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Opera suspicionată (OS) Suspicious work	Opera autentică (OA) Authentic work

OS	JEDERÁN, É, HORVÁTH, K, GŐDÉNY, M. The accuracy of High Resolution Magnetic Resonance in local staging of rectal cancer. *AMM (Acta Medica Marisiensis),* vol.56, no.2, p.84-85, 2010.
OA	IAFRATE, F., LAGHI, A., PAOLANTONIO, P., RENGO, M., MERCANTINI, P., FERRI, M., ZIPARO, V., PASSARIELLO, R., Preoperative Staging of Rectal Cancer with MR Imaging: Correlation with Surgical and Histopathologic Findings, RadioGraphics, no.26, p.701–714, 2006.

Incidența minimă a suspiciunii / Minimum incidence of suspicion	
p.84:15: - p.84:17	p.702:25d – p.702:29d
p.84:03s – p.84:07s	p.702:25s – p.702:30s;
p.84:13s – p.84:17s	p.702:21s – p.702:30s
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Preoperative Staging of Rectal Cancer with MR Imaging:

Correlation with Surgical and Histopathologic Findings

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RadioGraphics, 2006**; 26**:701–714

Introduction

Rectal cancer is a common disease with a high rate of mortality in Western countries. Many improvements have been made over the past 20 years in the surgical, radiologic, and oncologic treatment of rectal cancer. However, this neoplasm remains associated with a poor prognosis owing to the high risk of metastases and local recurrence. After surgical treatment, local recurrence rates for rectal cancer can vary from 3% to 32% (1–5).

Total mesorectal excision (TME) involves resection of both the tumor and the surrounding mesorectal fat. At present, TME is the surgical treatment of choice for rectal cancer, being associated with a recurrence rate of less than 10% when used as a single-modality therapy (6). The introduction of this surgical technique reduced the mortality rate associated with rectal cancer from 16% to 9% in one study (7).

In selected patients with involvement of the mesorectal fascia at the time of diagnosis, the use of preoperative radiation therapy is advocated and has been shown to reduce the recurrence rate from 8.2% to 2.4% at 2 years (6,8). This therapeutic approach demands accurate preoperative tumor staging—namely, detection of rectal carcinoma infiltration into the mesorectal fat, involvement of the mesorectal fascia, and nodal involvement.

The goal of imaging in rectal cancer is to stratify cases on the basis of the risks of recurrence by means of accurate evaluation of the T staging. At present, there is no consensus on the role of diagnostic imaging (endorectal ultrasonography [US], computed tomography, and magnetic resonance [MR] imaging) in the preoperative T staging of rectal cancer.

In this article, we discuss the diagnosis, management, and treatment of rectal cancer and review the normal rectal anatomy. We also discuss and illustrate the correlation of MR imaging findings with pathologic findings in rectal cancer and the clinical impact of MR imaging in this setting.

Histologic Criteria* for T Staging of Rectal Cancer

Tumor Stage	Criterion
T1	Tumor invades the submucosa
T2	Tumor invades the muscularis propria
T3	Tumor penetrates the muscularis propria and invades the subserosa or nonperitonealized perirectal tissue
T4	Tumor directly invades other organs or structures

*2003 criteria from the International Union Against Cancer.

Rectal Cancer

Rectal cancer is one of the most common tumors in industrialized countries (40 cases in every 100,000 individuals) and one of the most common malignant tumors of the gastrointestinal tract (9). Rectal cancer has a slight male predilection, and its prevalence increases steadily after the age of 50 years. Adenocarcinomas account for the vast majority (98%) of rectal cancers and are the focus of this article. Other rectal tumors are relatively rare and include carcinoid tumors (0.1% of cases), lymphoma (1.3%), and gastrointestinal stromal tumors (<1%).

