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SAR user guide to the rectal MR synoptic report (primary staging)

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Abstract
Rectal MR is the key diagnostic exam at initial presentation for rectal cancer patients. It is the primary determinant in establishing clinical stage for the patient and greatly impacts the clinical decision-making process. Consequently, structured reporting for MR is critically important to ensure that all required information is provided to the clinical care team. The SAR initial staging reporting template has been constructed to address these important items, including locoregional extent and factors impacting the surgical approach and management of the patient. Potential outputs to each item are defined, requiring the radiologist to commit to a result. This provides essential information to the surgeon or oncologist to make specific treatment deisions for the patient. The SAR Initial Staging MR reporting template has now been officially adopted by the NAPRC (National Accreditation Program for Rectal Cancer) under the American College of Surgery. With the recent revisions to the reporting template, this user guide has been revamped to improve its practicality and support to the radiologist to complete the structured report. Each line item of the report is supplemented with clinical perspectives, images, and illustrations to help the radiologist understand the potential implications for a given finding. Common errors and pitfalls to avoid are highlighted. Ideally, rectal MR interpretation should not occur in a vacuum but in the context of a multi-disciplinary tumor board to ensure that healthcare providers use common terminology and share a solid understanding of the strengths and weaknesses of MR.

Keywords Rectal cancer · Magnetic resonance imaging · Structured reporting · Staging

Purpose and background

This practical guide is geared toward the general abdominal radiologist to help correctly complete the SAR rectal cancer synoptic report at initial staging/presentation. The guide has been extensively revised from the initial version in order increase the usefulness to the radiologist. Each line item on the synoptic report is displayed in the guide followed by an explanation on how to correctly report out the specific finding.

The purpose of this guide is to:

(1) Provide further detail regarding the various Magnetic Resonance (MR) imaging assessments required in the synoptic report.
(2) Explain the impact of the selected reporting options on patient management.

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This guide is organized in parallel with the synoptic report and follows the same order as the reporting template.

Potential pitfalls will be highlighted to help the radiologist avoid any common errors in interpretation.

Clinical indication

This is a free text option. Prior to issuing a report, it is important for the radiologist to obtain as much specific information as possible. At a minimum, this includes location of the tumor at colonoscopy and the pathology results. Clinical intake sheets can be helpful to capture this information although not mandatory (see Table 1, Sample Clinical Intake sheet).

Important caveats

1. If the tumor histology is squamous rather than adenocarcinoma, this reporting template should **not** be used.
   - Squamous carcinomas in the distal rectum and anal canal should be staged as an anal cancer and **not** as a rectal cancer.
   - This applies even if the tumor is primarily or exclusively in the distal rectum.
2. If there is no biopsy proof of cancer (i.e., only high grade dysplasia):
   a The conclusion of the report should reflect that the staging may not be applicable if cancer is not subsequently found at resection.
3. In the case of a resected polyp with incidentally discovered dysplasia/carcinoma, the radiologist should consider using a free form report or a modified/abbreviated template as many of the report items will not apply.

Technique

This is a free text option. The radiologist should comment on the specific protocol used for performing the rectal MR, including details on the adequacy of the study. It would be acceptable to simply state "The rectal cancer staging protocol was undertaken on a 1.5 T or 3 T magnet."

See appendix following this guide regarding additional information regarding optimal technique.

Comparisons

Any applicable studies and dates.

Table 1 Sample clinical intake sheet

1. Does the patient have biopsy-confirmed rectal adenocarcinoma?	☐ Yes ☐ No
2. Mucinous histology	☐ Yes ☐ No ☐ Not available
3. Is the tumor palpable on digital rectal examination (DRE)?	☐ Yes ☐ No
4. Distance of tumor to anal verge based on DRE or endoscopy	_____cm
5. Was there tumor within a cancerous polyp which has been completely excised?	☐ Yes ☐ No
6. Previous surgery	☐ Yes ☐ No Date: MM/DD/YY Type of surgery: _____
7. Previous chemotherapy	☐ Yes ☐ No Date: MM/DD/YY Type of last cycle: _____
8. Previous radiotherapy	☐ Yes ☐ No Date: MM/DD/YY Type of last treatment: _____

The information in this table is very helpful to the radiologist at the time of reporting and can be completed by the referring provider when requesting an MRI examination for Rectal Cancer staging.

Primary tumor: morphology, location, and characteristics

Distance to the anal verge: [number] cm

Tumor location (high 10–15 cm, mid 5.0–9.9 cm, low 0–4.9 cm) is assessed using the distance between the anal verge and the inferior edge of the tumor.

The anal verge is the distal most portion of the anal canal and serves as the transition point between the anal mucosa and perianal skin. At MR, the measurement is made from the inferior aspect of the internal sphincter (denoted by a fatty plane between the internal sphincter and external sphincter) as a surrogate marker for the anal verge (Fig. 1a–c, arrow). Measurement from this point to the most inferior aspect of the tumor is best made on sagittal images. This MR measurement determines the tumor location (high/mid/low) and correlates best with the reference gold standard measurement which is made at rigid proctoscopy [1].

Craniocaudal length of tumor (in cm) may be measured on sagittal, coronal, or coronal oblique images (Fig. 1). Slice location between the superior extent and inferior extent on axial images can also be used to calculate the distance.

Distance to the top of sphincter complex/anorectal junction: [number] cm

This measurement is made between top of the anal sphincter and the inferior edge of tumor (Fig. 1c). At surgery, this measurement provides an estimate of the maximal expected distal margin in the surgical specimen with a sphincter-sparing low anterior resection. Surgeons usually prefer a distal margin of at least 2 cm, but new studies suggest that 1 cm is sufficient [2, 3].

Relationship to anterior peritoneal reflection: ☐ above ☐ straddles ☐ below

The anterior peritoneal reflection is an anatomic landmark seen on MR which helps to distinguish between the peritonealized and nonperitonealized portions of the rectum. Identification of the anterior peritoneal reflection can be challenging, as it is partly dependent on the amount of intrapelvic fat in the region (fat provides intrinsic contrast to outline the peritoneal lining).

