

**American College of Radiology  
ACR Appropriateness Criteria®**

**Clinical Condition:** Pretreatment Staging of Colorectal Cancer

**Variant 1:** Rectal cancer (small or superficial).

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
US pelvis endorectal	8	Also includes endoscopic US.	O
X-ray chest	8	If chest is not imaged by CT.	⊕
CT chest abdomen pelvis with or without contrast	8	For staging. CTC may be done in conjunction with CT abdomen and pelvis.	⊕ ⊕ ⊕ ⊕
MRI pelvis with or without contrast	7	Endorectal coil or phased-array coil. See statement regarding contrast in text under “Anticipated Exceptions.”	O
MRI abdomen with or without contrast	6	Consider if enhanced CT is contraindicated. See statement regarding contrast in text under “Anticipated Exceptions.”	O
FDG-PET whole body and CT whole body with or without contrast	5	A diagnostic-quality CT examination is performed.	⊕ ⊕ ⊕ ⊕ ⊕
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 2:** Rectal cancer — large lesion.

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
CT chest abdomen pelvis with or without contrast	8	To evaluate for synchronous lesions, CTC may be done in conjunction with CT of abdomen and pelvis.	⊕ ⊕ ⊕ ⊕
FDG-PET whole body and CT whole body with or without contrast	8	Has been shown to alter staging compared to CT. A diagnostic-quality CT examination is performed.	⊕ ⊕ ⊕ ⊕ ⊕
X-ray chest	8	To evaluate for metastatic disease if chest is not imaged by CT.	⊕
MRI abdomen with or without contrast	7	Consider if enhanced CT is contraindicated. See statement regarding contrast in text under “Anticipated Exceptions.”	O
MRI pelvis with or without contrast	7	Endorectal coil. See statement regarding contrast in text under “Anticipated Exceptions.”	O
US pelvis endorectal	6		O
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Clinical Condition:****Pretreatment Staging of Colorectal Cancer****Variant 3:****Colon cancer (other than rectum).**

<b>Radiologic Procedure</b>	<b>Rating</b>	<b>Comments</b>	<b><u>RRL*</u></b>
CT chest abdomen pelvis with or without contrast	8	To evaluate for synchronous lesions, CTC may be done in conjunction with CT of abdomen and pelvis.	☼ ☼ ☼ ☼
X-ray chest	8	To evaluate for metastatic disease if chest is not imaged by CT.	☼
FDG-PET whole body and CT whole body with or without contrast	7	A diagnostic-quality CT examination is performed.	☼ ☼ ☼ ☼ ☼
MRI abdomen and pelvis with or without contrast	7	If CT is contraindicated or liver lesion requires further characterization. See statement regarding contrast in text under "Anticipated Exceptions."	O
<b><u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

# PRETREATMENT STAGING OF COLORECTAL CANCER

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## **Summary of Literature Review**

### **Introduction/Background**

Colorectal cancers are the second most common tumors in the United States and the most common gastrointestinal cancer. The National Cancer Institute estimates that over 141,000 new cases of colorectal cancer will be diagnosed in 2011 [1]. Most of these patients will undergo surgery for palliation or possible cure.

### **Colonic Malignancy**

Barring contraindications from associated medical conditions, virtually all patients with colonic cancer will undergo some form of surgical therapy for attempted cure or palliation. The purpose of the preoperative imaging workup is directed at determining the presence or absence of synchronous carcinoma, additional adenomas, contiguous organ involvement, or distant metastases. Staging information also aids in comparing the effectiveness of different therapies [2,3].

### **Rectal Malignancy**

The preoperative staging assessment of rectal carcinoma has significant therapeutic implications. Patients with node-negative rectal carcinomas that have not reached the serosa may be adequately treated by radiation therapy

with or without transanal excision [4]. Furthermore, clinical trials combining preoperative chemotherapy and radiation followed by primary resection have shown improved survival in patients who present with transmural invasion or who are lymph node positive [5]. Thus preoperative imaging for local staging of rectal cancer is used routinely [5-7].

### **Imaging Modalities**

Computed tomography (CT) scanning, magnetic resonance imaging (MRI), and transrectal ultrasound (TRUS) have all been extensively evaluated in initial staging of colorectal carcinoma [2,3,5,8-26]. There are few initial therapeutic options for patients with colon carcinoma beyond surgery. Surgical excision with satisfactory margins is necessary to provide a significant disease-free interval. However, in rectal carcinoma, several other parameters can help determine the definitive treatment. Transanal excision has been shown to provide long-term survival equivalent to surgery in selected cases (ie, node-negative lesions without extension into the muscularis layer), and it may carry a higher patient acceptance [4]. Alternatively, in patients with transmural disease, preoperative radiation may improve survival. These decisions, however, cannot be made without accurate presurgical staging. Although reports suggest that MRI and TRUS may provide better methods than CT for staging rectal cancer, to date they have not been successful enough to be used routinely as the sole imaging modality [27-29].

