



Correlation between MRI and biopsy investigations in diagnosis of colorectal cancer among patients presented with colorectal mass at St. Paul's Hospital Millennium Medical College

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Dedication

To my wife H. Ingoro Angelo, I am so grateful for your patience during my absence and your support throughout the period of my study;

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I. ABSTRACT

Aims and objectives:

To study correlation between MRI and biopsy investigations in diagnosis of colorectal cancer in patients presented with colorectal mass/rectal bleeding at St. Paul's hospital Millennium Medical College from 2015 to 2019 GC.

Materials and methods:

This cross section retrospective study included all inpatients and outpatients at SPHMMC who presented with rectal bleeding or mass in the period of five years and with both MRI and biopsy investigations.

Results:

Total 162 patients 116 were included and 97.4 % presented with rectal bleeding 61.2% bleeding for six month, 2.6 % operable. Location 51.7% in mid rectum followed by lower rectum 36.2%. MRI T staging 12.0% were T1/T2 and 46.0% to T3 and 42.0% to T4. Of the study populations tumor histology; 91.4% were adenocarcinoma, 100% have had no staging used, and 55.2% could be operated.

Conclusion

MRI is useful and reliable modality for assessing preoperative staging and CRM involvement, permitting the physicians to stratify the patients and determine the optimal therapeutic planning for individual patients who need surgery also the patients who were at risk of recurrence. In St. Paul's Hospital, a combination of high-resolution MRI with DWI before surgery is implemented for patients who were treated with preoperative CRT for locally advanced rectal cancer.

Key words: Colorectal cancer, MRI and biopsy.

Abbreviations:

¹⁸F-FDG	¹⁸ fluorodioxylglucos
ADC	Apparent diffusion coefficient
CRM	Circumferential resection margin
CRT	Chemoradition Therapy
CT	computed tomography
DWI	Diffusion-weighted imaging
EUS	Endorectal ultrasound
MDCT	Multidetector Computed tomography
MRI	Magnetic resonance imaging
PET/CT	Positron emission tomography computed tomography
SPHMMC	Saint Paul's Hospital Millennium Medical College
TME	Total Mesorectal excision

II. INTRODUCTION

A. Background

In Ethiopia, the research study on pattern of cancer indicated that the gastrointestinal tract cancer which incorporating colorectal cancer is one of the top five non communicable diseases. And in particular, it is the fifth most common cancers. This anatomically situates at distal part of large intestine. It is manifested due to the multifactorial risk or in other words enormous factors are the results in this category of the cancer. (1)

Globally, the cancer statics illustrates that this carcinoma of colorectal is the most common and stood as the third among non-communicable diseases. (2)

For both local recurrence and metastases, this neoplasm possesses a high risk. Conventionally, the cancer of rectal surgery is identify to be associated with high rates of locally recurrent. The percentages range for 3% to 32%. (3)

Recently, there have been two advances made in pursuit of alleviating this sort of cancers. Those advances have contributed significantly in reduction of the high local recurrence rate. The reduction is estimate at 10%: total mesorectal excision surgery (TME) and the neoadjuvantchemo radiotherapy (4).

The correct T (Tumor) and N (lymph node) staging of colorectal cancer is crucial in stratifying patients who will benefit from surgery alone or combination of both.

There are enormous diagnostics utilized in colorectal cancer diagnosis and staging. The examples of those diagnostics are as follows: Endorectal ultrasound (EUS), CT, MRI and PET-CT.

Endorectal ultrasound

The endorectal ultrasound (EUS) is operated as follows: the water is filled into the balloon. Consequently, this balloon will be probed the rectum. This balloon contains a high frequency transducer and trans-anal.

EUS has a capacity to delineate five layers of rectum wall. Additionally, it alternates between hyper-echoic and hypo-echoic bands.[\[5,6\]](#).

In particular, EUS is effective assessment of the depth of tumor which invades into the wall of the rectum. Its accuracy is range from 69% to 94%[\[7-10\]](#).

Computed tomography

The computed tomography is imaging modality which commonly utilized in preliminary staging the cancer of rectum. This imaging modality has a characteristics of fast scanning time and it is widely available. Furthermore, in a single examination, it has a capacity to assess the pelvis, entire abdomen and even chest. Hence, it provides fast room to evaluate not only local staging, but also distant metastases [\[11,12\]](#).

