MRI in Rectal Cancer

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Colorectal Cancers are the 2nd most common cause for cancer related deaths

Local pelvic recurrence after surgical resection

Incurable disease and poor QOL
• Post Operative Recurrence
• Positive Surgical Margin
• Tumor within 1mm of cut margin-pathology
• Reduce Local Recurrence by Preop CRT

*Dutch Trial, NEJM 2001 (2% vs 8%)*
*NCIC Trial, Lancet 2009 (5% vs 12%)*
BACKGROUND

- Preoperative Identification of Margin at Risk
- Rectal MRI Identify At risk / Positive Margin
  Prognostic features (EMVI, Nodes)

Treatment Stratification:
Surgery vs Preop CRT
Bulky or Stenotic tumors

Very High or Very Low Mass

Mesorectal Fascia

LN detection – outside mesorectum

Post neoadjuvant response evaluation?

MRI is also performed without Endoluminal device insertion

ERUS VS MRI
MRI “RECTUM” PROTOCOL

- TORSO PA MULTICHANNEL COIL
- Diffusion Weighted Imaging (DWI)
- 1.5T / 3T MRI System
- T2 – SAG, COR, AX
- HI RES OBLIQUE T2
- Multiphasic Gd-Enhanced Series
- 3D T2 ?
High-Quality MRI Is A Fundamental Requirement To Obtain Accurate Anatomical Information Of The Tumoral Relationships
High-Quality MRI is a fundamental requirement to obtain accurate anatomical information of the tumoral relationships.
DWI

- Post CRT Evaluation (Adds value to T2)
- Tumor recurrence
- LN, Tumor visualization
• Rectal ?

Endoluminal Contrast

• Intravenous ?

DYNAMIC RUN

Tumor Detection
Post CRT
LN Characterization
Tumor Localization – Anal Verge
Adjacent Organs - Vagina, Prostate, SV
Anterior Peritoneal reflection
T2 AXIAL

Muscularis Propria

Submucosa
**SUGICAL IMPLICATIONS: TOTAL MESORECTAL EXCISION (TME)**

*Mesorectal Fascia = Excisional Margin in TME = Circumferential Resection Margin (CRM)*
Peritoneum attaches in a V shaped manner onto the anterior surface of upper rectum

“Seagull Sign”
Role of MRI : Rectal Cancer

- Preoperative Staging & Treatment Stratification
- Post Neoadjuvant Therapy
- Tumor Recurrence Evaluation
Preoperative Staging

- TUMOR LOCALIZATION & SPHINCTERS
- EXTRAMURAL SPREAD (T STAGE)
- CIRCUMFERENTIAL RESECTION MARGIN (CRM)
- PERITONEAL REFLECTION
- EXTRAMURAL VASCULAR INVASION (EMVI)
- LYMPH NODES-N
- METASTASIS-M (Bones)
TUMOR LOCALIZATION & SPHINCTERS

LOW 0-5cm, MID 5-10cm, UPPER 10-15cm
SPHINCTER INVASION
T Stage

T1 invades sub-mucosa

T2 invasion of circular/longitudinal layers

T3 invasion through muscularis

T4 direct invasion of visceral peritoneum (T4a) OR other organs (T4b)
Clinical Distinction - Not Relevant!
T2/T3
T3
CRM and MRI

• MRI: >5mm from CRM (Beets-Tan)

• Pathology >1-2mm Negative Margin

MERCURY TRIAL  MRI >1mm from CRM= Neg.Margin
CRM >5mm

CRM = 0 mm
CRM & Satellite Tumoral Nodule
Peritoneal Reflection
Extramural Venous Invasion (EMVI)

Discrete Serpiginous or Tubular Intermediate Signal Projections in Mesorectal fat

MRI – Sens 62%  
Spec 88%
LOWRECTALCANCER

- Adenoca in 0-5cm from anal verge
- High Positive CRM rates
- Permanent Stoma
- Anal Ca(SCC) is NOT Rectal cancer(Adenoca)
LOW (ANO)RECTAL CANCER

Relation to Anorectal Junction

- Level 1: submucosa only
- Level 2: internal sphincter
- Level 3: intersphincteric fat
- Level 4: external sphincter or beyond

