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Preoperative evaluation of pelvic MRI findings in patients with rectosigmoid cancer in Golestan Province

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ABSTRACT

Colorectal cancer (CRC) is the third leading cause of death in the world, accounting for 16% of all new cancer diagnoses. Patients with cancer should be closely monitored before making treatment decisions. Diagnosis of metastatic disease is especially important because it has a significant impact on the therapeutic approach. Magnetic resonance imaging (MRI) is considered a superior method for preoperative evaluation in rectal cancer. Therefore, this study was performed to evaluate MRI findings in patients with rectosigmoid cancer in Golestan province in 2019 and 2020. This is a cross-sectional and descriptive study that was performed on 43 patients with rectal cancer for 2 years in Gorgan. Patients with other cancers, other metastatic cancer, and a history of surgery were excluded. Demographic information (age, gender and ethnicity) was obtained and recorded from patients 'electronic records and patients' MRI information through the picture archiving and communication system (PACS) of Gorgan MRI centers. Among 43 patients with rectosigmoid cancer, 65.1% of them were male and the mean age was 58.58 ± 14.73 years. The average mass length was 48.44 mm and the distance from Anal Verge was 69.81 mm. The tumor morphology of patients' rectosigmoid mass in imaging was related to Semi Circumferncial (62.72%) and Circumferncial (37.21%). T1/T2, N2a, and M0 with the percentages of 41.9%, 39.5%, and 90.7%, respectively, had the highest frequency in patients. TNM Staging was not significantly related to gender or ethnicity. Peritoneal reflection was also more common in Sistani and Turkmen ethnic groups. In conclusion, the results of this study showed that high-resolution MRI under the imaging protocol for obtaining quality images can help to accurately regional staging necessary for optimal treatment.

Keywords: Rectosigmoid cancer, rectum cancer, magnetic resonance imaging, staging.

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INTRODUCTION

The prevalence of colorectal cancer (CRC) is the third leading cause of death in the world and accounts for 16% of all new cancer diagnoses (Kang et al., 2017). About 14.4% of newly diagnosed cases of CRC are distant at the time of diagnosis of metastasis, and 50% of patients eventually develop metastatic disease (Lavdas et al., 2018). In Iran, CRC is the fifth most common cancer in men and the third in women (Pourahmad et al., 2016).

Although the advent of targeted therapeutic agents has improved the survival rate of metastatic disease, the overall therapeutic goal for metastatic CRC remains palliative care (Taylor et al., 2019). Recent advances in endoscopic tools and techniques have increased the detection of colon lesions, colon cancers, and adenomas (Odalovic et al., 2017). Accurate assessment of lymph node metastasis (LN) in CRC is crucial to deciding on appropriate treatment options such as endoscopic resection or surgery, as well as for a prognostic factor (Ahmad et al., 2019).

Magnetic resonance imaging (MRI) has become an

emerging technique for cancer staging because it can provide anatomical information with soft tissue contrast while providing polarized tissue properties through DWI, perfusion imaging, and liver-specific T1 contrast imaging (Park et al., 2014). MRI is highly accurate for metastatic disease without scattering ionizing radiation. MRI is a safer, more efficient, and more accurate alternative to the standard approach and eliminates unnecessary interventions and increases the therapeutic effect, and increases survival (Kang et al., 2016). On the other hand, another advantage of MRI compared to EUS is that MRI is not affected by tumor stenosis and does not allow distant metastases to remain unknown. Hence, MRI is considered a superior method for preoperative evaluation (Jung et al., 2012).

Preoperative evaluations are of great importance in rectal cancer because the treatment decision depends on radiological findings (Lehtonen et al., 2022). Therefore, due to the high prevalence of CRC in Golestan province (Niknam et al., 2019) and the lack of similar studies in this field, the present study was performed to evaluate radiological findings in pelvic MRI of patients with CRC in Golestan province.

METHODS

This study is a cross-sectional retrospective and descriptive-analytical study. The study population includes all patients with a final diagnosis of rectal cancer who have been referred to Gorgan teaching and medical hospitals during 2019-2020. The sampling method was census. Patients with other cancers, other metastatic cancer, having a history of surgery, and incompletely completed records lacking the information needed by the researcher were excluded.

Patient information was collected from the patient's clinical records through a questionnaire. The researcher-made questionnaire consisted of two parts: demographic and clinical information. Demographic information including age, gender, ethnicity, and family history of cancer was obtained from patients' electronic records. Information about magnetic resonance imaging (MRI) (Siemens Magnetom Symphony 1.5 Tesla MRI) results of patients including (Tumor location and morphology, T and N categories, the presence of extramural vascular invasion, and, relationship with surrounding structures) was obtained and recorded through the picture archiving and communication system (PACS) of MRI centers in Gorgan (Eizadi and Golestan Medical Imaging). As well, the M category is identified by chest x-ray and a contrast-enhanced computerized tomography (CT) scan of the abdomen and pelvis which is available in the PACS system. The collected data were analyzed using STATA software version 14. To describe quantitative variables, central indices, dispersion and to describe qualitative variables, frequency ratio, and frequency were used. Chi-square, independent t-test, and analysis of variance were used for data analysis. A P-value less than 0.05 was considered a statistical difference.

