Malignant Rectal Dx

WHY MR IMAGING?

- Rectal adenocarcinomas are diagnosed by endoscopy and biopsy
  - diagnosis known at the time of MRI
- MRI allows accurate staging of anorectal cancer
  - staging determines appropriate treatment plan
    - surgical approach
    - neo-adjuvant chemo-radiation
  - staging correlates well with 5-year survival

References:

Malignant Rectal Dx

BACKGROUND

- Adenocarcinomas comprise most (98%) of anorectal malignancies
  - 45,000 new cases/year in the USA
  - 17,000 deaths/year
- Squamous cell carcinomas arise at the anorectal transition area & are considered anal CA
- Other rare cancers may involve the anorectum
  - lymphoma (1.3%), GIST (0.3%)
  - carcinoid (0.1%), melanoma (0.1%), ...

American Cancer Society: Cancer facts and figures 2007. Atlanta, GA

Learning Objectives

THE MENU [45 min]

- Background
- Rectal Anatomy
- TNM Classification
- MRI Techniques
- Rectal CA
- Other Malignant Dx
  - Anal CA
  - GIST, Lymphoma
  - Melanoma, Carcinoid

Malignant Rectal Dx

WHY MR IMAGING?

- Endorectal US is alternative imaging tool
  - tumor staging excellent (69%-97%), low stage
  - operator dependent, interobserver variability
  - limited depth of penetration
  - can not reach upper rectal tumor
  - poor sensitivity for detecting and characterizing lymph nodes
The Rectum

ANATOMY

Rectum = 12 cm length
- Upper 1/3 (11-15 cm)
  - Peritoneum lateral & anterior
- Middle 1/3 (7-11 cm)
  - Peritoneum anterior
- Lower 1/3 (2-7 cm)
  - No peritoneum

Rectal ampulla (middle and lower 1/3)
Valves of Houston (Kohlrusch’s valve)

The Rectum

ANATOMY

Blood supply
- Superior
  - Inferior mesenteric artery
- Middle
  - Internal iliac artery
- Inferior
  - Internal pudendal artery

Rectal Carcinoma

STAGING

TNM classification
- Tis: intraepithelial, lp
- T1: submucosa
- T2: muscularis propria
- T3: mesorectal fat
- T4a: visceral peritoneum
  - b: adjacent organs

Stage
- Tis
- T1-T2
- T3-T4
- Any T

N0: no nodal involvement
- N1: 1 (a) or 2-3 (b) regional nodes or (c) tumor deposit(s)
- N2: ≥ 4 regional nodes
  - N2a = 4-6 nodes
  - N2b > 7 nodes

M0

*regional LNN = perirectal, internal iliac, inferior mesenteric, superior and inferior hemorrhoidal
Rectal Carcinoma

TNM STAGING OR CRM?

- CRM = circumferential resection margin
- CRM = pathological term that refers to the surgically dissected surface of the specimen and corresponds to the non-peritonealized aspect of the rectum
  - only applicable for rectal ca below peritoneal reflection
  - term MRF (mesorectal fascia) more appropriate
  - pushing border of the tumor (not spiculations)
  - crucial distance
    - 5 mm or more on MRI: 2 mm CRM (Regina Beets-Tan)
    - 1 mm or more on MRI: negative CRM (Gina Brown)

- EMD = extramural depth of invasion
  - EMD = measured for definite tumor border (not spiculations)
  - applies to all T3 and T4 tumors, high to low!!
  - different recurrence rates and survival for early (<5 mm) versus bulky (>5 mm) T3

STAGING IMPLICATIONS

- Transanal excision
  - Tis, T1
- Total Mesorectal Excision
  - LAR: T2/T3 not involving sphincters or levator ani
  - APR: T2/T3 involving sphincters or levator ani
- Pelvic exenteration
- Laparoscopic resection
  - upper and middle cancers, females

Operative Choices


- Total Mesorectal Excision (TME)
  - LAR: T2/T3 not involving sphincters or levator ani
  - APR: T2/T3 involving sphincters or levator ani

Operative Choices


Early T3 Bulky
Rectal Carcinoma
STAGING IMPLICATIONS

Neoadjuvant Therapy

- United States: Preoperative chemo-XRT
  - T3/T4 or N disease (Stage II and III)
  - (45-55 Gy) 6 weeks
downstaging, decrease recurrence, sphincter sparing surgery (no survival benefit!)

- Northern Europe:
  - Preoperative RT
  - Short course (5 doses of 5 Gy)
  - No routine chemo preop unless close (1-2mm) or involved CRM

Neo-Adjuvant Therapy

Radiation is toxic and causes impaired bowel and sexual function. Overstaging is bad too!


