MR Imaging of Rectal Cancer

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KEYWORDS

• Rectum • Rectal neoplasms • MR imaging • Anatomy • Neoplasm staging • Neoplasm recurrence

KEY POINTS

- Rectal MR imaging plays a pivotal role in the pretreatment and posttreatment assessment of rectal cancer, assisting the multidisciplinary team in tailoring treatment.
- The success of rectal MR imaging strictly depends on obtaining good image quality to evaluate the main anatomic structures and their relationships to the tumor.
- In primary staging, it is important to describe tumor location, T and N category, extramural venous invasion, tumor relationship to the sphincter complex, and circumferential resection margins.
- Neoadjuvant therapy is considered the standard of care for patients with locally advanced tumors, resulting in tumor downstaging and improved local control.
- At restaging, besides the T and N categories, it is important to assess treatment response, particularly with the emergence of nonoperative approaches.

INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer in men and the second most common in women worldwide.[1] It is also the second leading cause of cancer death.[2] In 2017, an estimated 95,620 new cases of CRC will be diagnosed in the United States alone. Of all these cases, 39,910 will occur in the rectum. Overall, cancer prevention, screening programs, and improvements in early diagnosis and treatment have improved CRC survival rates in the last few years.[2] In addition, the emergence of a multidisciplinary team effort (with close cooperation among surgeons, oncologists, endoscopists, radiologists, and radiotherapists) as well as technological advances in surgical techniques, (CRT), and imaging techniques, especially in the field of MR imaging, have played a pivotal role for improving patients' outcomes.[3,4] However, despite improvements in patient survival and the overall incidence rate, the incidence of CRC and rectal cancer (RC) in particular has increased among patients younger than 50 years old.[5]

RC is known to have a propensity to recur locally and to metastasize systemically. Up until the 1990s, surgery was considered the only type of treatment, and more than 50% of the patients had local recurrence (LR).[3] The prognosis of RC has been directly related to the infiltration into the mesorectum and the ability to surgically attain negative circumferential resection margins (CRM).[6] The introduction of the total mesorectal excision (TME) technique and CRT led to improvements in local disease control.[7–11] Moreover, pathologic complete response (pCR), observed in 15% to 27% of cases after CRT, has created the concept of minimally invasive surgeries and nonoperative management (ie, a watch-and-wait

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approach), showing improvement in patient quality of life and outcome.[3,12–14]

To optimize patient outcomes in the current clinical scenario where different treatment approaches can be considered, rectal MR imaging plays a key role assisting the multidisciplinary team in treatment planning. This article aims to review current concepts in the management of patients with RC, focusing primarily on MR imaging for primary staging, restaging, and assessing LR. The authors also emphasize the use of a structured radiologic reporting system with standardized terminology, which reduces misinterpretation and enhances the communication process between radiologists and other specialists.[15]

IMAGING MODALITIES FOR STAGING RECTAL CANCER

Staging is important for determining the optimal treatment approach for RC. Several diagnostic modalities are available: digital rectal examination (DRE) and sigmoidoscopy, endorectal ultrasound (ERUS), high-resolution pelvic MR imaging, computed tomography (CT), and PET/CT.

DRE and sigmoidoscopy followed by biopsy with pathologic examination are themselves often used to diagnose RC. Sigmoidoscopy is also considered the method of choice to determine the location of the tumor based on the distance between the tumor and the anal verge (AV).[16,17] However, for local staging, both have limited impact.[18]

ERUS provides a clear evaluation of the layers of the bowel wall and can provide preoperative assessment of the depth of tumor penetration. ERUS can also evaluate the presence of local lymph node (LN) metastases.[19] However, its inability to assess the tumor relationship with CRM, tumors beyond the reach of the probe, stenotic tumors, and extra-mesorectal LNs, as well as to distinguish fibrosis from tumor, makes it limited for staging advanced RC in both primary and post-CRT settings.[20,21] For the specific differentiation between T1 and T2 tumors, ERUS is recommended.[16]

Compared with all imaging modalities, high-resolution pelvic MR imaging is considered the standard imaging modality for local staging of RC for both primary (preoperative) staging and restaging. Briefly, primary staging MR imaging can assist in (a) selecting patients suitable for neoadjuvant therapy, (b) guiding surgical planning, and (c) identifying poor prognostic factors, such as presence of extramural vascular invasion (EMVI) or mucin, and CRM positivity.[20] The Magnetic Resonance Imaging and Rectal Cancer European Equivalence (MERCURY) study showed that high-resolution MR imaging can accurately assess the CRM preoperatively, differentiating low-risk from high-risk patients.[4] On the other hand, restaging MR imaging is important for (a) the evaluation of tumor regression, (b) tailoring surgical planning, (c) diagnosing clinical complete response in association with clinical and endoscopic examinations, and (d) monitoring of patients in a watch-and-wait program. Last, MR imaging is also important during follow-up by allowing an early diagnosis of recurrence and outlining disease extension within the pelvic compartments in order to help determine resectability and to plan the best treatment approach.[22]

CT is unreliable for local T and N staging. In regards to systemic staging, contrast-enhanced CT of the chest, abdomen, and pelvis is the modality of choice according to the National Comprehensive Cancer Network (NCCN) guidelines.[18]

PET/CT scan is not routinely indicated for staging RC according to the NCCN.[18] It should only be used to evaluate an equivocal finding on contrast-enhanced CT or in patients with strong contraindications to intravenous contrast media injection.[18] There are a few studies that have evaluated the use of PET/CT for detecting response to treatment[23]; however, no formal consensus has been established.[18] PET/CT can also be considered for surveillance and evaluation of recurrent disease.[18]

Early experience in PET/MR imaging has demonstrated higher accuracy in T staging and at least comparable accuracy in N and M staging to PET/CT, because of high soft tissue contrast provided by MR imaging; however, larger studies are needed to evaluate the added value of this modality.[24]

CURRENT CONCEPTS AND MANAGEMENT OF RECTAL CANCER

TNM staging is summarized in **Table 1**.[18] TNM staging is the most commonly used cancer staging system, whereby T describes the tumor, N describes the LNs near the tumor, and M describes whether the tumor has metastasized. The prefixes “c,” “p,” and “y” denote clinical, pathologic, and postneoadjuvant therapy, respectively.

In the United States, treatment of RC is based on NCCN guidelines, which adhere to the TNM staging set by the American Joint Committee on Cancer. According to this, patients without distant metastasis and with clinical stage cT1-2 and cN0 based on ERUS or MR imaging should undergo surgery. On the other hand, patients with locally advanced RC (cT3-4, cN0, or any cT and cN1-2),