Ethics statement

Ethical approval for this study was obtained from the Ethics and Research Committee of Golestan University of Medical Sciences (IR.GOUMS.REC.1400.202). Also, due to the retrospective nature of the study and the use of medical records, there was no need for informed consent. The guidelines on research involving the use of human subjects (beneficence, non-maleficence, veracity, confidentiality, and voluntarism) were strictly adhered to according to the Helsinki Declaration. Participants did not incur any cost by participating in this study and there was no financial inducement.

RESULTS

Preoperative MRI of the pelvis was performed in 43 rectosigmoid cancer patients with a mean age of 58.58 ± 14.73 years (range: 21 to 86 years). Of all patients, 28 (65.1%) were male and the rest were female. Also, 30 (69.8%) were of Persian ethnicity, 9 (20.9%) were Turkmen and 4 (9.3%) were Sistani.

As shown in Table 1, the tumor morphology of patients' rectosigmoid mass in imaging was related to Semi Circumferncial (62.72%) and Circumferncial (37.21%). The tumor morphology was associated with sex and ethnicity. The length of rectal mass in men and women was 49.61±19.82 and 46.27±15.76 mm, respectively, but this difference was not statistically related. The position of the beginning and end of the rectosigmoid mass was reported for the subjects with polypoid and semicircular masses, with a frequency of 22.2% and 14.8% for the beginning of the 9 and 8 o'clock mass, respectively, and for the end of the 2 o'clock mass. 18.5% were the most common situations. Rectosigmoid mass was metastatic in 5 patients (11.6%), of which 3 (10.7%) were male and 2 (13.3%) were female, this difference was not statistically related. T1/T2, N2a and M0 with the percentages of 41.9, 39.5 and 90.7%, respectively, had the highest frequency in patients whose TNM staging was not related to gender and ethnicity. Figure 1 shows the TNM staging of rectal cancer in which T represents the tumor, N indicates the lymph nodes near the tumor, and M indicates whether the tumor has metastasized.

Masses with Semi Circumferncial and Circumferncial morphologies were more likely to invade peripheral fat (62.7 and 37.2%, respectively) than other morphologies. However, this difference was not statistically related. On the other hand, half of the polypoid masses invaded the

Table 1. Clinical characteristics of patients with rectal cancer examined with preoperative MRI in Golestan Province, Iran.

Morphology	Circumferncial	16 (37.21%)
	Semi Circumferncial	27 (62.79%)
Mucinous	Yes	4 (9.3%)
	No	39 (90.7%)
Craniocaudal Length (mm) Mean ± SD	48.44 ± 18.38	
Male	49.61 ± 19.82	
Female	46.27 ± 15.76	
Distance of Rectal Cancer from the Anal Verge	69.81 ± 29.05	
Mean ± SD	67.75 ± 29.23	
	73.67 ± 29.33	
Elementary Circumferential Location (o'clock position)	11 and 3 o'clock	9 (28.12%)
	3 and 7 o'clock	5 (15.62%)
	7 and 11 o'clock	18 (56.25%)
Terminal Circumferential Location (o'clock position)	11 and 3 o'clock	13 (40.62%)
	3 and 7 o'clock	8 (25%)
	7 and 11 o'clock	11 (34.37%)
Fat Surrounding Rectum Invasion	Yes	24 (55.8%)
	No	19 (44.2%)
Invasion size(mm) Mean ± SD	7.71 ± 8.96	
Mesorectal Fascia Invasion (MRF)	Yes	3 (6.98%)
	No	40 (93.02%)
Extramural Vascular Invasion (EMVI)	Yes	2 (4.7%)
	No	41 (95.3%)
Adjacent Organ Invasion	Yes	5 (11.6%)
	No	38 (88.4%)
Metastasis	Yes	5 (11.6%)
	No	38 (88.4%)
T Staging	T1or T2	18 (41.9%)
	T3a	1 (2.3%)
	T3c	10 (23.3%)
	T3d	6 (14.0%)
	T4a	4 (9.3%)
	T4b	4 (9.3%)
N Staging	N0	10 (23.3%)
	N1a	4 (9.3%)
	N1b	5 (11.6%)
	N2a	17 (39.5%)
	N2b	7 (16.3%)

Table 1. Continues.