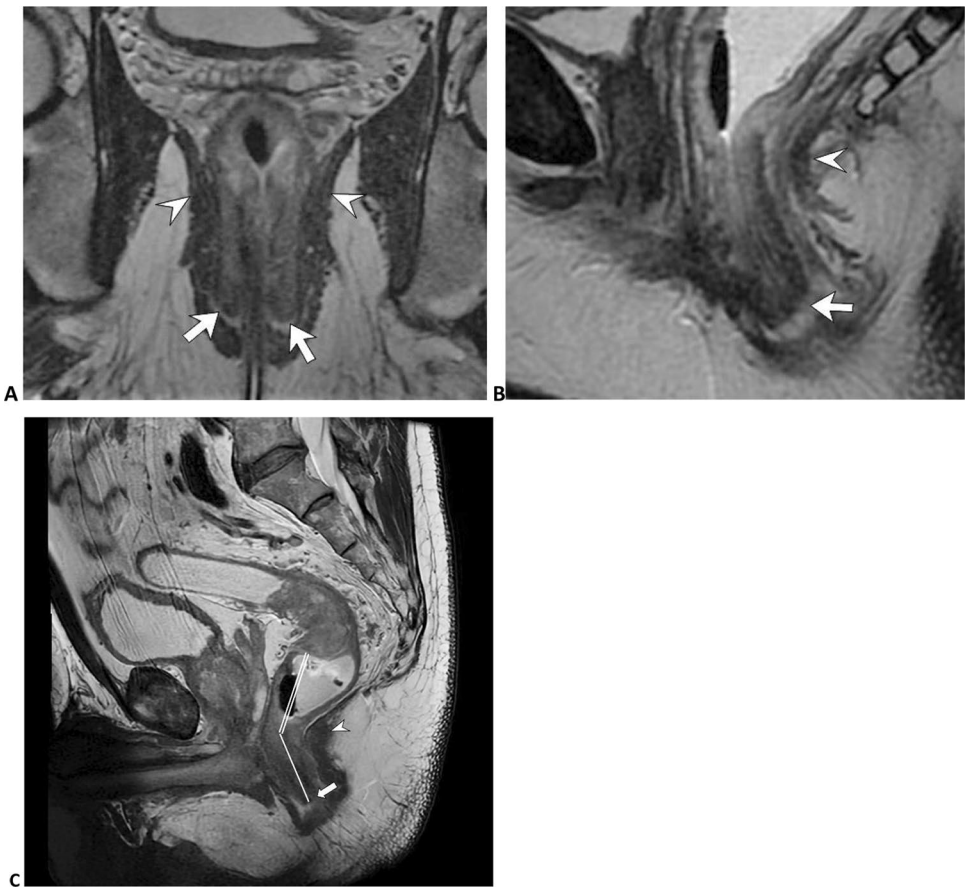

Fig. 1 Anatomy of the Anal Canal. **a**, **b** Oblique coronal and Sagittal T2-weighted images of the anal canal demonstrate a fatty plane (arrow), which serves a landmark for the inferior aspect of the internal sphincter and subcutaneous portion of the external sphincter. The puborectalis muscle (arrowhead) is typically at the slight bend of the anorectal angle and marks the top of the anal canal. **c** The MR anal verge distance is typically made on the sagittal images and represents the sum of two measurements from (1) the inferior point of the internal sphincter to the anorectal junction (line) and (2) the anorectal junction to the inferior most aspect of tumor (compound line). The arrow marks the inferior aspect of the internal sphincter which is the surrogate landmark for the anal verge. The arrowhead marks the puborectalis muscle at the anorectal junction

The peritoneal lining can be identified in most cases on sagittal T2-weighted images, appearing as a thin, low signal line extending caudally towards the ventral aspect of the rectum. In females, the caudal aspect is located at approximately the posterior aspect of the utero-cervical junction, and in males, at the level of the seminal vesicles.

The anterior peritoneal reflection (Fig. 2, arrow) represents the lowest point of the peritoneal cavity where the peritoneal lining touches the anterior rectum. Above this point, the rectum transitions into an intraperitoneal structure. The transition has an oblique configuration, with the anterior surfaces becoming intraperitoneal in location more caudally than the posterior surfaces (Fig. 10). Although best seen on sagittal T2 images, this landmark can often be identified on short-axis axial (oblique axial) images as a V-shaped structure contacting the anterior rectum at a single point (Fig. 2b). Once identified, the location of the rectum can be confidently classified as *extraperitoneal* on the axial images inferior to this level. Superior to this slice level, the rectum is transitioning into an intraperitoneal location.

Craniocaudal length: [number] cm

Length measured either on sagittal or coronal series. Alternatively, table position of the axial images between the superior edge and inferior edge can also be used to calculate this distance.

Circumferential location (o'clock position): ☐ to ☐ o'clock

This tumor location is referenced with a patient supine in the MRI scanner. Because of the confusion with some surgeons who may think the location description is with the patient in a prone JackKnife or Kraske position (which would flip the clock anterior–posterior), alterative descriptors such as 'anterior', 'posterior', 'left lateral', and 'right lateral' may be considered.

Morphology: ☐ polypoid ☐ annular ☐ partly annular

Lesions/masses with "polypoid morphology" are focal in nature, typically involving less than 90° of the luminal circumference, with protrusion into the lumen (Fig. 3a) [4].

"Annular" lesions are by definition circumferential, involving 360° of the rectal wall.

"Partly annular" lesions involve > 90 but < 360° of the luminal circumference.

Mucinous: ☐ no mucin ☐ some mucin ☐ mostly mucin

Qualitatively, non-mucinous rectal adenocarcinoma usually demonstrates intermediate signal intensity on T2-weighted

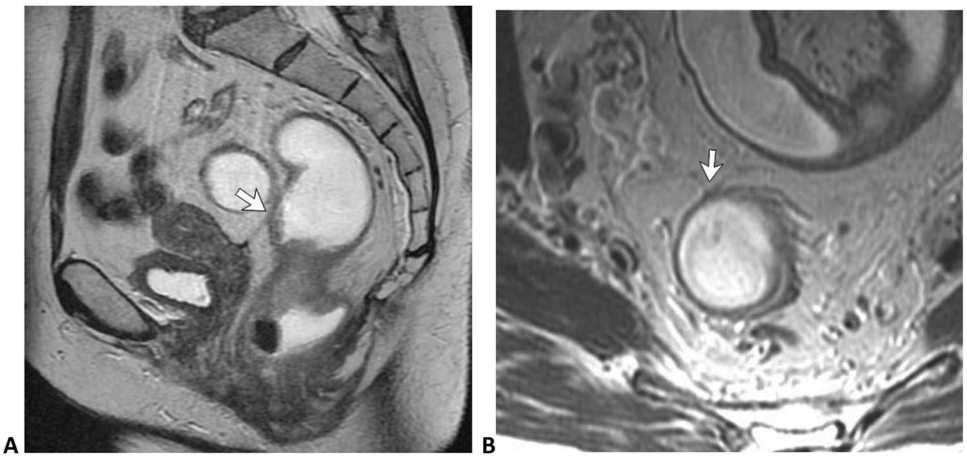

Fig. 2 Anterior peritoneal reflection. **a** On Sagittal T2W imaging, the peritoneal lining presents as a thin, low signal intensity line extending from the posterior uterocervical junction to contact the ventral rectum (this point is the anterior peritoneal reflection; arrow). Based on this assessment, the radiologist determines whether the tumor is "above", "below", or "straddles" (extends both above and below) the anterior peritoneal reflection. Here, the tumor is below. **b** On axial imaging, the apex of the peritoneum attaches to the anterior rectal wall in a V-shaped or seagull configuration

