Imaging in Rectal Cancer

Magnetic Resonance Imaging Versus Endorectal Ultrasonography

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KEYWORDS

• Rectal cancer • Endorectal ultrasonography • Magnetic resonance imaging
• Circumferential resection margin • Tumor staging

KEY POINTS

- Endorectal ultrasonography (ERUS) provides excellent visualization of the layers of the bowel wall; magnetic resonance imaging (MRI) does not.
- ERUS provides better visualization of superficial tumors; MRI provides better visualization of locally advanced or stenotic tumors.
- MRI and ERUS are complementary tools in evaluation of lymph nodes.
- MRI is best at visualizing the circumferential resection margin.

INTRODUCTION

In the last decades, we have seen dramatic improvements in the outcomes of patients with rectal cancer. The rate of local recurrence has decreased, the probability of survival has increased, and the quality of life has improved. Advances in surgical pathology, which have added to our understanding of the causes of locoregional recurrences, refinements in surgical techniques, and the widespread use of neoadjuvant therapy, have all contributed to these improvements. However, advances in imaging have also played a pivotal role in identifying those at risk for recurrence, helping in planning surgical procedures and selecting patients for neoadjuvant therapy. Adequate imaging is a fundamental component of rectal cancer management.

Preoperative evaluation of the patient with rectal cancer goes beyond determination of tumor stage. Treatment planning requires not only defining the depth of tumor invasion in relation to the bowel wall, and the presence of metastatic regional lymph nodes, but also the precise relationship of tumor to other pelvic structures such as

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Surg Oncol Clin N Am 23 (2014) 59–77
http://dx.doi.org/10.1016/j.soc.2013.09.011 **surgonc.theclinics.com**
1055-3207/14/$ – see front matter

the mesorectal fascia, the levator muscle, the anal sphincters, and adjacent organs. In addition, assessment of the pelvic nodal basins outside the mesorectal fascia, and assessment of the retroperitoneal nodes, liver, and lungs, can provide useful information that may affect the treatment strategy.

Magnetic resonance imaging (MRI), endorectal ultrasonography (ERUS), and computed tomography (CT) are the imaging modalities most commonly used in evaluation of the patient with rectal cancer. Each has unique strengths and limitations. Rather than being used in the locoregional staging of rectal cancer, CT scanning is mainly used to exclude distant metastasis, and will not be reviewed here.

MRI of the rectum can be performed with either an endorectal coil or a phased-array surface coil. Endorectal coil MRI yields high-resolution images of the layers of the rectal wall, although clear differentiation between the mucosa and submucosa remains difficult. However, endorectal coil MRI provides only limited views of the rectum, cannot be used in the setting of stenotic or high tumors, and is poorly tolerated by patients. Therefore, endorectal coil MRI is not commonly used in the evaluation of rectal cancer and is not discussed in this review. Rectal MRI with a phased-array surface coil does not depict the layers of the bowel wall; however, it yields large field, high-resolution images of the rectum and other pelvic structures and is now an essential tool in the preoperative evaluation of rectal cancer. ERUS is a simple, widely available office procedure that provides high-resolution images of the rectal wall and surrounding tissues, within a short focal range. Because ERUS depicts the different layers of the bowel wall, it is useful in staging early rectal cancer; however, given its short focal range, it is not accurate in assessing the relationship of more advanced tumors to important anatomic structures, such as the mesorectal fascia. Thus, MRI, ERUS, and CT should be seen as complementary rather than competing tools, each providing unique and important information in the evaluation of the patient with rectal cancer.

In this article, an overview is provided of the anatomy of the rectum and other pelvic structures relevant to the preoperative evaluation and surgical treatment of rectal cancer. We then review the technical aspects, applications, and limitations of MRI and ERUS, the imaging modalities commonly used in preoperative assessment.

RELEVANT ANATOMY

The rectum corresponds to the distal portion of the large bowel, but neither its beginning nor end is sharply defined by specific anatomic landmarks. Proximally, the sigmoid colon transitions into the rectum at the rectosigmoid junction, located approximately 12 to 15 cm from the anal verge. The relationship of the large bowel with the promontory, often considered the beginning of the rectum, is variable, because it depends on the laxity of the mesorectum. Distally, the rectum transitions into the anal canal at the level of the anorectal ring, a palpable anatomic landmark corresponding to the impromptu of the puborectalis on the bowel wall. The anal canal extends from the anorectal ring to the anal verge, the palpable groove between the distal edge of the internal sphincter and the subcutaneous portion of the external sphincter. The location of a rectal tumor is best determined by measuring the distance of the lower edge of tumor from the anal verge, using a rigid proctoscope. This permits simultaneous viewing of the tumor, the anal verge, and the measuring marks on the instrument. However, measurements obtained from high quality sagittal images can also provide a good estimate of the distance of the tumor from the anal verge.

Similar to other segments of the gastrointestinal tract, the rectal wall is composed of a mucosa, a, submucosa, and a muscularis layer. The muscularis propria of the