Teaching Point

Imaging plays a crucial role in the preoperative management of rectal carcinoma. Indeed, the diagnosis of rectal cancer is usually made on the basis of a rectal digital examination, sigmoidoscopy or colonoscopy, a double contrast enema examination, and confirmatory histologic findings (10). However, these approaches do not adequately show the depth of tumor spread or the extent of lymph node involvement, both of which are important prognostic features (11–15). Preoperative staging techniques for rectal cancer should allow identification of *(a)* patients with extrarectal spread, who might benefit from preoperative radiation therapy; and *(b)* patients with minimal or no sphincteral involvement, who might be suitable for sphincter-sparing surgery.

Teaching Point

For optimal patient outcome, it is crucial to stratify cases into those in which patients can benefit from local therapy (eg, transanal local

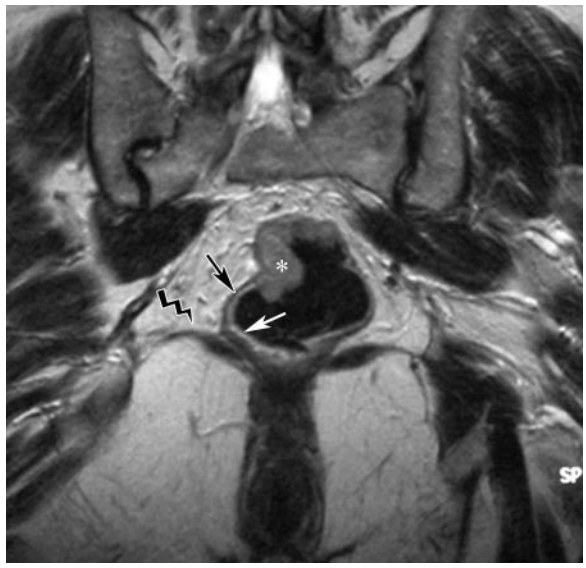
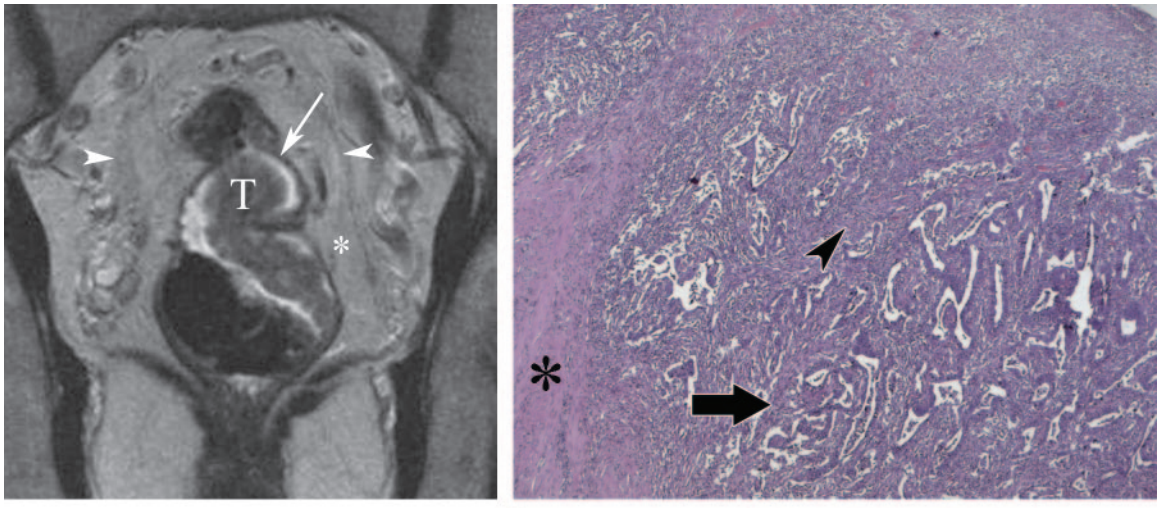


Figure 5. Rectal carcinoma. Coronal turbo spin-echo T2-weighted MR image shows a stage T1 tumor (*) of the rectum. The tumor has an intermediate signal intensity between the high signal intensity of the fat tissue (jagged line) and the low signal intensity of the muscular layer (black arrow). The inner layer of the rectal wall (white arrow) consists of mucosal and submucosal layers and has a high signal intensity.



a. b.

