# DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING IN PREOPERATIVE EVALUATION OF DEPTH OF TUMOR INVASION (T STAGING) AND MESORECTAL FASCIA INVOLVEMENT IN CARCINOMA RECTUM

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## ABSTRACT

**Objective:** To determine the accuracy of MRI in pre-operative assessment of T staging and mesorectal fascia involvement in carcinoma rectum.

**Methodology:** A cross sectional study was conducted in Radiology Department of Khyber Teaching Hospital, Peshawar. Fifty two patients were included in the study from January 2016 to January 2018. MRI scan was performed on 1.5 Tesla scanner and staging was done by experienced Radiologist. MRI findings were compared with histo-pathological and surgical results.

**Results:** The overall accuracy, sensitivity, specificity, positive predictive value and negative predictive value of MR based T staging were 87.2%, 80.77%, 93.10%, 91.30% and 84.38% respectively. Accuracy, sensitivity, specificity, positive predictive value and negative predictive value of MRI based assessment of mesorectal fascia involvement were 88.89%, 75%, 92.86%, 75% and 92.86% respectively.

**Conclusion:** The diagnostic accuracy of preoperative MRI of rectum was found to be high in tumor staging and mesorectal fascia involvement.

**Key Words:** Magnetic resonance imaging, Tumor staging, Carcinoma rectum

## INTRODUCTION

Carcinoma occurring in the distal 15cm of the intestinal tract, distance measured from the anal verge is termed as rectal carcinoma[1]. Colorectal carcinoma is the third most common cancer in the United States. Of the new cases per year, 40,000 are rectal carcinoma[2]. Out of all rectal neoplasms 95-97% of are adenocarcinoma rectum[3]. The management plan for non-metastatic rectal cancer depends on clinical staging which is primarily determined on the basis of radiological imaging[4]. According to American Joint Committee on Cancer (AJCC) staging and TNM definition, T-staging is related to depth of invasion of tumor. T1 is considered tumor invasion in sub mucosa, T2 is invasion into the muscularis propria but do not reach the sub serosa. T3 cancer invades beyond the muscularis propria into the perirectal tissue. T4 cancer invades through the visceral covering (T4a), or directly invades or is adherent to other organ or structure (T4b)[5].

MRI is considered a standard imaging modality for pre-operative local staging of carcinoma of rectum due to excellent soft tissue contrast, relatively large field of view and multiplanar capabilities[6]. Sub mucosa is hyper intense and muscularis propria and mesorectal fascia are hypo intense on T2W images. This is particularly useful for evaluation of tumor depth[7]. Tumor is recognized by intermediate signal intensity between the high signal intensity of fat tissue and low signal intensity of muscularis layer[8]. Reliable distinction between T1 and T2 is difficult on MRI[9]. Some previous guidelines for structured reporting of rectal carcinoma has combined T1 and T2 as T1+T2[10].

Mesorectal fascia is low signal intensity structure on MRI that surrounds rectum and perirectal fat. It forms boundary of surgical excision plane during total mesorectal excision, since its involvement is a risk factor for post-surgical tumor recurrence and metastasis[11]. Tumor to mesorectal fascia distance is called Circumferential Resection Margin (CRM). Presence of tumor within 1mm of mesorectal fascia is considered as positive margin[12].

Prognosis of carcinoma rectum is dependent on the stage at the time of diagnosis and the treatment plan. It

is therefore vital to accurately stage these tumors pre-operatively. MRI is essential in staging, surgical planning and in identifying patients who may benefit from pre-operative chemo-radiotherapy. The aim of this study was to identify the diagnostic accuracy of MRI in pre-operative assessment of depth of tumor invasion (T staging), mesorectal fascia involvement in carcinoma rectum taking surgical findings and histopathology as gold standard.