### *Computed Tomography*

Initially, CT was the first “staging” modality evaluated. Early enthusiastic reports of accuracy ranged between 85%-90% [5], and it reported to be an excellent preoperative staging method with the ability to depict both tumor and metastases. CT is still recommended in the initial evaluation of all patients scheduled for colorectal carcinoma surgery because of its ability to obtain a rapid global evaluation and demonstrate complications (perforation, obstruction, etc) that may not be clinically apparent [22,30].

Larger, more carefully controlled studies, however, have shown that the overall accuracy of CT is in the 50%-70% range, varying directly with the stage of the lesion (ie, T4 lesions are more accurately assessed than T2 or T3 lesions) [8,26,30,31]. Overstaging is far more common, as it is difficult to accurately determine T-stage (depth of bowel wall penetration) on CT [19]. Another complicating factor, particularly in rectal cancer, is that perirectal spiculation can be confused with desmoplastic peritumoral inflammation, which can also lead to overstaging [32].

There is little agreement on the critical cut-off diameter to determine if lymph nodes are involved in the disease process. One study suggests 4.5 mm: however, nodal size is not seen as a predictor of nodal status at surgery [7,33]. Since detection of nodes involved with tumor remains a

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difficult problem, if a colonic resection is planned, local node groups are encompassed in a properly performed cancer operation. The specificity for detecting lymph nodes involved with tumor is only 45% [22].

Liver metastases are detected by CT with 85% accuracy and 97% specificity [26]. Detection of liver metastases by CT improves as disease stage increases. Among a group of 100 patients who underwent CT, CT arteriography (CTAP), and MRI, the sensitivity and specificity for liver metastases were 73% and 96.5% for CT, 87.1% and 89.3% for CTAP and 81.9% and 93.2% for MRI [31]. In addition, abdominal/pelvic CT has a high negative predictive value of 90% [10].

Detection of possible lung metastases is also an important part of the initial imaging evaluation of patients with colorectal carcinoma. Among patients with potentially resectable liver metastases and a negative initial chest radiograph, additional imaging with a chest CT revealed pulmonary metastases in only 5% of patients [34]. However, one study showed that rectal cancer is more likely than colon cancer to present with lung metastases without liver metastases and that this risk increases with advancing T stage. Although this study advised CT imaging of the chest in all rectal cancer patients, it was limited by the lack of pathological correlation [35].

Virtual colonoscopy (or CT colonography [CTC]) has proven to be a valid tool in identifying both primary and synchronous colonic lesions and for detecting extracolonic metastases. CTC is beneficial after incomplete colonoscopy to evaluate the remainder of the colon and is currently being advocated for use as a screening test [36]. More than 95% of patients prefer CTC to routine colonoscopy [37], and its use may increase patient willingness to receive regular screening for colorectal cancer. CTC has a staging accuracy of 81% [38] and has a sensitivity of 93% and a specificity of 97% for detecting polyps >1 cm. Sensitivity and specificity fall to 86% and 86%, respectively, for polyps measuring <1 cm [39].

#### *Magnetic Resonance Imaging*

Data from the Radiology Diagnostic Oncology Group (RDOG) study [26] showed that MRI had an accuracy of 58% for detecting local staging of rectal cancer and was equal to CT for detecting colonic neoplasms. Accuracy in identification of lymph node metastases was similar to CT with a sensitivity of 85%, and MRI was slightly superior for detecting liver metastases.

Recently, several groups, using endorectal MR coils and 3.0T magnets [40], have shown impressive results in depicting the layers of the rectal wall with resultant improvement in the accuracy of assessing the depth of bowel wall penetration [27-29]. There is no consensus in the literature as to whether endorectal coils should be used routinely in practice. Some studies contend that endorectal coils provide improved diagnostic accuracy as compared to phased-array coils alone for T stage, with sensitivity reaching 100% and specificity of 86%. Endorectal coils have limitations in assessing upper rectal

tumors and lateral pelvic and inferior mesenteric lymph nodes. Although phased array coils are far superior in detecting lymph node metastases, they are limited in the imaging of obese patients and in the evaluation of lower rectal tumors [41,42]. With the advent of 3.0T imaging, most imaging can be performed with a pelvic phased-array coil only.

MRI can aid in the accurate prediction of a histologically involved circumferential resection margin with a reported sensitivity of 94%-100%; and a specificity of 85%-88%. The distance to the mesorectal fascia is an important prognostic factor for determining risk of local recurrence. MRI has an accuracy of 86% in predicting the circumferential margin involvement [43,44]. Furthermore, from a surgical perspective, assessment of the mesorectal fascia involvement and tumor-free circumferential resection margin is crucial for surgical planning that determines whether total mesorectal excision (TME) or extended TME should be performed [45-47].