In the previous studies applied conventional CT to estimate rectal cancers of locally advanced, that is, less or equates T3 demonstrated that the rates of T staging accuracy is stood at range 79% to 94%.

With the technologic advances in this context, multidetector CT (MDCT)possess the capacity to provide improved spatial resolution. Nevertheless, the multiplanar reformation and thin collimation scanning enhance the rates of accuracy. The estimation is greater than 90%.[\[13\]](#).

Whereas MDCT has appeared showing some limitations (and in particular early staging is limited to rectal wall, examples are distinction between T1 tumor and T3 tumor), EUS seems to have been more effective.

Magnetic resonance imaging

The use of magnetic resonance imaging (MRI) commenced since 1986. The functions of MRI have been delineating rectal tumor and showing stages of local rectal cancers. The preliminary MRI studies applied a body coil indicated that the rates of MRI accuracy have a range from 59% to 88%. These ranges of accuracy have appeared to be similar to that of CT [13-15]. In recent times, MRI used in diagnosis of rectal cancers operates on one of the following options: It is either an endorectal coil or a phased array surface. Numerous studies in this context have illustrated that using MRI of phased array have shown high rates of accuracy. These ranges commence at 65% and extend to 86%.

Positron emission tomography computed tomography

The positron emission tomography computed tomography (PET-CT) possesses not only the capacity to measure metabolic changes inside cancerous cells, but also it has capability to visualize the change within those cells.

The most commonly used of PET-CT is that fluorodeoxyglucose. It is abbreviated as FDG. Whereas it is taken up, the tumor increases. This is for the fact that the activity of metabolism within the tumor cells is mounting. With this, it facilitates radiolabelling efficiently. As a result, studies conducted in this context indicated that PET-CT has the capability to reliably identify cancer of colorectum. Nonetheless, it can detect the depth of this cancer [16,17].

Additionally, FDG-PT has the limitations as follows: Lack of details in regard to anatomy, poor spatial resolution. These limitations hinder to determine the degree of local cancer involvement, CRM status, or relationship to the sphincter complex difficult.

B. Statement of the problem

Worldwide, evidence has indicated that the cancer of colorectum leads the third cause of mortality. This has made an alarming concern countrywide.

For the location of this cancer embedded in pelvic fat and for the absence of peristalsis makes rectum the most appropriate organ to obtain imaging with MRI. Thus; to evaluate colorectal pathologies, the use of imaging modality is essential(18).

Nonetheless, it is identify that use of tools of imaging, for instance, colonoscopy and barium enema, provides inadequate information relevant to extraluminal seeding of tumor. Hence, the preoperative planning is ambiguous. (19).

For a patient will be managed accordingly, the result of MRI is crucially important. Thus; to accurately stage the neoplasm, it is the imperative of Radiologist

Despite the use of MRI-T staging in institutions, there is no or little information in terms of its accuracy in diagnosis of cancer of colorectal at St. Paul's Hospital, which correlate this with biopsy.

C. Significance and rationale of the study

The policy of the ministry of health aims at improving healthcare services in the department of Oncology. This is by early identification and diagnosis of cancer. This is in turn facilitate efficient and effective treatment in order to prevent the recurrence

In the institution, most of patients are diagnosed only by endoscopy biopsy which provides histologic diagnostics of cancer type. Hence, to stratify patients by imaging is required. Despite the fact that sensitivity of specificity of MRI in diagnosis is high, its relation with surgical biopsy is rather comparable.

Whereas, there is information gap in diagnosis and staging of this sort of cancer, the findings from this research study will fill knowledge gap. Additionally, it will be essential document for researchers and generate baseline indicators in order to improve diagnostic service delivery. Importantly, it will enhance planning and policy making.

III. LITERATURE REVIEW

A. Colorectal cancer

Rectal cancer becomes the most common neoplasm and among morbidities, it contributes majorly as one of leading cause of mortality. Recently, whereas lifestyle dynamically changes, the prevalence of this neoplasm increases. Hence, it is nowadays, graded to be the third most common cancer globally. Of all colorectal cancers types, rectal carcinoma is the most common. It is accounting for 65%. The adenocarcinoma is standing at 98% of these cancers. The tumor of locally recurrent might be had a linkage to distance of tumor to the CRM: the circumference reaction margin and to the extramural tumor spread into mesorectum. An approach of multidisciplinary which defines the optimally timing therapy and which combines radiotherapeutic intervention, surgery and chemotherapeutic intervention is crucially necessary. This is in order to develop an effectively individual therapeutic strategy [20].

