Anorectal pitfalls in computed tomography colonography

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Abstract

There is a wide array of pathological lesions seen in the anorectal region with CT colonography (CTC), much of which is unique to this location. Many relatively common findings in the anorectal region are typically benign, but can be misinterpreted as malignant. There are also technique-related pitfalls that can impede accurate diagnosis of anorectal findings at CTC. Understanding common and uncommon lesions in the anorectal region as well as recognizing technical pitfalls will optimize interpretation of CTC and decrease the number of missed cancers and false positives. This review will systematically cover that they key pitfalls confronting the radiologist at CTC interpretation of the anorectal region, primarily dividing them into those related to underlying anatomy and those related to technique. Tips for how to effectively handle these potential pitfalls will also be discussed.

Keywords CT colonography · Virtual colonoscopy · Pitfalls · Anorectal

Introduction

CT colonography (CTC) is a highly effective, minimally invasive test for colorectal cancer screening [1–3]. It is a low-dose, non-contrast CT exam with a specialized protocol to optimize the detection of colorectal polyps and masses. Of the various segments of the colorectum, the anorectal region deserves special attention [3, 4]. The distal rectum at the anorectal junction is the most common location of missed cancers at CTC [2, 5]. Meticulous technique and knowledge of potential pitfalls will help to minimize such missed lesions. In addition, there are several unique and benign anorectal findings, which are relatively common and can mimic pathology [6]. Confident recognition of these entities combined with digital rectal exam may spare the patient from unnecessary sedation and colonoscopy.

Polypoid lesions specific to the anorectal region include hypertrophic anal papillae, internal hemorrhoids, lesions related to solitary rectal ulcer syndrome, and anal condylomata. Pseudolesions related to the rectal catheter and other technical pitfalls may also occur in this region. Submucosal and extrinsic lesions such as retrorectal cystic hamartomas, rectal gastrointestinal stromal tumors, and rectal hemangiomas can occur in the anorectum, but careful evaluation will help differentiate them from the other polypoid lesions with a presentation suggesting origination from the deeper bowel wall (i.e., nonmucosal-based) or extrinsic location. With diligence, knowledge, and good technique, many of the anorectal findings can be confidently interpreted and not require further evaluation. For the remaining lesions, digital rectal exam, anoscopy or flexible sigmoidoscopy are the next tools for further evaluation to exclude the target colorectal soft-tissue polyp.

This article will review the common entities that occur in this region and provide helpful tips to increase confidence in a benign diagnosis or need for additional evaluation. Strategies to decrease the possibility of missed low cancers will be covered. It is our hope that this pictorial essay will help the reader improve their confidence in this difficult interpretative area.

Lesions not specific to the anorectal region

Colorectal polyp

As with any portion of the colorectum, the target of CRC screening (i.e., soft-tissue polyps) can arise from the

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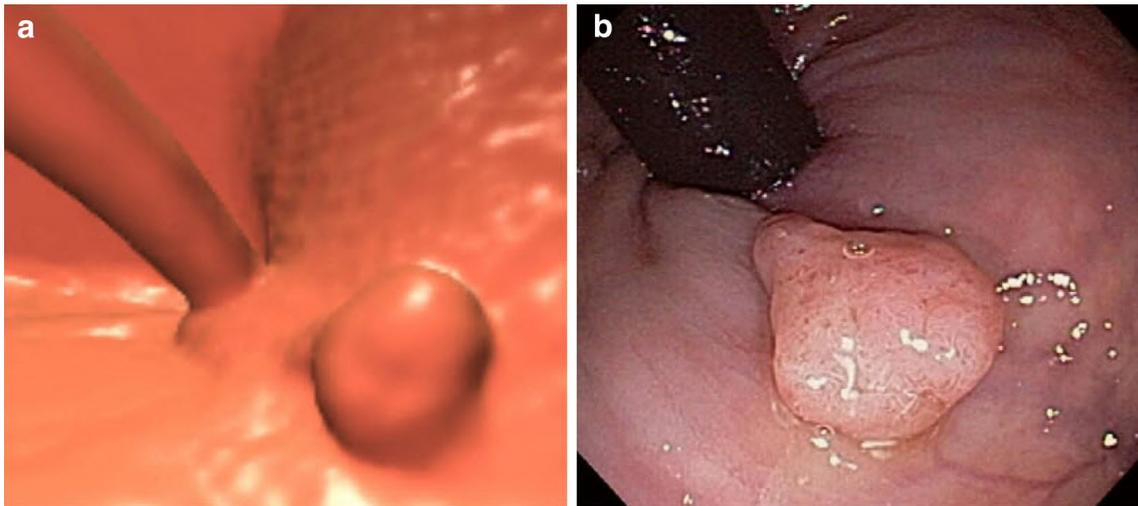
Fig. 1 Tubular adenoma in the low rectum. **a** 3D CTC image of the anorectal junction shows a large sessile polyp, which is separated from the rectal catheter. **b** The lesion was confirmed at same-day colonoscopy and proved to be a large tubular adenoma From Ref. [3] with permission
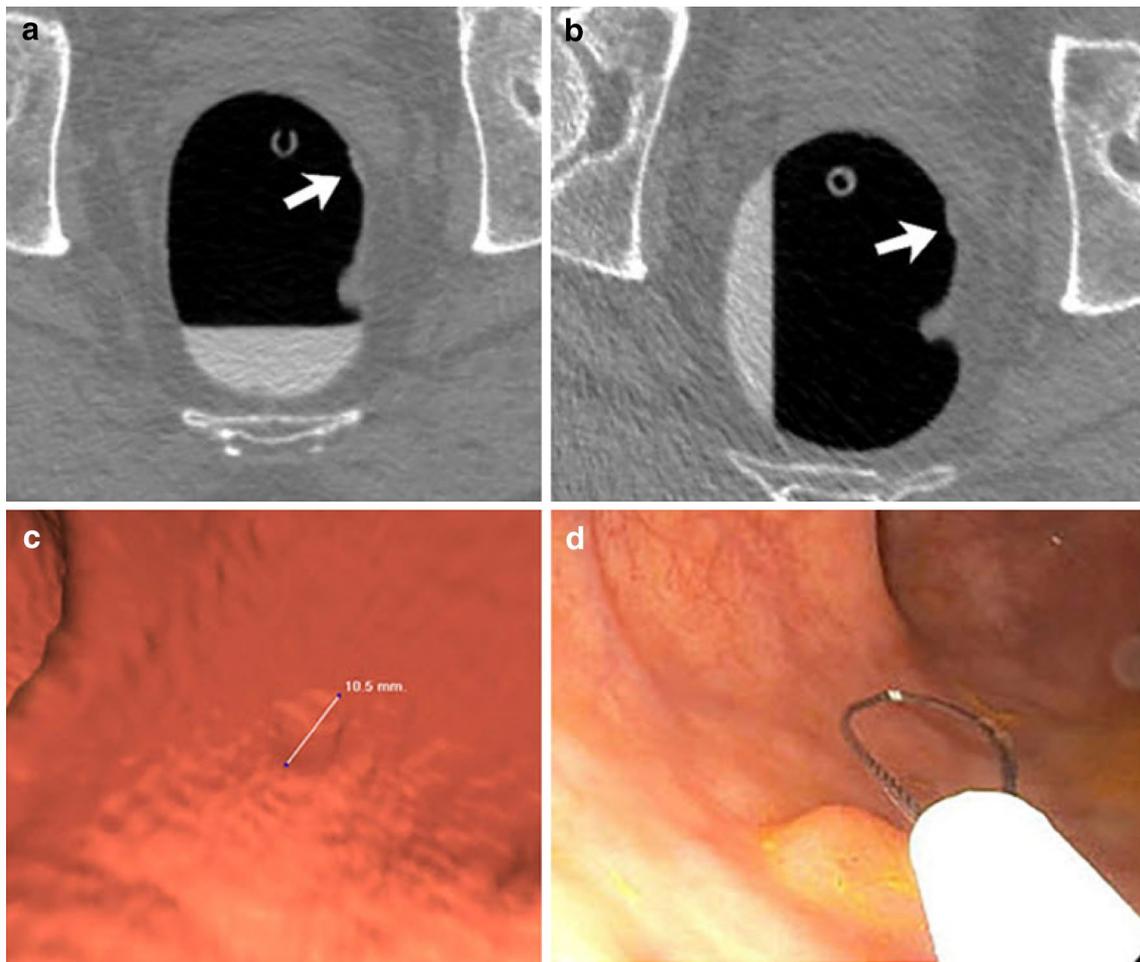

Fig. 2 Flat lesion in low rectum (hyperplastic polyp). **a** and **b** Supine and decubitus 2D CTC images show a subtle flat lesion with a very thin layer of contrast coating, which highlights an underlying flat polyp (arrows). **c** 3D CTC endoluminal view shows the typical flat morphology. **d** Colonoscopic image at snare polypectomy confirms the flat lesion. Often, these small, flat rectal lesions are hyperplastic in nature, as in this case
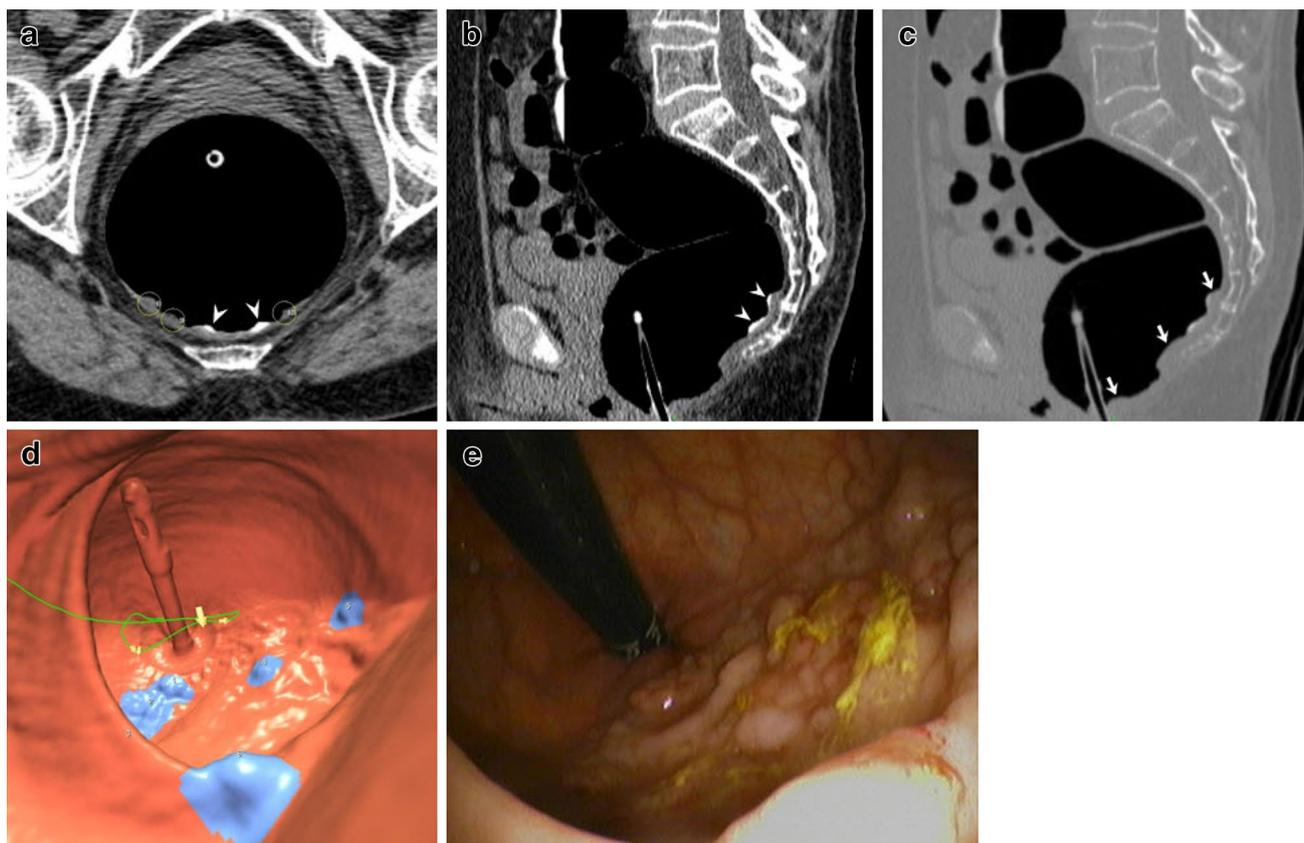
Fig. 3 Large rectal carpet lesion (villous adenoma). **a–c** Axial and sagittal 2D CTC images show a large, flat lobulated lesion (arrows) that measured up to 8 cm in linear size, but was not bulky. The lesion extends to the anorectal junction and demonstrates surface coating with oral contrast (arrowheads), which aids in detection. **d** 3D endoluminal CTC image shows the carpet lesion with superimposed blue mucosal lining in the low anorectal region (Fig. 1). It is