## METHODOLOGY

This cross sectional study was performed between January 2016 to January 2018 in Radiology Department of Khyber Teaching Hospital Peshawar. Informed consent was taken after complete explanation of the nature of study. The study included 52 patients. All patients were staged pre operatively with MRI by consultant Radiologist according to TNM classification system[10]. Since differentiation between T1 and T2 is difficult on MRI we combined both as T1+T2 (intra mural lesion). Less than 1mm distance of tumor from mesorectal fascia was considered CRM positive. After total mesorectal excision the extent of local tumor was histopathologically assessed according to TNM staging. Patients with pre-operative course of radiotherapy and patients with metastatic disease were excluded from the study.

All scans were performed on Philips 1.5 Tesla MRI modal 2006. Rectal cleansing was performed by asking to use two laxative rectal suppositories two hours before MRI examination. Patient was placed in supine position on MRI table. Axial, coronal and sagittal T2W-FSE images with fat suppression were obtained with respect to the long axis of the rectum (Table 1). Statistical analysis were performed using SPSS software version 16, (SPSS Inc. Chicago, IL).

## RESULTS

Our study included 52 patients, 17 men and 12 women. The mean age was 56 years with age range of 35-75 years. Among them 19 tumors were located in the upper–middle rectum and 10 were present in the lower rectum. Histo-pathological evaluation of resected tumor revealed adenocarcinoma in all patients.

The tumor size ranged from 2.0 to 7.5 cm with mean tumor size of 5.0 cm. Histopathological staging revealed intramural tumor (T1+ T2) in 20 (38.46%) patients, T3 in 24 (46.15%) and T4 in 8 (15.38%) patients.

The diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value of MRI based T staging is shown in Table 2. MRI correctly assessed T1+T2 stage in 16 out of 20 intramural lesion giving sensitivity of 80%. T3 lesions were correctly assessed in 20 out of 24 lesions giving sensitivity of 83.33%. Six out of 8 T4 lesions were correctly assessed by MRI giving sensitivity of 75%.

### Table 1: MRI parameters(1.5 T) for staging rectal cancer (FSE T2-W imaging)

| MRI Parameters | Sagittal | Axial | Coronal | Oblique |
|---|---|---|---|---|
| TR (ms) | 3500 | 3320 | 3500 | 4000 |
| TE (ms) | 91 | 91 | 91 | 80 |
| No. of Slices | 28 | 40 | 25 | 15 |
| Bandwidth (Hz/pixel) | 391 | 391 | 391 | 391 |
| FOV (mm) | 220 | 220 | 220 | 200 |
| Slice Thickness (mm) | 3 | 4 | 4 | 3 |
| No. of Acquisition | 3 | 2 | 2 | 3 |
| Matrix | 350x320 | 350x320 | 350x320 | 250x250 |
| Acquisition Time (min) | 4 | 5.5 | 4 | 5 |
| Voxel Size (mm) | 0.7x0.7x4.0 | 0.7x0.7x4.0 | 0.7x0.7x4.0 | 0.6x0.6x3.0 |

### Table 2: Diagnostic yield of MRI in rectal carcinoma patients

| MRI Yield | Accuracy | Sensitivity | Specificity | Positive Predictive Value | Negative Predictive Value |
|---|---|---|---|---|---|
| Overall | 87.2% | 80.77% | 93.1% | 91.3% | 84.38% |
| T1+T2 | 88.46% | 80% | 93.75% | 88.89% | 88.24% |
| T3 | 88.46% | 83.33% | 92.86% | 90.91% | 86.67% |
| T4 | 87.2% | 75% | 93.1% | 91.3% | 84.38% |
| Mesorectal Fascia Involvement | 88.89% | 75% | 92.86% | 75% | 92.86% |

