Staging of Rectal Cancer: MRI versus Endoscopic Ultrasound

Nadim George Haddad, MD
Associate Professor Of Medicine
Fellowship Director Div. Of G.I.
Georgetown University Hospital

Epidemiology

- From 1985 to 1997, incidence decreased by 1.6% per year
- 2001 USA incidence - 44 cases per 100,000
  - About 34,000 new cases per year
- 2007 USA incidence rectal cancer: 23,840 men and 17,580 women
- National Cancer Institute Estimated new cases and deaths from rectal cancer in the United States in 2009: 40,870

Staging

TNM Definitions Primary tumor (T)
- TX: Primary tumor cannot be assessed
- T0: No evidence of primary tumor
- Tis: Carcinoma in situ: intraepithelial or invasion of the lamina propria
- T1: Tumor invades submucosa
- T2: Tumor invades muscularis propria
- T3: Tumor invades through the muscularis propria into the subserosa, or into nonperitonealized pericolic or perirectal tissues
- T4: Tumor directly invades other organs or structures, and/or perforates the visceral peritoneum

Regional lymph nodes (N)
- NX: Regional lymph nodes cannot be assessed
- N0: No regional lymph node metastasis
- N1: Metastasis in one to three regional lymph nodes
- N2: Metastasis in four or more regional lymph nodes

Distant metastasis (M)
- MX: Distant metastasis cannot be assessed
- M0: No distant metastasis
- M1: Distant metastasis

AJCC Stage Groupings
- Stage 0: Tis, N0, M0
- Stage I: T1, N0, M0
- Stage I: T2, N0, M0
- Stage IIA: T3, N0, M0
- Stage IIB: T4, N0, M0
- Stage IIIA: T1, N1, M0
- Stage IIIB: T2, N1, M0
- Stage IIIC: T3, N1, M0
- Stage III: Any T, N2, M0
- Stage IV: Any T, any N, M1

AT DIAGNOSIS:
- Localized — confined to primary site/mucosa, submucosa, muscle layer — 44%
- Lymph node involvement — 40%
- Distant metastases — 16%
- Estimated about 50% of rectal cancers are cured

Why is staging important?
- 1990 – NIH Consensus Conference recommended adjuvant ChemoXRT for advanced locoregional rectal cancer
  - DFN: perirectal fat extension (T3 or T4) or mesorectal or pelvic lymph nodes (N1 or N2)
- Results: decreased local recurrence and possible improved survival
- Surgical approach
  - ie T1/T2N0 may be performed transanally
Staging Modalities

- CT Scan
- MRI
- EUS
- DRE

Staging

- MRI
  - Mandatory in UK, Denmark, Norway, Sweden
  - Circumferential resection margins
  - Extramural venous invasion
  - 75-85% accuracy
  - MERCURY
    - Study confirming diagnostic accuracy/reproducibility
    - Predicts involvement of surgical margin and extramural tumor invasion
  - Taylor et al. AJR Dec 2008
    - Systematic evaluation of MRI findings
- Questions for the radiologist:
  - Phased array coils v. endorectal coils
  - Field Strength
  - Still need bowel prep
  - Decrease artifact from air-tissue border

Normal anatomy of the mesorectum

Coronal turbo spin-echo T2-weighted MR image shows the normal anatomy of the rectum

Stage T1 rectal carcinoma

MRI of a T1 rectal carcinoma showing the extent of the tumor and surrounding structures.
Rectal adenocarcinoma

Iafrate F. et al. Radiographics; 2006; 26: 701-714

© 2006 by Radiological Society of North America

INVOLVEMENT OF MESORECTAL FASCIA

EXTRAMURAL VEIN INVASION

PREOPERATIVE STAGING OF RECTAL CANCER WITH MRI

Table 3: Magnetic resonance imaging (MRI) v digital rectal examination in 241 patients assessed by both methods undergone primary surgery or short course radiotherapy followed by immediate surgery.

<table>
<thead>
<tr>
<th></th>
<th>Lower</th>
<th>Middle</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI</td>
<td>241</td>
<td>138</td>
<td>60</td>
</tr>
<tr>
<td>Diag.</td>
<td>106</td>
<td>51</td>
<td>50</td>
</tr>
</tbody>
</table>


