Radiology-Pathology Correlation of Rectal Cancer with Magnetic Resonance (MR) Imaging and Whole-mount Pathologic Specimen; General Review of Rectal MR Imaging and Clinical Implications

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The major purpose of this educational exhibition is to demonstrate the educational cases with rectal MR imaging and whole-mount specimen for radiology-pathology correlation.

Introduction

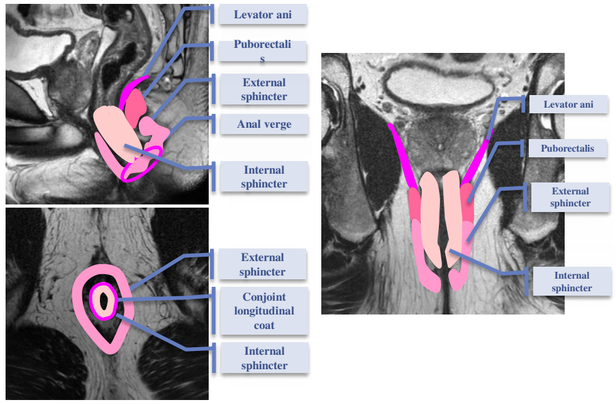
An accurate staging and description of tumor location is important for treatment planning. Early stage rectal cancer (cT1 & cT2) and some advanced rectal cancer can be cured by local excision (TME or ESD) by resection with negative margins. Positive surgical margin is closely related with local tumor recurrence and reduced disease-free survival. Advanced rectal cancer with deep cancer invasion, lower rectal cancer neighboring or involving the anal sphincter, lymph node metastasis, or distant metastasis disease should be treated by other treatment options such as preoperative chemoradiation therapy (CRT), systemic chemotherapy, or local radiation therapy. Rectal MRI plays a critical role in post-treatment evaluation for the treatment of choice by the assessment of clinical restaging, treatment response, remaining cancer burdens, and surgical extent..

Rectal MRI techniques - ESGAR Guidelines -

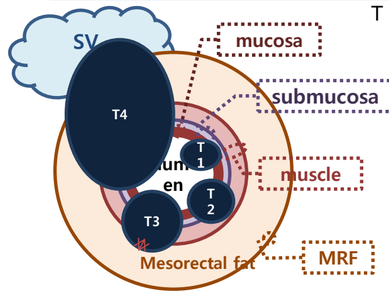
Hardware and patient preparation	
Field strength	1.5 or 3.0 T, minimum 1.0 T
Coil	Surface coil, not endorectal coil
Endorectal filling or enema	Not routinely recommended
Sequences	
Routine	2D T2WI
DWI	Not obligatory for the initial staging
Others	3D T2WI, fat suppression, contrast enhancement, and steady state sequences are not recommended.
Planes	Sagittal & axial – mandatory Axial & coronal – perpendicular and parallel to cancer axis
Slice thickness	1~3mm, maximum 4mm

Most institutions are following these guidelines with their own imaging protocols by using various kinds of MR machines, and sometimes adding the advanced sequences such as DWI and DCE MRI.

Anatomy
- Anal verge and anal sphincter-

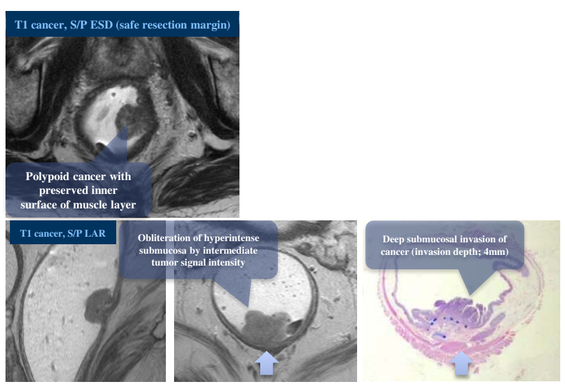


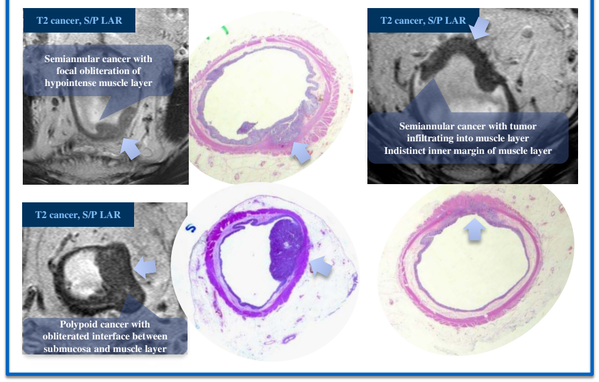
TNM staging of rectal cancer
- T staging -