Consequently, it is diagnostically mandatory to accurately stage rectal cancer preoperatively. Nonetheless, the difficulty for imaging is to differentiate tumors which have distinguished risks for recurrence. And these different tumors are as follows: Advanced or metastatic disease, early stage lesions localized, advanced cancer localized [21].

In the recent times, enormous literature has largely placed the intended focus on the importance of CRM: circumference resection margin. This is because, CRM is considered to be a strong predictor for locally recurrent cancer [22, 23].

Nowadays, it is indicated that MRI: magnetic resonance imaging which possesses phased array surface coil is the most reliable way to stage cancer of rectum and to evaluate involvement of CRM: Circumference resection margin. Nevertheless, there is a mounting consensus which is inconsistent with this indication. This is for the fact that the technique of study has had some issues regarding its optimality. Furthermore, other literature does not refer to distend the lumen of rectum [24, 25].

Nevertheless, in the studies on advanced rectal cancer reported that the distention enhances wall of rectum depiction which has a characteristics of better estimation of tumor extension [26, 27].

Technique for MRI: Magnetic resonance imaging

In our institution, magnetic resonance imaging (MR imaging) is conducted as follows: MR imaging with the use of 1.5T unit and with phased array surface coil, patients are not required to have special routine rectal preparation prior to this procedure. Whereas the localizer is acquired; consequently, angle is adjusted to 45° in relation to canal of anus. Subsequently, T2WI coronal sequences are obtained. Afterwards, axial and sagittal are acquired which are followed by T1WI axial, DWI and ADC map. Finally, the contrast is not mandatory.

The acquisition parameters as follows:

Fast low-angle shot 2D T1-weighted sequences (repetition time [TR] 130 ms, echo time [TE] 4.32ms, field of view [FOV] 370 mm, slice 5 mm, acquisition time 20 seconds).

Turbo Spin Echo (TSE) T2-weighted sequences (TR 4000 ms, TE 103 ms, FOV 350 mm, slice 5mm, acquisition time 24 seconds) acquired on axial plane; in at least two planes, sagittal and axial scan orthogonal to the long axis of the rectal tumour, are acquired. For low lying cancers, an additional oblique coronal scan is

perform along the long axis of the anal canal. The MRI exam takes about 25-30 minutes.

Image Analysis

At MRI, the T staging of rectal cancer is substantially in accordance with differences in intensity of T2 signal between the wall of rectal layers and the tumor. There are three different layers on T2 weighted image which can be identified. These are as follows:

The first layer is that an inner hyper-intense layer represents sub mucosa and mucosa. Between these, there is no obtainable differentiation. Whereas the second is a hypo-intense intermediate layer which is equated to muscularis propria, the third one is an external hyper intense layer is a layer which corresponds to fat tissue. Additionally, there is a thin low intensity layer is the layer which engulfs the mesorectum. This in turn equates to mesorectum fascia with unambiguously visible views of posterior and lateral [28]. These categories of tumor T stage are in accordance with 2002 TNM 6th edition [29] and in line with that of 2020 7th edition [30].

Putting into consideration the differentiation between lesions (T1 and T2), it is quite challenging. Hence, the combination of these stages is to be consolidated into the group of less than or equal to T2 intramural lesions. This is a characteristic of tumor signal intensity which is confined to muscular layer. It has an intact interface between the muscularis propria. For the scenario of T3 stage is when the muscular layer does lose its homogeneity of low signal intensity. Thus, this seems to disrupt with nodular margin or spiculations which extends into mesorectal fat. It is assumed that the invasion of tumor into surrounding structures is T4 stage [31, 32].

