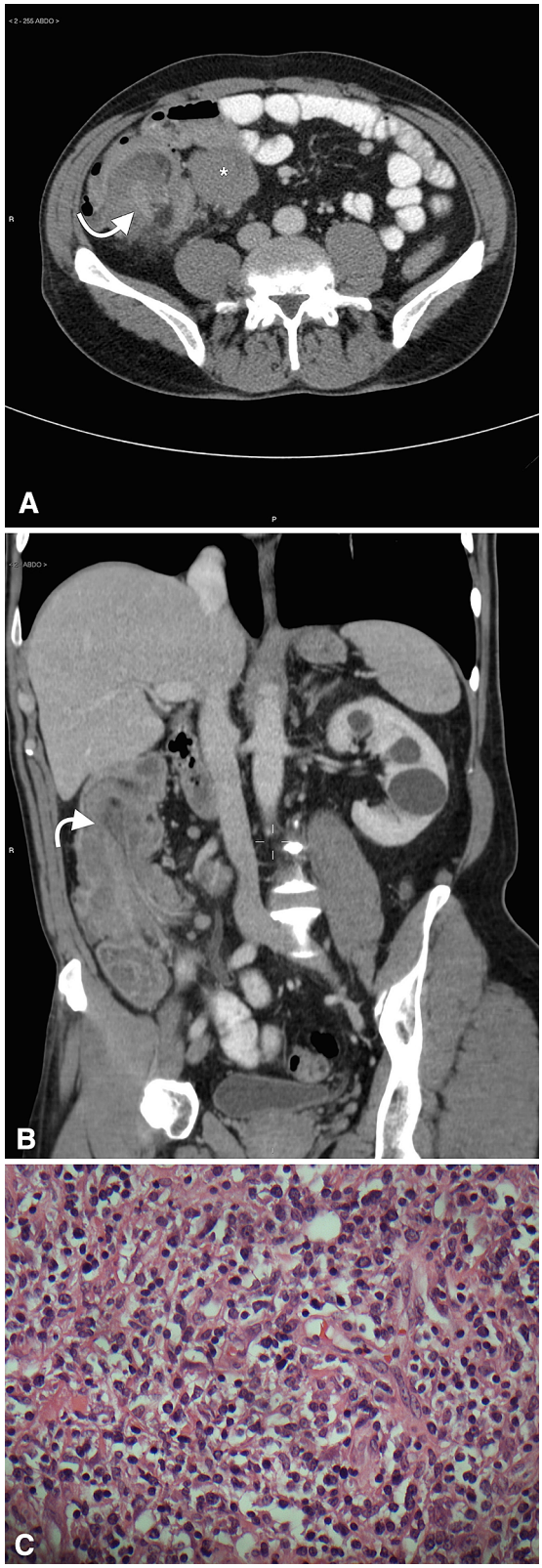
Primary lymphoma of the large bowel accounts for 0.4% of all tumors of the colon, and colorectal lymphomas constitute 6–12% of gastrointestinal lymphomas. The caecum and rectum are more commonly affected than most other parts of the large bowel [23].

Most colonic lymphomas are usually non-Hodgkin's type of B cell type. Typical patterns of presentation may be as polypoid masses, most frequently near the ileocaecal valve; or an infiltrative mass with circumferential bowel thickening, a cavitating mass; mucosal nodularity, fold thickening and aneurysmal dilatation [23, 24]. Intussusception is typically described with involvement of the right colon (Fig. 13) [23].

Features such as extension into the terminal ileum, well-defined margins with preservation of fat planes and the absence of invasion into adjacent structures may help distinguish colorectal lymphoma from adenocarcinoma. Lymphoma can cause marked luminal narrowing without causing obstruction due to the absence of a desmoplastic response and weakening of the muscularis propria of the wall by submucosal lymphoid infiltration (also, explaining characteristic aneurysmal dilatation) [23]. Lymphoma is also likely to involve multiple and longer segments in comparison to primary colonic tumor [24].

