Staging Colorectal Cancer

- CT is recommended as the initial staging scan for colorectal cancer to assess local extent of the disease and to look for metastases to the liver and/or lung.

- Further imaging for local staging depends on whether the primary tumor is in the colon or the rectum.

- For patients with rectal cancer who are potential candidates for surgery, MR is recommended for more precise local T-staging and for N-staging.

- MR is more sensitive than CT for detecting liver metastases in patients with steatosis.

- PET/CT is useful for detecting extra-hepatic disease in high-risk patients and for examining for post-operative recurrence of disease.

Although colorectal cancer is often considered as a single entity, initial management and staging of colorectal cancers differ depending on whether the primary tumor is located in the rectum or the colon. The rectum is short (approximately 15 cm) and very close to other structures, with only a narrow margin of fat between the rectal wall and the mesorectal fascia. In addition, unlike the colon, there is no protective peritoneal lining surrounding the rectum. Furthermore, resection of rectal cancers is more challenging than that of colon cancers because of the complex anatomy in the pelvis and the proximity of the pelvic wall. As a result, the failure rate after surgery for locally advanced rectal cancers is greater than that for colon cancer. For example, the 5-year survival rate for stage IIIA cancers of the colon is 84%, compared with 56% for stage III cancers of the rectum. The strongest predictor of recurrence in rectal cancer is involvement of the mesorectal fascia. Therefore, it is critical to determine such involvement prior to treatment as well as other factors of staging, such as nodal involvement and distal metastases.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial pre-operative staging</td>
<td>48-77% CT, 85% MRI</td>
</tr>
<tr>
<td>T-staging of rectal cancer</td>
<td>77% CT, 82-92% MRI</td>
</tr>
<tr>
<td>Detection of liver metastases</td>
<td>73-82% CT, 82-97% MRI</td>
</tr>
<tr>
<td>N-staging</td>
<td>23-73% MRI, 85%</td>
</tr>
<tr>
<td>Imaging vascular anatomy for planning resection</td>
<td>(Recommended)</td>
</tr>
<tr>
<td>Staging recurrent disease</td>
<td>Sensitivity, 46-69%; Specificty, 96% CT; Sensitivity, 79-93%; Specificity, 96% MRI</td>
</tr>
</tbody>
</table>

*If severe steatosis is present, accuracy for detecting liver metastases drops to 48% by CT and to 70% by MRI.

†PET has no role in initial staging unless extrahepatic disease is suspected or results from other imaging modalities are equivocal.
Figure 1. Initial Staging of Colorectal Cancer with CT. (A) Pelvic image shows site of the primary tumor (arrow). (B) Abdominal image shows an enlarged lymph node (arrow), which may be due to metastasis. (C) Image shows an enhancing lesion (arrow) in the dome of the liver, which needs further characterization.

Role of CT

The first step after the diagnosis of rectal or colon cancer is contrast-enhanced multidetector CT of the abdomen and pelvis (Table 1). Pulmonary metastases are more common in rectal cancer, so CT of the chest should be considered as well. These scans will help to determine the extent of local disease and the presence of metastases in the liver and/or lung (Figure 1). If liver metastases are present, resection of the primary tumor and liver metastases can be considered. In this case, contrast-enhanced CT can be used to determine the vascular anatomy of the liver (Figure 2), which is essential for planning the surgical approach for removal of liver metastases. Pulmonary metastases may also be resected. Chemotherapy may be used to shrink liver tumors away from critical structures, ultimately making them amenable to surgical resection. If chemotherapy is selected for treatment, CT is used to monitor the response to chemotherapy. Tumor shrinkage on CT is generally regarded as an indication of response (RECIST criteria).

However, CT has its limitations. Its accuracy for determining the presence of nodal involvement is low, with estimates of accuracy ranging from 23-73%. The accuracy of staging in the liver is 78%, extrahepatic involvement is 71%, and the overall accuracy of staging is 48-74%.