Whereas circumference resection margin (CRM) is assessed precisely; its involvement assumed on the following conditions: if distance from either a suspected lymph node, the extramural tumor extension is the shortest or a tumor deposit in mesorectum, to the mesorectal fascia is a distance of less than 2mm. In reference to N staging, the existence of regional lymph nodes is assessed in accordance with the size and number of nodes. A distance of 5mm or greater from the nodes is considerably named metastatic. This is on condition that the distance of less than 5mm is considerably uninvolved. The images of MR are analyzed. This is performed by abdominal radiologist with experience on Radiology information system (RIS). This system is used in reporting cases of MR images.

MRI with diffusion weighted imaging for evaluating post CRT cancer of rectal response

DWI: Diffusion weighted imaging is a functional technique of MRI of newly emerging. The technique has an implementation capacity of conventional MRI evaluation and the capability of noninvasive characterization of the tissues. This is in accordance with features of water diffusion. As a result, DWI ably provides information about microstructure. This incorporates changes in integrity and cellularity of the membranes. These do precede conventional morphological changes or alterations. The application of DWI is to identify and to characterize the tumor. Importantly, it is to differentiate both viable solid portions and necrotic solid portions inside the tumors. This is by estimating quantity of ADC values, that is, apparent diffusion coefficient [33, 34].

The decreased the value of ADC, the increased the density of the cell. This is due to that fact that the diffusion of water molecules is restricted. Furthermore, this aims to increase in regions with necrotic [33, 35].

The tumor ADC values of responses with complete or good substantially higher than the tumor of poorly characterized responses. The existence of values of CRT ACI indicate necrotic CRT tumors with resistant [36, 37].

This approach suggests prediction of CRT response prior to the therapy and it is useful. Nonetheless, the values of post CRT ADC of rectal cancers were lower than the values of before CRT tumors. This difference was attributable to formation of scar tissue or fibrosis. Hence, there was no correlation with the response of the tumor. These findings illustrate that DWI addition to MRI of standardized might make both facilitation of identifying viable tumors and of detecting patients with CRT response. Furthermore, it has been recently meta-analyzed the restaging of DWI. This meta-analysis indicated that there were good pooled sensitivity and specificity rates. These rates stood at of 83% and 84% respectively. Hence, DWI ably provides a biomarker which is useful in evaluating and monitoring the CRT therapy response [39, 40].

Pathological Investigation

The samples of endoscopy or specimens of surgical rectal cancer resection are prudently assessed. This is examined by pathologic expertise. The mesorectum integrity is assessed microscopically. And the inked peritoneum did not cover the segment. Afterwards, in a duration of 48 hours and in concentration of 10% formalin, this specimen is fixed. Subsequently, it is sectioned along the plane of coronal. This is so as to get the thickness of 0.5cm slides to improve the evaluation of CRM, that is, circumference rectal margin. The tumor samples relevant to CRM are obtained [41].

The distance which is situated between the tumor is either illustrated by the following options: It is either by main mass direct extension or by metastatic

lymph node or by venous invasion. The measurement of CRM is microscopically performed [42].

The inked CRM specimen which has a distance of $< 1\text{mm}$ commencing from the tumor is considered to be had positively charged CRM. All of lymphatic node specimens are sampled and particularly those are in nearness to margin which is inked separately sampled. The histologic categorization of those tumors are performed in accordance with WHO standard which is in line with those are done in accordance with 2002 6th edition of TNM. It is, furthermore, observed that this classification is in line with that of 2010 7th edition of TNM.

Comparing biopsy and MRI in colorectal cancer diagnosis and staging

In a research study conducted in Egypt on utilization of MRI with high resolution for rectal carcinoma preoperative staging and with involving the circumferential resection and mesorectal fascia revealed that MRI base T staging sensitivity stood at 95% and that the specificity estimated at 87% and that PPV: Positive predictive value was at 92% and that NPV: Negative predictive value has an estimation of 93% [43].

In Portuguese research literature on staging of preoperatively rectal cancers applied MRI indicated that the correlation in reference to pathologic staging of MRI Base have had both sensitivities of 33.3% and specificities of 94.7%. Furthermore, this literature illustrated that PPV: Positive predictive value stood at 33.3% and that NPV: Negative predictive value has had an estimation of 94%. It is to unambiguously clarify that those percentages are for N staging [44].