areas that represent CAD detection. CAD picks up focal polypoid areas, but does not recognize it as a single lesion. **e** Optical colonoscopy shows the carpet lesion, which is relatively subtle for its large size. The yellowish adherent mucus corresponds to areas of contrast tagging at CTC. This proved to be a villous adenoma, still benign despite its large size From Ref. [13] with permission

important to realize only a small subset of soft-tissue polyps with specific histology which can potentially acquire the defects over time to transform to cancer and, of these adenomatous or serrated lesions, only a tiny percentage do so [7]. Size has been used to determine likely risk of transformation and thus management. Polypectomy is recommended for lesions 10 mm or greater with the option of surveillance for isolated sub-centimeter polyps (6–9 mm) [8, 9]. Soft-tissue polyps can present with various morphologies including sessile (dome shaped with a broad-based attachment), pedunculated (polyp attached by a stalk), and flat.

Flat polyps are an important subset that can lead to difficult detection in the anorectal region (as well as in other areas of the colon) due to their minimal bulk and projection into the colonic lumen (Fig. 2) [10]. They are plaque-like lesions raised less than 3 mm from the surface. Detection is aided by a phenomenon of contrast coating of the mucosal surface overlying these polyps [11]. These lesions often elaborate a layer of mucin, which mixes with the tagging

agents to create a contrast coat. If there is a plaque of contrast seen fixed on both views, identification of underlying soft tissue suggests a coated flat polyp.

Flat lesions that are greater than 3 cm in length are referred to as carpet lesions or laterally spreading tumors [12, 13]. Carpet lesions are large in cross section but not bulky due to their flat morphology. These lesions have a predilection for the cecum and rectum (Fig. 3). Typically, the histology is benign villous or serrated in nature, but may contain foci of high-grade dysplasia or cancer. Thus, detection of these lesions is important as they often progress ultimately to cancer over time. Overall, flat and carpet lesions are less conspicuous and difficult to detect during CTC than polypoid lesions, which project into the lumen [14, 15]. Perhaps, more commonly, carpet lesions are mistaken for untagged stool if the reader is not aware of this entity. However, a fixed location in the rectum, which does not change in appearance, or location between the views should raise the suspicion of this lesion. Similar to other smaller flat lesions, there is contrast often coating present with quality bowel
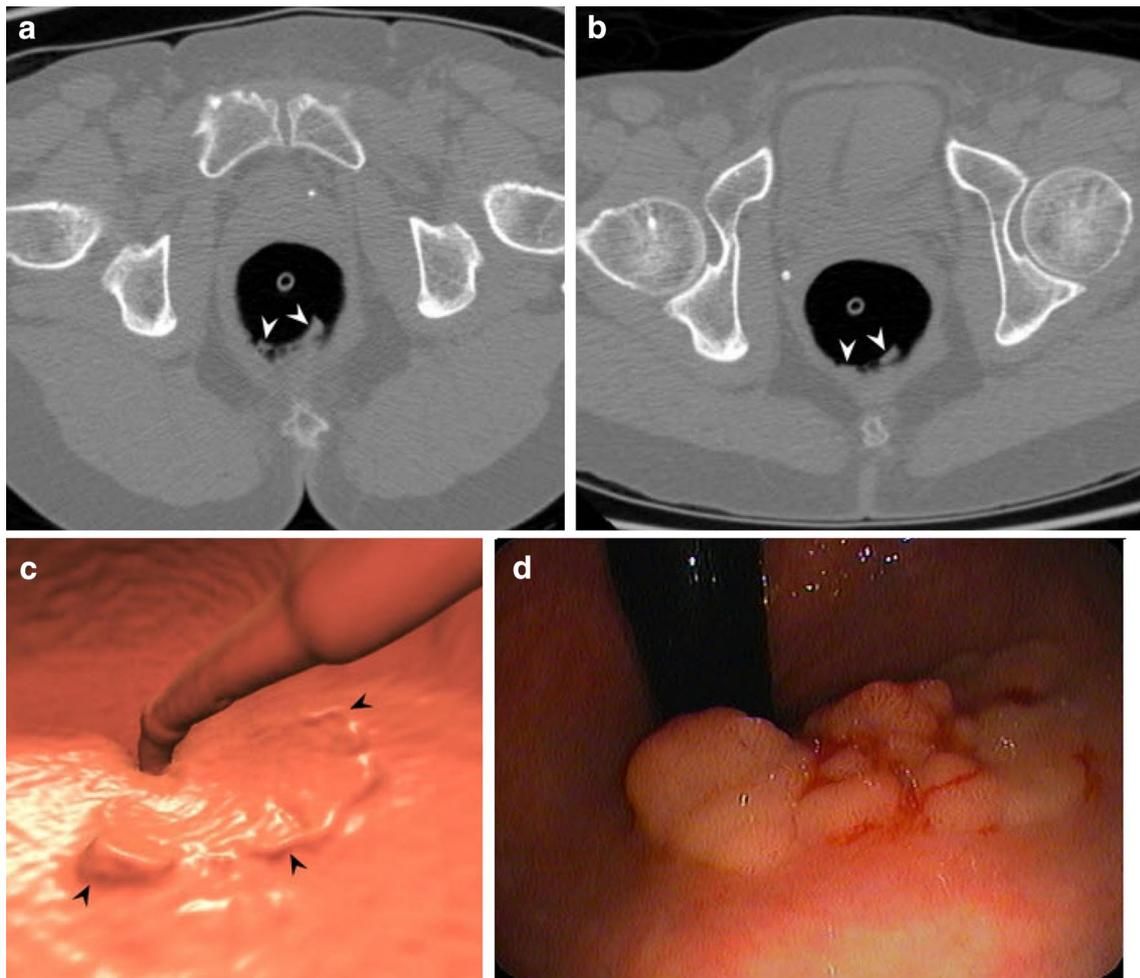
Fig. 4 Large nonpolypoid low rectal lesion partially obscured by rectal balloon catheter. **a** and **b** Prone and supine 2D CTC image shows frond like soft-tissue projections (arrowheads) subjacent to and partially effaced by the balloon catheter. **c** The impression from the balloon on the lesions is better depicted on the 3D endoluminal CTC image (arrowheads). **d** Optical colonoscopy shows the carpet lesion extending to the anorectal junction. The lesion proved to be a tubulovillous adenoma From Ref. [3] with permission

preparation. Contrast mixes preferentially with the mucin produced by the sessile serrated and villous polyps but not the normal colonic mucosa [16]. In the rectum, true neoplasms can be further effaced or partially obscured by the rectal catheter balloon (Fig. 4) [17]. It is helpful to deflate the balloon on the final series, usually the prone or decubitus, to decrease this possibility.

Low rectal and anal cancers

The greatest concern in misinterpreting the anorectal region during CTC is missing a frank malignancy, either a low rectal or anal cancer. In fact, the anorectal region is the most common site of missed malignancy at CTC [2]. Despite a typically larger size and more mass-like growth pattern, these lesions may also be obscured or partially effaced by the rectal catheter (Fig. 5). This is particularly true of the large caliber catheters with retention cuffs. Besides missing lesions, smaller lesions could be mistaken for kissing artifact of the balloon (Fig. 5). Anal cancers are most often squamous cell carcinomas. Because they are centered in the anal canal with variable extension into the rectum (Fig. 6), they may be subtle at CTC.