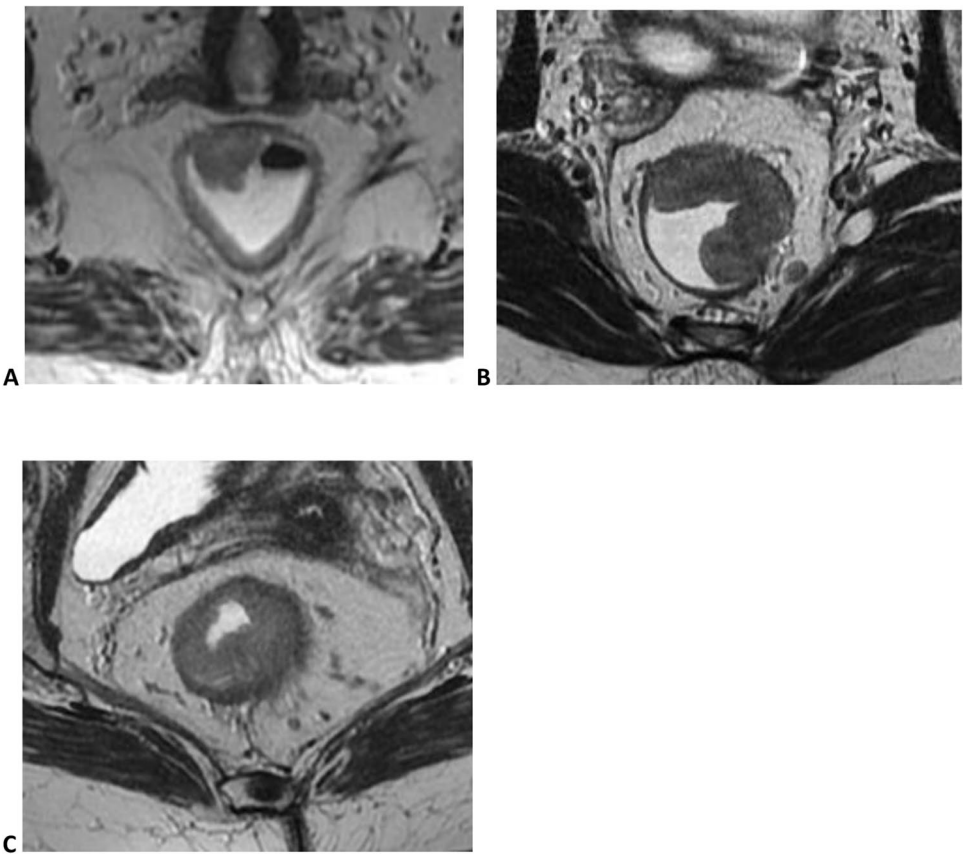

Fig. 3 Tumor morphology. **a** polypoid morphology involves less than 90° of the luminal circumference. **b** partly annular-between a polypoid and annular mass. **c** Annular morphology involves the entire circumference of the wall, typically with luminal narrowing

Fig. 4 Variability in Mucin Expression. **a** The tumor demonstrates T2 'fluid' hyperintensity in > 50% of the lesion, which would be categorized as 'mostly mucin'. **b** In some cases, cystic locules containing mucin can be more numerous, as seen in a different patient. This would also be categorized in the 'mostly mucin' category

images (slightly higher than skeletal muscle; moderately higher signal intensity compared to the muscularis propria).

In contrast, mucinous rectal adenocarcinoma can be recognized by markedly hyperintense T2-weighted signal, iso- or nearly isointense to fluid, within the stroma of the lesion (not just secreted into the lumen). The appearance of mucin can vary from homogenous hyperintense T2 signal to more cystic locules between patients (Fig. 4). Some lesions are almost entirely mucinous, while others may contain small pockets of mucin. Accurate categorization of suspected mucinous composition is important for prognostic reasons. Pathologically, a rectal lesion is reported as "mucinous" when at least 50% of the tumor is composed of extracellular mucin on the path specimen. Since the entire tumor is visible on MRI, sensitivity for detection of mucin is higher. Although smaller mucinous components (< 50%) in lesions might not otherwise meet the pathologic definition for a mucinous tumor, they can still affect prognosis. Therefore, it is important to report any mucinous composition on MRI.

Three choices are available on the template: **no mucin**; **some mucin;** and **mostly mucinous.** The radiologist should categorize a lesion as ""some mucin" (ie, if any fluid signal is identified within the lesion on qualitative assessment but less than 50% of tumor) or "mostly mucinous" (≥ 50% of tumor is mucinous/holds fluid signal).

Mucin pseudocapsule

One pitfall to be aware of in mucinous rectal tumors is the presence of a "pseudocapsule", which is seen in T3 disease and appears as a thin, low T2 signal line at the tumor/fat margin. This represents the interface between mucin extending through the muscularis and the adjacent perirectal fat.

There is often a focal outpouching/convexity of the rectal wall which indicates a breach of the muscularis propria. The low T2 signal linear appearance of the interface can mimic an intact muscularis propria, but the radiologist should be aware that the muscularis is likely breached, particularly if there is a focal outpouching of the contour (Fig. 5a–c). In some cases, a focal convexity may not be present, despite disruption of the muscularis propria (Fig. 5d). In this situation, the radiologist should still consider the possibility of T3 disease.

MR-T category

MR-T category is assigned based on depth of rectal wall invasion. Rectal cancer begins as a mucosal process, usually as an adenomatous or serrated polyp that has undergone malignant transformation. The tumor grows and can extend into deeper layers of the bowel wall and beyond. The most important distinction at the time of initial MR staging is whether the tumor is contained by the muscularis propria (consistent with a T1 or T2 cancer), or there has been extension past the muscularis propria (T3 or T4 cancer).

Specific important comments:

1. MR cannot reliably distinguish between T1 or T2 cancers but combines them together (denoted by T1/2 on the template). If a distinction between T1 and T2 cancer is required for possible endoscopic resection, these patients should be referred to endoscopic rectal ultrasound, which can more reliably resolve the layers of the bowel wall.
2. Stage T3 is subdivided on MR based on EMD (extramural distance) or distance of spread beyond the muscularis propria (T3a < 1 mm EMD, T3b 1–5 mm,