**Figure 1: Polypoidal soft tissue mass circumferentially involving the lower recrtum, with infiltration of perirectal fats from 3 to 9 0'clock postion and involvement of mesorectal fascia (T3). Fat planes with prostate are indistinct**
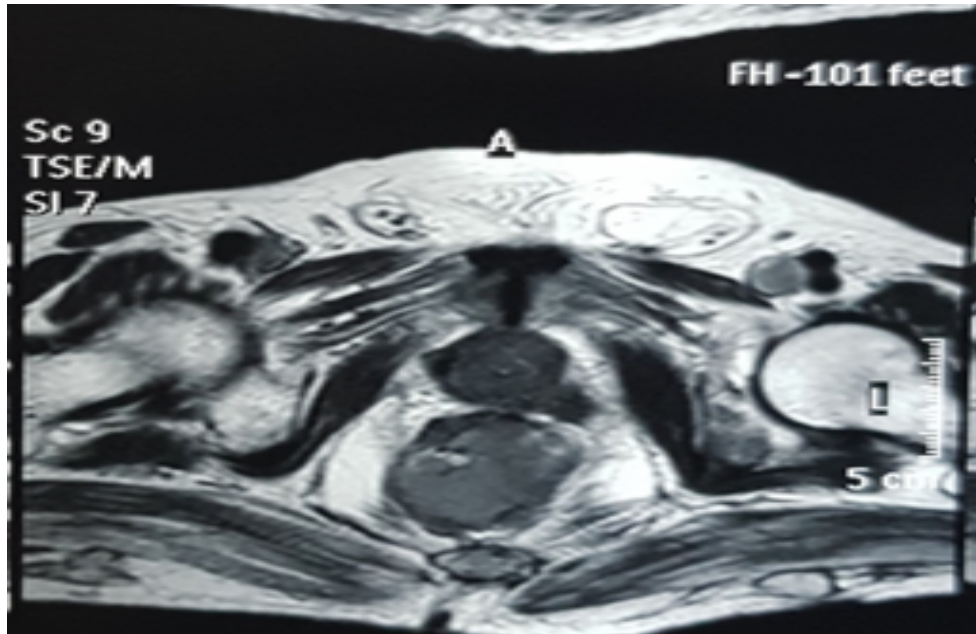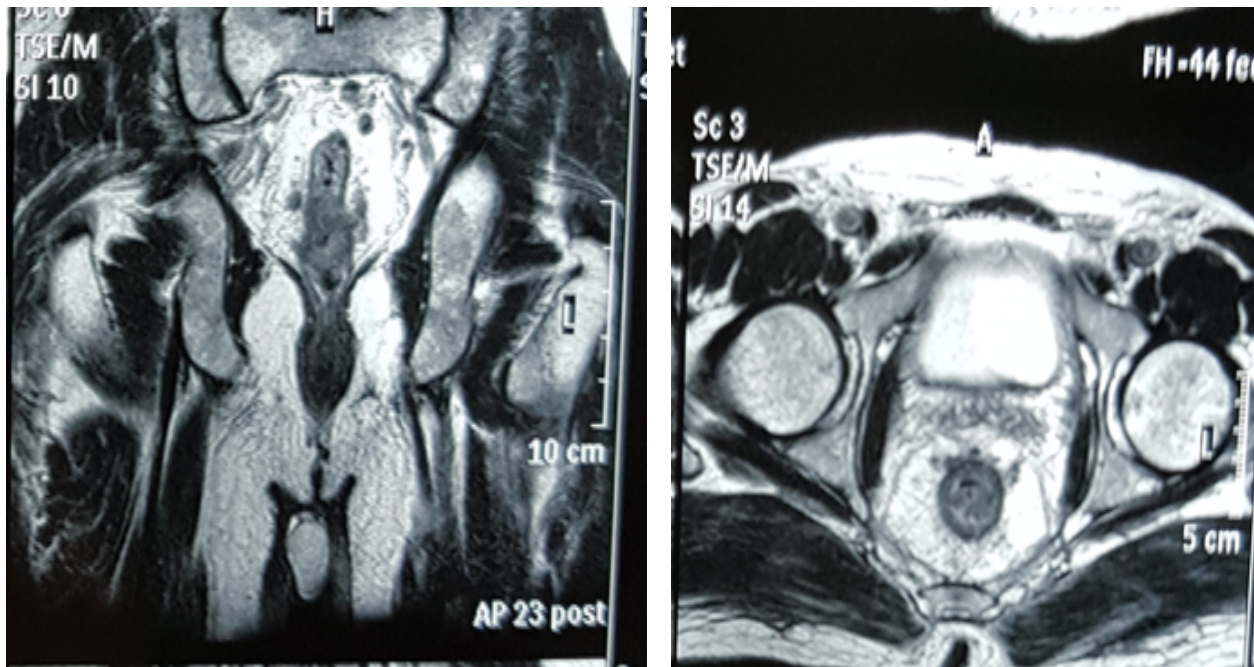


