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Original Article

Diagnostic Accuracy of MRI for Detecting the Preoperative Tumor Staging of Colorectal Carcinoma

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ABSTRACT

Colorectal cancer is the third most common carcinoma worldwide and is second leading cause of death in the developed world. Early detection of tumor staging may lead to opting proper management plan and increase chances of survival. **Objective:** To determine diagnostic accuracy of MRI in evaluating preoperative tumor staging of colorectal carcinoma. **Methods:** The cross-sectional study was conducted at, Liaquat University Hospital - Hyderabad/Jamshoro from Jan 2022 to July 2022 on a sample of 204 patients of either gender with aged between 20 to 80 years and presenting with suspected colorectal cancer, diagnosed on the basis of clinical symptoms and physical examination. Patients were enquired about age, gender, duration of symptoms, history of per-rectal bleeding and pain. Preoperative MRI scan along with the Postoperative histopathological assessment of colorectal carcinoma staging of all patients was done. **Results:** Out of 204 patients, 60% of sample i.e. 123 patients were male and 81 (40%) were females with a median age of 68 (29-92) years. Most of the patients had well differentiated colorectal cancers i.e. 175 (85.8%) with 2/3rd sample had more than 5 cm height of primary tumor from the anal verge. T3 tumor stage was found to be highest in number (50.5%), followed by T2 (30.9%) and T4 (11.3%). The diagnostic parameters of preoperative MRI in detecting tumor staging was found to be good when correspondent to postoperative histological findings. **Conclusion:** The study showed that the accuracy of MRI in staging colorectal cancer is significantly high when compared with postoperative histopathological staging.

INTRODUCTION

Colorectal cancer is the third most common carcinoma worldwide [1]. It is the second leading cause of death in the developed world [2]. It has a slight male predilection, with slightly increased prevalence after the age of 50 years. Adenocarcinoma accounts for the vast majority (98%) of cases. Other rectal tumors are relatively rare and include carcinoid tumor (0.1%), lymphoma (1.3%), and gastrointestinal stromal tumors (<1%) [3]. Many improvements have been made over the past 20 years in surgical, oncological and radiological treatments of rectal cancer. It is still associated with delayed diagnosis and consequent bad poor prognosis (also the risk of local recurrence and metastasis). A timely diagnosis can hasten treatment and give hopes of a better prognosis. Although rectal tumors can be diagnosed with digital examination, barium enema, and colonoscopy or sigmoidoscopy, these endoluminal techniques do not provide sufficient information about the extraluminal spread of tumor which is necessary for preoperative planning. MRI can be a more promising alternative [4]. The anatomic location of the rectum, its fixation in the pelvic fat, and the lack of peristalsis make the rectum an ideal organ for imaging with MRI. However at present there is no consensus on the role of diagnostic imaging despite the fact that MRI has the potential to diagnose rectal wall laminar structure and show the details of the relationship of the tumor with the meso-rectal fascia and surrounding organs [5, 6]. Al-Sukhni *et al* recently reported a meta-analysis of 21 studies

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where MRI with phased-array coil was found to have 94% specificity (range, 88%–97%) for predicting CRM involvement [7]. A tumor volume reduction of more than 75% was significantly associated with pathologic complete response and higher disease- free survival rate [8]. Currently there is no agreement with regard to the role of gadolinium-enhanced MRI in patients with colorectal cancer [9]. However, it may improve the detection of tumors and malignant lymph nodes increase the accuracy of MRI for diagnosing T3 tumors and loco-regional extensions [10-12]. The basic purpose of our study was to correlate and describe the sensitivity and specificity of MRI findings while taking histopathological findings as gold standard in our own setting. Thin-section MRI with a phased array coil is beginning to be used for T staging of colorectal cancer, and fast assuming the role of an established modality for the preoperative imaging of colorectal cancer in the developed world, but its use in our part of the world is far from optimum. Thus the study was designed to determine diagnostic accuracy of MRI in evaluating mesorectal fascia invasion in pathologically proven cases of colorectal carcinoma.

METHODS

The cross-sectional study was conducted at Department of General Surgery, Liaquat University Hospital - Hyderabad/Jamshoro from Jan 2022 to July 2022 on a sample of 204 patients of either gender with aged between 20 to 80 years and presenting with suspected colorectal cancer, diagnosed on the basis of clinical symptoms and physical examination. Patients were chosen via Non-probability, consecutive sampling. After taking written informed consent, patients were enrolled in the study and were enquired about age, gender, duration of symptoms, history of per-rectal bleeding and pain. Preoperative MRI scan along with the Postoperative histopathological assessment of colorectal carcinoma staging of all patients was done. Non-consenting patients and patients who had taken treatment (medications, radiation or chemotherapy) prior to MRI were excluded from the sample. Patients having extensive metastatic disease on previous imaging (CT scan and MRI), patients having contra-indication for MRI examination (like having prosthesis, cardiac pacemaker etc.) and pre-diagnosed cases (on the basis of biopsy) were also excluded from the sample. Data was analyzed using Microsoft Excel 2016 and SPSS v. 21.0. Qualitative data was expressed as number and percentage (No & %). Quantitative data was expressed as mean & standard deviation (X ± SD). The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated in the following way: patients were classified as positive if both MRI and histopathology were suggestive of disease (table 1).

Tumor stage	Level of involvement
T1	Limited to mucosa and submucosa
T2	Extension into but not through muscularis propria
T3	Invasion of perirectal fat
T4	Invasion of adjacent structures

Table 1: Colorectal carcinoma t-staging: tumor staging criteria of colorectal carcinoma

RESULTS

Out of 204 patients, 60% of sample i.e. 123 patients were male and 81 (40%) were females with a median age of 68 (29-92) years. Most of the patients had well differentiated colorectal cancers i.e. 175 (85.8%) with 2/3rd sample had more than 5 cm height of primary tumor from the anal verge (Table 2).

