

Magnetic Resonance Imaging in Rectal Cancer

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KEYWORDS

- Rectal cancer • Preoperative staging • Magnetic resonance imaging • Rectal anatomy
- Circumferential resection margin

KEY POINTS

- Magnetic resonance (MR) imaging plays a key role in staging evaluation of rectal cancer. The cornerstone of staging MR involves high-resolution T2 imaging orthogonal to the rectal lumen.
- The goals of MR staging are identification of patients who will benefit from neoadjuvant therapy prior to surgery in order to minimize postoperative recurrence and planning of optimal surgical approach.
- MR provides excellent anatomic visualization of the rectum and mesorectal fascia (MRF), allowing for accurate prediction of circumferential resection margin (CRM) status and tumor stage.
- Improved accuracy for lymph node staging can be achieved through evaluation of node morphology, signal heterogeneity, and dynamic enhancement characteristics in addition to size.
- MR has an evolving role for the evaluation of neoadjuvant treatment response, further triaging optimal patient treatment and surgical approach.

INTRODUCTION

Rectal cancer is one of the most common malignancies, with an incidence of 40 in 100,000.¹ Colorectal cancer is the third leading cause of cancer-related mortality worldwide in both men and women.² In 2013, an estimated 140,000 new colorectal malignancies will be diagnosed in the United States alone, and more than one-quarter of these will arise from the rectum.² Rectal cancers are associated with poorer prognosis and higher local recurrence than their counterparts in the colon. Although precise staging of rectal cancer is possible only with a surgical specimen, progress in preoperative management has necessitated the advent of accurate staging methods prior to surgical resection. Total mesorectal excision (TME) is the standard of care, with additional neoadjuvant concurrent chemoradiation therapy (CCRT) in a select group of patients. In patients

with advanced local-stage disease, neoadjuvant CCRT has improved local control and is associated with reduced toxicity when compared with postoperative adjuvant therapy.³ As such, initial staging investigations should identify the patients who benefit from preoperative therapy with intent to minimize the risk of tumor recurrence, while avoiding unnecessary treatment of patients in whom no benefit has been shown. Preoperative staging can also assist in surgical planning, identifying candidates for sphincter-preserving surgery. In this regard, high spatial resolution MR imaging has been established as an accurate preoperative staging technique and plays a critical role in pre-treatment staging and evaluation for recurrence. In more recent years, the role of MR imaging has expanded to include evaluation of neoadjuvant therapy response, further tailoring surgical approaches and oncologic treatment options. MR re-staging is of particular utility at institutions that

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have adopted organ-preserving techniques, such as transanal excision and nonoperative management (ie, a wait-and-see approach) for clinical CR.

CURRENT CONCEPTS IN RECTAL CANCER

Surgical resection is the mainstay of curative therapy for rectal cancer. TME is the standard of care, which involves radical removal of the entire rectal compartment with surrounding mesorectum through identification of naturally occurring tissue planes of the MRF.⁴ The risk of local recurrence is considerably lower when the rectum is excised intact.⁵ For tumors in the high rectum, low anterior resection (LAR) is the surgery of choice, whereby a portion of the distal rectum can be preserved. Tumors in the mid- to low-rectum are resected to the level of the pelvic floor muscles. For more distal tumors, sphincter-sparing surgeries, such as ultra-LAR with coloanal anastomosis and intersphincteric resection with coloanal anastomosis, may be attempted. Utilization of a sphincter-sparing technique results in improved surgical outcome in terms of recurrence and postoperative leak⁶ and substantially improves quality of life in postoperative patients. Abdominoperineal resection (APR) includes removal of the entire sphincter complex and is reserved for tumors in the low rectum that are fixed to adjacent pelvic organs or structures.⁷ Patients with operable locally advanced tumor or recurrent tumors are considered for total pelvic exenteration, which involves complete resection of the pelvic viscera and draining lymphatics, with the objective of removing all malignant disease.

The CRM is a pathologic term that refers to the surgically dissected surface of the specimen and

corresponds to the nonperitonealized portion of the rectum.⁸ A negative CRM is defined as greater than or equal to 1 mm between the tumor edge and the surgical margin and is associated with a significantly lower risk of local recurrence than a positive CRM (<1 mm).⁹ The relationship of tumor to the anterior peritoneal reflection is important when considering CRM, because the anterior peritoneal reflection extends in a nearly circumferential fashion around the upper rectum but only involves the anterior aspect of the lower rectum (Fig. 1). The term, CRM, is not appropriate for tumors involving the upper and/or anterior peritonealized portion of the rectum.

The MRF is the extraperitoneal pelvic fascial plane that surrounds the mesorectum. CRM is defined by the surgical specimen, the goal of which is to approximate MRF. MRF is visualized on MR imaging and is a more appropriate term for MR reporting. As with CRM, the term MRF only applies to nonperitonealized portion of the rectum.

IMAGING MODALITIES IN RECTAL CANCER DIAGNOSIS AND STAGING

MR imaging is the primary imaging modality for local staging evaluation for rectal cancer. Compared with other cross-sectional imaging modalities, the main benefits of MR imaging include high soft tissue contrast resolution for tumor delineation and ability to visualize and assess MRF/CRM and its relationship to the tumor and evaluation of regional lymph nodes. MR has an established role in initial staging but in more recent years utilization has evolved to include evaluation of treatment response and local recurrence.

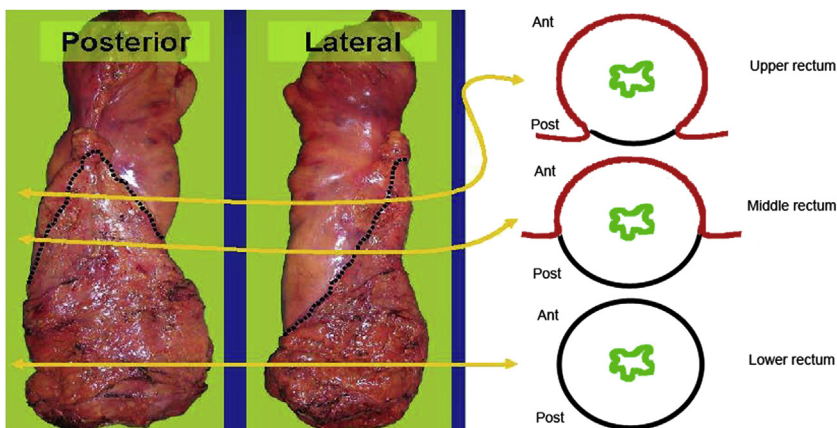


Fig. 1. Gross pathologic specimen of TME with schematic depiction of CRM (black line) and peritonealized rectum (red line). The anterior aspect of the upper rectum is predominantly peritonealized, whereas the lower rectum is entirely nonperitonealized. Ant, anterior; Post, posterior. (Courtesy of Dr Mahmoud Khalifa, Toronto, ON.)

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