Role of Imaging in Rectal Cancer

Staging of rectal cancer is necessary to provide the optimal treatment strategy although proctoscopy or sigmoidoscopy with biopsy are diagnostic. This is achieved by locoregional assessment of the disease by various available radiological investigations. Staging information includes extent of tumor involvement of the rectal wall and adjacent structures, presence or absence of adjacent lymphadenopathy, and determination of distant metastasis. Several modalities exist for the preoperative staging of rectal cancer, like computed tomography (CT); magnetic resonance imaging (MRI) with traditional body, endorectal, or phased-array coils; endorectal ultrasonography (ERUS) with rigid or flexible probes; and positron emission tomography (PET) with and without CT fusion. Typically, a combination of these modalities is used to provide complete staging information. The choice of modality is often influenced by local expertise and availability. Imaging in rectal cancer is important in deciding the best treatment modalities offered by multi-disciplinary approach.

CT imaging allows visualization of the entire abdomen and pelvis. Staging accuracy for CT ranges from 53% to 94% for T-stage accuracy. T-stage accuracy improves in more locally advanced tumors with CT. Nodal staging accuracy ranges from 54% to 70%. Although improvement in CT imaging (e.g., multidetector row spiral CT) has occurred, data are limited on whether such advances will result in improved locoregional staging accuracy. Yet, CT is used routinely in the staging of rectal cancer, mostly for the evaluation of distant metastasis.

The use of MRI in staging rectal cancer was first reported in 1986. MRI has gradually surpassed CT for locoregional rectal cancer staging. The initial studies of MRI in rectal cancer staging were done with a body coil, which lacked the ability to differentiate the layers of the rectal wall. Consequently, T-staging accuracy of 59% to 88% was reported, which was similar to that reported for CT imaging. The development of endorectal coils made detailed imaging of the rectal wall possible, with a corresponding improvement in T-staging accuracy of 71% to 91%. However, endorectal coil MRI is hampered by limited availability, high cost, and a diminished field of view due to signal attenuation at a short distance from the coil that can prevent full evaluation of the mesorectal fascia and surrounding tissue. In addition, positioning the endorectal coil is difficult in patients with proximal or nearly obstructing tumors, leading to failed coil insertion in up to 40% of patients. The advent of dedicated external coils (e.g., phased-array coils) allowed for high spatial resolution and an enhanced imaging field.

Nodal staging in rectal cancer is complicated by the fact that micrometastasis can occur in normal-sized nodes. Although radiologic imaging may detect nodes as small as 2 mm to 3 mm in size, morphologic criteria alone are poor predicting whether a node is reactive or metastatic. Consequently, the nodal staging accuracy of MRI has been highly variable, ranging from 39% to 95%. Recently, MRI with the use of contrast agents, such as ultra-small superparamagnetic iron oxide (SPIO), has been proposed as a method of improving nodal staging. SPIO undergoes phagocytosis by macrophages in lymph nodes and results in a shortening of the T2 relaxation time and a decrease in signal intensity of normal lymph nodes, which theoretically should improve the detection of micrometastatic nodal disease. Although previous studies in patients with head and neck and urologic tumors have been encouraging, published studies using this agent in staging rectal cancer are lacking. However presently MRI is used as a routine preoperative investigation in rectal cancer in countries like Europe.

In this issue of the journal, there is an article by Chowdri et al on multi-detector row computed tomography (MDCT) versus endorectal Coil magnetic resonance imaging (ECMRI) in staging of carcinoma rectum. The results of the study show that the diagnostic accuracies of MDCT and ECMRI for T1/T2 lesions are 75% and 87.5%, whereas the diagnostic accuracies for T3 lesions were 85.2% and 100%, and for T4 lesions 100% each respectively. The authors conclude that Endorectal coil MRI is superior to MDCT in local (T) staging of rectal tumors and has overall more diagnostic accuracy, sensitivity and specificity than MDCT, with ECMRI having a lesser tendency to under-stage the disease. However, both ECMRI and MDCT are almost equally accurate and specific in detecting perirectal lymph node involvement.