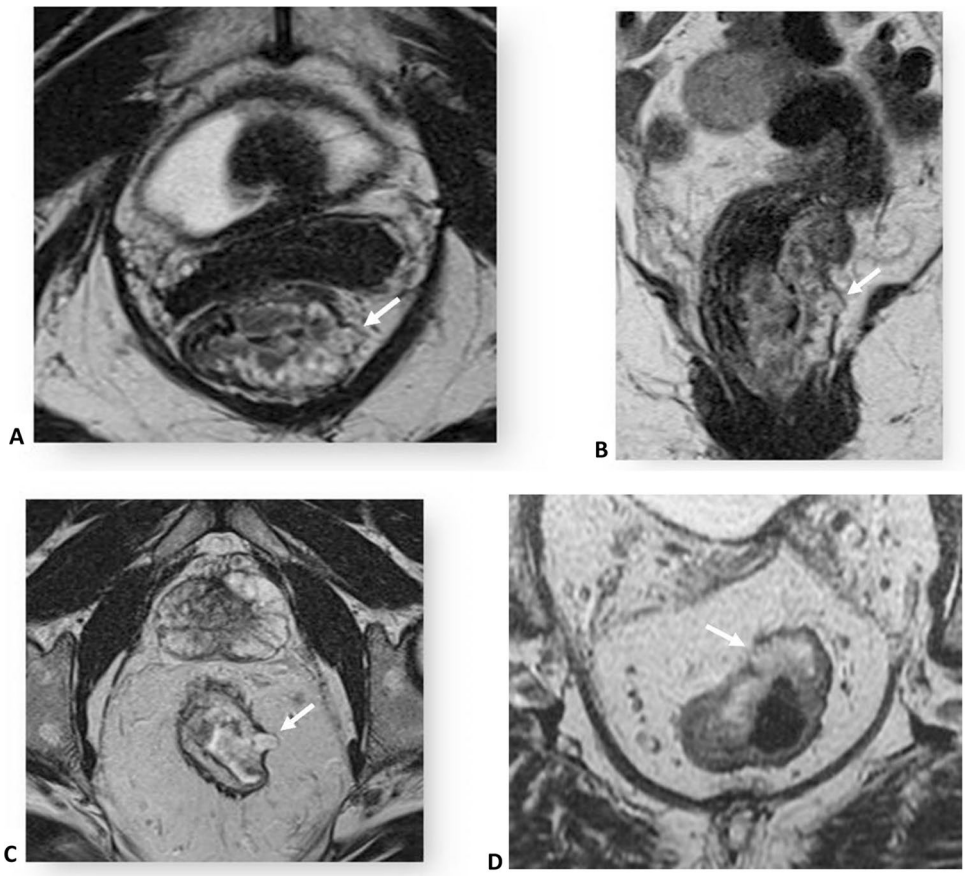

Fig. 5 "Pseudocapsule" associated with T3 mucinous tumors. **a**, **b** Axial oblique (A) and coronal oblique (**b**) images in the same patient demonstrate a focal outpouching of high T2 signal (mucin; arrow) related to a mucinous rectal cancer. The outpouching is contained by a low T2 signal line, which should not be mistaken for an intact muscularis propria. **c** a mucinous tumor in a different patient also shows a focal outpouching of mucin (arrow), separated from the adjacent fat by a thin, T2 hypointense line. The focal outpouchings in these patients raise suspicion for T3 disease. **d** In some cases, the focal outpouching may be subtle (arrow) but the radiologist should still consider the possibility of T3 disease

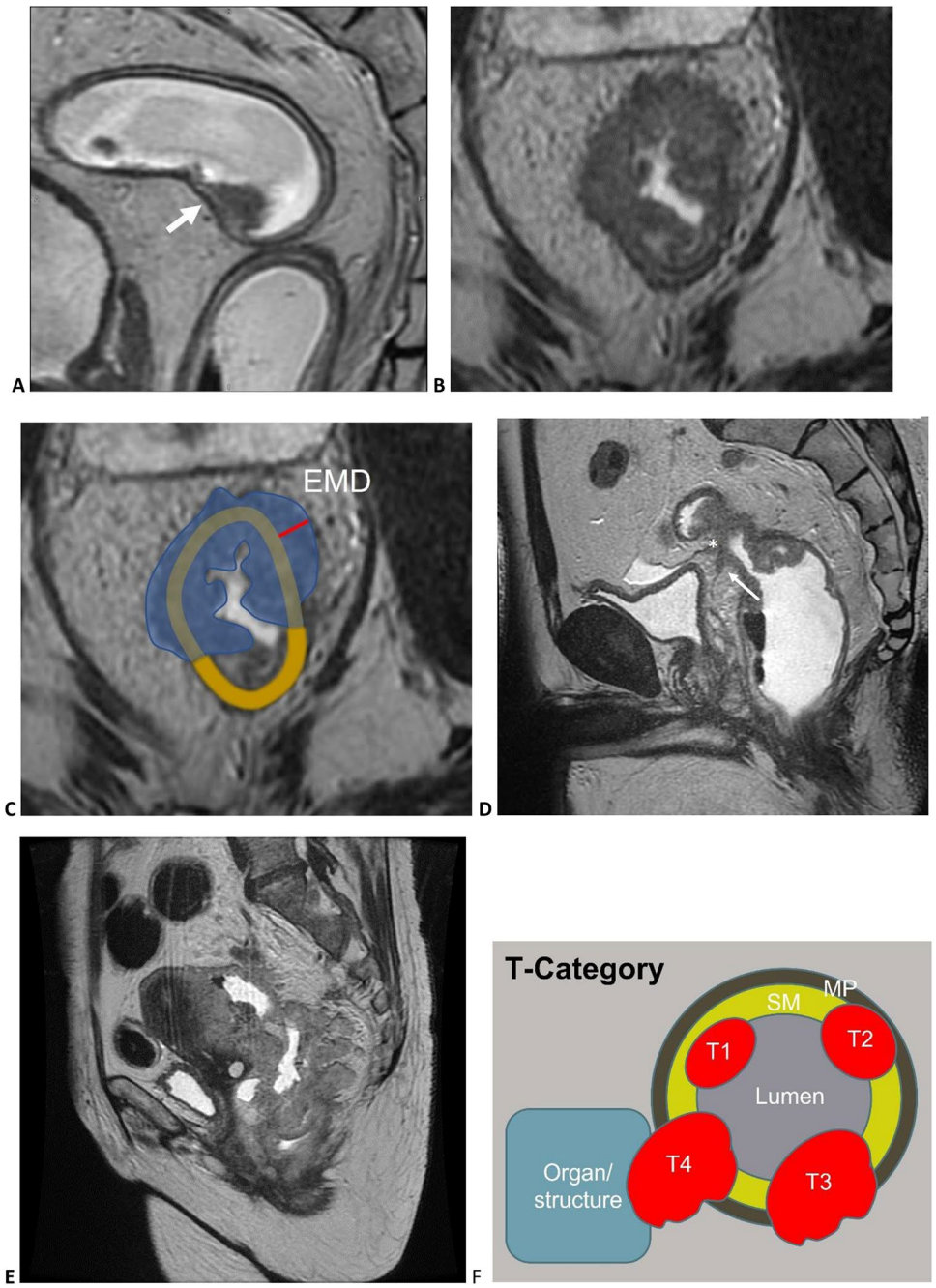

Fig. 6 Spectrum of different T-categories. **a** T1/2 lesion. Notice the intact outer T2 hypointense layer which is smoothly curving, showing an intact muscularis propria (MP; arrow). There is a hint of T2 hyperintense submucosa deep to the soft tissue tumor and superficial to the outer black band. However, we do not try to distinguish between T1 and T2 status. **b** T3 tumor involving the anterior rectum with clear extension beyond the muscularis propria. The irregular outer boundary indicates that the tumor edge is no longer contained by the MP. **c** Overlays of the T3 tumor (in B) depict the tumor (blue) with the theorized location of the prior MP (yellow band) extending from the normal posterior wall. This allows a calculation of the EMD (red line). **d** T4a tumor with nodular thickening of the peritoneal lining at the anterior peritoneal reflection (asterisk) leading to a designation of T4a status. Also note the extension of the tumor along the anterior mesorectal fascia (arrow). **e** T4b cancer with direct extension into the posterior aspect of the uterus and vagina with loss of the fat planes between the rectum and pelvic organs. **f**, Schematic of T-categories (T1 extending into submucosa, T2 into muscularis propria, T3 beyond MP, T4 with invasion into an adjacent organ/structure). To note, T1 and T2 are typically combined into a single category at MR as the decision regarding neoadjuvant therapy remains the same

T3c > 5–15 mm, T3d > 15 mm). EMD holds prognostic information.