Figure 6. Stage T1 rectal carcinoma. **(a)** Coronal turbo spin-echo T2-weighted MR image shows a huge pedunculated tumor *(T)* on the left lateral rectal wall. The integrity of the muscular layer (arrow) appears not to be disrupted. The mesorectal fat (*) has a homogeneous appearance without tumoral involvement. The mesorectal fascia (arrowheads) is also well depicted. **(b)** Photomicrograph (original magnification, ×4; hematoxylin-eosin [H-E] stain) shows neoplastic glands (arrow) disrupting the mucosal and submucosal layers of the rectal wall and the integrity of the muscular layer (*). A desmoplastic reaction (arrowhead) is visible near the neoplastic glands.

Correlation of MR Imaging Findings with Pathologic Findings

The identification and staging of rectal cancers at MR imaging is largely based on differences in T2 signal intensity between the tumor, the mucosa and submucosal layers, the muscular layer, the perirectal fat, and the mesorectal fascia. The perirectal fat has high signal intensity on turbo spin-echo T2-weighted images and surrounds the low-signal-intensity muscularis propria. The tumor itself has an intermediate signal intensity between the high signal intensity of the fat tissue and the low signal intensity of the muscular layer. Furthermore, its signal intensity is higher than that of the mucosal and submucosal layers (Fig 5).

The mesorectal fascia appears as a thin, hypointense line surrounding the hyperintense perirectal fat. However, the spatial resolution of