M Staging	M0	39 (90.7%)
	One organ	2 (4.7%)
	Two organs and more	1 (2.3%)
	Seeding (M1c)	1 (2.3%)
Staging	Stage 1	6 (14.0%)
	Stage 2a	1(2.3%)
	Stage 2b	1 (2.3%)
	Stage 3a	7 (16.3%)
	Stage 3b	2 (4.7%)
	Stage 3c	22 (51.2%)
	Stage 4	4 (9.3%)
Peritoneal Reflection Involvement	Yes	4 (20%)
	No	16 (80%)

Primary tumor (T)	
TX	Primary tumor cannot be assessed
T0	No evidence of a primary tumor
Tis	Carcinoma in situ, intramucosal carcinoma
T1	Tumor invades the submucosa
T2	Tumor invades the muscularis propria
T3	Tumor invades through the muscularis propria into pericolorectal tissues
T4a	Tumor penetrates to the surface of the visceral peritoneum
T4b	Tumor directly invades or is adherent to other organs or structures
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
N1a	Metastasis in one regional lymph node
N1b	Metastasis in two to three regional lymph nodes
N1c	Tumor deposit(s) in the subserosa, mesentery, or nonperitonealized pericolic or perirectal tissues without regional node metastasis
N2	Metastasis in four or more regional lymph nodes
N2a	Metastasis in four to six regional lymph nodes
N2b	Metastasis in seven or more regional lymph nodes
Distant metastasis (M)	
M0	No distant metastasis
M1	Distant metastasis
M1a	Metastasis to one site or organ without peritoneal metastasis
M1b	Metastasis to two or more sites or organs without peritoneal metastasis
M1c	Metastasis to the peritoneal surface alone or with metastases to other sites or organs

Figure 1. TNM classification of rectal cancer (Kalisz et al., 2019).

mesorectal fascia, while the vast majority of other morphologies did not invade, which was statistically related (p = 0.028). Also, EMVI, invasion of adjacent organs, metastasis and staging did not show a statistical difference between morphological types. Masses with Infiltrative Polypoid and Circumferncial morphologies had peritoneal reflection involvement with 100% and 40% frequency, respectively, which was statistically related (p = 0.006).

DISCUSSION

The present study, based on internationally recognized guidelines and guidelines, examined MRI imaging findings in patients with rectal cancer, which were described based on key anatomical landmarks, location, and characteristics of rectal masses.

Anal verge location (AV) is very important to assess the extent of craniocaudal tumor spread. Measuring the length of the tumor and its distance from the anal verge is as flexible as measuring sigmoidoscopy. Based on the findings of the present study, the AV value was obtained in patients at 29.05 ± 69.81 mm. Lateral spread of the tumor is reflected through the rectal and mesorectal walls and beyond in the T category, and assessment of this requires identification of the layers of the rectal wall. The mesorectum is full of fat and contains the arteries and lymphatic tissues that surround the rectum and is seen from the anterior, just below the anterior peritoneal reflection. Mesorectal Fascia is an important milestone for determining the margin of TME (Total Mesorectal Excision) surgery and identifying high-risk cases for local recurrence (Arya et al., 2020). On the other hand, anterior infiltrative masses can penetrate anterior peritoneal reflection because on the dome of the bladder

and above the seminal vesicle in males and on the femoral fundus in females at the junction with the rectum, along its anterior surface to the upper and one third It is located in the middle (Cleary et al., 2018), based on the findings of our study, in the anterior masses of the rectum, in 4 patients peritoneal reflection was observed. On the other hand, tumors spread into the infralevator chamber can involve the anal sphincter complex. The levator ani muscle that forms the pelvic floor is like a hammock on either side of the mesorectum. Its most distal junction is in the puborectalis area near the anorectal junction and posteriorly, proximal to the tail tip. In the inforrator space, when the tumor engages the lower rectum, the extension can extend into the sphincter complex, including the internal sphincter, the space between the sphincter and the external sphincter (Platt et al., 2018), which according to our study data, rectal mass in only one case showed invasion of the anal sphincter.

The location of the tumor is traditionally defined as the distance of the lower limit of the tumor from the AV and its presence in the lower, middle, and upper part of the rectum with the maximum craniocaudal length (Beets-Tan et al., 2018). The lower border of the tumor from the anorectal junction (ARJ) was also recorded. The latest ESGAR and SAR guidelines state that peripheral location from hour to hour must also be reported regularly and that tumor morphology needs to be explained. It should be noted whether the tumor is mucinous or non-mucinous because tumors have a much worse prognosis with a tendency to metastasize. Mucinous tumors have very clear stromal signals in T2-weighted sequences (Beets-Tan et al., 2018). In the present study, 4 tumors with mucinous characteristics were identified. Unfortunately, one patient died. The pathology report of two patients after surgery confirmed the adenocarcinoma mass.

