



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 year¹
- 2007 USA incidence rectal cancer: 23,840 men and 17,580 women²
- 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

www.cancer.gov

Staging

AJCC Stage Groupings

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

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Epidemiology

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

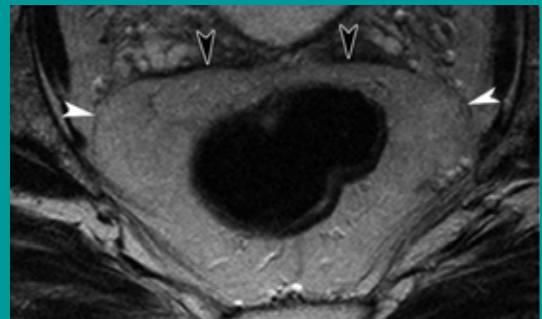
Staging

- 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

Staging

- MRI
 - Zhang et al. AJR May 2008
 - 38 pts with rectal ca underwent MRI
 - T accuracy 92%
 - 97% of resectable cases, sphincter sparing surgery accurately chosen
- Questions for the radiologist:
 - Phased array coils v. endorectal coils
 - Field Strength
- Still need bowel prep
 - Decrease artifact from air-tissue border

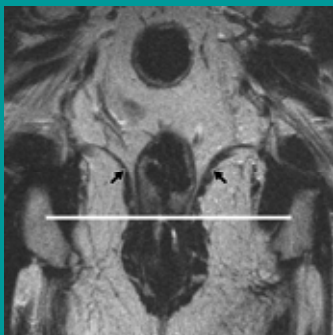
Normal anatomy of the mesorectum



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

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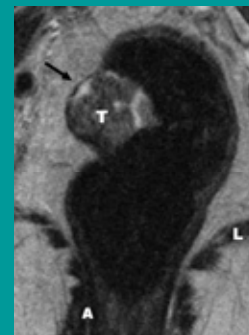
Coronal turbo spin-echo T2-weighted MR image shows the normal anatomy of the rectum



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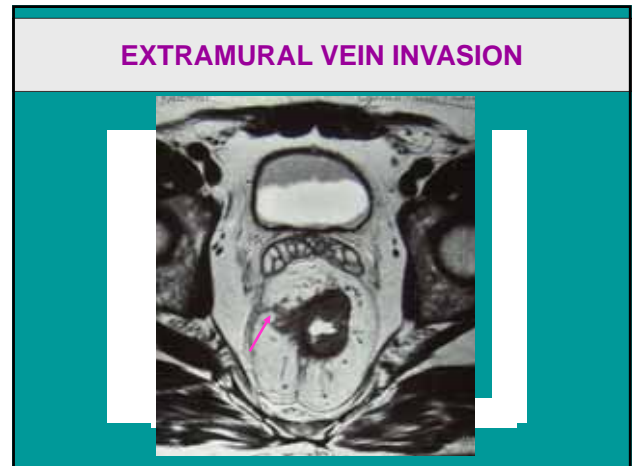
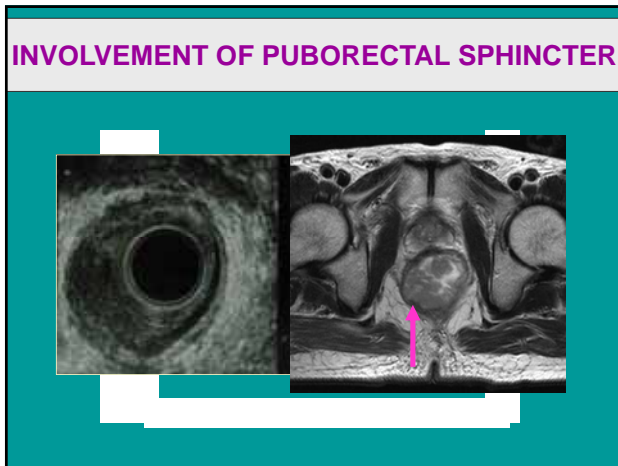
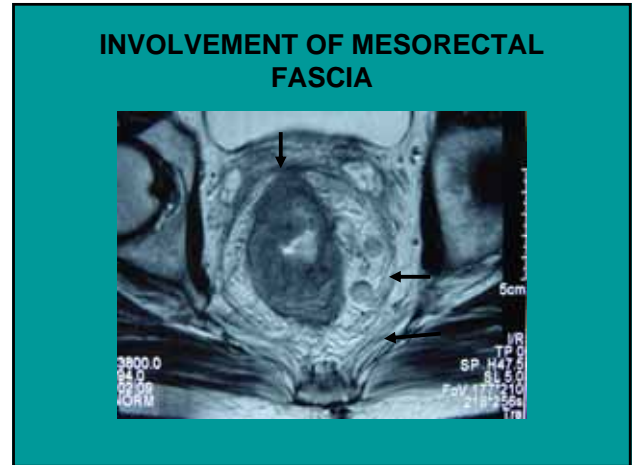
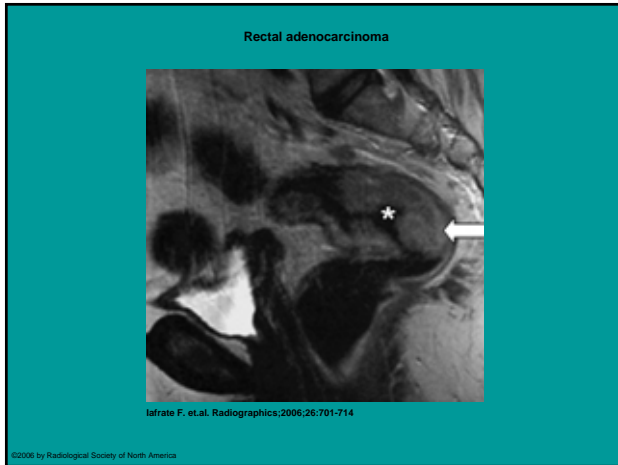
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Stage T1 rectal carcinoma