Moreover, recent evidence has indicated that a complete response on CT does not necessarily correlate with a complete clinical response. In one small study, the sites of some liver metastases that had shown complete response were resected during surgery and found to have some viable cancer cells. Other metastases that showed complete response on CT were not removed, but follow-up CT one year later showed recurrent disease.
Role of MR Imaging

For patients with rectal cancer, MR is recommended as an additional step after CT if they are potential surgical candidates. MR offers superior soft tissue resolution and permits visualization of the layers of the rectum, the mesorectal fascia, and the anal sphincter (Figure 3). With MR, it is possible to observe tumor penetration of the wall, extension beyond the wall, and penetration into the mesorectal fascia. MR is more accurate and less operator dependent than the alternate imaging modality, endorectal ultrasound, with T-staging accuracy of 84.6%, compared to 76.9% for CT. In addition, MR detects tumor penetration of the rectal wall (sensitivity 86%, specificity 65%), which is better than endorectal ultrasound (sensitivity 89%, specificity 33%).

MR imaging with a phased array surface coil is a high-resolution technique that results in a superior display of the tumor and the mesorectal fascia, is better for predicting nodal disease, and is more comfortable for patients than endorectal coil imaging. Both techniques have an accuracy of about 70-85%. For these reasons, phased array surface coil imaging has largely replaced imaging with an endorectal coil at Mass General Imaging.

Lymph Node Metastases

If the cancer has metastasized to the regional lymph nodes, the risk of tumor recurrence is increased. Metastasis to nodes close to the mesorectal fascia can adversely affect the ability to obtain a clear circumferential resection margin during surgery. Lymph node size, which can be measured by either CT or MR, is not a reliable method for assessing the likelihood of metastasis, although 3-6 mm is considered indeterminate, >6 mm suspicious, and >8 mm malignant. MR signal or contour abnormalities are better predictors of metastasis, with an 85% agreement with pathology. These are better seen in 3T MR images than in 1.5T images. Diffusion-weighted MR imaging (DWI) also shows promise for detecting metastatic lymph nodes. This technique depends on factors such as cellularity, extracellular space, and integrity of cell membranes, all of which can be abnormal in malignant tissue and affect the diffusion of water in the tissues. DWI is an additional MR sequence that takes about 5 minutes.
Liver Metastases
Sixty percent of patients with colorectal cancer will develop liver metastases. If left untreated, the median survival is 6-12 months with no survival beyond 5 years. Surgery, which is feasible in 15-20% of patients with liver metastases, increases the 2-year survival rate to 66% and the 5-year survival rate to 33-58%. The ability to perform liver surgery or other treatments such as selective internal radiation therapy or chemoembolization depends on the size of the tumor, the number of lesions, the distribution of the tumors in more than one liver segment, and the patient's health status.

CT can detect >80% of lesions >1.5 cm in diameter with confidence. However, hypovascular lesions are less conspicuous in CT images of fatty livers than in MR images. Accuracy of CT in moderate to severe steatosis has been estimated to be 48%, compared to 88% in the absence of disease. In comparison, the accuracy of MR in moderate to severe steatosis has been estimated to be 70%, compared to 97% in the absence of disease. Therefore, patients with colorectal cancer may benefit from MR for M-staging if they have fatty livers.

Role of PET
PET is less sensitive than MR for detecting liver metastases and has no role in initial staging of colorectal cancer unless extra-hepatic disease is suspected, especially in high-risk patients who have high levels of liver biomarkers. However, PET/CT, which combines high-resolution anatomic data from CT with metabolic data from PET, is useful for examining for post-operative recurrence (Figure 4).

Scheduling
Appointments can be scheduled by calling 617-724-9729 or through the Radiology Order Entry system, http://mghroe/. CT is available at the main campus, the Mass General / North Shore Center for Outpatient Care, and the Mass General Imaging Centers in Chelsea, Waltham, and Worcester. MR is available at the main campus, the Mass General / North Shore Center for Outpatient Care, and at the Mass General Imaging Centers in Chelsea and Waltham. PET/CT is available at the main campus and at the Mass General Imaging Center in Chelsea.

Further Information
For more information about imaging studies for staging colorectal cancer, please contact Dushyant Sahani, MD, Director of CT Imaging, Mass General Hospital, at 617-726-3937.

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References