3. If contiguous spread with thickening of the peritoneal lining is seen, then the tumor is categorized as T4a (see Fig. 6d) which increases the risk of intraperitoneal metastases.
4. Direct extension of tumor signal abnormality into adjacent organs or pelvic floor musculature (levator ani, including the puborectalis, pubococcygeus, and ileococcygeus) is considered T4b cancer.
5. The category of 'T2/T3' from the prior template has been removed in this version. The rationale for this is that at many centers:
   a. The treating physicians want to know likelihood of T2 vs T3 and prefer a more definitive category, with a comment in the case of equivocal cases
   b. When the MRF is not involved, the treating physicians may treat early T3 disease (T3a) as T2 disease.

** FOR LOW RECTAL TUMORS—Invasion of anal sphincter complex:

Low rectal cancers are defined as tumors that arise within 5 cm of the anal verge

Caveat: If the histology is squamous (not adenocarcinoma), the anal cancer staging template should be used instead of this rectal cancer staging template.

Low cancers present several treatment issues related to the anatomy of the low pelvis and its relationship to the anal canal. Surgical resection of low rectal cancers is technically more difficult due to thinning of the mesorectum within this area at the pelvic floor. Given the pelvic anatomy, higher local recurrence rates and higher rates of MRF involvement occur [5].

When describing the involvement of anal sphincter complex, the radiologist should provide a specific comment on whether the tumor extends laterally beyond the internal sphincter into the intersphincteric space or even to involve the external sphincter, as this may impact surgical approach (Fig. 7). Surgical options for treatment of low cancers can vary between institutions, therefore it is best to learn the specific institution's approach.

One area of confusion involves staging rectal cancers *with anal sphincter involvement*. Again, it is good to discuss with the oncologists and surgeons to have internal institutional agreement. One common approach is to T stage by the rectal component and describe the anal sphincter involvement. If the cancer is contained entirely within the anal sphincter without any distal rectal involvement, a T stage should not be assigned for the cancer with instead a description regarding the portions of the anal sphincter that are involved.

EMVI: ☐ No ☐ Yes (indicate location, series and image number)

Extramural vascular invasion (EMVI) refers to the local extension of rectal tumor into the lumen of a mesorectal vessel which perforates the rectal wall. EMVI is primarily diagnosed pathologically, but MR has been shown to be reliable for identifying EMVI with high specificity when the vessel is expanded with tumor. At MRI, EMVI is diagnosed when a tubular, serpiginous structure containing intermediate T2-signal intensity extends from the tumor into the mesorectum (Fig. 8). Overall, MR holds a sensitivity of 62% with a specificity of 88%, keeping in mind that normal caliber vessels with tumor are difficult to detect [6].

EMVI is typically seen in T3 or T4 cancers. It is rare in T2 cancers without other areas of frank extension of tumor through the muscularis propria, but should be reported if seen. A recent study confirmed that MRI-detected EMVI in rectal cancer is an independent negative prognostic factor for disease-free survival and overall survival. In addition, there is an increased risk of synchronous metastases (fivefold), and increased risk of subsequent metastases in follow-up after surgery (fourfold) [7].

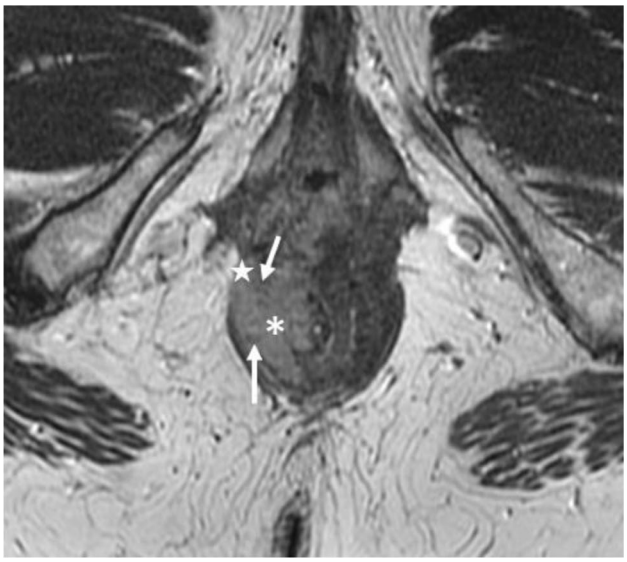

Fig. 7 Low rectal cancer. Note the gray signal tumor involving the internal sphincter (asterisk) extending laterally deeper than the level of the internal sphincter, beyond the intersphincteric space (arrows) and involving the external sphincter (star)

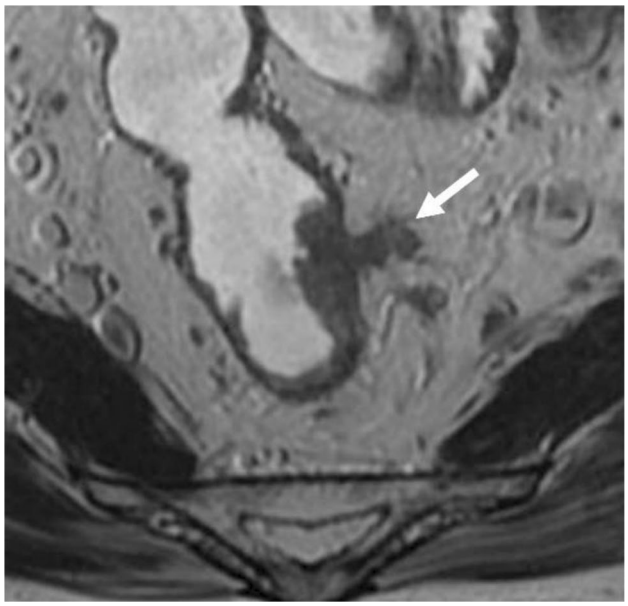

Fig. 8 EMVI. EMVI appears as a lateral projection extending in perpendicular fashion (arrow) from the rectal cancer. The tubular nature should raise the suspicion that this is an expanded vessel from direct extension of the tumor into the vessel lumen, consistent with EMVI

When EMVI is identified at MR, the radiologist should indicate the location of the finding including a series and image number as noted on the template.

Mesorectal Fascia (MRF) (for T3 only)

Shortest distance of tumor to MRF: [] mm (indicate location, image, and series number)

☐ N/A: (tumor involving peritonealized portion of the rectum).

Is there a separate tumor deposit, LN or EMVI threatening (= 1 mm and = 2 mm) or invading (< 1 mm) the MRF? ☐ No ☐ Yes (if yes, note location, image, and series number).