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PREOPERATIVE STAGING OF RECTAL CANCER WITH MRI

Table 3 Magnetic resonance imaging (MRI) v digital rectal examination in 245 patients assessed by both methods undergoing primary surgery or short course radiotherapy followed by immediate surgery

	Clear	Involved	Grand total
MRI prediction at circumferential resection margin:			
Clear	215	15	230
Involved	4	11	15
Grand total*	219	26	245
Digital rectal examination:			
Mobile	161	16	177
Fixed/ tethered	58	10	68
Grand total†	219	26	245

*Accuracy=226/245 (92%); sensitivity=11/26 (42%); positive predictive value (PPV)=11/19 (73%); specificity= 215/219 (98%); negative predictive value (NPV)=2/5 (53%).
 †Accuracy=171/245 (70%); sensitivity=10/26 (38%); specificity=1/61/219 (74%); PPV=10/68 (15%); NPV=1/177 (0.6%).

Diagnostic accuracy of preoperative MRI in predicting curative resection of rectal cancer Mercury study group. Br Med J 2006

Operative characteristics of endorectal MRI in staging rectal carcinoma

Table 5 Operative characteristics of endorectal MRI in staging rectal carcinoma.

Reference	Year	Number of patients	T stage (%)	N stage (%)	Overall accuracy (%)
Chan et al. ⁷⁹	1991	12	67 ^a 77 ^b	57	NR
Schnall et al. ¹¹²	1994	36	NR	NR	78
Meyenberger et al. ¹³	1995	21	40	78	NR
Kulling et al. ⁸⁰	1997	12	71.4	75	NR
Zagonia et al. ⁷⁷	1997	10	NR	NR	80
Blomqvist et al. ⁵⁴	1997	48	81 ^a 82 ^b	83 ^a 74 ^b	NR
Gualdi et al. ⁷⁸	2000	26	85	81 ^a 66 ^b	NR
Maldjian et al. ⁷⁵	2000	14	NR	NR	76.9

^aSensitivity of endorectal MRI in staging T3 tumors. ^bSpecificity of endorectal MRI in staging T3 tumors. Abbreviations: NR, not reported.