There are several protocol modifications which are helpful to minimize the impact of the balloon and potential miss of a significant neoplasm. These include using smaller CTC-specific flexible catheters to decrease the possibility of the balloon obscuring the mass, as well as deflating the balloon immediately before one of the later series acquisitions. A common method is to deflate the balloon after the patient has been turned prone for the second series and immediately prior to the image acquisition. Digital rectal exam should be undertaken in conjunction with CTC (either by the radiologist or recommended in the report) to complete screening
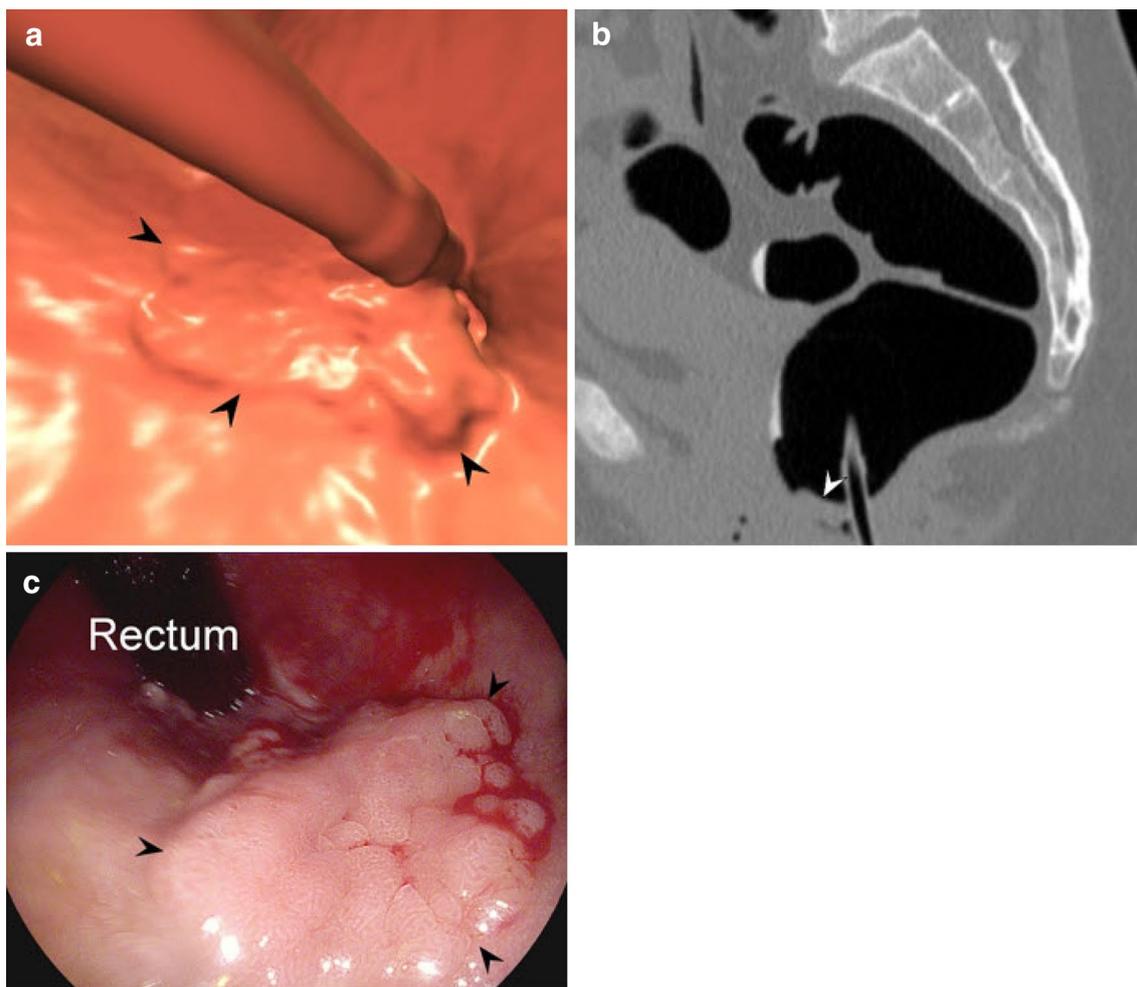
Fig. 5 Low rectal cancer initially missed on CTC. **a** and **b** 3D endoluminal and 2D CTC images show a plaque-like soft-tissue lesion (arrowheads) that is partially compressed and obscured by the rectal balloon. **c** Optical colonoscopy also demonstrates the lobulated, relatively subtle flat mass (arrowheads), which proved to be an adenocarcinoma at pathology From Ref. [5] with permission

and decrease the possibility of a lesion being obscured by the balloon.

Non-neoplastic polypoid entities specific to the anorectal region

Hypertrophic anal papillae

Hypertrophied anal papillae are benign, focal fibrous thickenings at the dentate line that form in response to chronic irritation, similar to skin tags in other areas. At direct visualization at anoscopy or endoscopy, they have a specific characteristic appearance where biopsy/resection is not required. These lesions often have a pearly white appearance originating from the dentate line. At CTC, they present as a nonspecific polyp. However, if the polyp is 5–6 mm or less and abuts the catheter at the anorectal junction, the

diagnosis of anal papilla can be usually made confidently (Fig. 7), and confirmed by digital rectal exam if desired. The key to avoiding this diagnostic pitfall is recognizing the specific anatomic location at the anorectal junction (dentate line) and using a small rectal catheter that is less likely to obscure the origin of the anal papilla. In contrast, a true rectal polyp will usually demonstrate some separation from the anorectal junction. Rarely, if the anal papilla is large or pedunculated and appears removed from the anorectal junction and catheter, further evaluation may be needed for confirmation to exclude a colorectal polyp (Fig. 8).

Solitary rectal ulcer syndrome

Solitary rectal ulcer syndrome is a benign, chronic, and poorly understood disease process. The cause is thought to be related to repeated direct microtrauma and/or local ischemia related to longstanding obstructive constipation
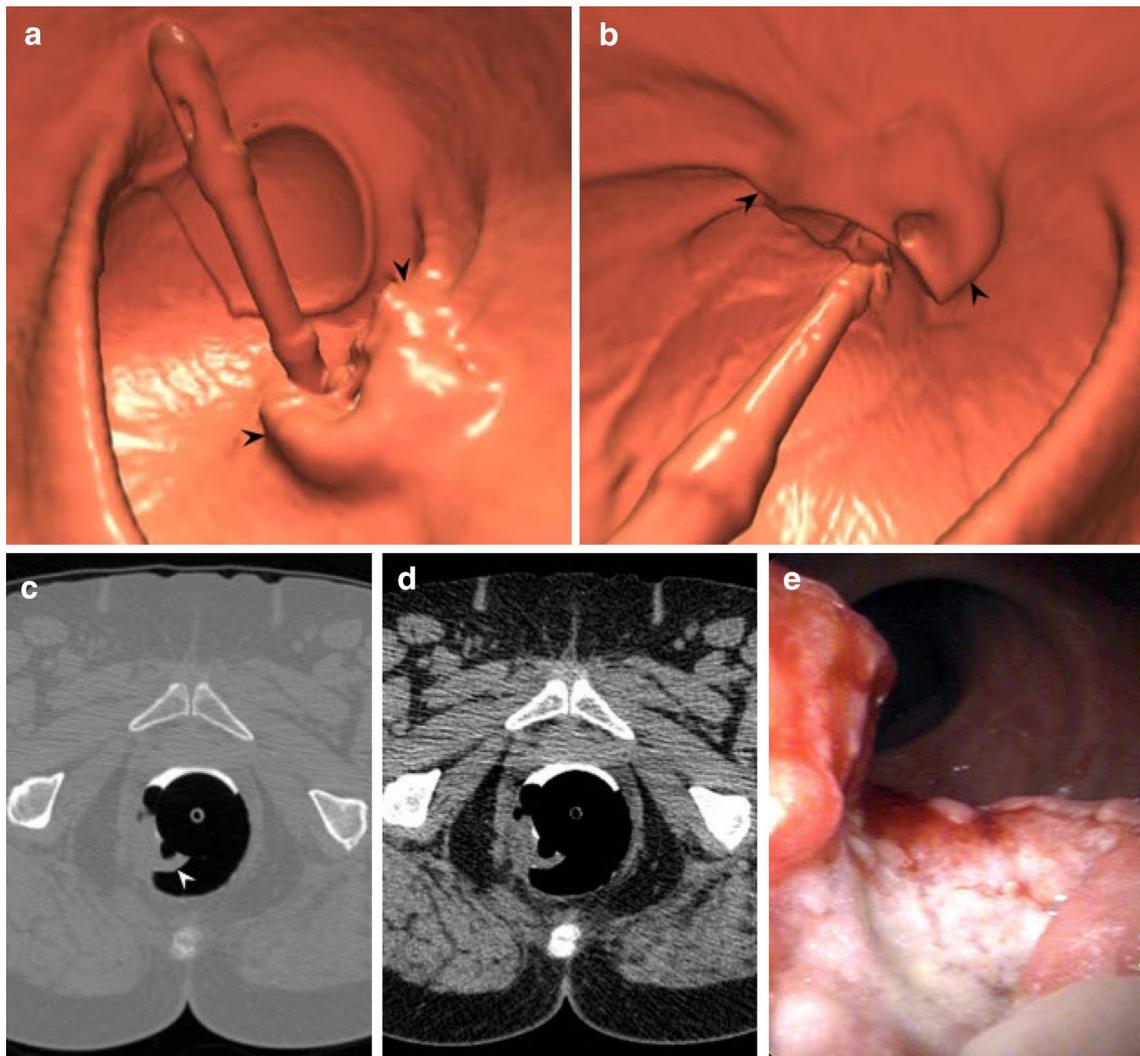
Fig. 6 Anal squamous cell carcinoma. **a–d** Prone 3D endoluminal and 2D CTC images show an irregular soft-tissue mass (arrowheads) emanating from the anorectal region. There is significant mass effect on the lesion from the adjacent rectal catheter. **e** Image from colonoscopy shows the ulcerated mass, which proved to be an anal squamous cell carcinoma From Ref. [3] with permission

and rectal intussusception. The name is misleading, because solitary rectal ulcer syndrome appears ulcerative in less than 50% of cases, and may appear as polypoid lesions up to 25% of the time [18]. The appearance is nonspecific and ranges from fold thickening, nodularity, stricture, polyp, or ulcer [19]. As such, a wide array of findings is possible at CTC. Solitary rectal ulcer syndrome has significant overlap with other rectal disorders of defecation, including prolapse and colitis cystica profunda. An ulcer or polyp in the anterior rectum centered on a rectal fold with clinical symptoms of evacuation disorder is suggestive of this benign condition [20]. Diagnosis often requires biopsy due to the overlap in appearance between this benign condition, malignancy, and rectal endometriosis [19].

Anal condyloma

Anal condylomata, or anal warts, are a sexually transmitted disease caused by human papillomavirus (HPV). HPV is the most common risk factor for the development of anal intraepithelial neoplasm, which is a precursor for squamous cell carcinoma of the anus [21]. Anal condylomata may have an endorectal component that can be seen on CTC (Fig. 9). They typically present as small or diminutive clustered lesions in the distal rectum near the anorectal junction. Some lesions can be much larger, especially in the setting of HIV/AIDS (Fig. 9). The appearance overall is nonspecific, but the clinical history in conjunction with physical exam findings may be helpful to suggest this entity. Immunocompromised patients, including transplant recipients and HIV patients, can have more aggressive forms of anal condylomata [22].
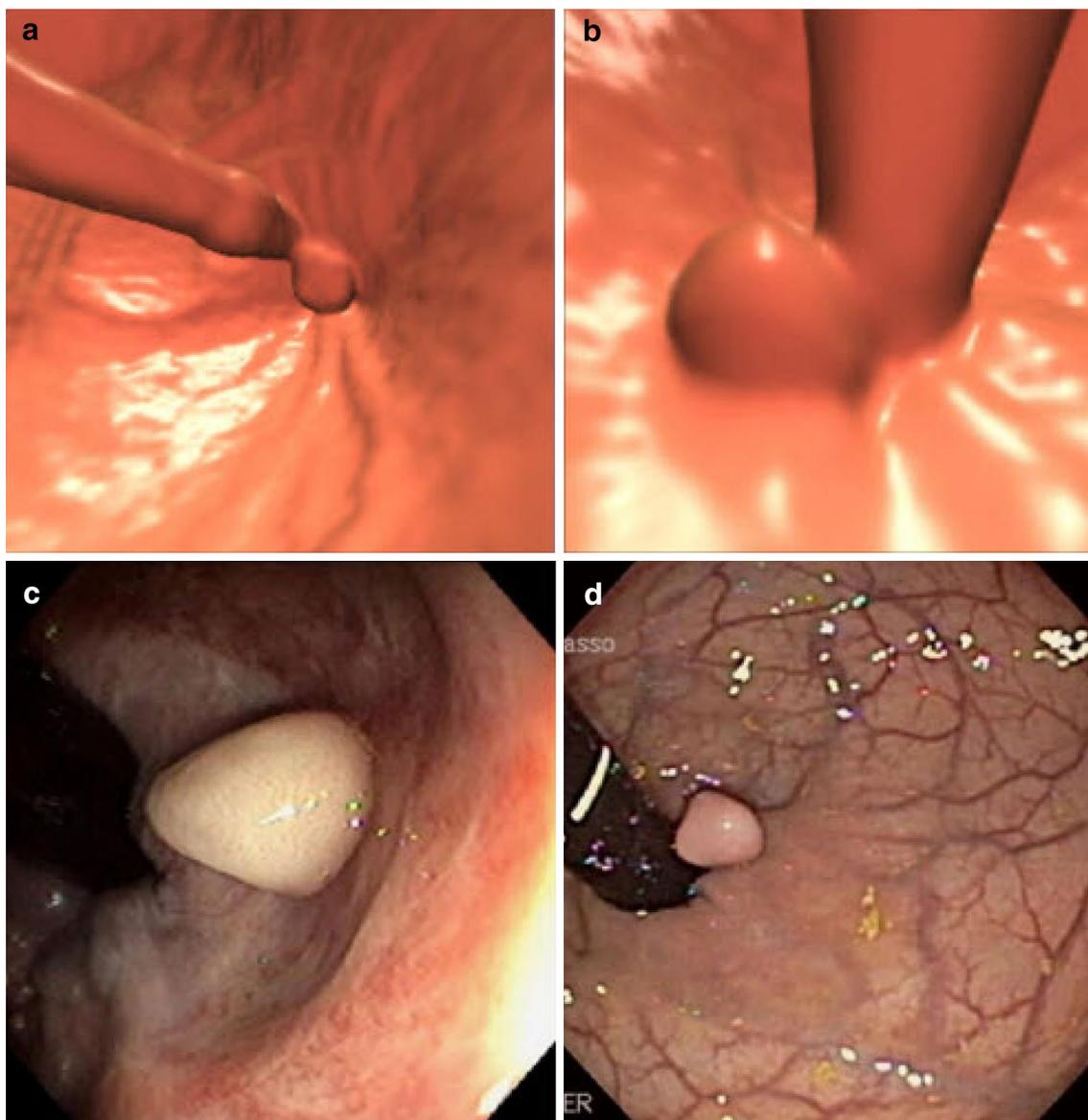
Fig. 7 Hypertrophic anal papillae. 3D endoluminal CTC (**a**, **b**) and optical colonoscopy (**c**, **d**) images from different patients show the typical appearance of hypertrophic anal papillae. The polypoid lesions tend to be small and characteristically contact the rectal catheter or endoscope given their origin from the dentate line From Ref. [3] with permission