Non-invasive villous tumors of colon

Colorectal polyps are most commonly adenomatous and may be tubular, tubulovillous, or villous with malignant potential increasing with size. A distinct entity called 'carpet lesion' has been described, separate from flat adenomas and plaque carcinomas. Most of these have been described in the right colon or rectum, and are



◀**Fig. 13.** Lymphoma of the ascending colon. Axial (**A**) and coronal (**B**) CT images showing intussusception, with in-drawing mesentery (*curved arrow*), in a patient with primary B cell lymphoma of the ascending colon; multiple pathological pericolic lymph nodes (*) are seen medial to the colon. (**C**) Photomicrograph (original magnification ×20; hematoxylin-eosin [H-E] stain) shows infiltrate within the large bowel wall, consisting of lymphoid cells with vesicular nuclei and frequent mitotic figures, consistent with high-grade lymphoma.

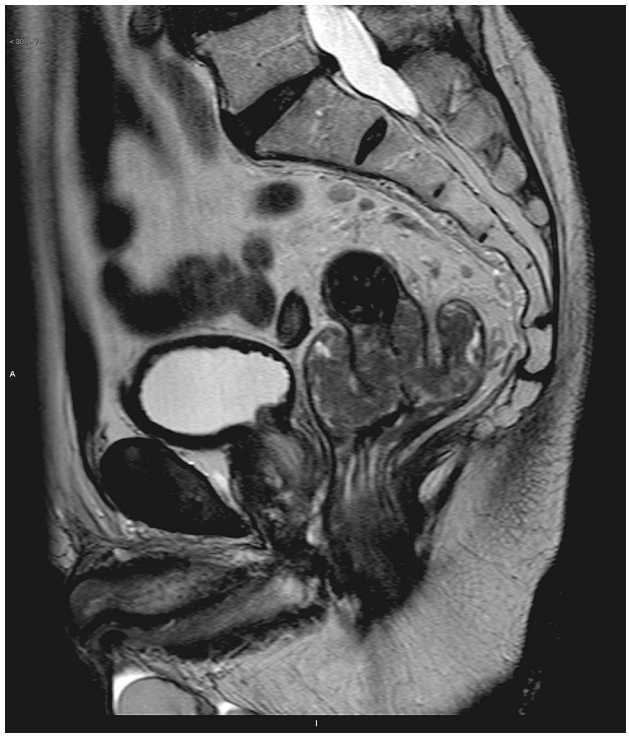


Fig. 14. Carpet lesion in rectum. Sagittal T2W MR image, showing a lobulated, elevated, mixed high signal thickening to the wall of the mid rectum, spreading laterally over 3 cm consistent with a carpet-type villous adenomatous change. Histology revealed villous adenoma with areas of dysplasia but no invasive malignancy.

classically laterally spreading lesions more than 3 cm in size (Fig. 14) [25, 26].

Radiologically, they range from subtle undulation to extensive lobulated filling defects, mostly reported on barium enema [25]. On MRI, they resemble villous adenoma, heterogeneous mixed signal mass filling the lumen, and can extend over large areas of the rectum

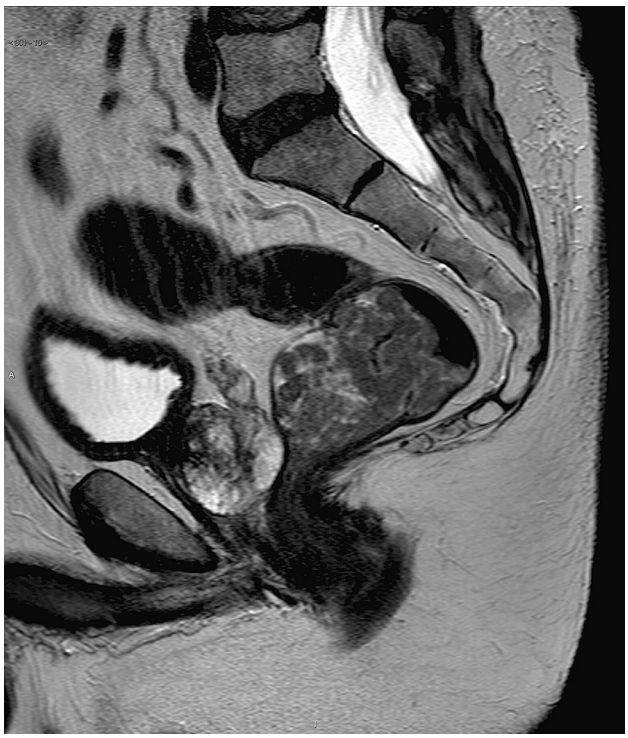


Fig. 15. Villous adenoma rectum. Sagittal T2W MR image showing a lobulated mixed high signal mass, filling up, and distending the lower and mid rectum, consistent with a villous adenoma. Biopsy revealed features of tubulovillous adenoma without any areas of invasive malignancy.