Rectal Carcinoma
MRI TECHNIQUES

Endorectal Coil MRI

- Axial & sagittal & oblique axial and oblique coronal T2-weighted FSE/TSE
- TR/TE: 4500/102 msec; ETL:16; FOV:14cm; M:384x224
  - 3 mm slice thickness/skip 1 mm
  - Axial T1-weighted SE ??
  - TR/TE: 600/17msec; FOV: 14cm; M:256x192
  - Fat-suppressed SPGR w/wo IV 0.1mmol/kg gadolinium-DTPA ??
  - TR/TE: 260/4.2 msec; flip α:75; FOV: 14cm; M:256x128
  - FS-fast SPGR post gad (body coil)

---

MRI TECHNIQUES

Endorectal Coil MRI

- Axial & sagittal & oblique axial and oblique coronal T2-weighted FSE/TSE
- TR/TE: 4500/102 msec; ETL:16; FOV:14cm; M:384x224
  - 3 mm slice thickness/skip 1 mm
  - Axial T1-weighted SE ??
  - TR/TE: 600/17msec; FOV: 14cm; M:256x192
  - Fat-suppressed SPGR w/wo IV 0.1mmol/kg gadolinium-DTPA ??
  - TR/TE: 260/4.2 msec; flip α:75; FOV: 14cm; M:256x128
  - FS-fast SPGR post gad (body coil)

---

MRI TECHNIQUES

Endorectal Coil MRI

- Axial & sagittal & oblique axial and oblique coronal T2-weighted FSE/TSE
- TR/TE: 4500/102 msec; ETL:16; FOV:14cm; M:384x224
  - 3 mm slice thickness/skip 1 mm
  - Axial T1-weighted SE ??
  - TR/TE: 600/17msec; FOV: 14cm; M:256x192
  - Fat-suppressed SPGR w/wo IV 0.1mmol/kg gadolinium-DTPA ??
  - TR/TE: 260/4.2 msec; flip α:75; FOV: 14cm; M:256x128
  - FS-fast SPGR post gad (body coil)
Rectal Carcinoma
MRI TECHNIQUES

**Pelvic Phased-array Coil MRI**
- axial & sagittal & oblique axial & oblique coronal T2-weighted TSE/FSE
  - TR/TE: 4000/85 msec; FOV: 24 cm; M: 512x512
  - 3 mm slice thickness/skip 0; acq time 3-4 minutes
- axial T1-weighted 3D-GRE DIXON ??
  - TR/TE: 5.64/2.45 msec; FOV: 25 cm; M:320; acq 1.5 min
- 3 plane fat-suppressed 3D-GR w/wo IV
- 0.1mmol/kg gadolinium-DTPA (dynamic axial)
  - TR/TE: 4.98/1.72 msec; FOV: 25 cm; M:320; acq 20 sec
- axial DWI (0-500-1000)

**Endorectal MRI**
DO THEY MISS IT?

"E-coil going away party"
Rectal Carcinoma

MRI FEATURES

Low Rectal CA
- located within 5 cm of the anal verge
- increased risk of perforation and recurrence
- differentiated based on relation to top PR muscle
  - superior to PR: identical as middle & high CA
  - inferior or at PR: report relationship and involvement of internal sphincter (T2), interspinsteric space (advanced T2), external sphincter (T3), involvement of other organs (T4)


Rectal Carcinoma

MRI FEATURES

Atypical Features
- mucinous adenoca
- villous adenoma/adenoca
- fistulizing adenoca

Vliegen RF, et al. Rectal ca: MRI in local staging - is gadolinium-enhanced CT helpful? Radiology 2006;234:179-188

Mucinous probable T4 tumor

Villous adenoma

Fistulizing T4 tumor

Rectal Carcinoma

MRI FEATURES

Nodal Disease
- strong independent predictor of survival and local recurrence
- pathways of nodal spread
  - mesorectal lymph nodes
  - superior rectal vessels
- MRI nodal visualization
  - identifies nodes > 2-3 mm
  - 65% of mesorectal nodes
  - only 2% malignant

Rectal Carcinoma

MRI FEATURES

Nodal Disease
- Nodal spread in rectal cancer is UPWARD from tumor!!
- Limited extend laterally and downward!!
  - if upward routes are blocked by cancer
  - DWI detects nodes, doesn't characterize them!!

Rectal Carcinoma

MRI FEATURES

Nodal Disease
- Size criteria
  - limited success (mean 3.8 mm; 53% < 5 mm)
  - size criterion of 5 mm short axis: sens 66%, spec 76%
  - benign nodal hyperplasia is common
- Morphological criteria
  - may be more accurate than size
  - irregular nodal outline
  - signal heterogeneity (T2-WI)
  - sens 85%, spec 97%