Operative characteristics of endorectal MRI in staging rectal carcinoma

Table 6: Operative characteristics of endorectal MRI in staging rectal carcinoma.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Number of Patients</th>
<th>T stage (%)</th>
<th>N stage (%)</th>
<th>Overall accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheah et al.</td>
<td>2001</td>
<td>12</td>
<td>T3 (77%)</td>
<td>N1 (77%)</td>
<td>T3 (77%)</td>
</tr>
<tr>
<td>Schnell et al.</td>
<td>2004</td>
<td>18</td>
<td>T3 (78%)</td>
<td>N3 (78%)</td>
<td>T3 (78%)</td>
</tr>
<tr>
<td>De Smaten et al.</td>
<td>2005</td>
<td>25</td>
<td>T3 (75%)</td>
<td>N3 (75%)</td>
<td>T3 (75%)</td>
</tr>
<tr>
<td>Kellett et al.</td>
<td>2006</td>
<td>12</td>
<td>T3 (71%)</td>
<td>N3 (71%)</td>
<td>T3 (71%)</td>
</tr>
<tr>
<td>Legono et al.</td>
<td>2007</td>
<td>48</td>
<td>T3 (76%)</td>
<td>N3 (76%)</td>
<td>T3 (76%)</td>
</tr>
<tr>
<td>Brown et al.</td>
<td>2008</td>
<td>26</td>
<td>T3 (85%)</td>
<td>N3 (85%)</td>
<td>T3 (85%)</td>
</tr>
<tr>
<td>Gould et al.</td>
<td>2009</td>
<td>14</td>
<td>T3 (79%)</td>
<td>N3 (79%)</td>
<td>T3 (79%)</td>
</tr>
</tbody>
</table>

*Diagnostic accuracy of endorectal MRI in staging rectal cancer.
Accuracy of tumor (T) staging by pelvic phased-array coil MRI in patients with rectal cancer since 1997

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Number of patients</th>
<th>Overall accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hartnell et al.</td>
<td>1991</td>
<td>36</td>
<td>35</td>
</tr>
<tr>
<td>Driscoll et al.</td>
<td>1996</td>
<td>35</td>
<td>80</td>
</tr>
<tr>
<td>Bonney et al.</td>
<td>2000</td>
<td>37</td>
<td>65</td>
</tr>
<tr>
<td>Kies et al.</td>
<td>2000</td>
<td>21</td>
<td>81</td>
</tr>
<tr>
<td>Braune-Franz et al.</td>
<td>2001</td>
<td>75</td>
<td>93</td>
</tr>
<tr>
<td>Doglioni et al.</td>
<td>2000</td>
<td>24</td>
<td>96</td>
</tr>
<tr>
<td>Mathur et al.</td>
<td>2000</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td>Matsuda et al.</td>
<td>2000</td>
<td>19</td>
<td>90</td>
</tr>
<tr>
<td>Ferrer et al.</td>
<td>2000</td>
<td>33</td>
<td>88</td>
</tr>
<tr>
<td>Blanchet et al.</td>
<td>2000</td>
<td>49</td>
<td>71</td>
</tr>
</tbody>
</table>

Table 3 Accuracy of tumor (T) staging by pelvic phased-array coil MRI in patients with rectal cancer since 1997.

Accuracy of node (N) staging by pelvic phased-array coil MRI in patients with rectal cancer

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Number of patients</th>
<th>Overall accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hartnell et al.</td>
<td>1997</td>
<td>36</td>
<td>76</td>
</tr>
<tr>
<td>Kim et al.</td>
<td>2000</td>
<td>217</td>
<td>62</td>
</tr>
<tr>
<td>Bongiorni et al.</td>
<td>2000</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Kies et al.</td>
<td>2000</td>
<td>79</td>
<td>46</td>
</tr>
<tr>
<td>Brown et al.</td>
<td>2003</td>
<td>69</td>
<td>56</td>
</tr>
<tr>
<td>Matsuda et al.</td>
<td>2003</td>
<td>19</td>
<td>89.6</td>
</tr>
<tr>
<td>Ferrer et al.</td>
<td>2003</td>
<td>29</td>
<td>59</td>
</tr>
<tr>
<td>Blanchet et al.</td>
<td>2003</td>
<td>49</td>
<td>76</td>
</tr>
<tr>
<td>Blanchet et al.</td>
<td>2005</td>
<td>29</td>
<td>72</td>
</tr>
</tbody>
</table>

Table 4 Accuracy of node (N) staging by pelvic phased-array coil MRI in patients with rectal cancer.

