RECTAL CANCER: is MRI mandatory for accurate staging?

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• Colorectal cancer is the third most common cancer in men after prostate and lung and the second most common in women after breast cancer.
• One-third of colorectal cancers occur in the rectum.
• Recent population data show that the survival rates for rectal cancer have improved and surpassed those of colon cancer.
• This trend has been attributed to the combined effects of better staging, improved preoperative treatment strategies, and total mesorectal excision (TME) surgery.

• The use of chemotherapy and radiation therapy (CRT) followed by TME has been widely adopted for the management of locally advanced rectal cancers because this approach increases the probability of anal sphincter preservation and decreases the local recurrence rate.
• As we enter the era of personalized medicine, with therapies stratified according to the risk of local or distant recurrence, imaging has become an essential tool in the preoperative decision making to avoid both under- and overtreatment.

• Optimal treatment of rectal cancer involves a multidisciplinary approach, with collaboration required between radiologists, oncologists, surgeons, and pathologists to achieve local control and decrease the rate of recurrence.
• Several studies have been published that show the ability to accurately stage rectal cancer with magnetic resonance (MR) imaging.

• MR imaging is now an essential tool to enable the oncology team to make appropriate treatment decisions.
• However, rectal cancer evaluation with magnetic resonance (MR) imaging is a challenge in nonexpert hands.

• Radiology reports generally lack specific detail as pertains to cancer staging and preoperative risk assessment.
• In a recent study, the authors showed that report quality could be significantly improved by introducing a standardized form.

• Nougaret et al, 2013 created a mnemonic to help radiologists use a systematic approach to the interpretation of rectal MR imaging. We proposed the mnemonic “DISTANCE” in this way.
MR Image Interpretation: Mnemonic “DISTANCE”

- **DIS**: Distance from Inferior Part of Tumor to Transitional Skin.
- **T**: T Staging.
- **A**: Anal Complex—Sphincters and Puborectal Muscles.
- **N**: Nodal Staging.
- **C**: Circumferential Resection Margin.
- **E**: Extramural Vascular Invasion.
DIS: Distance from Inferior Part of Tumor to Transitional Skin

- The level of the tumor is given from the anal verge because this is a useful reference point for surgeons.
- Traditionally the rectum has been divided into thirds since outcomes and surgical management are affected by the location of the tumor.
DIS: Distance from Inferior Part of Tumor to Transitional Skin

Upper.—

• The lowest edge of the tumor is more than 10 cm from the anal verge.

• The anterior wall of the upper rectum is covered by the peritoneal reflection; the risk of peritoneal perforation in upper rectal tumors is high, and a warning to the surgeon will enable careful dissection to minimize the risk of tumor spillage.

• Careful assessment of the peritoneal reflection must be performed in upper rectal tumors.
DIS: Distance from Inferior Part of Tumor to Transitional Skin

Middle.—

• The lowest edge of the tumor is located between 5 and 10 cm from the anal verge.
• This segment of the rectum, which lies below the peritoneal reflection, is completely encircled by mesorectum and will therefore be suitable for TME.
• The surgical margins will be formed by the mesorectal fascia; this is the plane of dissection in TME surgery.
DIS: Distance from Inferior Part of Tumor to Transitional Skin

Lower.—

- The lowest edge of the tumor is less than 5 cm from the anal verge.
- At this level, the mesorectum tapers sharply.
- Anteriorly the mesorectal fascia fuses with the remnant of the urogenital septum. The anorectal junction is held forward by the puborectal sling.
DIS: Distance from Inferior Part of Tumor to Transitional Skin

- At the anorectal junction, the muscularis propria of the rectum changes: The circular layer thickens and becomes the internal sphincter. The external sphincter complex is composed of the most inferior part of the levator ani muscle, the puborectalis sling, and the external sphincter muscles.

- Submucosal apposition of the two sphincters in the lower anal canal gives rise to the palpable intersphincteric groove.

- The upper border of the puborectalis sling forms the upper edge of the surgical anal canal. Evaluation of the relationship of the tumor to the upper margin of the puborectalis sling assists in the presurgical determination of whether sphincter-sparing resection is feasible.

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The overall reported accuracy for T staging by using a pelvic phased-array coil ranges from 59% to 95%.

The identification and staging of rectal cancers at MR imaging is largely based on differences in T2 signal intensity between the tumor, submucosa, muscular layer, and mesorectum.
T: T Staging

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T: T Staging
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- The identification of the peritoneal attachment and its involvement is important because tumors with peritoneal reflection invasion (T4a) may require preoperative radiation therapy.
The following are diagnostic clues at the workstation for T staging:

- T stage must be assessed on planes strictly perpendicular to the tumor. Incorrect prescription of the acquisition plane leads to blurring of the muscularis propria and may lead to overstaging.
- In differentiating between stage T2 and T3 tumors, the crucial criterion is involvement of the perirectal fat. In stage T3, the muscularis propria is completely disrupted and cannot be clearly distinguished from the perirectal fat.
- The depth of extramural spread must be measured in millimeters beyond the outer edge of the longitudinal muscular layer.
- Peritoneal reflection must be assessed in upper rectal tumors. It may be identified on sagittal T2-weighted images as a low-signal-intensity linear structure that can be seen extending from the posterior aspect of the dome of the bladder to the ventral aspect of the rectum.
A: Anal Complex—Sphincters and Puborectal Muscles