The mesorectal fascia is a fascial plane that is visualized on MR. It encloses the mesorectum (which includes the primary end organ of the rectum and the draining lymphatics within the mesorectal fat) and constitutes a functional anatomic unit whereby a mesorectal resection confers an oncologically sound surgical resection. The relationship between the tumor and this fascial plane can predict whether the circumferential resection margin (CRM) (ie, radial margin) of the surgical specimen will be free of tumor. If the closest point of the tumor is:

(i) < 1 mm or touching, the MRF should be reported as involved predicting a positive CRM (Fig. 9)
(ii) 1–2 mm, the result is an equivocal MRF involvement leading to a either a positive or negative CRM (threatened CRM)
(iii) 3 mm or greater, the MRF is not involved predicting a negative CRM

Important caveats:

(1) The MRF only exists for the extraperitoneal portion of the rectum. Below the anterior peritoneal reflection, it completely encircles the rectum. Above the anterior peritoneal reflection, the rectum begins to transition into the peritoneal cavity (Fig. 10) where ultimately the superior third of the rectum is completely intraperitoneal, suspended on a mesentery, and not surrounded by MRF. Thus, a MRF distance (i.e., closest distance between the tumor and MRF) is not applicable for tumor involving the intraperitoneal portions of the rectum as the MRF does not exist.
(2) Even if there is a suspicious lymph node located close to the MRF, the distance to the MRF should not be measured from that involved lymph node, as it does not increase the risk of recurrence or lower disease-free survival compared with actual tumor at that site [8]. However, it is important to communicate its location to the surgeon to allow them to take extra care during TME surgery in this area.
(3) When EMVI represents the closest portion of the tumor to the MRF, some institutions use the distance to the MRF to establish MRF status, while others do not. At this time, there is no consensus regarding utilizing the measurement from EMVI to MRF if it represents the closest portion of tumor. It may be useful for radiologists to discuss with the multidisciplinary care team to determine the specific approach at the institution.

Fig. 9 Involved MRF. Note that the tumor is in very close proximity to the MRF (open circle). If the tumor extends to contact or is within 1 mm of the MRF (as in this case), this would be consistent with an 'involved MRF' which would predict a positive circumferential margin (CRM) of the surgical specimen

Tumor deposits (TD)

☐ No.

☐ Yes (describe number and location); Series and image number: [].

It is now becoming clear that not all "nodules" in the mesorectal fat represent lymph nodes; in fact, there is considerable overlap between lymph nodes (LN) and tumor deposits (TDs). By definition, TDs do not contain lymphoid tissue. However, it can be challenging to distinguish TDs from malignant LN on MRI, and this is a subject of ongoing research.

At imaging, the presence of TDs is implied when a soft tissue nodule in the mesorectum interrupts a small

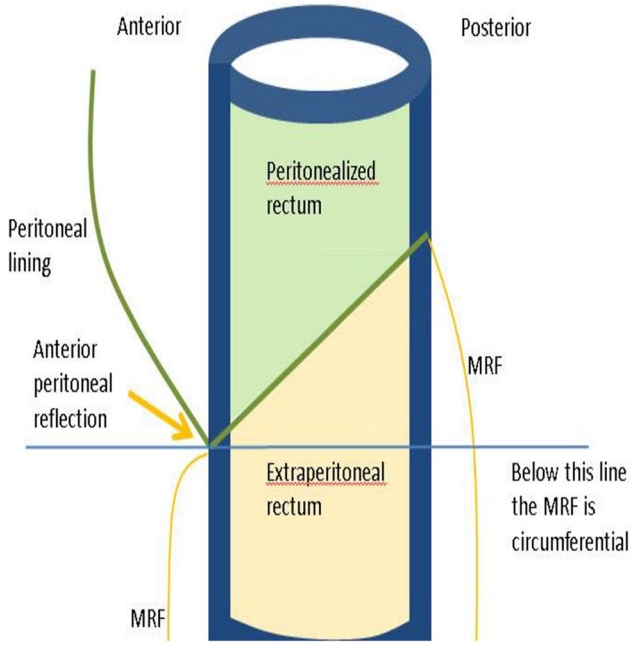

Fig. 10 Diagram of the MRF. Sagittal projection of the MRF and relationship with the peritoneal cavity. Note that below the anterior peritoneal reflection (yellow arrow), the MRF encircles the rectum 360 degrees. Cranial to this point, the rectum is enters the peritoneal cavity. The anterior and anterolateral surfaces become intraperitoneal at lower levels than the posterior surfaces. The MRF does not exist for the peritonealized portions of the rectum and a MRF distance is not reported if a rectal tumor is completely above the peritoneal reflection

mesorectal vessel on two orthogonal series. A recent publication by Lord et al. indicates that TDs have a markedly different appearance to lymph nodes on MRI. TDs are seen as irregular nodules within the mesorectum and appear to directly interrupt the course of veins, while remaining discontinuous from the primary tumor (Fig. 11). In contrast, lymph nodes are more discrete and adjacent to vessels. One distinguishing feature between TDs and LNs is the fact that TDs cannot be separated from the vein when assessed on two orthogonal views. TDs also tend to taper into the vein (described as a comet-tail appearance, Fig. 11c) rather than being alongside the vein and forming an acute angle. As is often the case with EMVI, recent studies indicate that the presence of TD also confers poor prognosis [7, 9].

Tumor deposits can be challenging to distinguish from lymph nodes, but they are often located close to vessels, have irregular or "shaggy" margins, and tend to display very low signal on T2W images. Often, the patient will have concurrent EMVI (Fig. 11a).

Important caveats

Despite the absence of lymphoid tissue, TD are technically considered **N1c** disease according to the 8th edition of the American Joint Cancer Commission (AJCC). This can cause some confusion in reporting and interpretation since tumor deposits and lymph nodes are pathologically distinct and have variable prognostic features. It is important for the reporting radiologist to be familiar with this classification when communicating with the multidisciplinary team.

Because of this potential confusion, the SAR DFP synoptic report has purposefully separated tumor deposits and lymph nodes into two distinct categories.

Lymph Nodes

Mesorectal/superior rectal lymph nodes:

☐ N0 (no visible lymph nodes).

☐ N + (short axis ≥ 9 mm).

☐ N + (short axis 5-8.9 mm AND at least 2 morphologic criteria*).

☐ N + (short axis < 5 mm AND all 3 morphologic criteria*).

☐ Nx (all other cases).

*Suspicious morphologic criteria: (1) round shape, (2) irregular borders, (3) heterogeneous signal intensity.

Suspicious extra mesorectal lymph nodes:

☐ No.

☐ Yes (if yes, pick location from list below:)

If yes, location and short axis diameter:

[Right/left] common iliac, [] mm.

[Right/left] external iliac, [] mm.

[Right/left] internal iliac, [] mm.

[Right/left] obturator, [] mm.

[Right/left] inguinal, [] mm.

[Right/left] retroperitoneal, [] mm.

In rectal cancer staging, the following **regional** lymph nodes should be assessed:

Mesorectal/superior rectal (above the anterior peritoneal reflection anteriorly and posteriorly) (Fig. 12 a, b), **and extra-mesorectal groups** including internal iliac, obturator lymph nodes (Fig. 12Cc).