Diffusion-weighted imaging (DWI) has shown to be more sensitive and specific than standard contrast-enhanced MRI with gadolinium or SPIO-enhanced MRI, with values of 82% and 94%, respectively [48,49]. It is believed to be superior for tumor detection and characterization and for monitoring tumor response. Adding DWI to conventional MRI yields better diagnostic accuracy than conventional MRI alone [49]. DWI does not use contrast and is more sensitive than contrast-enhanced CT in detecting metastases [50]. It also has the potential to be clinically effective for the evaluation of preoperative TNM staging and the postoperative follow-up of colorectal cancer.

#### *Transrectal Ultrasound*

TRUS has become the standard imaging procedure for staging rectal carcinoma [17,18,20,51]. Because TRUS enables one to distinguish layers within the rectal wall, it is an accurate method for detecting depth of tumor penetration and perirectal spread [9,13]. Reported sensitivities ranged between 83% and 97% [12,25]. The T-stage accuracy for TRUS (84.6%) is far superior to that of CT (70.5%) [33]. However, overstaging can be a problem, especially when differentiating T2 from T3 lesions [52]. TRUS however, is of value in assessing apparently superficial rectal carcinomas that are potentially suitable for treatment by transanal or local excision or endocavitary radiation [11,53].

One study compared the frontal US probe to the radial probe and found that the accuracy for T staging was 89% for the frontal but only 69% for the radial probe, with no overstaging seen with the radial probe [54].

Detection of lymph node involvement with TRUS is difficult. Sensitivity is 50%-57% [16], and overall accuracy of 62%-83% [32]. Although TRUS can frequently be used to detect regional lymph nodes, it has not been shown to be predictive of the histology of the visualized lymph nodes [16,19]. Many lymph nodes measuring <5 mm in diameter have associated micrometastases, and some early-stage T1 and T2 tumors

are likely to have lymph node micrometastases missed at TRUS. This may be responsible for the high rate of pelvic recurrence within this patient group [55].

### Nuclear Medicine

Positron emission tomography (PET) and PET/CT have been shown to alter therapy in almost a third of patients with advanced primary rectal cancer [56]. In a study comparing PET/CT with TRUS, MRI and helical CT in imaging patients with low rectal carcinoma, PET/CT identified discordant findings and was far superior in 38% of patients. The result was an upstaging in 50% of these patients and downstaging in 21% [57]. A relatively new concept of PET/CTC has been reported to be significantly more accurate in defining TNM stage [58] than CTC alone [59]. However, it is not used routinely in most centers. The accuracy of PET/CT is similar to that of CT in terms of T stage [58] but is far superior in detecting hepatic and peritoneal metastases (sensitivity of 89% and specificity of 64%) [60]. The sensitivity of detecting nodal metastases is only 43% with a specificity of 80%, and again size is not a helpful characteristic.

There is also a potential role for PET in restaging colorectal cancer after chemoradiotherapy by measuring the pretreatment and post-treatment standard uptake volume (SUV) and assessing response by decreasing SUV [61]. Limitations of PET include decreased sensitivity in detecting small colonic lesions 5-10 mm in diameter and decreased 18F-fluorodeoxyglucose (FDG) uptake by mucinous tumors [60].

### Summary

- The preoperative staging assessment of rectal carcinoma has significant therapeutic implications in terms of surgical planning and neoadjuvant chemotherapy and radiation therapy.
- CT of the chest, abdomen, and pelvis is recommended in the initial evaluation of all patients scheduled for colorectal carcinoma surgery.
- TRUS enables one to distinguish layers within the rectal wall. It is an accurate method for detecting depth of tumor penetration and perirectal spread. However, it is associated with overstaging and is not fully accurate in differentiating T2 from T3 lesions.
- CTC is a valid tool for identifying both primary and synchronous colonic lesions and for detecting extracolonic metastases.
- The sensitivity and specificity of endorectal MRI for predicting circumferential margin involvement are 94% and 85%, respectively. No consensus is seen in the literature as to whether endorectal coil or phased-array coil should be used routinely, as both have limitations.
- DWI has shown to be more sensitive and specific than standard contrast-enhanced MRI with gadolinium contrast.

### Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of

manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m<sup>2</sup>), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m<sup>2</sup>. For more information, please see the [ACR Manual on Contrast Media](#) [62].

### Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
0	0 mSv	0 mSv
⊕	<0.1 mSv	<0.03 mSv
⊕ ⊕	0.1-1 mSv	0.03-0.3 mSv
⊕ ⊕ ⊕	1-10 mSv	0.3- 3 mSv
⊕ ⊕ ⊕ ⊕	10-30 mSv	3-10 mSv
⊕ ⊕ ⊕ ⊕ ⊕	30-100 mSv	10-30 mSv

\*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as NS (not specified).

## Supporting Document(s)

- [ACR Appropriateness Criteria® Overview](#)
- [Procedure Information](#)
- [Evidence Table](#)

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.