Sample characteristics	
Median Age (Years)	68 (29-92)
Men	123 (60%)
Women	81 (40%)
Median days from MRI to primary surgery	26 (1-119)
Height of primary tumor (from anal verge)	
0-5 cm	69 (34%)
5.1-10 cm	73 (36%)
>10.1 cm	62 (30%)
Tumor differentiation	
Moderately / Well differentiated	175 (85.8%)
Poorly	39 (14.2%)

Table 2: Characteristics of 204 patients undergoing surgery for colorectal cancer. Figures are number (percentage) of patients unless stated otherwise

T3 tumor stage was found to be highest in number (i.e. 50.5%), followed by T2 (30.9%) and T4 (11.3%) - (Table 3).

Preoperative tumor staging via MRI	
Pt1	17 (8.3%)
Pt2	63 (30.9%)
Pt3	103 (50.5%)
Pt4	23 (11.3%)

Table 3: Preoperative tumor staging via MRI & correspondence with histopathological findings

The diagnostic parameters of preoperative MRI in detecting tumor staging was found to be good when correspondent to postoperative histological findings (Table 4).

Diagnostic Accuracy of Preoperative Tumor Staging via MRI		
Parameters	With corresponding Histological Findings	Without corresponding Histological Findings
Sensitivity	0.91	0.83
Specificity	0.52	0.53
Positive predictive value	0.89	0.91
Negative Predictive Value	0.67	0.39

Table 4: The sensitivity, specificity, positive predictive value and negative predictive value of preoperative MRI

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DISCUSSION

Our study investigated the diagnostic accuracy of MRI in diagnosing preoperative staging of colorectal cancer. The results suggested that the diagnostic accuracy of MRI is very high as evident by similar results obtained on Postoperative histopathology. Colorectal cancer is a common malignant tumor, which often occurs in the elderly. The mortality rate of colorectal cancer is 4-10/10000 per year, which is one of the major causes of cancer-related death [13, 14]. The prognosis of colorectal cancer is related to age, general condition of the patient and depth of tumor invasion, lymph node metastasis, circumferential resection margin and invasion of extravascular vascular [15-17]. The 5-year survival rate of colorectal cancer is 66.6%, and localized cancer 88.2%, regional metastasis 70.0%, distant metastasis 14.0% [18]. The clinical stage of colorectal cancer is one of the factors that determine the patients whether to receive surgery directly, or neoadjuvant therapy followed by radical resection, or palliative chemotherapy, or radiotherapy. And the response evaluation of neoadjuvant therapy may change the following treatment [19]. Therefore, preoperative evaluation of colorectal cancer is important for the choice of treatment and prediction of prognosis. The gold standard for diagnosing colorectal cancer is endoscopy with biopsy for histopathological confirmation. And imaging examinations play an important role in the diagnosis of colorectal cancer. Imaging examinations for colorectal cancer include CT, MRI, endorectal ultrasonography (ERUS), and PET-CT [13, 20]. The strength of MRI is the ability to identify the mesorectal fascia, which makes it possible to preoperatively accurately identify those complete surgical excision are infeasible [21]. MRI can identify mucosa and muscle with different signal characteristics, and assess T stage based on signal intensity in and out the submucosa of the rectal wall. Lymphatic involvement assessment is based on the signal in mixed nodules, boundary irregularity, and nodule size. The effect of neoadjuvant therapy is assessed based on the proportion of residual tumor cells in the fibrotic matrix [18]. A meta-analysis showed that the sensitive of MRI for diagnosing T and N stage of colorectal cancer were 75% and 71% respectively [22]. Brown *et al* revealed that compared with pathological results, the coincidence rate of MRI in diagnosing T stage was 94%, and N stage was 85%. MRI was of poor assessment in lymph nodes relatively [23]. Our study suggested the similar results. In addition, the accuracy of MRI in restaging after neoadjuvant therapy was relatively low. The reason was that the edema, inflammation, necrosis, and fibrosis of tissue made it indistinguishable from tumors after chemo-radiotherapy [20]. Mac Dermid revealed that the proportion of postoperative adjuvant chemotherapy in colorectal cancer patients was increasing significantly after multidisciplinary team with the improved 3-year survival [24]. And for metastatic colorectal cancer, the 3- and 5-year survival improved [25]. Burton *et al* showed the positive rate of circumferential resection margin in colorectal cancer reduced after preoperative diagnosis via MRI. A population-based study suggested colorectal cancer patients received more preoperative MRI examination and the TNM stage was more complete [26].There was a predominance of male patients in the sample (60%), which is indicative of the fact that a higher incidence of colorectal cancer (CRC) is found in males compared to females [27]. The diagnostic parameters of preoperative MRI in detecting tumor staging were found to be good when correspondent to postoperative histological findings. Published evidence reports the sensitivity of MRI to be $\geqslant$93.3%, which is near to our finding (91%) [28]. MRI has been shown to be an effective tool for the accurate staging of colorectal cancer and, the interpretation of MR images in patients with colorectal cancer allows the identification of several prognostic factors [29]. The reports correspond well with current study findings.

CONCLUSIONS

In conclusion, curent study showed that the accuracy of MRI in staging colorectal cancer is significantly high when compared with postoperative histopathological staging. This study has formulated an evidence based account of the accuracy of this diagnostic modality and the significance of preoperative T staging of colorectal carcinoma tested in our part of the world that would encourage healthcare providers towards a greater usage of preoperative MRI for timely diagnosis and thus a consequent better prognosis.

Conflicts of Interest

The authors declare no conflict of interest

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