Al Sukhni meta-analysis showed 87, 75, and 85% sensitivity, specificity, and accuracy of MRI for T category evaluation (Al-Sukhni et al., 2012). T category is determined according to the deepest part of the tumor invasion, which often coincides with the central area of the wound (Kennedy et al., 2019). Two-dimensional T2 sequences are more than 80% accurate for differentiation between T2 and T3 tumors [16], but not sufficient for differentiation between T1 and T2 tumors. Our studies showed that about 42% of patients were in the T1 and T2 stages. The ESGAR guidelines recommend routine reporting of T3 (a-d) subsets based on the extent of extramural spread to the mesorectal fat. The basis of this classification is that tumors with the extramural proliferation of more than 5 mm (T3c / T3d) have a poor prognosis (with a decrease in survival from 85 to 54%) (Taylor et al., 2011). Even if MRF is not threatened or involved and therefore requires intensification of treatment (Arya et al., 2020). However, there may be a restriction on the distinction between T2 and T3a tumors (less than 1 mm of extramural proliferation) due to the tumor encroaching on the fat around the rectum, which can be a tumor or a desmoplastic reaction. Most over staging and under staging occur between T2 and T3 tumors. The solution to this dilemma is to consider low signal intensity spikules as fibrosis (T2), while moderate signal intensity is thicker or extensive lesions (in mesorectal fat) are considered as tumors (Arya et al., 2020). Only one patient in our study was in this condition when the tumor stage, T3a, was considered. T4b tumors are those that invade nearby organs, which may show changes in signal intensity similar to a rectal tumor. Recent guidelines make it clear that invasion of the pelvic floor muscles, pelvic floor, bones, nerves, or ureter is also T4b (Gollub et al., 2019).

MRI has a high specificity of 94% to rule out MRF involvement [16]. Two-dimensional T2-weighted sequences are accurate for involved and non-involved MRF decisions, while DWI-MRI sequences are insufficient. Previously, the proximity of a node, deposit, or EMVI to MRF was considered to determine the status of MRF (Nougaret et al., 2013). In a study of 396 patients, Shihab et al. noted that MRF involvement by nodules was uncommon (Shihab et al., 2010). Current guidelines no longer consider these as criteria for determining MRF status. However, the presence of suspicious nodules, deposits, or EMVI close to MRF still needs to be explained in the report for accurate surgical planning (Gollub et al., 2019).

MRI diagnostic accuracy for category N is lower than for category T group (Al-Sukhni et al., 2012). New criteria have been proposed for describing nodes in metastatic (N +) nodes, and these are based on the size and morphology of the node, and the guidelines recommend that these common cases be used. Node properties rely on two-dimensional images with T2-weighted and DWI-MRI is not accurate for differentiating N + and N0 nodes (Beets-Tan et al., 2013). The new nodal criteria are useful for describing mesorectal nodules, but can also be used for extrasensory nodules. The Eighth Edition of the AJCC classifies the N category as N0, N1, and N2 based on the number of nodes, but does not specify the location (Amin et al., 2017). According to our findings, the highest frequency of identified patients was in stage N2 at the time of imaging.

Microscopic as well as the macroscopic spread of the tumor in the perirectal arteries reduces overall survival and is associated with distant metastases and local recurrence (33, 34). EMVI as a tumor median signal replaces the vascular flow vacuum as the vessel enlarges and its lines become irregular (Nougaret et al., 2013). MRI has a high specificity (96%) in detecting macroscopic EMVI (in images with T2-weighted and not in DWI) and can be used to intensify treatment (Schaap et al., 2018; Prampolini et al., 2020). Only 2 patients in the present study showed evidence of EMVI involvement in imaging.

The biggest limitations of the present study were the single-center design and the short study period and the limited sample size. On the other hand, the occurrence of the Covid-19 pandemic, caused the focus and energy of the imaging centers to be entirely focused on issues related to the Covid-19 pandemic.

CONCLUSION

The findings of the present study indicated that high-resolution MRI examination under the imaging protocol for obtaining quality images can help with regional staging necessary for optimal treatment. Managing rectal cancer is a multidisciplinary endeavor today. Advances in rectal cancer imaging enable the radiologist to play an important role in assisting in optimal management in both baseline and re-examination. Structured reporting templates help ensure accurate information transfer. Imaging information can help treat person-to-person cancer rectally.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Ethics and Research Committee of Golestan University of Medical Sciences (IR.GOUMS.REC.1400.202). The guidelines on research involving the use of human subjects (beneficence, non-maleficence, veracity, confidentiality, and voluntarism) were strictly adhered to according to the Helsinki Declaration. Participants did not incur any cost by participating in this study and there was no financial inducement.

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