Involved lymph nodes outside these areas are characterized as distant disease (positive **M** disease) where involvement lead to poorer outcomes. These include **retroperitoneal LNs above the level of IMA takeoff, common iliac, external iliac, and inguinal LNs**(discussed below) [10].

While MRI demonstrates excellent accuracy for T-staging, it is not as robust for N-staging. This is a particular challenge because a significant proportion of metastatic lymph nodes in rectal cancer measure less than 5 mm in diameter. Therefore, size alone is not a reliable feature to assess malignant nodal spread [11, 12].

Regional lymph nodes are therefore evaluated using the **Dutch Consensus criteria**: **size, signal intensity, margin, and shape** [13]. A lymph node is considered

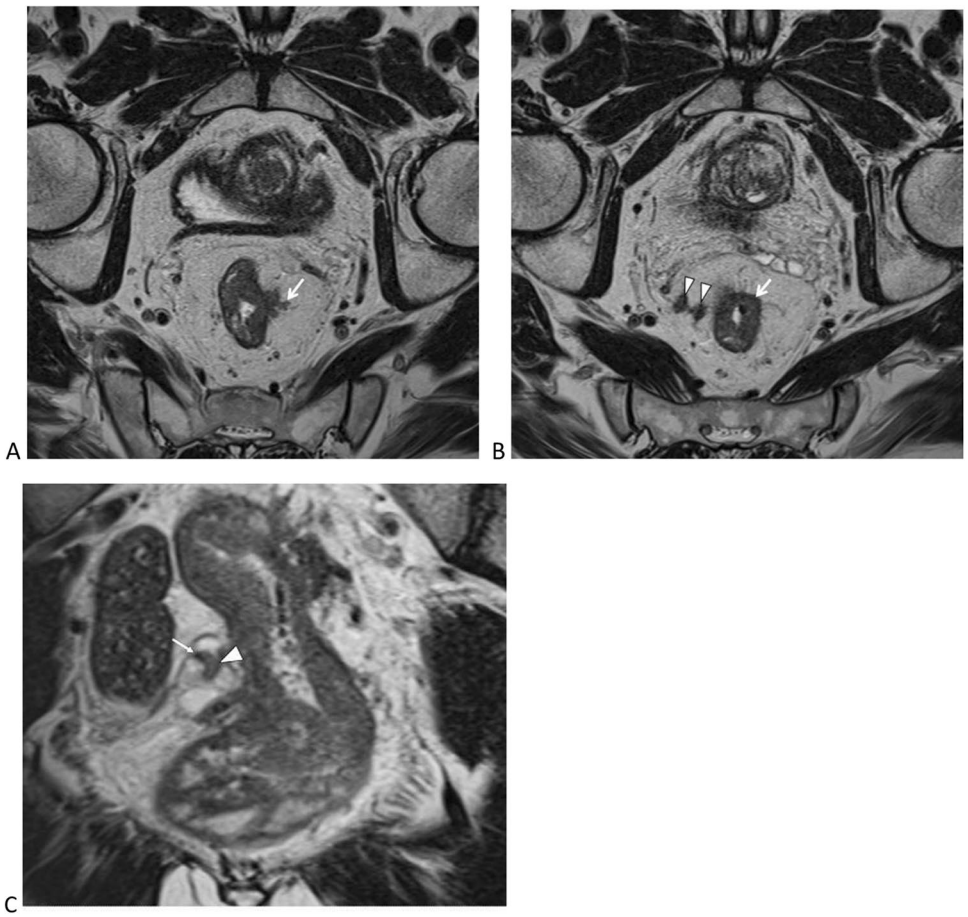

Fig. 11 Identification of tumor deposits (TD). **a**, **b**, Axial oblique T2-weighted images in a patient with rectal adenocarcinoma demonstrate an ulcerated, semi circumferential anterior rectal mass with EMVI [(**a**), arrow]. In the right perirectal fat, two ill-defined nodules with irregular margins are identified, separate from the EMVI [(**b**), arrowheads]. The irregular shape of the nodules and the presence of EMVI is more suggestive of TD rather than malignant lymph nodes. **c**, In a different patient with rectal adenocarcinoma and extensive EMVI, a right-sided TD (arrowhead) has a curvilinear appearance, tapering towards an adjacent vein (arrow)—this is referred to as the "comet tail" sign

morphologically suspicious when one of the following 4 criteria are satisfied:

1. Short axis diameter equal or greater than 9 mm
2. Short axis diameter between 5–8.9 mm and 2 more morphologically suspicious characteristics
3. Short axis diameter < 5 mm AND 3 morphologically suspicious characteristics
4. All mucinous lymph nodes (any size)

The Society of Abdominal Radiology (SAR) recommends a simplified method of reporting N stage, with "**N-**", indicating no nodal disease present, and "**N +**" indicating the presence of suspicious nodes regardless of number. N stage reporting varies by center, requiring ongoing communication between the radiologist and referring clinicians.

Abnormal ***extramesorectal*** nodes can be present in two scenarios:

(1) **Positive N disease** *but outside the operative field of total mesorectal excision (TME)*. Although lateral pelvic side wall lymph nodes (including *internal iliac* and *obturator* lymph nodes) are located outside the operative field, involvement of these nodes constitutes **regional** lymph node disease from direct lymphatic drainage. These nodes along the lateral side wall are important to identify and impact the management approach as these lymph nodes are not normally removed during surgery as opposed to mesorectal lymph nodes which are at TME.

(2) **Metastatic disease (M1).** The M1 category indicates that lymph node involvement that represent distant disease. Malignant involvement of these groups leads to worse outcomes compared to lymph node involvement in the mesorectal and lateral pelvic side wall groups described above. Lymph node groups consistent with M1 disease include *common iliac, external iliac, inguinal,* and *retroperitoneal* nodes (above the take-off of the IMA).

Caveat

1. Regarding **external/inguinal lymph nodes** and **low rectal cancers**: low cancers *with involvement of the anal sphincter/canal below the dentate line* have a distinct pattern of nodal spread, as the lymphatics directly drain to both the external iliac and inguinal lymph nodes. In