LeBlanc JK (2007) Imaging and management of rectal cancer
Nat Clin Pract Gastroenterol Hepatol 4: 665–676 doi:10.1038/npgashep0977

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

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

Reference	Year	Number of patients	Overall accuracy (%)
Hadfield <i>et al.</i> ⁵⁴	1997	38	55
Drew <i>et al.</i> ⁵⁰	1999	26	80
Blomqvist <i>et al.</i> ⁴⁹	2000	37	65
Kim <i>et al.</i> ⁶⁵	2000	217	81
Beets-Tan <i>et al.</i> ⁶⁰	2001	76	83
Gagliardi <i>et al.</i> ⁶³	2002	28	86
Mathur <i>et al.</i> ⁶⁶	2003	36	59
Matsuoka <i>et al.</i> ⁶⁷	2003	19	80
Ferri <i>et al.</i> ⁶²	2005	33	88
Bianchi <i>et al.</i> ⁶¹	2005	49	71

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

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

Reference	Year	Number of patients	Overall accuracy (%)
Hadfield <i>et al.</i> ⁶⁴	1997	38	76
Kim <i>et al.</i> ⁶⁵	2000	217	63
Blomqvist <i>et al.</i> ⁴⁹	2000	47	47
Gagliardi <i>et al.</i> ⁶³	2002	26	69
Brown <i>et al.</i> ⁵⁵	2003	60	85
Matsuoka <i>et al.</i> ⁶⁷	2003	19	89.5
Ferri <i>et al.</i> ⁶²	2005	29	59
Bianchi <i>et al.</i> ⁶¹	2005	49	76
Bianchi <i>et al.</i> ⁶⁶	2006	29	72

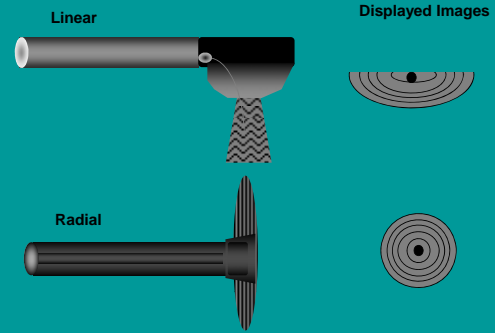
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EUS - Technique

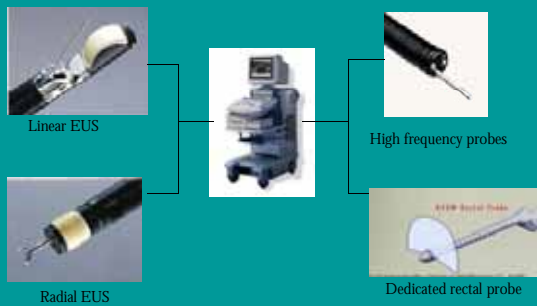
- Patient in the left lateral decubitus position
- Radial echoendoscope inserted at least to 30cm, visualize:
 - iliac adenopathy
 - wall and surrounding structures
 - Internal and external anal sphincter
- Irrigation used to enhance image



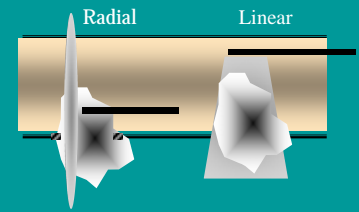
Linear and Radial Endosonoscopes



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

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

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

Reference	Year	Number of patients	Overall accuracy (%)
Jochem et al. ²²	1990	50	80
Orron et al. ²⁷	1990	77	75
Glaser et al. ²¹	1990	86	88
Tio et al. ¹²	1991	61	80
Milom et al. ²⁸	1992	67	85
Katsura et al. ²⁹	1992	112	82
Hertzog et al. ¹⁵	1992	111	89
Pechyav et al. ¹¹¹	1990	109	95
Massari et al. ²⁵	1998	75	90.7
Kim et al. ⁹	1999	89	81.1
Akasu et al. ¹⁹	2000	154	96
Marusch et al. ²⁴	2002	422	83.3
Garcia-Agular et al. ²⁰	2002	545	69
Harewood et al. ¹⁶	2002	80	91
Nesbakken et al. ²⁶	2003	81	74
Mackay et al. ²³	2003	433	89
Bali et al. ³¹	2004	33	79

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

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

Reference	Year	Number of patients	Overall accuracy (%)
Jochem et al. ²²	1990	50	72
Orron et al. ²⁷	1990	75	82
Glaser et al. ²¹	1990	73	80
Massari et al. ²⁵	1998	75	76
Kim et al. ⁹	1999	89	63.5
Akasu et al. ¹⁹	2000	154	72
Marusch et al. ²⁴	2002	111	80
Garcia-Agular et al. ²⁰	2002	545	64
Harewood et al. ¹⁶	2002	80	82
Nesbakken et al. ²⁶	2003	81	65
Mackay et al. ²³	2003	203	66
Bali et al. ³¹	2004	33	59

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EUS

Possible Downfalls:

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

Case 1

38 year old male with anemia and unexplained diarrhea.