Internal hemorrhoids are specific to the anorectal region, but are discussed below with submucosal lesions.

Submucosal and extrinsic lesions in the anorectum

Submucosal lesions make up the most diverse pathology in the anorectal region. These lesions are located deep to the mucosa and, broadly speaking, can include either intramural or extrinsic lesions. Submucosal and extrinsic lesions are most often benign, such as internal hemorrhoids and retrorectal cystic hamartomas (tailgut cysts). However, lesions such as gastrointestinal stromal tumors (GIST) do have some malignant potential. Submucosal lesions often appear as smooth, broad-based impressions on three-dimensional fly-through. The obtuse angles formed suggest a deeper origin compared with mucosal-based lesions. The two-dimensional CTC views can be useful in determining the etiology, tissue type, and extent of disease to avoid potential misdiagnosis as a mucosal-based mass or polyp.

Internal hemorrhoids represent dilated submucosal vessels above the dentate line, and are a common anorectal finding at CTC. Most cases are asymptomatic and incidental, but
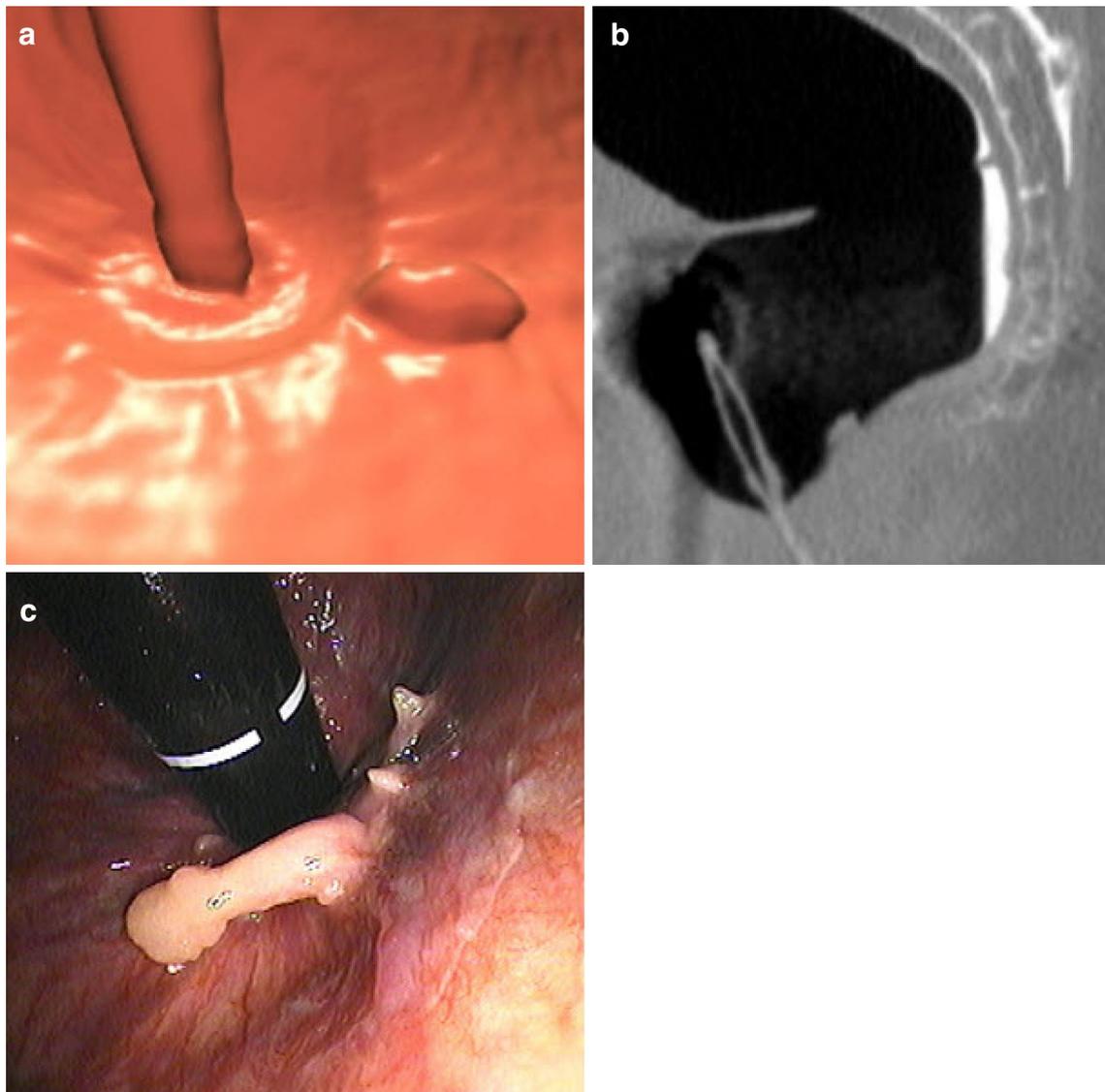
Fig. 8 Pedunculated anal papilla with connection to dentate line obscured by rectal balloon at CTC. **a** and **b** 3D endoluminal and 2D CTC images show a polypoid lesion, which appears to be removed from the anorectal junction. **c** At optical colonoscopy, this proved to be a pedunculated anal papilla. The stalk of the lesion was effaced by the rectal balloon at CTC, thus mimicking a potential neoplastic low rectal polyp From Ref. [3] with permission

the appearance can be polypoid (Fig. 10) or even mass-like with circumferential involvement around the rectal catheter. When not thrombosed, a key finding of internal hemorrhoids is marked change in appearance with patient positioning. However, thrombosed hemorrhoids can appear mass-like and fail to compress (Fig. 11). When symptomatic, they may present with bleeding or prolapse (Fig. 12). Rectal varices are an additional vascular finding that can be seen in the low rectum. The serpiginous appearance of these dilated submucosal vascular channels, which are associated with portal hypertension, should not be confused for neoplastic disease (Fig. 13).

Rectal GISTs arise from the muscularis propria of the rectal wall. After the stomach and small bowel, the rectum is the third most common location of GISTs. As with other locations, rectal GISTs tend to have an exoenteric growth pattern and most often appear as classic broad-based impressions at three-dimensional CTC (Fig. 14) [23]. Two-dimensional CTC images will show the true nature of these solid masses. Although CTC is typically performed without intravenous contrast, rectal GISTs exhibit enhancement if intravenous
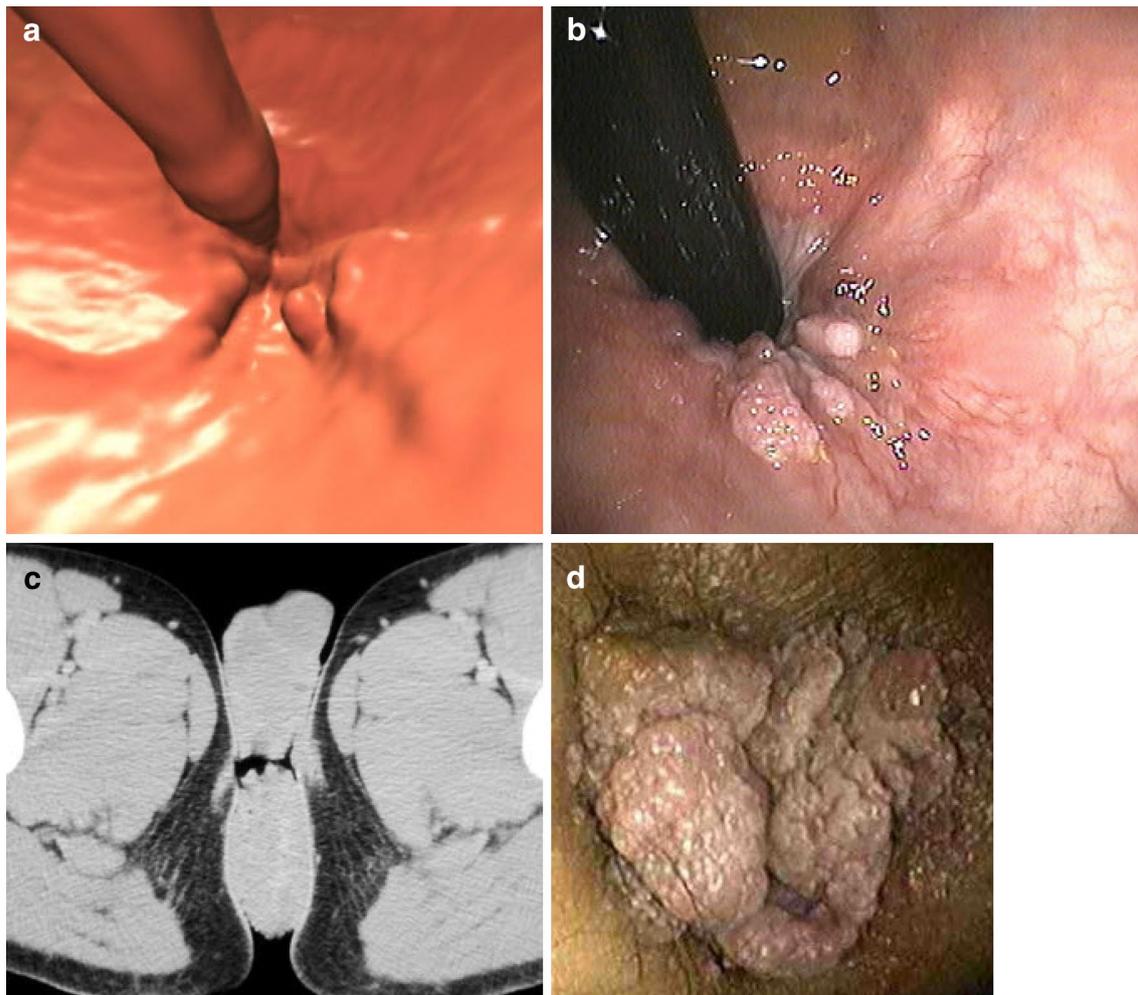
Fig. 9 Anal condylomata. **a** and **b** 3D endoluminal CTC and corresponding optical colonoscopy image show a subtle anal condyloma at the anorectal junction. At CTC, collapsed folds or internal hemorrhoid could have a similar appearance. **c** and **d** CT and photograph from two separate patients with HIV show much bulkier disease with a prominent exophytic component From Ref. [4] with permission

contrast is administered (Fig. 14). Most GISTs are benign, but metastatic spread to the liver and peritoneal cavity is typical of malignant lesions.