T staging
- T1; mucosa & submucosa
- T2; muscularis propria
- T3; mesorectum
  - T3a; <1mm
  - T3b; 1~5mm
  - T3c; >5~15mm
  - T3d; >15mm
- T4a; visceral peritoneum (cf. MRF)
- T4b; adherent to other organs or structures

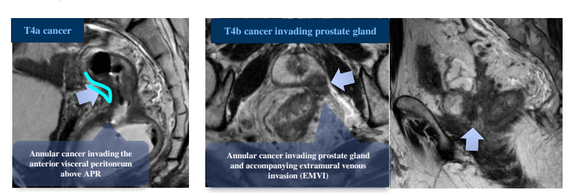
Differentiation of T1 and T2 cancer is not reliable by using MRI. Endorectal ultrasound (US) is still recommended in the evaluation of early rectal cancer. However, high-resolution MRI can be used in differentiation of T1 and T2 cancer by assessing the preservation of interface between hyperintense submucosal layer and hypointense muscularis propria. When this interface is obliterated by intermediate tumor signal intensity, it can be deep submucosal invasion (T1 SM3) or superficial muscle invasion (T2) which require the surgical intervention. Endoscopic resection (ESD) is not the treatment of choice in these cases.





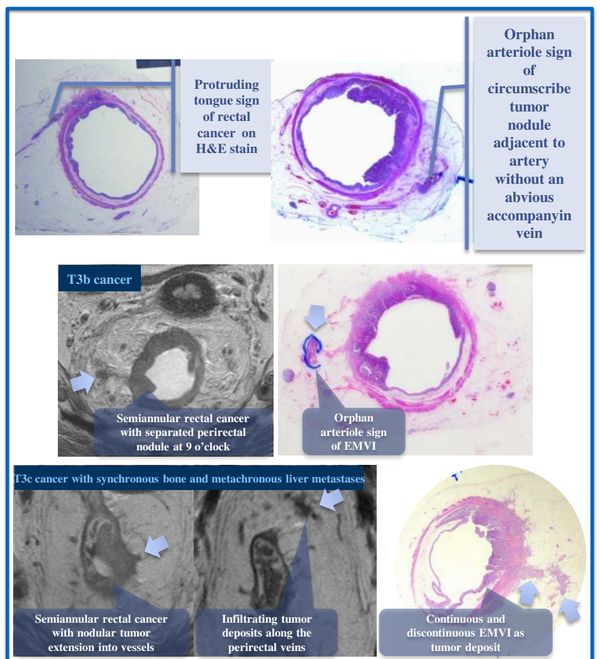
T3 cancer is classified into T3a~T3d according to the depth of tumor invasion outside the muscularis propria. The depth of invasion is closely related with survival rate independent of nodal staging. The depth of invasion outside the muscularis propria more than 5mm shows poor prognosis. Therefore, the depth of tumor invasion should be measured from the imaginary muscle outer coat.

Advanced cancer invading CRM, adjacent organs, or visceral peritoneum requires neoadjuvant CRT and reassessment of the treatment response and staging. High-resolution MR has a high negative predictive value for the prediction of tumor invasion into the adjacent structures such as prostate, seminal vesicle, uterus, urinary bladder, or sacrum.



Extramural venous invasion (EMVI)

EMVI is histopathologically defined as the extension of rectal tumor into the veins beyond the muscularis propria. EMVI is frequently demonstrated in rectal MRI. However, it is notoriously under-reported in pathologic examination. It should be detected in at least 25% of resections for rectal cancer according to Royal college of Pathologist in UK. It is an important clinical predictor of visceral metastasis, relapse, and reduced survival in rectal cancer. In stage II tumors, positive EMVI in preoperative MRI may prompt oncologists to offer adjuvant chemotherapy. Neoadjuvant therapy in positive EMVI can improve disease free survival.



On T2WI, EMVI is suggested when vessels close to the tumor are obviously irregular or expanded by tumor signal intensity. EMVI would be continued from primary tumor or separated far from primary tumor (continuous vs. discontinuous EMVI). Therefore, the presence of EMVI should be assessed regardless of T or N staging.