(Fig. 15). Although villous adenomas are typical, carpet lesions, particularly when large and mildly elevated, can often be indistinguishable from infective or inflammatory proctitis, primary rectal adenocarcinoma or endometriosis. Often repeated endoscopy and biopsy are required for a definite diagnosis. Similar to other villous tumors, these are usually resected based on their potential for malignant degeneration [25, 26].

Endometriosis

Endometriosis is the presence of functioning endometrial glands and stroma outside the uterine cavity. It can lead to severe pain and infertility for patients [27]. Although laparoscopy, biopsy, and histological confirmation is the gold standard for diagnosis of endometriosis, MRI is especially useful for detecting deep pelvic endometriosis where it can mimic primary colorectal malignancy. Deep infiltrative pelvic endometriosis is defined as extension of endometrial glands and stroma at least 5 mm beneath the peritoneal surface [28]. The endometrial glands and stroma infiltrate the fibromuscular tissue and cause smooth muscle proliferation and a fibrous reaction, which leads to solid nodule formation [28, 29]. When endometriosis involves viscera, the implants attach to the serosal surface of the bowel and can invade the muscular layers, causing marked smooth muscle proliferation. This can then result in strictures and obstruction, which could potentially be confused with tumor [30].

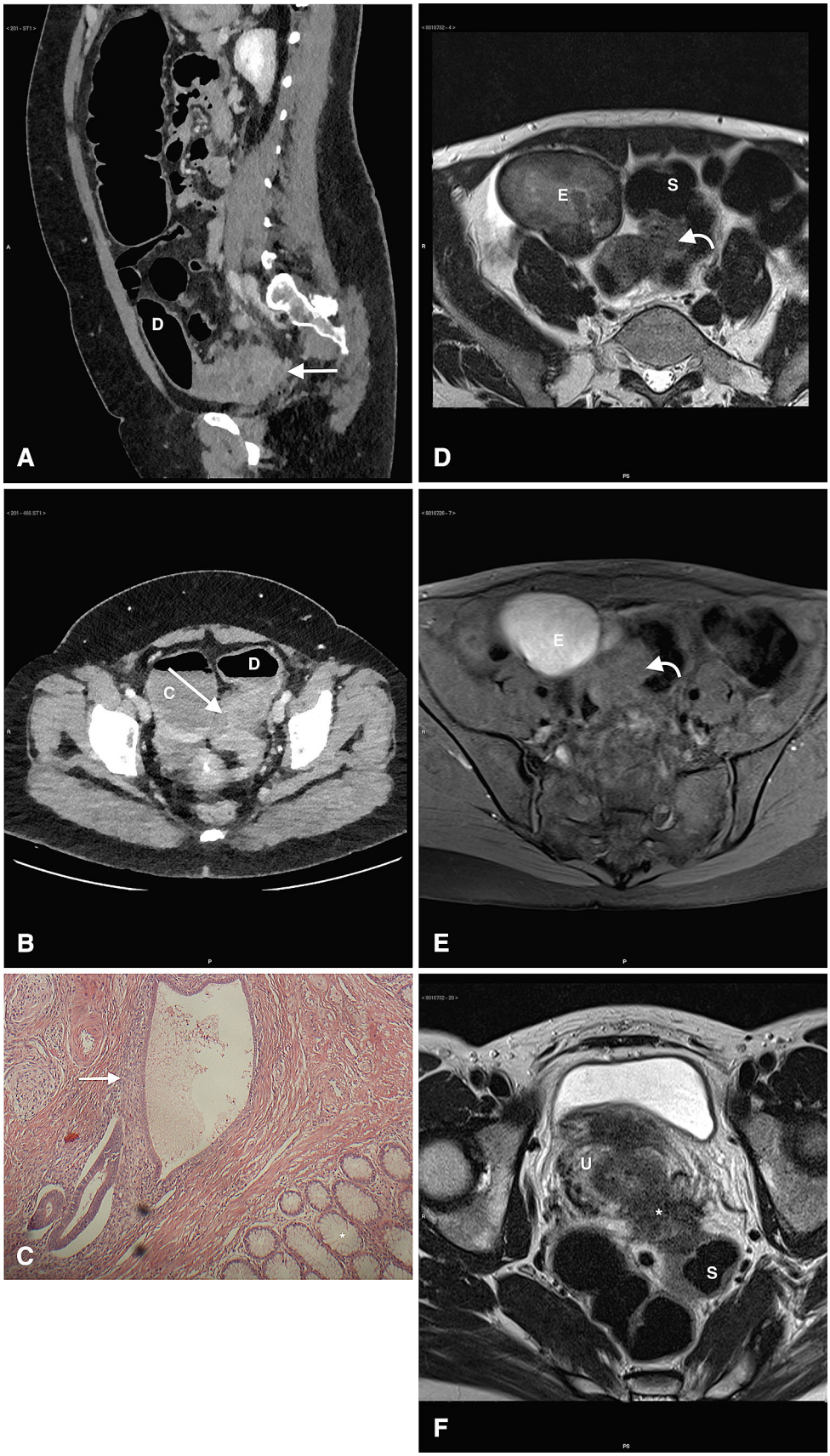
Fig. 16. Deep pelvic endometriosis affecting sigmoid colon. ► Sagittal (**A**) and axial (**B**) CT images showing an abnormal mass with wall thickening and serosal irregularity (*arrow*) centered at the proximal sigmoid colon with dilatation of the colon upstream, distal descending colon (D), and caecum (C). (**C**) Photomicrograph (original magnification ×40; hematoxylin-eosin [H-E] stain) shows endometrial glands (*arrow*) in large bowel mucosa (*). Axial T2W (**D**) and axial T1 fat-saturated (T1-FS) (**E**) MR images of a different patient showing a polypoid endometrial mass (*arrow*) in the sigmoid (S) with low T2 and intermediate T1-FS signal and further large endometrioma with high signal on T1-FS image in the right iliac fossa (**E**). Axial T2W image more inferiorly (**F**) shows characteristic irregular low signal endometriotic infiltrate in the rectouterine pouch and ligament (*) extending from the uterus (U) into the sigmoid (S).