Less common submucosal lesions in the anorectal region include rectal hemangiomas, lymphoid polyps, and carcinoid tumors. The most common site of colorectal cavernous hemangiomas is the rectosigmoid colon [24]. The submucosal appearance on three-dimensional CTC is nonspecific, but the finding of phleboliths within the lesion on two-dimensional imaging is highly suggestive of cavernous hemangioma (Fig. 15). Carcinoid tumors of the colon are relatively uncommon, but are most frequently seen in the rectum. These rectal lesions are usually small and benign. Given the typical small size, it can be difficult to differentiate between a submucosal rectal carcinoid and a mucosal-based polyp [24].

Extrinsic masses occurring in the presacral space have a broad differential diagnosis [25]. Retrorectal cystic hamartomas, also known as tailgut cysts, are the most common incidental presacral lesion seen in adults, including those undergoing CTC screening [26, 27]. If they induce mass effect on the adjacent rectum, they will appear as a smooth, broad-based posterior bulge on three-dimensional CTC. On two-dimensional CTC evaluation, retrorectal cystic hamartomas will have a variable heterogeneous cystic appearance (Fig. 16). Other potential extrinsic lesions in the presacral space include nerve sheath tumors, solitary fibrous tumor, teratoma, sarcomas, dural ectasia, and a host of sacral bone tumors [24, 25].
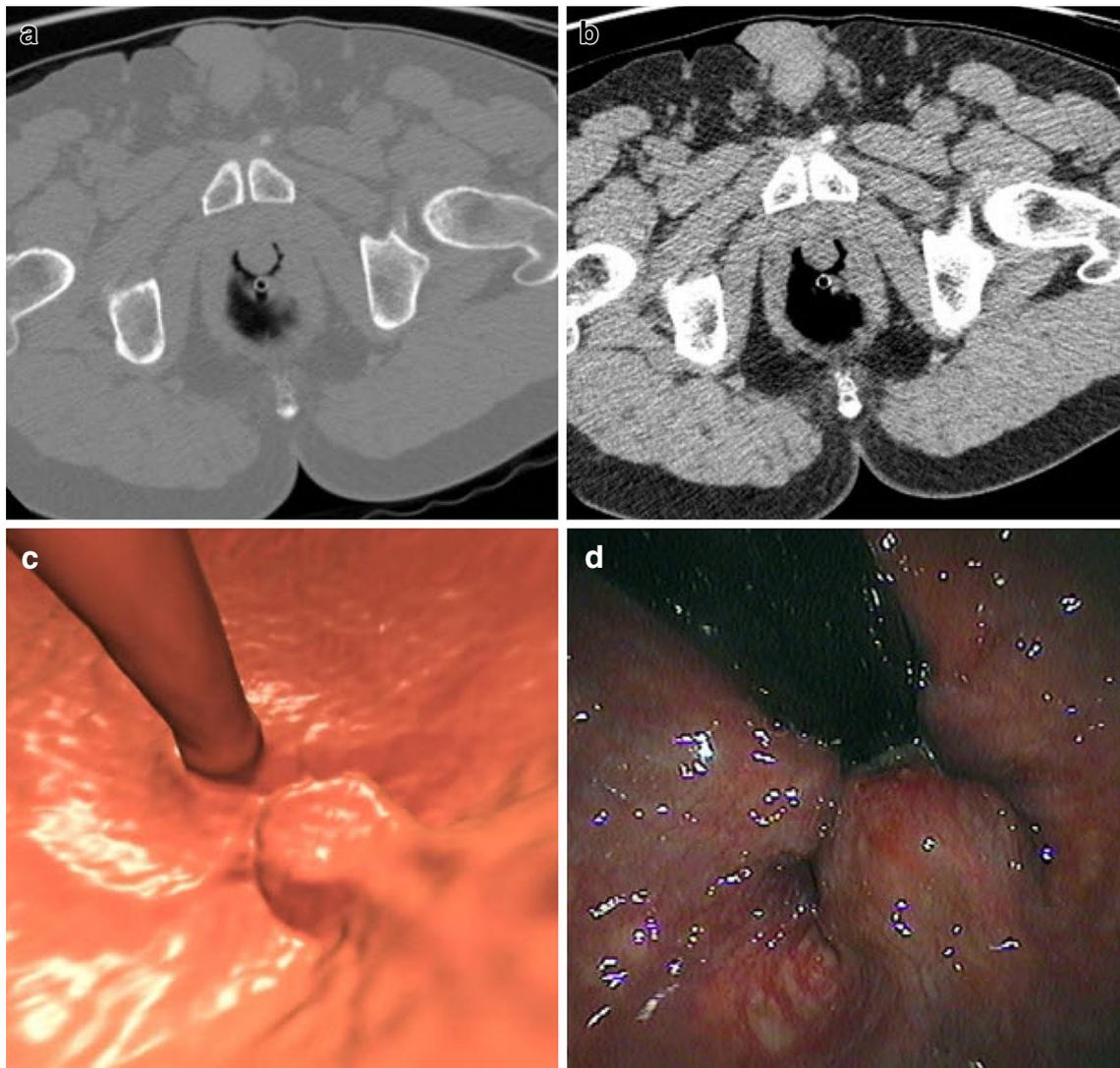
Fig. 10 Internal hemorrhoids. **a–c** 2D and 3D endoluminal CTC images show a polypoid lesion at the anorectal junction. **d** Retroflexed image from optical colonoscopy confirms internal hemorrhoids From Ref. [3] with permission

Pseudolesions and technical pitfalls in the anorectal region

Bowel preparation

Proper attention to technique can decrease many technical pitfalls at CTC interpretation. This includes thorough bowel preparation to eliminate or reduce residual stool and retained fluid, which can create pseudolesions as well as obscure pathology. Optimal patient preparation also includes contrast agents that tag both fluid and residual particulate matter [28–30]. As discussed above, surface coating of flat polyps to make them more conspicuous is critical for detection. These agents also admix with any retained stool to easily allow differentiation from any soft-tissue polyps. Adequate, or preferably optimal, colonic distention minimizes the risk

that collapsed rectal folds will mimic pathology. Other technical considerations include patient positioning and proper imaging technique.

Our bowel preparation begins 1 day before CTC starting with a liquid only diet at midnight [28–30]. This reduces solid fecal material. The patient is instructed to maintain hydration throughout the preparation. At mid-day on the day before CTC, 10–20 mg of bisacodyl is ingested. In the late afternoon or early evening, the cathartic portion of bowel preparation begins with one bottle of magnesium citrate. Two to three hours later, an additional bottle of magnesium citrate is ingested along with the first tagging agent, consisting of one bottle, 2% w/v barium. Finally, 2–3 h later, the second tagging agent, consisting of one bottle iohexol, is ingested. If the cathartic step is initiated at 2 pm, the final step can be completed as early as 6 pm. The iodinated
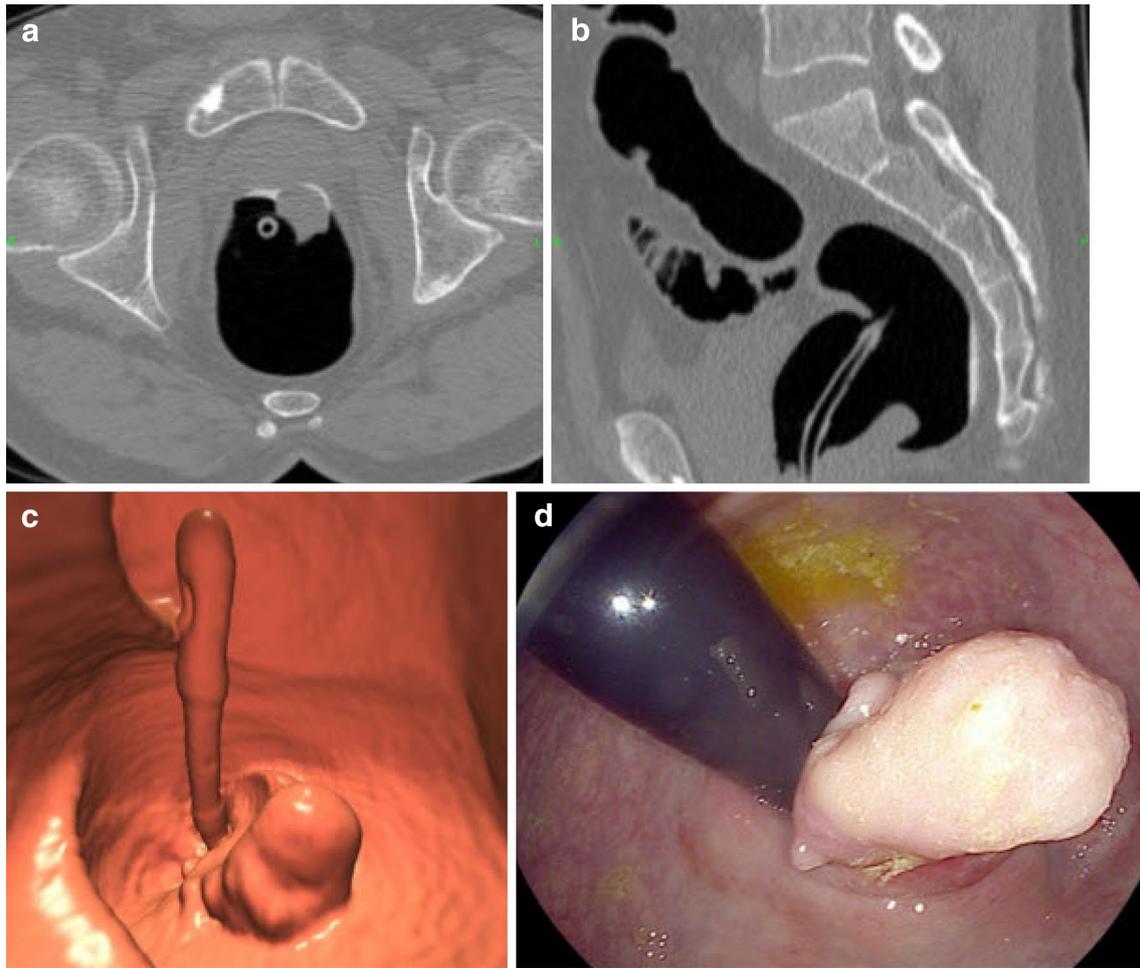
Fig. 11 Large thrombosed internal hemorrhoid. **a–c** 2D and 3D endo-luminal CTC images show a large protuberant mass extending from the anorectal junction. Note the impression of the rectal balloon upon the mass. **d** Biopsy at colonoscopy was non-diagnostic. The mass was surgically resected and proved to be a chronically thrombosed hemorrhoid with fibrosis

water-soluble contrast agent tags residual luminal fluid, which provides an attenuation difference with submerged polyps. The barium contrast is incorporated into any residual stool to increase attenuation and improve differentiation between retained fecal material and polyps. Finally, polyp coating with contrast increases conspicuity of flat lesions, including right-sided serrated polyps [11, 31–33].

