MRI in the Staging of Rectal Cancer

Kartik S Jhaveri, MD
Abdominal Imaging
Assistant Professor, Faculty of Medicine
kartik.jhaveri@uhn.on.ca
Objectives

• Why MRI?
• Normal MR Anatomy
• Preoperative Staging
  T
  N
  M
• Post Treatment and Recurrence Evaluation
• Conclusion
Endorectal US (ERUS) has high accuracy

So Why MRI…….?
Limitations of ERUS:

- Small or Very large tumors
- Very High or Very Low Mass
- Stenotic Cancer
- Mesorectal Fascia
- LN detection < MRI

MRI is also performed sans ER device
ERUS VS MRI

<table>
<thead>
<tr>
<th>Stagge (S)</th>
<th>T1 VS T2</th>
<th>ERUS</th>
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</thead>
<tbody>
<tr>
<td>T2 VS T3</td>
<td>MRI &gt; ERUS</td>
<td></td>
</tr>
<tr>
<td>T3 VS T4</td>
<td>MRI &gt; ERUS</td>
<td></td>
</tr>
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<td>N</td>
<td>MRI &gt; ERUS</td>
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<td>M</td>
<td>CT/PET-CT</td>
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Medical Imaging • University Health Network • Mount Sinai Hospital • Women's College Hospital • University of Toronto
What About CT?
CT VS MRI

- CT = Inferior Contrast Resolution
NORMAL MRI ANATOMY

T2 Axial

Inner High Signal - Mucosa/Submucosa
Middle Low Signal – Muscularis Propria
Outer High Signal – Mesorectal Fat
T2 CORONAL

- MR- Coronal
  - The levator ani muscle (yellow arrows) and puborectalis muscle (arrow heads)
  - External sphincter (green arrows) & Internal sphincter (asterisk)
T2 SAGITTAL

- MR-Sagittal
  - Tumor localization (from anal verge)
  - Adjacent organs: prostate (arrow heads), seminal vesicles (yellow asterisks), bladder (B), uterus (white asterisks), vagina (arrows)
MESORECTAL FASCIA
ROLE OF HIGH RESOLUTION MRI

• Pre-operative road map of tumor

  T stage (2, 3 OR 4)  
  CRM (Circumferential resection margin)  
  Distance from anal verge/sphincter

• Define Prognostic groups

  Deciding Preoperative therapy  
  Local Recurrence Risk
Management

- T1  • Transanal Excision
- T2  • TME
- T3  • Preop Chemorad + TME
- T4  • Preop Chemorad + Exenteration

vs

TME + Postop Chemorad
MRI Accuracy

- T Staging: 71-91%
- N Staging: 43-85%
- CRM: 95%

Highest Accuracy and Consistency

Beets-Tan RG et al. Lancet 2001
Brown G et al. BJS 2003 & RSNA 2004
T Stage

- **T1 s carcinoma in situ**
- **T1 invades sub-mucosa**
- **T2 invasion of circular/longitudinal layers**
- **T3 invasion through muscularis**
- **T4 direct invasion of other organs or visceral peritoneum**
T3
T3

- Circumferential Resection Margin = CRM
CRM and MRI

- MRI: >6mm from CRM
- Pathology >2mm Negative Margin
Good and Bad T3

CRM > 6 mm

CRM = 0 mm
Pre sacral infiltration
MRI PITFALLS IN T STAGE

• T1 VS T2

• T3 –DESMOPLASTIC REACTION-OVERSTAGING

• CRM -Thin Patients
  - Anterior wall tumor
  - Lower rectal tumor
T1 OR T2
T3
OVERSTAGING
Desmoplastic Reaction

RadioGraphics 2006; 26:701–714
CRM

LOW AND ANTERIOR TUMOR
N STAGE

N0: No regional lymph node metastasis

N1: Metastases in 1 to 3 nearby lymph nodes

N2: Metastases in 4 or more nearby lymph nodes

N3: Distant LN
Rectum: External & Common iliac and abdominal
Criteria of nodal metastasis

Size: >8mm and round
>10mm in short axis and oval

Border: Spiculated or indistinct

Signal intensity

Enhancement pattern

Moderate accuracy, sensitivity and specificity !!!
N STAGE
Nanoparticle Enhanced MR – Nodal staging

USPIO

*NEJM*. Harisinghani et al. 348 (25): 2491
USPIO

BENIGN

MALIGNANT

Courtesy. Dr Harisinghani, MGH
USPIO-enhanced MR Imaging for Nodal Staging in Patients with Primary Rectal Cancer.
Max J. Lahaye et al *Radiology: 246: Number 3, March 2008*

Short axis <10mm
Sensitivity 93%
Specificity 96%
N-stage: PET/CT

Accuracy upto 80%

Advantage of PET: Identification of sub-centimeter, metastatic nodes.

Disadvantage of PET: cannot detect small volume disease within nodes (microscopic metastases).
Response Assessment To ChemoRads

- MRI
- Diffusion Weighted MRI (DWI)
MRI
Diffusion Weighted Imaging-DWI

• DWI is a recently introduced technique that depicts differences in molecular diffusion caused by the random and microscopic motion of molecules, which is known as Brownian motion.

• Restricted Diffusion results in higher signal on DW image (EPI)-more typical of malignant tissue.

• May have role for assessing or predicting treatment response by ADC calculation.
DWI-Rectal Cancer

- Residual Viable Tumor Evaluation using Color Mapping

Initial stage: T3

Post CCRT: T0
Recurrent Tumor Evaluation

- Sagittal plane essential when assessing sacral involvement
- Recurrence often nodular in morphology
- Post treatment fibrosis often co-exists
- MRI or PET?
Recurrent tumor
Recurrent tumor
Post APR. Benign presacral mass: Bx of the mass was negative.

Malignant presacral tissue.
Accuracy in high 90% for PET-CT
Intriguing Case

RECURRENTE ?
CHRONIC SINUS TRACT OR RECURRENCE

2007

2008
Conclusion

- Endorectal US for T1 VS T2
- MRI FOR Stage T3 and Higher
- MRI for CRM-Tumor distance
- Lower Accuracy for Nodal Staging
- USPIO in future
- PET-CT for Tumor recurrence in uncertain cases