All You Ever Wanted to Know about the Workup of Rectal Adenocarcinoma

Tian Zhang, HMS IV
Gillian Lieberman, MD
Beth Israel Deaconess Medical Center
Department of Radiology
November 17, 2008
Agenda

- Introduce patient
- Discuss Rectal Adenocarcinoma, staging, and management
- Companion cases
- Stage our patient
- Discuss limitations of imaging
Patient SK

- 34-year-old man, otherwise healthy, when he presents with post-prandial pain, frequent bowel movements, hematochezia, and unintentional 15-lb weight loss

- Urgent colonoscopy revealed large, fungating, bleeding mass; biopsied.
Our Patient SK, Biopsy

Fibrosis

Invasive adenocarcinoma

Desmoplasia

Possible lymphatic invasion (not called small biopsies)

Fibrosis

BIDMC, Courtesy of A. Schell
Rectal Adenocarcinoma

- Epidemiology
  - 3rd most common: ~148,000 new cases of colorectal adenocarcinoma per yr, 40,000 cases rectal
  - ~50,000 deaths per year
  - 20% pts have distant mets at dx
  - Men>women, incidence rises after 40yo

- Risk factors:
  - Polyps
  - IBD (Ulcerative Colitis or Crohn’s)
  - Family history of colorectal adenocarcinoma
What determines treatment and prognosis after adenocarcinoma is diagnosed?

Staging of the patient’s tumor at time of diagnosis is most important!
Rectal AdenoCA Staging

TNM staging:

T status:
T0: no primary
Tis: CA in situ
T1: Submucosa
T2: Muscularis propria
T3: Perirectal fat
T4: Other organs/peritoneum

Nodal status:
N0: no nodes
N1: <3 LNs >3mm each
N2: >3 LNs >3mm each

Met status:
Mx: Not assessed
M0: No mets
M1: Distant mets

McMahon CJ & Smith MP. Seminars in ultrasound, CT, and MRI. 2008.
Stage and Prognosis

- **Stage 0**: Tis N0 M0
- **Stage I**: T1/T2 N0 M0 92%
- **Stage II**: T3/T4 N0 M0 73%
- **Stage IIIA**: T1-2 N1 M0 55.1%
- **Stage IIIB**: T3-4 N1 M0 35.3%
- **Stage IIIC**: any T N2 M0 24.5%
- **Stage IV**: any T any N M1 8%

What do we use to stage patients?

IMAGING!
Menu of Imaging Studies

- **Endorectal Ultrasound**
  - Performed with endorectal balloon filled with water, with probe inside balloon
  - Sensitive for T staging of T1/T2 tumors
    - 94% sens and 86% spec for rectal wall invasion\(^1\)
  - More experience, older technology
  - Technically challenging, operator-dependent

- **Magnetic Resonance Imaging (MRI)**
  - Performed with barium/gastromark enema, and IM glucagon to slow peristalsis
  - Determine extent of T3 tumors, as well as invasion of pelvic organs/peritoneum: 74% sens and 96% spec\(^1\)
  - Detects LN involvement: 66% sens and 76% spec\(^1\)
  - Newer technology, new innovations

- **Computed Tomography (CT)**
  - For distant metastases
  - Restaging after chemoradiation therapy

- **MRI with endorectal coil**
  - LN involvement: 82% specific\(^2\)
  - Technically challenging

Companion Patient #1: Rectal Cancer on MRI

64 yo man with BRBPR
Colonoscopy:
Adenoma with high-grade dysplasia
   Pedunculated lesion, low signal intensity on T1, some areas of high signal intensity on T2, enhances heterogeneously after gadolinium administered.

Pedunculated adenocarcinoma.

Images from PACS, BIDMC, courtesy M. Smith
Companion Patient #1: MR for T-staging

Layers of rectum seen on MR with T2-weighted image:
1) Low SI: mucosa
2) High SI: submucosa
3) Low SI: muscularis propria
4) High SI: perirectal fat

Mesorectal fascia

Perirectal fat

Muscularis propria

Submucosa

Pathology showed T1

Images from PACS, BIDMC, courtesy M. Smith
How do we treat?

- Multimodality therapy
  - Surgical excision
  - Chemotherapy
  - Radiation therapy

Let’s discuss each of these in more detail.
Surgical Excision

- **Total mesorectal excision**
  - Transanal approach
    - For Tis/T1 tumors
  - Low Anterior Resection (LAR)
    - For T2/T3 tumors far from sphincter
  - Abdominoperineal Resection (APR)
    - For T3 tumors too close to sphincter
  - Pelvic Exenteration
    - For T4 tumors
Chemoradiotherapy

- **Stage I or II: Adjuvant chemotherapy**
  - FOLFOX:
    - FOLinic acid, 5-Fluorouracil, OXaliplatin