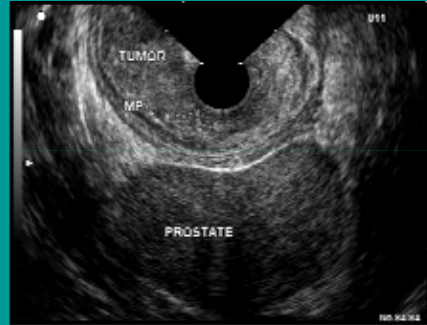
Rectal CA



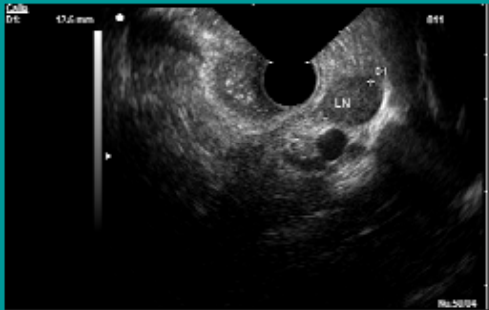
Seminal Vesicles



T3N1 Rectal CA



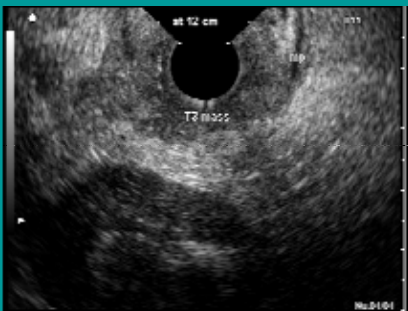
Peri-rectal Lymph Node



Case 2

58 year old male with change of bowel habits and BRBPR. Patient with colonoscopy which revealed rectal cancer.

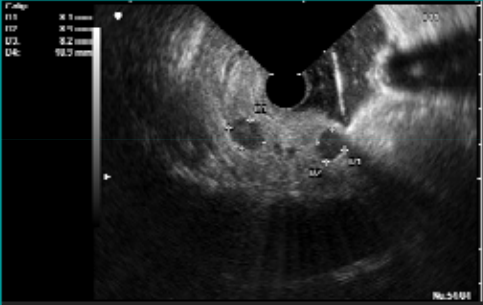
T3 Rectal Cancer



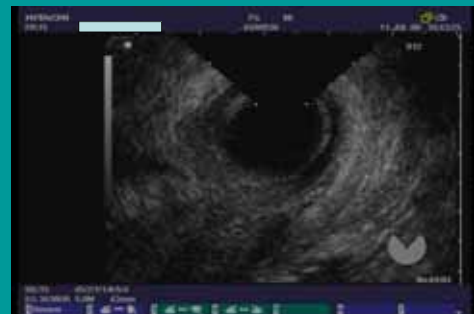
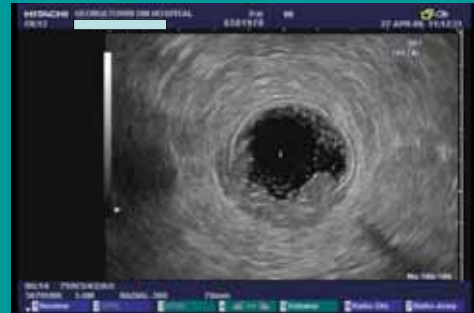
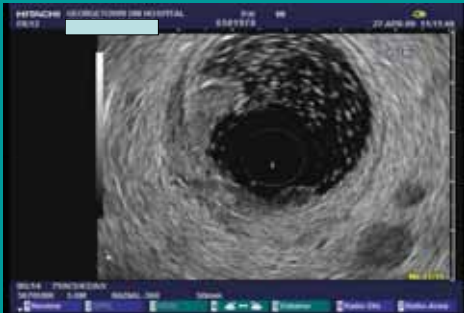
Tumor and Prostate



Peri-rectal Lymph Nodes



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 84.31%

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



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