**Figure 2: Lobulated thickening of lower rectum from 3 to 9'o clock postion with perirectal fat stranding(T3) and mesorectal fascia thickening**

MRI correctly predicted tumor free margin in 39 out of 41 patients in whom mesorectal fascia was not involved. Mesorectal fascia involvement was correctly identified in 9 patients. 3 cases were not correctly recognized on MRI. 2 cases which were CRM positive on MRI was negative on histopathology. Thus giving accuracy of 88.89% and sensitivity of 75% (Table 2).

## DISCUSSION

Several imaging methods have been studied to assess the spread of carcinoma rectum such as endorectal ultrasound, CT and MRI[13]. MRI has the benefits of multiplanar imaging and provides information about depth of invasion of tumor , relation of tumor to mesorectal fascia, CRM , extra mural venous invasion and lymph node involvement which are essential points in the management of locally advanced tumor[14,15]. Pre-operative radiotherapy in combination with standardized Total Mesorectal Excision reduces the recurrence rate from 8.2% to 2.4% in a 2 year follow up particularly for T3, T4 or node positive tumor[16]. Hence pre-operative MR based staging is crucial for selecting patients for appropriate treatment.

In our study, T staging on MRI was correctly identified in 42 out 52 patients (80.76%). Mismatch between MRI findings and histopathology for T staging occurred in total 10 patients. Two T2 lesions confirmed histopathologically were over staged as T3 on MRI, while four T3 patients were under staged as T2 on MRI. Hence main difficulty in MRI staging was differentiation between T2 and T3. MRI failed to recognize minimal surrounding organ invasion in low rectal carcinoma in two cases resulting in two histopathologically staged T4 being staged as T3. The highest accuracy and specificity were for T4 stage. The overall accuracy, sensitivity, specificity, positive predictive value and negative predictive value of MRI based T staging were 87.2%, 80.77%, 93.10%, 91.30% and 84.38% respectively that was in agreement with Gheida et al[17], Algebally et al[18] and Iannicelli et al[19].

MRI correctly showed tumor free CRM in 39 out of 41 patients with no involvement of mesorectal fascia. Mesorectal fascia involvement using cut-off distance of 1mm between tumor and mesorectal fascia was correctly identified in nine patients. Two cases suspected as positive CRM based on MRI was negative on histopathology. While three cases negative on MRI were confirmed as positive on histopathology due to failure to recognize lymph nodes within 1mm of mesorectal fascia. The accuracy, sensitivity, specificity, positive predictive value and negative predictive value of CRM assessment on MRI was similar to a meta-analysis by Xie et al[20] using <1mm distance for CRM involvement showing the highest overall accuracy, demonstrating 76% pooled sensitivity and 88% pooled specificity.

## LIMITATIONS

Limitations of this study were limited number of patients due to failure of follow up. Diffusion weighted imaging (DWI) was not applied to all patients so proper analysis for lymph node involvement could not be done. Lymph node analysis was not included in the study. Also the study was limited to the pelvis and separate examination of the chest and abdomen were not done to assess pulmonary or hepatic metastasis so M staging was also not included in the study.

## CONCLUSION

High resolution MRI of rectum was accurate in predicting tumor stage pre-operatively. MRI represents an accurate diagnostic tool to avoid overtreatment in those patients who can proceed directly to surgery and to select patients who can benefit from neoadjuvant chemotherapy.

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