EUS - Technique

- Patient in the left lateral decubitus position
- Radial echoendoscope inserted at least to 30cm, visualize:
  - Iliac adenopathy
  - Wall and surrounding structures
  - Internal and external anal sphincter
- Irrigation used to enhance image

Linear and Radial Endosonoscopes

 Probe and Processor Compatibilities

Linear and Radial Imaging:
Staging

- Transrectal Endoscopic Ultrasound
  - Improved T staging
    - 80-85% accuracy (UTD)
  - Compared to MRI with endorectal coils, EUS better for discerning T1 v. T2
- Nodal Staging Accuracy 70-75% (asge)
  - Sensitivity decreased for LNs < 5mm
  - FNA may be needed if T1/T2

### EUS

**Possible Downfalls:**
- Does not assess circumferential resection margin or extramural venous invasion
- Malignant strictures
  - Miniprobes
- Obstructing Lesion
  - Understaging

### Table 1. Accuracy of tumor (T) staging by endoscopic ultrasound in patients with rectal cancer since 1990

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Number of patients</th>
<th>Overall accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jochum et al.</td>
<td>2005</td>
<td>99</td>
<td>72</td>
</tr>
<tr>
<td>Onishi et al.</td>
<td>1999</td>
<td>75</td>
<td>92</td>
</tr>
<tr>
<td>O’Connell et al.</td>
<td>1999</td>
<td>75</td>
<td>92</td>
</tr>
<tr>
<td>Massion et al.</td>
<td>1998</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Knecht et al.</td>
<td>1999</td>
<td>89</td>
<td>83.5</td>
</tr>
<tr>
<td>Akasu et al.</td>
<td>2000</td>
<td>154</td>
<td>72</td>
</tr>
<tr>
<td>Massion et al.</td>
<td>2000</td>
<td>111</td>
<td>85</td>
</tr>
<tr>
<td>Garcia-Aguilar et al.</td>
<td>2000</td>
<td>545</td>
<td>66</td>
</tr>
<tr>
<td>Hennig et al.</td>
<td>2000</td>
<td>80</td>
<td>83</td>
</tr>
<tr>
<td>Nakashima et al.</td>
<td>2000</td>
<td>81</td>
<td>65</td>
</tr>
<tr>
<td>Makiyama et al.</td>
<td>2000</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>Saito et al.</td>
<td>2004</td>
<td>43</td>
<td>59</td>
</tr>
</tbody>
</table>

### Table 2. Accuracy of node (N) staging by endoscopic ultrasound in patients with rectal cancer since 1990

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Number of patients</th>
<th>Overall accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jochum et al.</td>
<td>2005</td>
<td>99</td>
<td>72</td>
</tr>
<tr>
<td>Onishi et al.</td>
<td>1999</td>
<td>75</td>
<td>92</td>
</tr>
<tr>
<td>O’Connell et al.</td>
<td>1999</td>
<td>75</td>
<td>92</td>
</tr>
<tr>
<td>Massion et al.</td>
<td>1998</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Knecht et al.</td>
<td>1999</td>
<td>89</td>
<td>83.5</td>
</tr>
<tr>
<td>Akasu et al.</td>
<td>2000</td>
<td>154</td>
<td>72</td>
</tr>
<tr>
<td>Massion et al.</td>
<td>2000</td>
<td>111</td>
<td>85</td>
</tr>
<tr>
<td>Garcia-Aguilar et al.</td>
<td>2000</td>
<td>545</td>
<td>66</td>
</tr>
<tr>
<td>Hennig et al.</td>
<td>2000</td>
<td>80</td>
<td>83</td>
</tr>
<tr>
<td>Nakashima et al.</td>
<td>2000</td>
<td>81</td>
<td>65</td>
</tr>
<tr>
<td>Makiyama et al.</td>
<td>2000</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>Saito et al.</td>
<td>2004</td>
<td>43</td>
<td>59</td>
</tr>
</tbody>
</table>

### Case 1

38 year old male with anemia and unexplained diarrhea.
Case 2

58 year old male with change of bowel habits and BRBPR. Patient with colonoscopy which revealed rectal cancer.
Studies – MRI v. EUS

- WJG – June 2008
  - 34 patients: biopsy proven rectal cancer

**ACCURACY:**
- MRI T staging 89.7%
- EUS T staging 85.3%
- MRI N staging 74.5%
- EUS N staging 76.5%

**SENSITIVITY**
- MRI T staging 79.4%
- EUS T staging 70.6%
- MRI N staging 61.8%
- EUS N staging 52.9%

**SPECIFICITY**
- MRI T staging 93.1%
- EUS T staging 90.2%
- MRI N staging 80.9%
- EUS N staging 84.3%

Conclusion

- EUS is the best method of local T1-T2 staging of rectal cancer.
- EUS/FNA/FNI for local therapy.
- The use of EUS for staging rectal cancer seems to improve disease-free survival because EUS facilitates the appropriate selection of patients for neoadjuvant therapy; the use of EUS has also increased the number of sphincter-preserving surgeries performed in patients with rectal cancer.
- MRI better for locally advanced tumor (T3/T4).
- Rectal cancer staging with EUS or MRI is not accurate after patients have received neoadjuvant therapy.
- MRI is the most useful staging tool for determining the status of the circumferential resection margin, which is important in the assessment of the risk of local recurrence.

MRI better for localy advanced tumor (T3/T4).

Bibliography