Adapted from User’s guide for the synoptic MRI report for rectal cancer. Cancer Care Ontario.
LOW (ANO)RECTAL CANCER

WIDE APR
**N STAGE**

N0: No regional lymph node metastasis

N1: Metastases in 1 to 3 regional lymph nodes

N2: Metastases in 4 or more regional lymph nodes

Regional Nodes – Mesorectal, iliac, sigmoid mesenteric, inferior mesenteric, (inguinal- if low rectum/anal canal)

Nonregional Nodes – Abdomen (eg paraortic) = ‘M’ disease
Criteria of Nodal metastasis

Morphologic criteria

Size > 8mm/10mm short axis

Irregular Contour and Heterogeneous signal

Sens 77-85% and Spec 88-97%

Brown G et al. “Morphologic predictors of lymph node status in rectal cancer with use of highspatial-resolution MRI with histopathologic comparison”.

Radiology 2003; 227:371–377
Extramesorectal Nodes (Lateral Pelvic Nodes)

PREOP CRT
NO PRE/POST CRT = LATERAL PELVIC RECURRENCE
**MRI PITFALLS IN T STAGE**

- **T1 VS T2**
- **T3 –DESMOPLASTIC REACTION-OVERSTAGING**
- **CRM** - Thin Patients
  - Anterior wall tumor
  - Lower rectal tumor
- **NODES** - Normal sized nodes vs Reactive Nodes
POST CRT EVALUATION

• Direct Surgical Approach after preop neoadjuvant therapy without repeat MR?
  ~ 80% Respond (~10-20% complete)

• Major Pelvic Surgery – Hi PostOp Morbidity (40-50%)

• Why Post CRT MRI?
  - Assess Tumor Response
  - Reassess Tumor Resectability – Threat to Margin?
  - Personalize Surgery based on Response –
    “Wait & Watch” vs TME vs APR?
<table>
<thead>
<tr>
<th>Description</th>
<th>Tumor Regression Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>No viable cancer cells</td>
<td>TRG 0 (Complete response)</td>
</tr>
<tr>
<td>Single cells or small groups of cancer cells</td>
<td>TRG 1 (Near complete response)</td>
</tr>
<tr>
<td>Residual cancer outgrown by fibrosis</td>
<td>TRG 2 (Partial response)</td>
</tr>
<tr>
<td>Minimal to no tumor kill</td>
<td>TRG 3 (No response)</td>
</tr>
</tbody>
</table>

**TUMOR REGRESSION GRADING**

**AJCC Tumor Regression Grade (Pathology)**

<table>
<thead>
<tr>
<th>MRI Description</th>
<th>mrTRG</th>
</tr>
</thead>
<tbody>
<tr>
<td>No tumor signal</td>
<td>1</td>
</tr>
<tr>
<td>Predominant Fibrosis(minimal tumor)</td>
<td>2</td>
</tr>
<tr>
<td>Mixed fibrosis and tumor</td>
<td>3</td>
</tr>
<tr>
<td>Predominant Tumor</td>
<td>4</td>
</tr>
<tr>
<td>Tumor(little fibrosis)</td>
<td>5</td>
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</tbody>
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*Patel U et al. AJR:199, October 2012*
POST CRT EVALUATION : MRI

- T stage ~50% (T2WI) ; DWI (improves accuracy)
- T2 MR Volumetry - Good TRG correlation
- NPV for CRM : 98%
- Overall CRM ~77%
- mrTRG : Predictive of CRM involvement
- Nodes ~72%

Memon S et al. Colorectal Dis. 2015 Apr
POST NEOADJUVANT EVALN

mrTRG1 (NEAR COMPLETE RESPONSE)
POST NEOADJUVANT EVALN

mrTRG4/5 - NO RESPONSE / PROGRESSION
SUMMARY

MRI – LOCAL STAGING OF RECTAL CANCER

ENDORECTAL US FOR T1 VS T2 (IF REQUIRED)

HIGH QUALITY MRI CRITICAL - HI RESOBLIQUET2

MRI KEY FOR CRM EVALUATION-TRIAGE

STRUCTURED REPORTING AND MDT BOARDS