Colonic distention

Colonic distention with CO_2 insufflation separates the mucosal surfaces to allow for detection of soft-tissue lesions against the gas interface [34]. The anal canal does not distend and requires digital rectal exam for complete evaluation. The patient is placed in a left lateral decubitus position on the CT scanner table. A soft rectal catheter is placed and the balloon is carefully inflated. Colonic distention is monitored by volume and pressure measurements to determinate

when the patient has been adequately distended. Supine scanning should be acquired when the pressure equilibrates in the mid-20s mm Hg and gas volume is greater than 4 L. If the images are adequate for distention and coverage, the patient is rolled to the prone position. Images are usually acquired in the prone position with the balloon deflated. It is important that at least one series of images is obtained with the balloon deflated, so that distal rectal pathology is not obscured. Additional decubitus images can be acquired if there is under-distention of a portion of the colon [35, 36].

Rectal catheter artifacts

It is important to be aware of the potential technical artifacts from the rectal catheter and balloon. The rectal catheter is a constant finding at CTC that commonly causes pseudolesions and less frequently can even obscure true lesions (Fig. 17) [17]. The inflated balloon, which is nearly invisible,
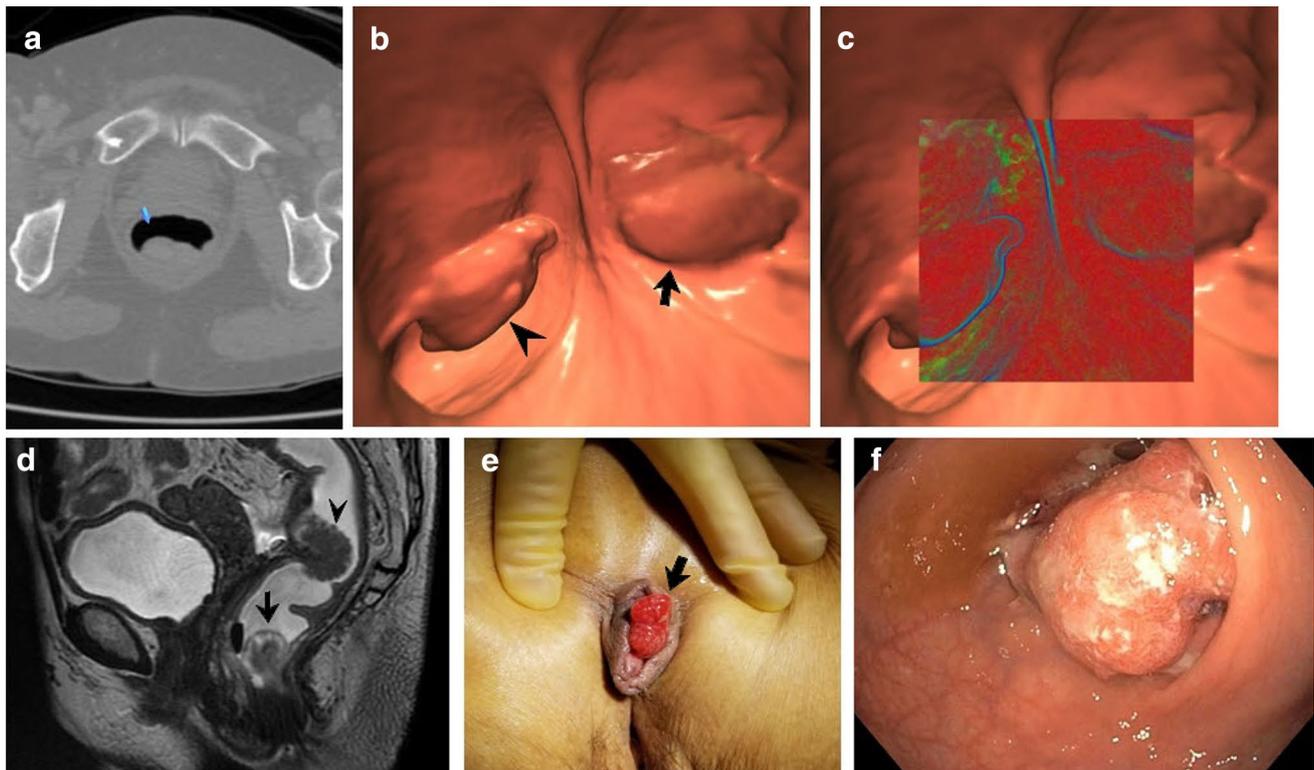
Fig. 12 Prolapsing internal hemorrhoid in patient with rectal cancer. **a–c** 2D and 3D endoluminal CTC images show two mass lesions, one near the anorectal junction (arrow) and the other in the mid-rectum (arrowhead). **d** Sagittal image from rectal MR shows both masses. The mid-rectal mass has a typical appearance for adenocarcinoma, whereas the low rectal lesion demonstrates submucosal T2-hyper-intensity. **e** and **f** At endoscopy, a prolapsing hemorrhoid was seen (arrow) as well as rectal cancer more proximally

can cause pseudolesions and mass effect on luminal fluid, the rectal wall, and focal lesions (Figs. 6, 11). Viewing on lung windows may help visualization of the balloon itself when an artifact is suspected. The tip of the catheter can appear as a polypoid lesion itself, or by causing extrinsic impression on an adjacent rectal fold on three-dimensional fly-through. Typically, the pseudolesions caused by the catheter tip are easily resolved by close inspection of the two-dimensional CTC images, especially the sagittal view [37]. Importantly, the inflated balloon or rectal catheter itself can obscure or distort anorectal lesions by obscuring the origin of the lesion. For example, we have seen cases where the balloon made it difficult to distinguish a pedunculated hypertrophied anal papilla from a mucosal-based neoplasm (Fig. 8). In other cases, the balloon or catheter has compressed or obscured true rectal neoplasms (Figs. 4, 17).

To minimize the effect of the balloon effacing a lesion or creating a pseudolesion, deflating the retention balloon is strongly recommended immediately before obtaining the second or final CTC series, which is typically done with the patient in the prone position. Also, a smaller caliber catheter with a 20–30 cc retention balloon is preferred.

Beam hardening and CT dose reduction

Another technical concern for interpreting anorectal lesions at CTC is beam-hardening artifact related to metallic implants. This appears as alternating dark and bright linear bands and is often due to hip arthroplasties or other ortho-pedic hardware in the pelvis. This artifact is seen both on the two-dimensional and three-dimensional images. Beam-hardening artifact can obscure important anorectal lesions
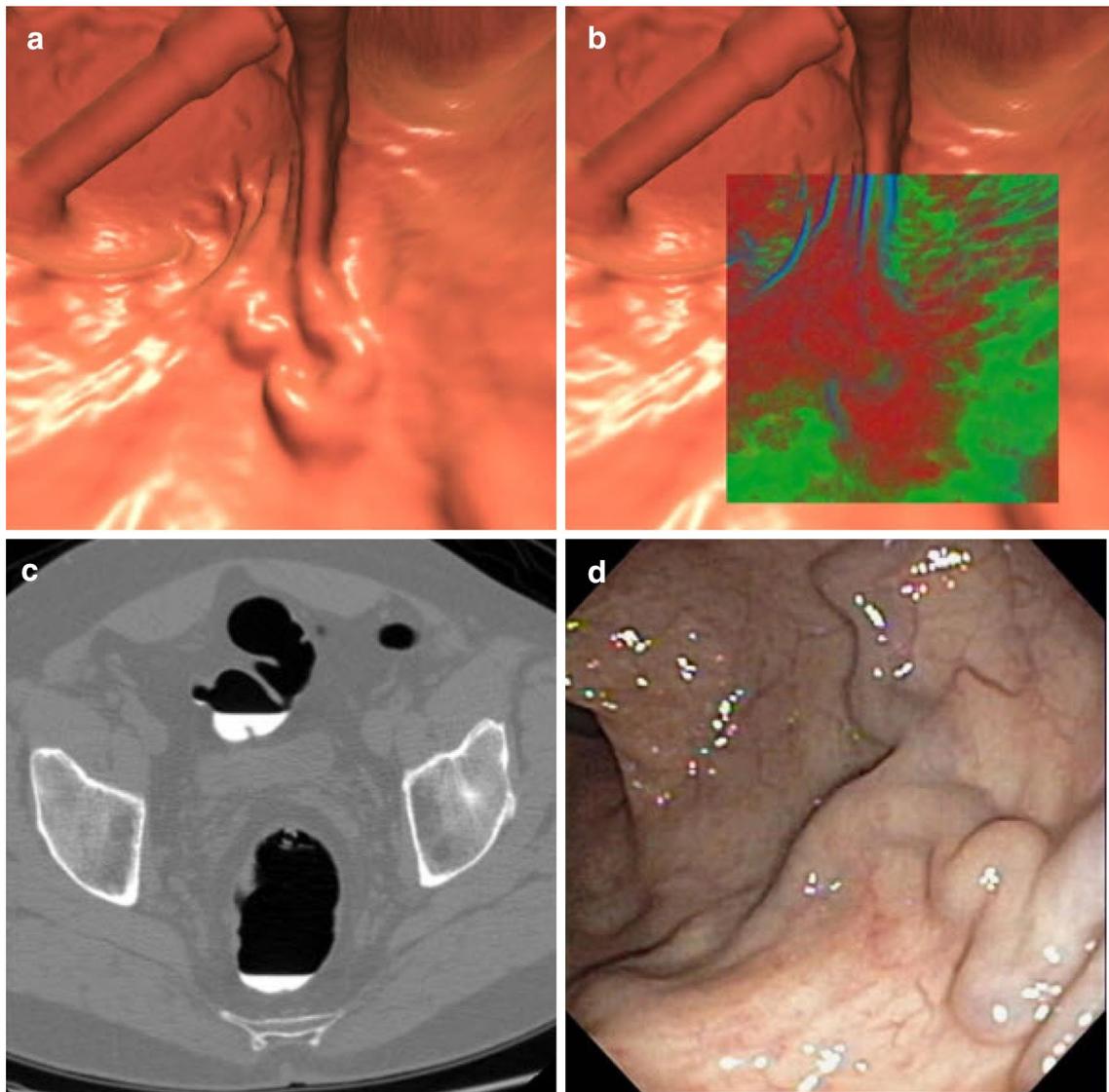
Fig. 13 Rectal varices. **a–c** 3D endoluminal and 2D CTC images show tortuous tubular structures compatible with rectal varices. Translucency rendering shows soft-tissue density. **d** Optical colonoscopy in another patient shows a similar appearance of rectal varices

(Fig. 18). Polyp windowing reduces the impact of the beam-hardening artifact and may allow for better lesion detection. The use of a metallic artifact reduction algorithm can further reduce the amount of streak artifact in the pelvis and improve anorectal evaluation (Fig. 19) [38].