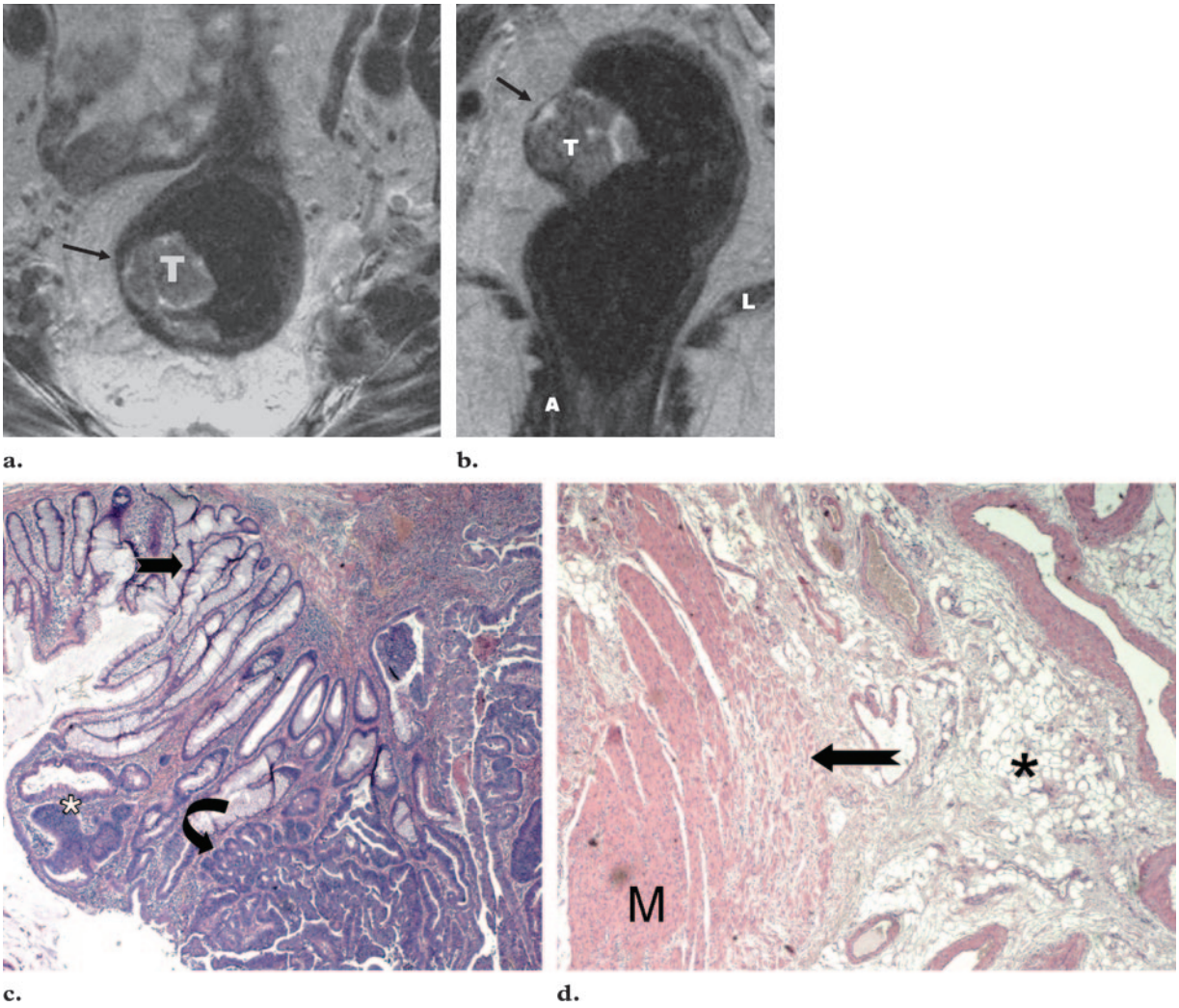


Figure 7. Stage T1 rectal carcinoma. **(a)** Axial turbo spin-echo T2-weighted MR image shows a polypoid tumor *(T)* on the right lateral aspect of the rectal wall protruding into the rectal lumen. It is difficult to determine whether the muscular layer (arrow), which appears thinned, is infiltrated or spared. **(b)** Coronal turbo spin-echo T2-weighted MR image shows the tumor *(T)* invading the rectal wall without infiltrating the perirectal fat (arrow). In this imaging plane, the distance of the tumor from the plane of the levator ani muscle *(L)* and from the anal sphincter complex *(A)* can easily be evaluated. **(c)** Photomicrograph (original magnification, ×4; H-E stain) reveals multiple neoplastic glands (curved arrow) confined to the submucosal layer. The border between normal bowel mucosal glands (straight arrow) and the neoplastic glands is clearly visible (*). **(d)** Photomicrograph (original magnification, ×4; H-E stain) shows that the integrity of the muscular layer *(M)* and the perirectal fat (*) has not been disrupted. The boundary between the muscular layer and fat tissue is evident (arrow).

phased-array surface coil MR imaging is not adequate to allow differentiation between the mucosal and submucosal layers of the inner layer.

At histopathologic analysis, a stage T1 tumor is characterized by infiltration of the submucosal layer and sparing of the muscularis propria (Fig 6); at phased-array MR imaging, differentiation between stage T1 and stage T2 tumors is rather difficult owing to low spatial resolution (Fig 7).

Transanal endoscopic microsurgery with a full-thickness excision represents a safe and effective treatment for adenomatous polyps, tumor in situ, and stage T1 rectal tumors.

Stage T2 tumors are generally characterized by involvement of the muscular layer, with loss of the interface between this layer and the submucosa. The muscular layer is partially reduced in thickness, although the outer border between the muscularis propria and the perirectal fat remains