The rectosigmoid is the most common part of the bowel involved by deep nodular endometriosis [27] Patients can suffer from dyschezia due to rectal involvement from endometriosis [30]. CT often shows nonspecific bowel wall thickening with an extrinsic mass or nodularity to the wall (Fig. 16). Thickening of the rectal wall, which is low signal on T2W imaging, sometimes with hyperintense foci of hemorrhage on the T1W fat-saturated sequence can aid in making the diagnosis [30]. Uniformly low signal on the T2W sequences corresponds to fibrous tissue in these lesions at histological examination. Hence, inclusion of T1W fat-saturated sequences can help distinguishing unsuspected endometriosis from primary colorectal tumor.

The differential diagnosis of endometriosis will only apply to female patients. In cases where there is uncertainty, other signs of endometriosis such as thickening of uterosacral ligaments, ovarian endometriomas, hematosalpinges, endometrial deposits on the uterus, tethering of the uterus to adjacent structures, may help in the differential diagnosis. If there is still uncertainty and concern still remains of a colorectal tumor, then direct visualization of the rectosigmoid colon and biopsy is advised.

Radiation stricture

Radiation strictures of the colon may occur secondary to treatment of pelvic malignancies. Relevant past medical history is of particular importance in guiding the radiologist toward a diagnosis of radiation-induced stricture, for example, the rectum in gynecological tumors, or the transverse colon and small bowel in gastroesophageal or pancreatic cancers (Fig. 17).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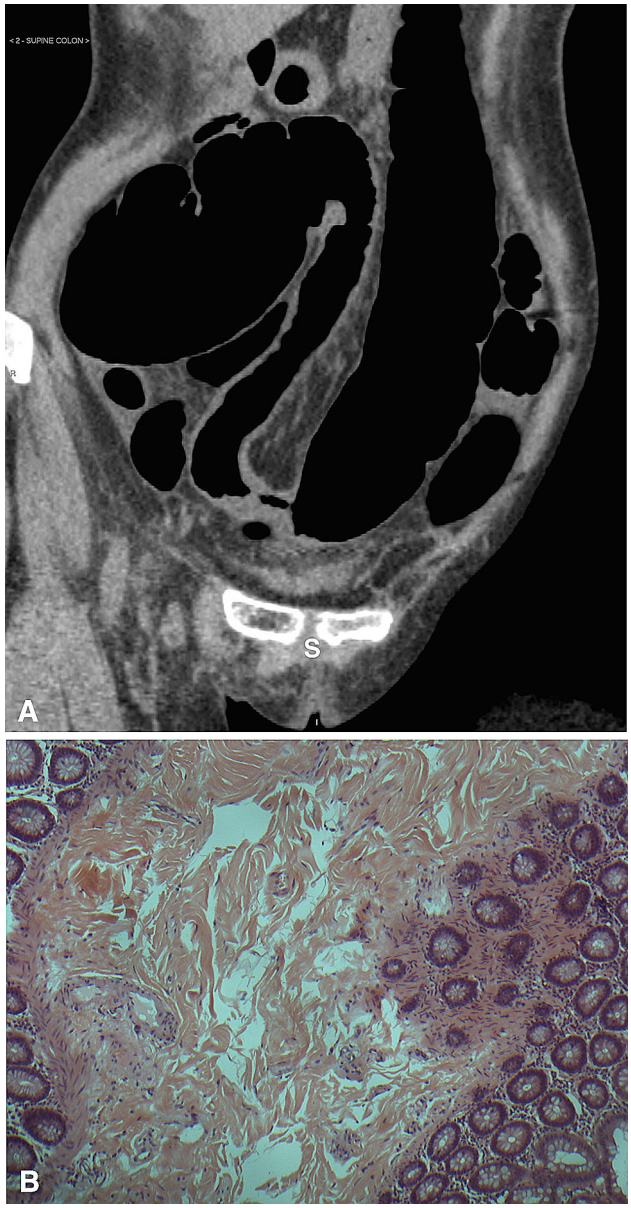

Fig. 17. Radiation stricture of transverse colon in a patient with previous history of radiotherapy for cervical carcinoma. Coronal CT image (**A**) showing a short segment stricture, with apparent shouldering at the proximal aspect, in the dependent portion of the 'U' loop of a redundant transverse colon, lying in the pelvis, just above the symphysis pubis (S). (**B**) Photomicrograph (original magnification ×10; hematoxylin-eosin [H-E] stain) shows large bowel mucosa, focal irregularity of glandular architecture, and focal fibrosis in lamina propria.

The bowel is sensitive to radiation damage due to the rapidly proliferating mucosa. This may initially manifest as acute colitis/proctitis with wall thickening, edema and sloughing, or possibly with associated ulceration or pseudopolypoid lesions. Ischemia and fibrosis may de-