Given the increased attention to radiation dose exposure, much effort has gone into reducing the dose of radiation received during diagnostic CT examinations. However, at extremely low-dose levels, image noise can become an issue,

especially with the use of traditional filtered back projection for image reconstruction [39–41]. With a fixed mA low-dose technique, image noise can be accentuated in the anorectal region due to the bony pelvis. Modulating tube current can avoid this discordance by boosting mA to maintain a static noise level throughout the abdomen and pelvis, decreasing photon starvation in the pelvis. More advanced CT reconstruction algorithm also improves image quality at low-dose levels.
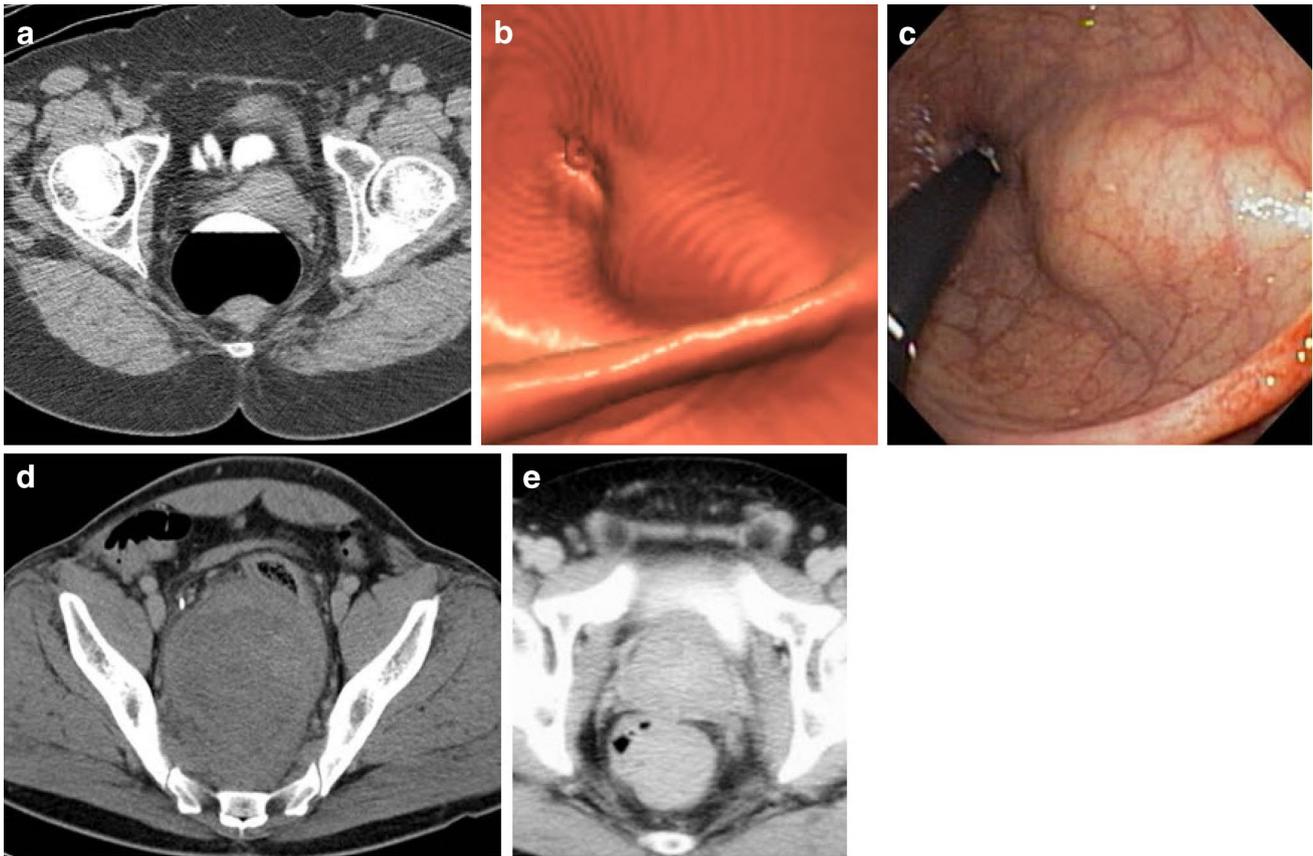
Fig. 14 Rectal GI stromal tumors (GISTs). **a** and **b** 2D and 3D endoluminal CTC images show a smooth, broad-based impression along the posterior rectum, which was missed at endoscopy (**c**). Subsequent CT-guided biopsy revealed a rectal GIST. **d** and **e** Contrast-enhanced CT in two additional patients with rectal GISTs demonstrate variable enhancement From Ref. [6] with permission
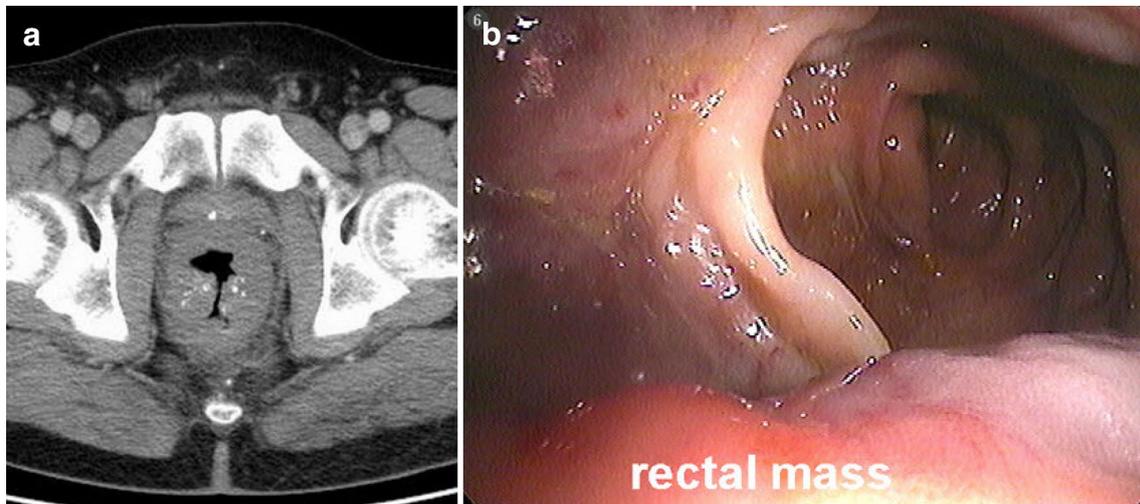