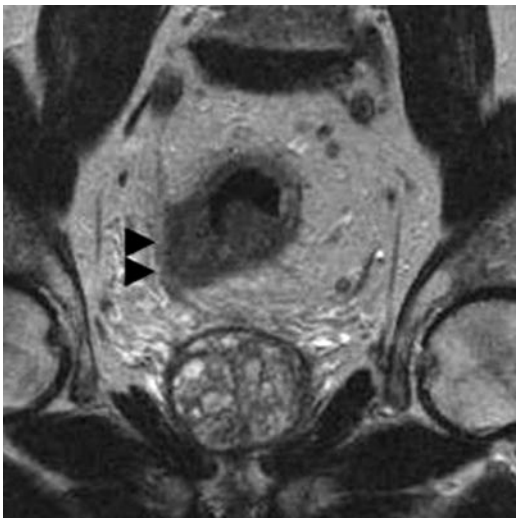


Figure 10. Stage T3 tumor with involvement of the mesorectal fascia. Coronal turbo spin-echo T2-weighted MR image shows a neoplastic rectal lesion infiltrating the mesorectal fat and involving the mesorectal fascia (arrowheads), which appears thickened. The mesorectal fascia represents the surgical resection margin. Patients with this kind of tumor benefit from preoperative neoadjuvant therapy to reduce the postoperative local recurrence rate.

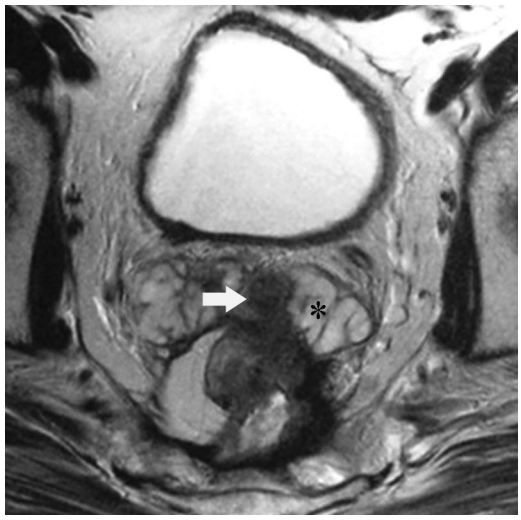


Figure 11. Stage T4 tumor. Axial turbo spin-echo T2-weighted MR image shows a neoplastic rectal lesion (arrow) disrupting the mesorectal fascia. Tumoral infiltration of the seminal vesicles (*) is also evident.

intact (Fig 8). In differentiating between stage T2 and stage T3 tumors, the crucial criterion is involvement of the perirectal fat, which is characterized by the inability to visualize the interface between the muscular layer and the perirectal fat, with a rounded or nodular advancing margin. In stage T3 tumors, the muscularis propria is totally disrupted and cannot be clearly distinguished from the perirectal fat (Fig 9).

In the evaluation of stage T3 tumors, one parameter is particularly important: the minimum distance between the tumor and the mesorectal fascia. This measurement is important for the stratification of cases on the basis of potential recurrence after TME. Indeed, despite good-quality TME surgery, 15%–20% of TME specimens have a positive CRM (40). In such cases, the CRM consists of the mesorectal fascia itself. Even if tumor–mesorectal fascia distance has not yet been included in the TNM staging system, there is strong evidence that neoplastic involvement of the CRM is closely related to a high recurrence rate after surgery (Fig 10) (1,40–42). In patients with suspected tumoral involvement of the mesorectal fascia, neoadjuvant treatments are advocated to reduce the risk of postsurgical recurrence (7). MR imaging is a highly accurate and reliable technique for the prediction of CRM infiltration and thus represents a noninvasive tool for identifying those patients who may benefit from preoperative chemotherapy or radiation therapy and those who should undergo TME.

Teaching Point

A valid criterion for predicting CRM infiltration is thought to be a cutoff distance of 6 mm between a tumor and the mesorectal fascia. This criterion was established by Beets-Tan et al (43), who observed that it was highly accurate in predicting CRM involvement. In their experience, a distance of at least 5 mm between a tumor and the mesorectal fascia at MR imaging helped predict an uninvolved CRM of 1 mm at histologic analysis with 97% confidence. Although not fully discussed in the literature, the usefulness of MR imaging in the evaluation of the CRM may be limited in *(a)* thin patients with little perirectal fat and *(b)* tumors of the anterior wall of the rectum, due to the poor visualization of the mesorectal fat.

In stage T4 tumors, the signal intensity of the tumor is seen infiltrating surrounding structures (ie, other organs and muscular structures of the pelvic wall) (Fig 11).