- **Stage III or IV:**
  - Neoadjuvant chemotherapy: 5-fluorouracil
  - Neoadjuvant radiation therapy: 50.4 Gy
  - New chemotherapeutic tested:
    - Cetuximab (monoclonal antibody α-EGFR)
German Rectal Cancer Study Group

- Randomized prospective trial
- >800 patients with T3/T4 or N+ disease randomized to neoadjuvant vs adjuvant chemoradiation
  - (5-FU + 50.4 Gy)
- Mean f/u 45.8 mos
- Main Results:

<table>
<thead>
<tr>
<th></th>
<th>Neoadjuvant</th>
<th>Adjuvant</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Relapse</td>
<td>6%</td>
<td>13%</td>
<td>0.006</td>
</tr>
<tr>
<td>APR</td>
<td>116</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>LAR</td>
<td>45/116 (39%)</td>
<td>15/78 (19%)</td>
<td>0.004</td>
</tr>
<tr>
<td>5yr OS</td>
<td>76%</td>
<td>74%</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Critique: 89% pts completed neoadjuvant, 72% pts completed adjuvant

Companion Patient #2: US Staging

Clinical Stage T2

51yo woman, p/w 2 months of BRBPR, assoc with diarrhea
Colonoscopy: rectal mass, adenocarcinoma

Interface btw balloon & mucosa (hyperechoic)
Mucosa (hypoechoic)
Submucosa (hyperechoic)
Muscularis propria (hypoechoic)
Perirectal fat (mixed echogenicity)

Endorectal Ultrasound

★ Tumor begins in mucosa and extends outward, without extension beyond the muscularis propria.
Companion Patient #2: US Staging

Clinical Stage T2N1

Oval lesion 5.6mm in diameter, which is hypoechoic within surrounding perirectal fat – likely lymph node.

Endorectal Ultrasound

Image from PACS, BIDMC, courtesy R. Kane & K. Krajewski
Our Patient: SK’s US

Technically challenging:

Endorectal probe could not pass beyond the large mass – not fully evaluated.

Visualized only the most proximal edge of tumor in anterior wall.

Image from PACS, BIDMC, courtesy K. Krajewski

Endorectal Ultrasound
Our Patient: SK at MRI

Tumor demonstrates low signal intensity on T1 and high signal intensity on T2. 7.7cm in superior-inferior axis. Does not invade pelvic organs; close to peritoneum.

Images from PACS, BIDMC, courtesy M. Smith
Our Patient: SK at MRI

Axial T1 Post-gadolinium

Heterogenous enhancement of mass
Clinical T3N2

Images from PACS, BIDMC, courtesy M. Smith
Our Patient: SK at CT

8mm ground glass pulmonary nodule

Pulmonary nodule was not FDG-avid on PET-CT. Possible metastasis, since it may be too small to take up FDG

Images from PACS, BIDMC, courtesy A. Sekhar
Our Patient SK: Clinical Summary

- Tumor infiltrates perirectal fat on MRI
- >3 bulky lymphadenopathy, suspicious for tumor involvement
- Possible metastatic pulmonary nodule on CT
- T3N2Mx, Stage III C

Treatment:
- Neoadjuvant chemoradiotherapy
- Surgical excision
- Close follow-up for pulmonary nodules
Let’s take a look at how CT definitively evaluates for distant metastatic lesions.
Companion patient #3: Distant Metastasis on CT

37yo man p/w rectal bleeding and 7-lb weight loss
Colonoscopy: Large mass, biopsied, pathology: adenocarcinoma

T3N2M1
Stage 4
Multiple round, hypoattenuated lesions, hypovascular compared to surrounding hepatic tissue with dual vascular supply.

Largest lesion
3.1cm x 3.3cm

Image from PACS, BIDMC, courtesy M. Smith
Finally, let’s discuss some limitations of imaging.
Room for improvement

- Overestimation of clinical stage:
  - German Rectal Study: 18% of cT3/T4 or N1 disease had T1N0 or T2N0 on pathology
  - Possible over-treatment with chemorads

- Recent study\(^1\) shows underestimated clinical stage:
  - 188 pts with cT3N0 (Stage II), 22% had undetected perirectal LN involvement on pathology (Stage III)
  - These patients may have benefited from chemoradiation treatment

- Reliance on imaging for staging only as good as imaging itself – there is room for improvement.

- New innovations in MRI technology in the pipeline (like iron oxide nanoparticles) to image lymph nodes and tumor extension with greater sensitivity and specificity.

Summary

- Imaging of rectal adenocarcinoma determines staging, which is important for treatment and prognosis of these patients.

- Complementary information can be obtained from endorectal ultrasound, MRI, and CT to stage the patient completely.

- Up to 40% of patients are clinically staged with earlier or more advanced stage than stage shown on pathology after excision – imaging may be able to perform better in the future.
References

Acknowledgments

- Dr. Katie Krajewski
- Dr. Robert Kale
- Dr. Andrew Schell
- Dr. Aarti Sekhar
- Dr. Marty Smith
- Dr. Gillian Lieberman
- Maria Levantakis