- Low rectal tumors are associated with higher rates of positive resection margins, higher local recurrence rates, and poorer survival.
- Pretreatment MR imaging must be able to allow us to define the location of the tumor relative to the sphincter complex to propose which patients need to receive CRT before surgery.
A: Anal Complex—Sphincters and Puborectal Muscles

STAGE 1
Tumor confined to bowel wall and intact outer muscle coat

STAGE 2
Tumor replaces muscle coat but does not extend into intersphincteric plane

STAGE 3
Tumor invades intersphincteric plane and lies within 1 mm of levator muscle

STAGE 4
Tumor invades external anal sphincter and is within 1 mm and beyond levators with or without invading adjacent organs
N: Nodal Staging

• Exact nodal staging is important because the number of metastatic nodes has been shown to affect the prognosis.
• Criteria based on the shape, border, and signal intensity characteristics have been shown to be more reliable than depending on size.
• By using these criteria, MR imaging can be used to determine lymph node involvement with an accuracy of 85% compared with histopathologic evaluation as a standard of reference.
N: Nodal Staging

- The following are diagnostic clues at the workstation for nodal staging:
  - Uniform nodes smaller than 10 mm with homogeneous signal intensity are not suspicious.
  - Nodes with irregular borders, mixed signal intensity, or both are considered to be suspicious.
  - Presence of one to three suspicious nodes is stage N1 and presence of four or more is stage N2.
  - Any lymph node lying within 1 mm of the CRM must be reported because it is highly suspicious of CRM involvement.
  - Recording the location and size of any suspicious pelvic sidewall lymph nodes is critical.
N: Nodal Staging
C: CRM

• The mesorectal fascia is seen as a fine low-signal-intensity layer enveloping the perirectal fat and rectum and represents the surgical excision plane in TME anterior resections.
• CRM involvement is an important independent prognostic factor for local recurrence and poor survival.
C: CRM
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- The following are diagnostic clues at the workstation for a positive CRM:
  - A positive margin is defined as tumor lying within 1 mm of the mesorectal fascia.
  - Positive margins can be due to tumor deposits, main tumor extension, extramural vascular invasion (EMVI), or suspicious lymph nodes.
  - Anteriorly the mesorectal fat can be thin, and the rectum can be close to the CRM. In cases in which the rectum abuts the mesorectal fascia anteriorly, the tumor must be at least a stage T3 before discussing CRM involvement.
E: Extramural Vascular Invasion

- EMVI is reported to occur in up to half the cases of colorectal cancer.
- It is an independent risk factor for local and distant recurrence and poorer overall survival.
- It is defined as the presence of malignant cells within blood vessels located beyond the muscularis propria in the mesorectal fat.
- MR imaging is the only imaging modality that has been shown to consistently demonstrate EMVI in rectal cancer.
E: Extramural Vascular Invasion
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- The following are diagnostic clues at the workstation for EMVI:
  - By definition, EMVI must be associated with tumors that are at least category T3. A stage T1 or T2 has no potential for invading extramural vessels.
  - Whenever the tumor is seen to lie close to a vessel, the radiologist should consider the possibility of EMVI.
  - Signs suggestive for EMVI are (a) presence of tumor signal intensity within a vascular structure, (b) expanded vessels, and (c) tumoral expansion through and beyond the vessel wall, disrupting the vessel border.
  - If EMVI is present, considerations of whether the involved veins threaten the mesorectal fascia have been made.
E: Extramural Vascular Invasion

NO EXTRAMURAL VASCULAR INVASION (EMVI)
A: Vessels close to the tumor but of normal caliber and with no tumor signal inside

SUSPICIOUS FOR EMVI
B: Expanded vessels with abnormal signal intensity within the vessel
C: Abnormal signal intensity within the vessel which remain normal in size
D: Obvious irregular vessel contour with nodular expansion by tumor
DIS: Distance from the inferior part of the tumor to the transitional skin
   Low third (<5 cm)
   Middle third (5–10 cm)
   Upper third (>10 cm)

T: T staging—Extramural spread must be recorded, as well as peritoneal reflection involvement
   T1: Tumor invades submucosa
   T2: Tumor invades but does not penetrate muscularis propria
   T3: Tumor invades subserosa through muscularis propria
      T3a: Tumor extends < 1 mm beyond muscularis propria
      T3b: Tumor extends ≥ 1–5 mm beyond muscularis propria
      T3c: Tumor extends > 5–15 mm beyond muscularis propria
      T3d: Tumor extends > 15 mm beyond muscularis propria
   T4: Tumor peritoneal reflection (T4a) or other organs (T4b)

A: Anal complex for low-lying tumor with specific classification
   Stage 1: tumor invading partial thickness of muscularis propria
   Stage 2: tumor invading full thickness of muscularis propria
   Stage 3: tumor invading the intersphincteric plane
   Stage 4: tumor less than 1 mm or beyond the puborectal muscle

N: N staging, assessed on border definition and signal criteria
   N0: No metastatic lymph nodes
   N1: Metastasis in 1–3 perirectal nodes
   N2: Metastasis in 4 or more perirectal nodes
   Pelvic side wall lymph nodes must be recorded for radiation therapy field and surgery adjustment

C: CRM (circumferential resection margin)
   A positive margin is defined as: tumor, lymph nodes, EMVI, or tumoral deposits lying within 1 mm (<1 mm) of the mesorectal fascia

E: Extramural vascular invasion

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THANK YOU

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REFERENCES