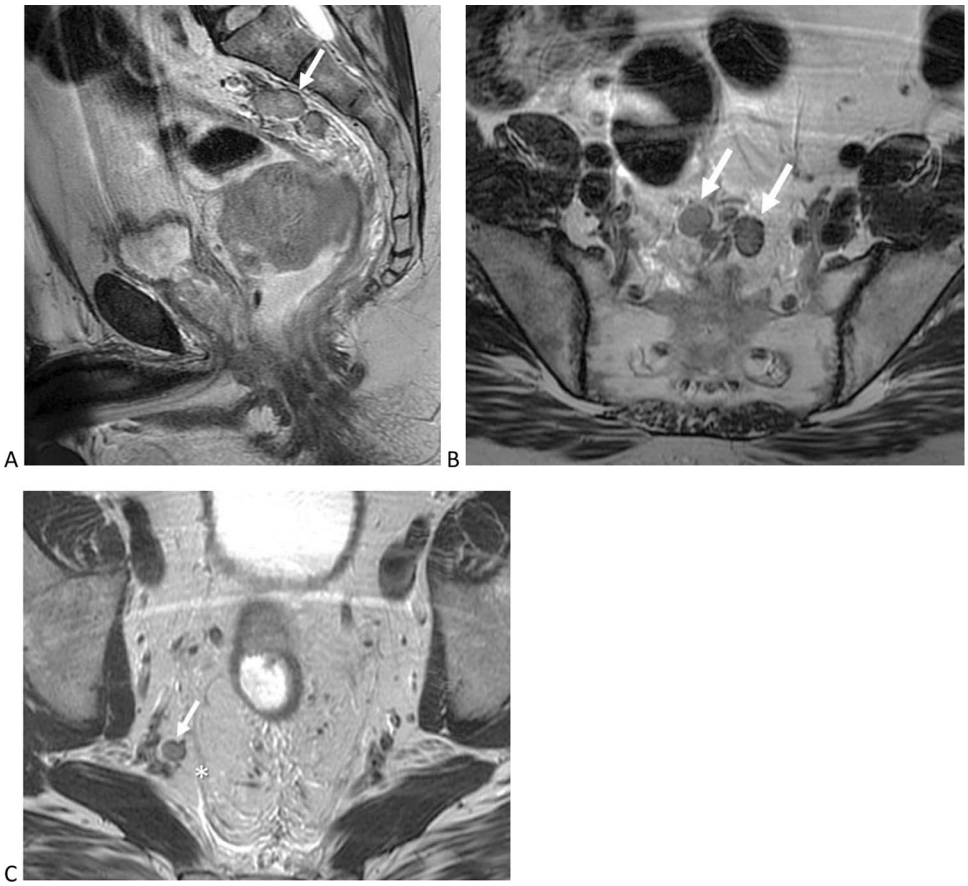

Fig. 12 Mesorectal and lateral pelvic side wall lymph nodes. **a**, **b**, Sagittal and axial images in a 60 year old male with superior mesorectal lymph nodes (arrows) which would be removed at TME. **c** Different patient with an internal iliac lymph node (arrow) with the iliac branches just lateral to the node. Note the extramesorectal location of the node, extrinsic to the MRF (asterisk). This lymph node is important to document to allow appropriate management, as it would not normally be removed at TME

this case, the lymph node involvement should be considered **N** disease and not **M** disease.

2. MRI assessment of lateral pelvic/extramesorectal lymph nodes (internal/external iliac and obturator compartments) may convey additional prognostic information. The Lateral Lymph Node Study Consortium in 2019 published a multicenter study indicating the following:

1. Abnormal external iliac nodes had a low risk of local recurrence, but a twofold increased risk of distant disease.
2. Positive obturator nodes had a very low risk of local recurrence.
3. Patients with abnormal internal iliac nodes had a 5-year local recurrence rate of over 50%.
4. Shrinkage of lateral nodes from a short-axis node size of 7 mm or greater on primary MRI to a short-axis node size of 4 mm or less on restaging MRI abolished the risk of lateral local recurrence (LLR) [14].

Therefore, radiologists should pay special attention to lateral wall nodes during MRI interpretation.

Pitfalls: Mucinous lymph nodes

Since T2-weighted images used for staging are performed without fat suppression, mucinous nodes can be challenging to identify when surrounded by relatively high signal intensity mesorectal fat (Fig. 13). Therefore, some institutions routinely acquire inversion recovery sequences. If fat suppression has not been obtained or is not available, the natural fat suppression of DWI sequences can also be a helpful tool. On low b-value DWI images, the mesorectal fat will be low in signal, making any nodes or tumor deposits more conspicuous. Once identified, however, it is important to evaluate the overall characteristics of these nodes on the high resolution T2-weighted sequence.

Pitfalls: calcified lesion vs. suspicious lymph node

Phleboliths within the pelvis can appear as dark T2-weighted signal intensity foci within the perirectal fat, nodes. Cross-referencing with CT when available can help to confirm the presence of phleboliths (Fig. 14).

Fig. 13 Identification of mucinous composition (tumor and lymph nodes). Axial oblique T2W image in a male patient showing a hyperintense tumor (asterisk), characteristic for mucinous composition. Two abnormal pelvic side wall nodes are also identified. Abnormally enlarged right internal iliac node (arrowhead) has intermediate signal intensity, while the enlarged left obturator node (arrow) contains mucin. Due to their inherently high T2-weighted signal intensity, mucin-containing nodes are less conspicuous on non-fat saturated images, requiring careful attention by the interpreting radiologist

Other: [free text: bones, bladder, GU organs, peritoneal mets, other incidental findings]

In this section, the reporting radiologist can list observations not addressed above, including skeletal/soft tissue findings, presence of peritoneal metastases, ascites, and incidental findings.

Conclusion

The SAR user guide provides practical guidance in completing the synoptic rectal staging template. This updated version of the user guide represents a complete revision from the prior guide to improve its usefulness. Given the central importance of rectal MR in the initial presentation of rectal cancer patients, accurate completion of the template is crucial. Explanation of the clinical outcomes from various report items as well as potential pitfalls to avoid should hopefully allow the radiologist to provide the necessary information to the surgeon and oncologist for correct locoregional staging and optimized management of these patients.

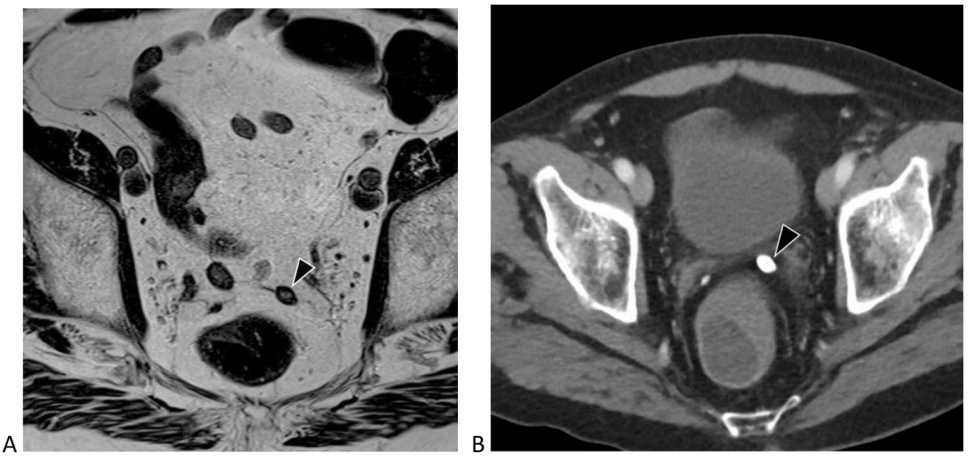

Fig. 14 Pitfall – calcified lesion vs. suspicious lymph node. **a** Axial T2-weighted MRI and **b** contrast enhanced CT in a male patient with rectal cancer. A densely calcified phlebolith within the pelvis (arrowhead in (**b**)) mimics a suspicious node on MRI (arrowhead in (**a**)), appearing as a dark T2-weighted signal intensity focus within the mesorectal fat

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