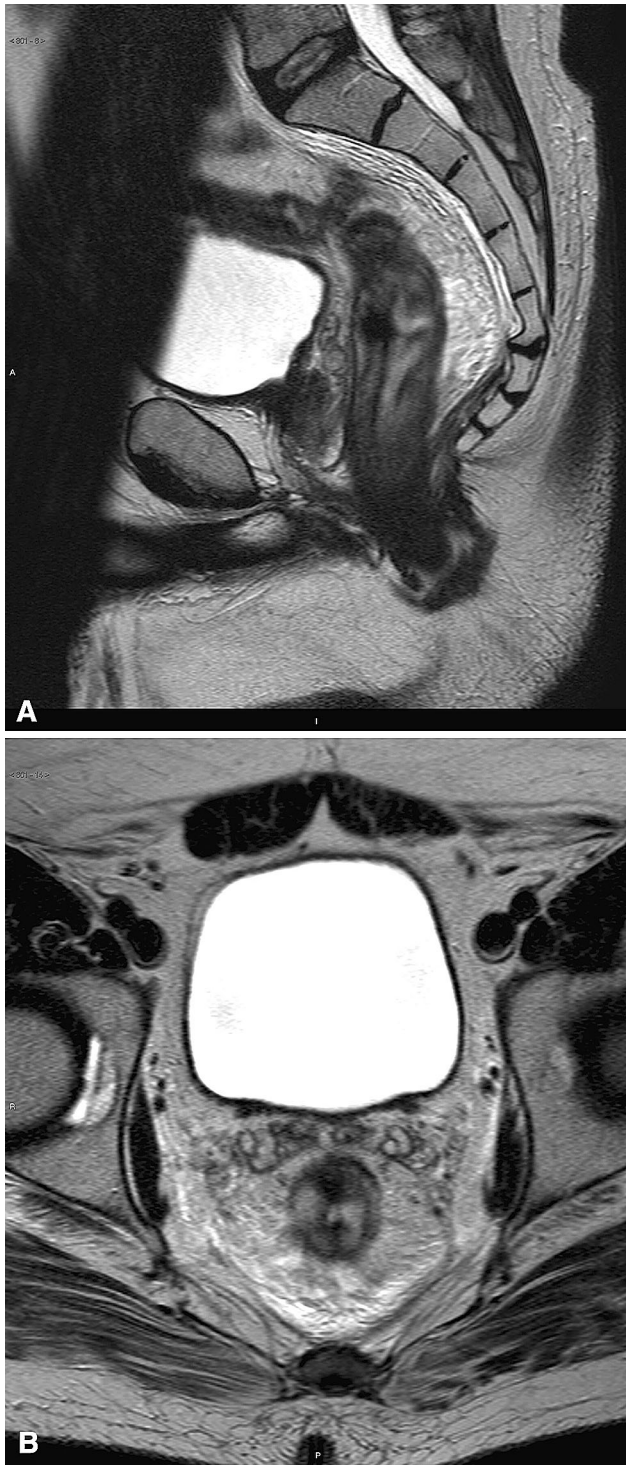

Fig. 18. Acute radiation change to rectum. Sagittal T2W (**A**) and axial T2W (**B**) MR images, show thickened edematous rectal wall with high signal to the submucosa and low signal to the outer wall consistent with acute radiation change to the rectum. This occurred after long course pre-operative radiotherapy for upper rectal cancer, in a patient who received 45 Gy in 25 fractions over 5 weeks.

velop over the longer term as chronic vascular and interstitial connective tissue changes occur, with intramural and perirectal fat infiltration. Eventually in the chronic phase, fibrotic strictures form, which may result in bowel obstruction [5, 31]. On MRI, at an early stage, there is increased signal to the submucosa on T2W images but the outer wall retains low T2 signal (Fig. 18). Progressive injury leads to wall thickening and diffuse increase in signal of the wall on T2W images, with loss of distinction between submucosa and muscle layer. [26]. At a later stage, with chronic injury, as fibrosis develops, the wall becomes featureless and strictured with low signal on T2W images.

The risk of radiation injury is related to several factors, such as radiation dose, number and frequency of radiation fractions, and duration of treatment [31]. Radiation strictures can be of various lengths or cause various degrees of narrowing, which can mimic colorectal cancer [30]. This is further confounded by the recognized risk of radiation-induced cancer developing at the site of previous irradiation [31, 32].

Short segment ischemic strictures

Ischemic colitis is the most common type of intestinal ischemia, described in three typical patterns: transient reversible ischemia, ischemic ulcers with stricturing, and gangrenous colitis. Right colon is affected by superior mesenteric artery (SMA) involvement, while left colon involvement occurs with inferior mesenteric artery involvement (IMA). Anatomically susceptible areas classically involved in ischemic disease are ''Griffith's point,'' at the splenic flexure and ''Sudeck's point,'' of the marginal artery of Drummond, at rectosigmoid [33].