While abdominal ultrasound is used for detecting liver metastasis, ascites, adenopathy, etc., intraluminal rectal
ultrasound examination of rectal lesions with a rigid probe or a flexible endoscope can provide lot of information locally and hence help in proper decision making for treating the disease. EUS has been used to stage rectal cancer since the early 1980s. EUS, considered the current gold standard, has T-stage accuracy of 75% to 95% as reported in literature. However, inaccuracy of EUS mostly results from overestimating of T2 as EUS cannot reliably distinguish between an irregular outer rectal wall image due to peritumoral inflammation and that due to transmural tumor extension. Stenotic lesions may present difficulty, as the probe may not be able to traverse the lesion, leading to suboptimal staging. This problem is greater with rigid probes. Catheter probe EUS, which can be done with a standard endoscope, may aid in obtaining accurate tumor staging in the setting of a malignant stenosis.

EUS nodal staging accuracy is less than that of tumor staging and ranges from 70% to 75%. Flexible probes have the ability to evaluate the iliac region for adenopathy, which is clinically important because these nodes are retained in standard TME resection. In one study, up to 28% of lymph node–positive distal tumors showed iliac adenopathy, with 6% of patients having only iliac adenopathy. Thus, failure to evaluate this region could lead to inadequate surgical margins in up to 6% of patients with low rectal lesions. Morphologic characteristics suggestive of malignant involvement include hypoechoic appearance, round shape, peritumoral location, and size more than 5 mm. An early study showed that lymph nodes >5 mm in size have a 50% to 70% chance of being malignant compared with only 20% of nodes <4 mm. EUS-guided fine-needle aspiration (FNA) allows confirmation of malignancy in suspicious nodes during the same examination, as long as the primary tumor does not lie in the path of the needle.

Three-dimensional EUS consists of the traditional transverse scan as well as coronal and sagittal scans that allow for a multiplanar display. This procedure has been found to be superior to CT and two-dimensional EUS in accurately determining tumor margins. The three-dimensional reconstruction is also thought to improve visualization of subtle protrusions of tumors infiltrating into adjacent tissues and organs, allowing for improved T and N staging. Three-dimensional EUS improved understanding of the spatial relationship of the tumor due to their ability to obtain multiplanar imaging.

PET uses the glucose metabolism of malignant cells to discriminate tumor from benign fibrosis. In rectal cancer, PET has been used primarily in detecting recurrent disease. Although not used routinely for the staging of primary rectal tumors, PET is increasingly being used in combination with CT to aid in the detection of nodal and distant metastasis. Limited data exist in the preoperative setting, but recent studies have found preoperative PET to change preoperative management in 17% of patients, predict postoperative survival, and improve staging accuracy in combination with CT.

Based on the currently available literature, EUS or phased-array MRI seem to be appropriate initial studies for local tumor staging. EUS seems to provide more accurate staging for mobile T1 and T2 lesions, whereas MRI seems to be superior for fixed, more locally advanced disease. However, both modalities provide comparable overall T- and N-staging, with EUS currently being the less expensive of the two. Recent studies support the high accuracy of MRI in predicting a clear circumferential resection margin in patients undergoing TME. Both modalities are limited by issues of availability and operator dependence. In contrast, CT scanning cannot be considered appropriate for local tumor staging at present, although additional studies with multidetector CT are warranted. CT is the current standard for distant staging, but the combination of CT and PET offers the promise of both anatomic and functional imaging over a wide area and is rapidly gaining acceptance.

Staging helps in choosing the most useful treatment plan based on evidence. Use of neoadjuvant treatment in locally advanced cancers in rectum with appreciable reported evidence in literature demands restaging and complete reassessment before offering curative surgical treatment in this group of patients. The functional imaging in future may prove beneficial with respect to knowing lymph node status and in detecting post treatment residual or recurrent disease.

References