Fig. 15 Rectal hemangioma. **a** Contrast-enhanced CT shows marked circumferential rectal wall thickening, associated with punctate calcifications that represent phleboliths within a rectal hemangioma. **b** Endoscopic image shows that the submucosal rectal mass has a reddish–purplish hue From Ref. [24] with permission
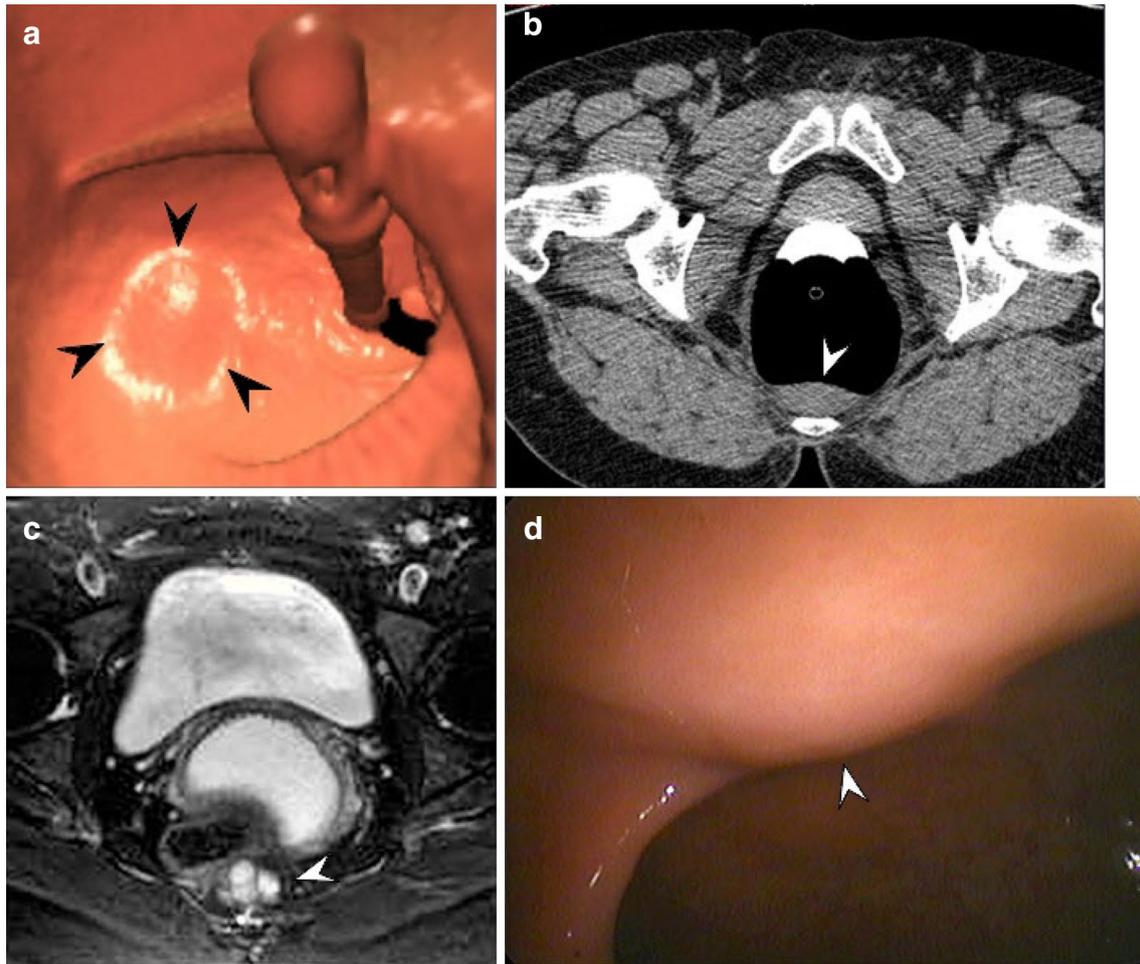
Fig. 16 Retrorectal cystic hamartoma (tailgut cyst). **a** and **b** 3D endo-luminal and 2D CTC images show a smooth, broad-based impression at the posterior rectum (impression) related to a presacral soft-tissue lesion. **c** T2-weighted MR image shows the presacral lesion has a multicystic appearance. **d** The lesion was missed at initial endoscopic imaging, but a subtle bulging was seen at repeat evaluation From Ref. [4] with permission
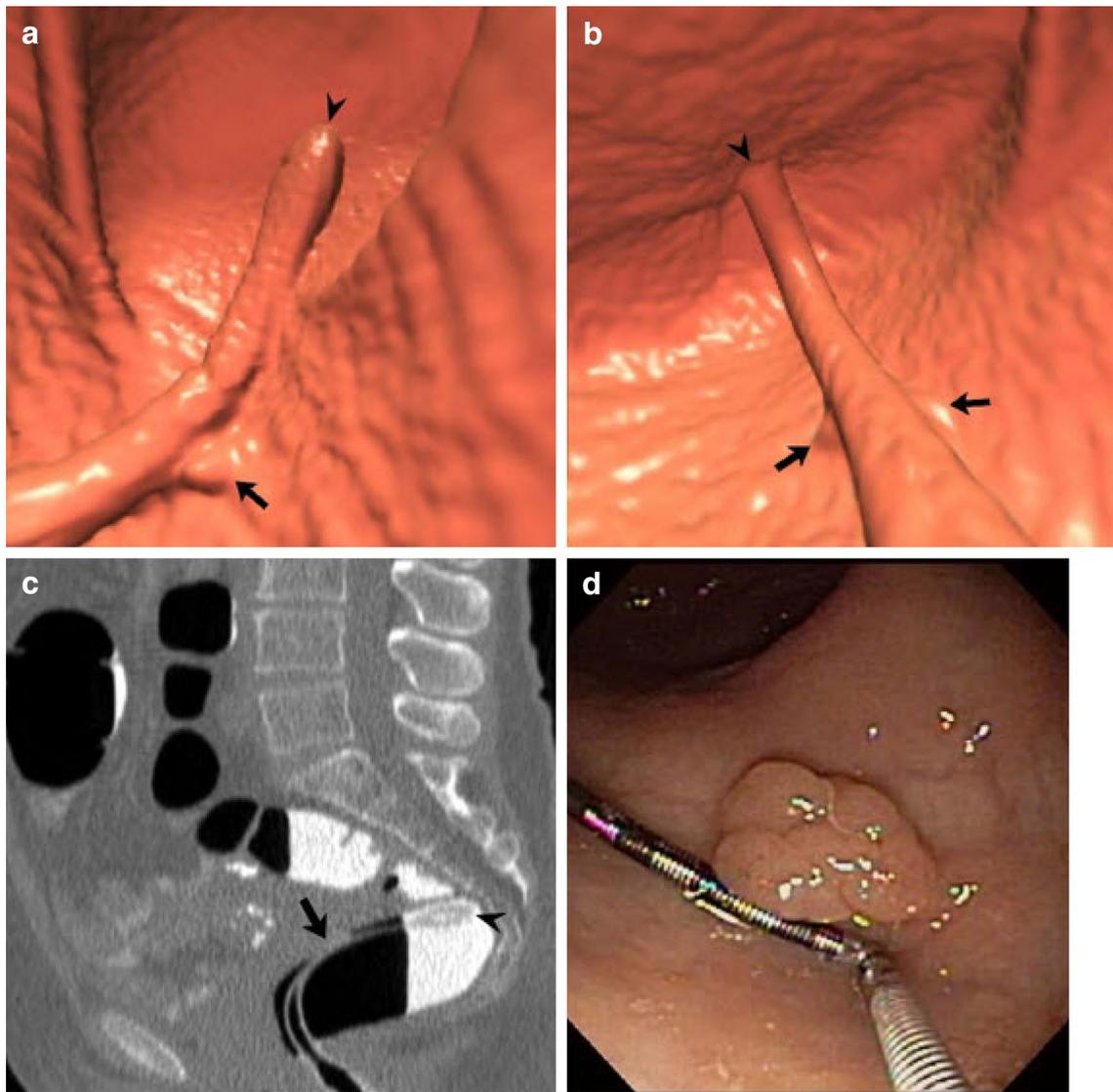
Fig. 17 Rectal polyp missed at CTC due to obscuration by rectal catheter. **a–c** 3D endoluminal and 2D CTC images show rectal catheter placement (arrowheads) that obscures an underlying soft-tissue polyp (arrows). **d** The polyp was subsequently found at optical colonoscopy From Ref. [17] with permission
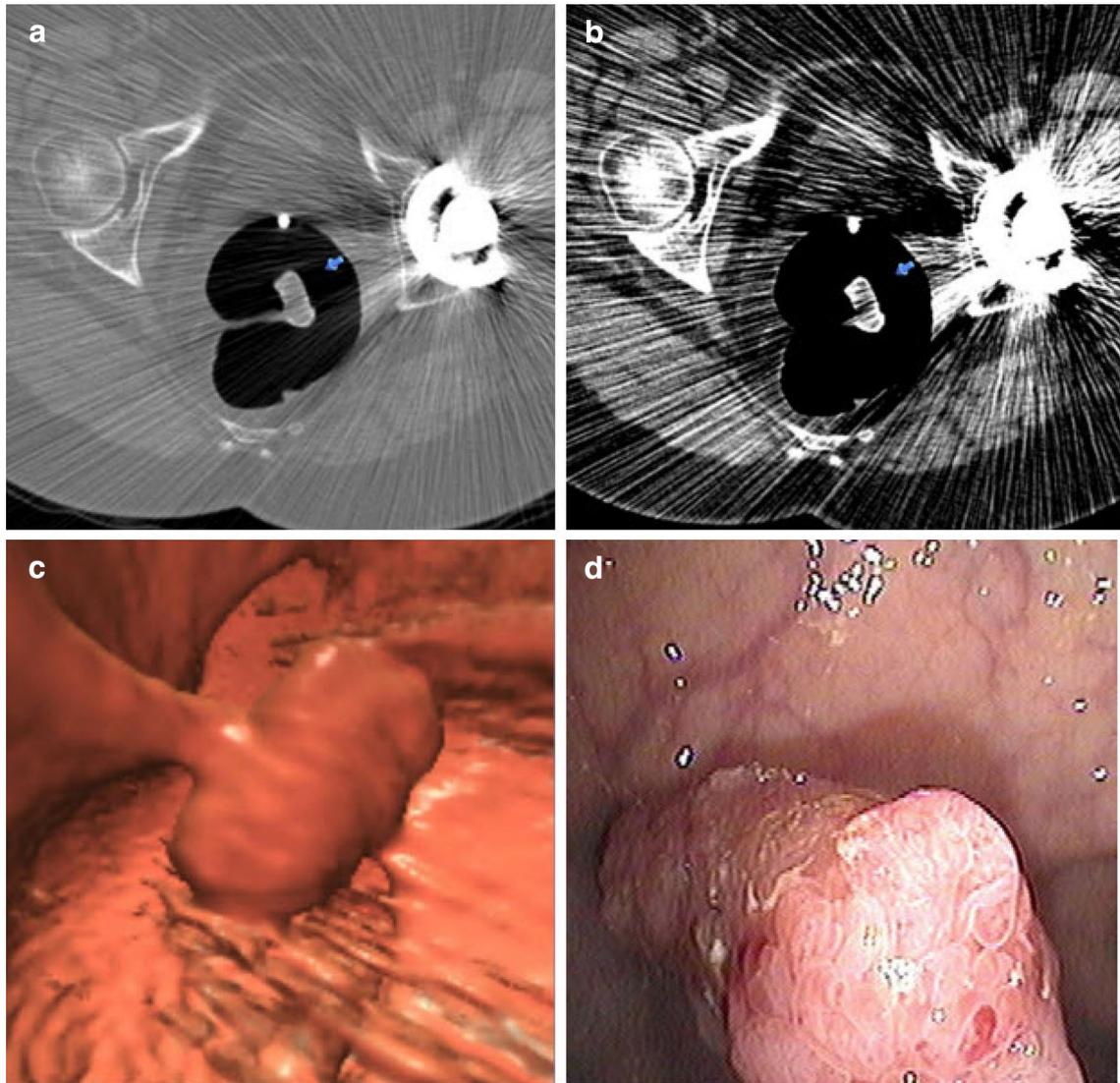
Fig. 18 Beam-hardening artifact. **a** and **b** 2D CTC images with polyp (**a**) and soft-tissue (**b**) windows show the alternating streaks caused by beam hardening from the left hip arthroplasty, which partially obscures a large pedunculated rectal mass. The artifact is somewhat lessened on polyp windows. **c** Beam-hardening artifact is also seen on the 3D endoluminal view. **d** The rectal mass was confirmed at optical colonoscopy From Ref. [3] with permission
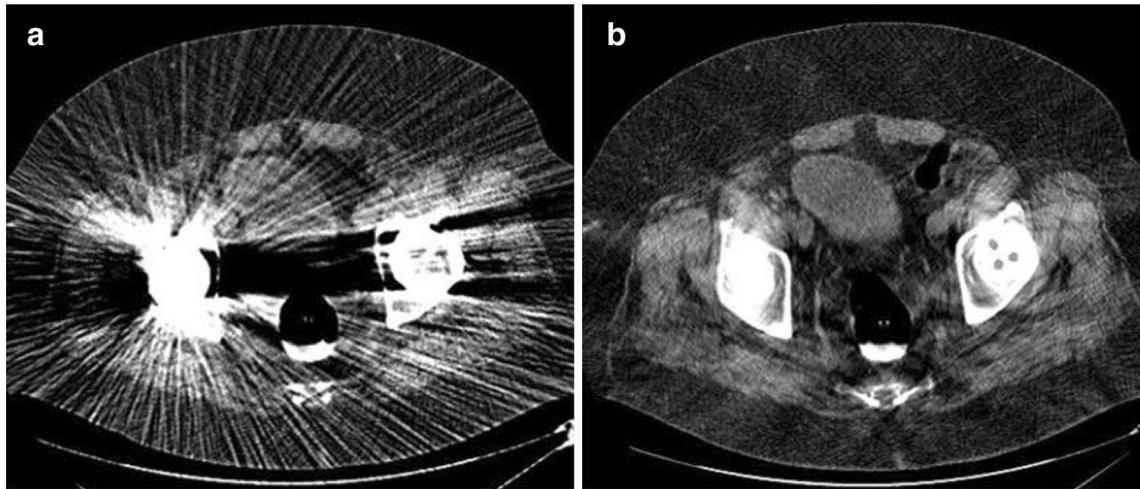
Fig. 19 Reduction of metal artifact. **a** and **b** 2D CTC images without (**a**) and with (**b**) metal artifact reduction algorithm in a patient with bilateral hip arthroplasties. Note how central pelvic structures, including the rectum, are much better visualized in **b**

Conclusion

This article covers the potential pitfalls at CTC interpretation of the anorectal region, which is important, because this region is the most common region for missed colorectal cancers. A variety of specific anorectal entities may mimic important pathology at CTC. Recognizing these pitfalls using both two- and three-dimensional CTC interpretation allows for more accurate evaluation. Understanding and minimizing potential technical pitfalls will further improve diagnostic performance. For the rare pseudolesions and pitfalls not fully and confidently characterized with CTC, digital rectal exam, anoscopy, or flexible sigmoidoscopy may be considered for further evaluation to exclude true pathology.

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