Rectal Carcinoma
MRI STAGING - EFFICACY

Meta-Analysis (2000-2010)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SENSITIVITY</th>
<th>SPECIFICITY</th>
<th>DOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRM involvement</td>
<td>77 (95%CI 57-90)</td>
<td>94 (95%CI 88-97)</td>
<td>56 (95%CI 15-205)</td>
</tr>
<tr>
<td>T-category</td>
<td>87 (95%CI 81-92)</td>
<td>75 (95%CI 68-80)</td>
<td>20 (95%CI 11-37)</td>
</tr>
<tr>
<td>Lymph node mets</td>
<td>77 (95%CI 69-84)</td>
<td>71 (95%CI 59-81)</td>
<td>8 (95%CI 5-15)</td>
</tr>
</tbody>
</table>

**Rectal Carcinoma**

**MRI FEATURES**

- **Extramural Vascular Invasion (EMVI)**
  - invasion of large vessels deep to muscularis propria
  - independent, negative prognostic factor of survival
  - MRI 62% sensitivity and 88% specificity
  - fair to moderate interobserver agreement (MERCURY) [kappa=0.41, 95% CI 0.31-0.49]

- **Anterior Peritoneal Reflection**
  - axial ("Seagull Sign") and sagittal images
    - above the tip of the seminal vesicles (approx 9 cm)
    - more variable insertion in women – no mesorectal fat!!

---

**WHAT TO COMMUNICATE?**

1. T3N2Mx rectal adenocarcinoma.
2. The inferior edge of the cancer is 4 cm from the top of the internal sphincter.
3. Circumferential margin (CRM) of 6.3 mm.
4. EMVI, EMD, anterior peritoneal reflection.

---

**Other Malignant Dx**

**ANAL CARCINOMA**

- Squamous cell carcinoma
- 4,650 new cases/year; 690 deaths/year
- lymphatic drainage also to inguinal & femoral nodes
- most caused by HPV infection (88%)
- cigarette smoking, immunosupression, HIV
- tumor **size** most important prognostic factor (TNM)
- Tx: radiation therapy (70-90% cure rate)

*American Cancer Society: Cancer facts and figures 2007. Atlanta, GA*

TNM classification
- T1: < 2 cm
- T2: 2-5 cm
- T3: > 5 cm
- T4: adjacent organs

T1 Anal CA

T2 Anal CA

T3 Anal CA
TNM classification
- N1: perirectal
- N2: unilateral iliac or inguinal
- N3: bilateral iliac or inguinal OR perirectal and inguinal
**Other Malignant Dx**

**LYMPHOMA**

- > secondary, primary uncommon
- non-Hodgkin, increasing due to HIV/AIDS
- occurs in both sexes, in adults
- > B-cell lymphomas
- longstanding inflammation
- immunosuppression
- 5-y survival 50% (surgery)


**Other Malignant Dx**

**GIST**

- most common mesenchymal tumor in the GI tract
- interstitial cells of Cajal of the myenteric plexus
- 95% express cell surface receptor KIT (CD 117)
- targets for KIT-inhibitor therapy


**Other Malignant Dx**

**GIST**

- 4000-5000/year in the US
- slight male predominance
- high rate of metastasis after local excision
  - Liver
  - Peritoneum
- conventional chemotherapy and radiation are completely ineffective
- Imatimib (Gleevec): competitively inhibits tyrosine kinases including KIT


**Other Malignant Dx**

**GIST**

- MR Imaging
  - homogeneous
  - mural mass
  - wall thickening
  - minor obstruction
  - fistula formation
  - adenopathy


**Other Malignant Dx**

**GIST**

- MR Imaging
  - large
  - well-marginated
  - expands the rectal wall
  - smooth, broad border
  - hemorrhage or necrosis
  - no perirectal adenopathy
  - exophytic component
  - cavitation
  - hypervascular

*Levy AI, et al. Anorectal GIST: CT and MRI imaging features with clinical and pathologic correlation. AJR 2003;180:1607-1612*
Malignant GIST

- rare slow growing malignancy
- rectum 3rd most common location in GI tract
- arises from subepithelial neuroendocrine cells
- peak incidence: 6th decade
- no sexual preponderance
- rarely produces carcinoid syndrome
- > 2cm: metastases in 82% (LN)
- Octreotide scan (somatostatin analogue)

Other Malignant Dx
CARCINOID

- solitary
- smooth
- round
- broad base
- protrusion

MR Imaging

MELANOMA

- anus 3rd most common source (skin & eyes)
  - 0.4%-1.6% of all melanomas
  - 1% of all anal canal tumors
- rectal melanomas exceedingly rare
- elderly pts with rectal bleeding and tenesmus
- Dx immunochemistry (HMB-45)
  - pigmentation (81-90%)
  - 5 year survival: 5%


Other Malignant Dx

- polypoid or fungating mass
- intraluminal protrusion
- focal expansion
- no obstruction
- high SI T1-WI (melanotic)

- Rectal cancer
  - staging
  - determination of therapy
  - accuracy nodal disease?
  - technique?
- Other cancers
  - absence of obstruction
  - different staging & Tx
  - specific MRI features

Conclusions
ANORECTAL MRI