CT is an excellent imaging modality for the detection of bowel ischemia. The findings of ischemia in the acute phase include bowel wall thickening, low or high attenuation of the wall, mural hypoenhancement, pneumatosis, pneumoperitoneum, and/or portal venous gas; mesenteric stranding and peritoneal fluid aid in the diagnosis. These associated imaging features in the appropriate clinical setting usually help in differentiating them from wall thickening secondary to colonic adenocarcinoma.

In the chronic phase, pericolic fluid is never found; there is fibrotic reaction in the injured colonic wall, leading to continuous mild and irregular circumferential wall thickening with gaping lumen. In this phase, it is no longer important to define the etiology but the effects of the ischemic injury (stricture and obstruction) secondary to non-uniform fibrosis of the bowel wall. [34].

Conclusion

Significant overlap remains between appearances of primary colonic or rectal tumor and tumor like inflammatory/non-inflammatory conditions or secondary tumor involvement. While a definitive diagnosis is suggested on imaging, review in light of appropriate clinical history, tissue histology, associated findings, and discussion at multidisciplinary team meetings are often essential prerequisite for accurate diagnosis and management planning in nearly all these cases.

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Compliance with ethical standards

Conflict of interest Akash Ganguly, Sara Meredith, Cairine Probert, Jasna Kraecevic, and Chinedum Anosike declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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