Direction infuture: Multimodality imaging to evaluate stages of rectal cancer

Evaluations of multimodal imaging in cancer of rectum do facilitate therapeutic design and patients' prognosis. The imaging techniques with quality of continuous improvement will make a provision of images not only with super resolution and with view of three dimensions; but also with decreased times of acquisition and with new functional qualities. There is a likelihood which states that the utilization of EUS will increase in staging investigations. Furthermore, these investigations will be corresponding to the therapeutic handling of rectal cancer. It is indicated that the application of DWI is useful as biomarker. Hence, DWI will be appropriately utilized for both evaluating and monitoring therapeutic responses to CRT. Nonetheless, requirements for both standardized protocol and experienced expertise in this context are crucially important. This is to efficiently maximize the approach. Despite the fact that PET-CT role is required to be compared with existing methods, PET-CT has a capacity to provide additional information which is valuable for evaluation post CRT response. In regard to the use of a combination of imaging methods which incorporate PET-CT, DWI, MRI with high resolution. These imaging will be providing prognostic information of valuable before definitive surgery.

Despite improvements in the context, the LN metastasis determination seems to be posing some challenges in the staging of rectal cancer. Hence, there is a need for further LN research.

Objective of this research study

B. General

The general objective for this research study is to correlate between magnetic resonance imaging and biopsy diagnostic investigations of patients with colorectal cancer and patients with colorectal mass at St. Paul's Hospital Millennium Medical College from 2015 to 2019 GG

C. Specific

The specific objectives are as follows:

1. To identify the most reliable feature in MRI diagnostics which suggests colorectal cancer clinically mass or bleeding;
2. To establish relation between MRI and biopsy in colorectal cancer diagnosis and staging
3. To correlate down staging of patients with therapeutically post chemoradiation.

IV. METHODS AND MATERIAL

A. The design of the study

This research study was an institutional based cross sectional of which both inpatient and outpatient at St. Paul's Hospital MMC incorporated. The consideration was put on patients who presented with clinically rectal mass or bleeding in a period of four years: 2015 to 2019 GC. Importantly, those who had attended both radiologic diagnosis: MRI and pathologic diagnosis: Biopsy. Their charts were revised.

B. Study area

This study was carried out in St. Paul's Hospital MMC. This hospital is situation in Addis Ababa. It is considered to be the second biggest hospital in Addis Ababa. In 1069, the Emperor Haile Selassie I had established the hospital. This was with the support of German Evangelical Church. This hospital affiliated to St. Paul's Hospital MMC. In 2007, the college was founded which is the center for training both postgraduates and undergraduates.

C. Population for this study

1. Source of the population

The source of population was all patients referred from different parts of Ethiopia to St. Paul's Hospital MMC for both radiologic diagnosis: MRI and pathologic diagnosis: Biopsy, clinically presented with rectal mass or bleeding in the hospital.

2. Study Population

The study population was all referred patients for biopsy and MRI exhibiting clinically rectal mass or bleeding and fulfilling the criteria of inclusion.

D. Criteria for exclusion and inclusion

1- Inclusion criteria

- The patients who have age of 18 years and more; clinically presented with rectal mass or bleeding; have undergone examination of both MRI and biopsy; possessed both results of imaging and pathology. Whereas the word “*rectal mass*” refers to as fullness and heaviness felt in rectum, the word “*bleeding*” means frank blood per rectum.

2. Exclusion criteria

- The patients who will not meet the inclusion requirements; and any information regarded to be incomplete.

3. Data collection technique

Whereas the source of data for this study were the patients’ charts available at St. Paul’s Hospital MCC, the systematic sampling technique was performed. The trained research assistants were using the pre-tested questionnaire in collecting the data. The process of the data collections was supervised by principal research investigator.

4. Sample size

Whereas all cases in the period of this study who are available at both Radiology department and Pathology department, the following equation of sample size was used in estimation of sample size:

$$n = \frac{(Z)^2 p(1-p)}{D^2}$$

Where:

$n \equiv$ Minimal sample size

$Z \equiv$ Value of standard normal distribution: confidence level

$p \equiv$ The probability or expectation of previous similar study

$D \equiv$ The maximum allowable or estimation of error

The minimum sample in the small population ($< 10\ 000$ for 1000 as an example)

$$N_{spz} = \frac{N}{1 + (n)}$$

$N_{spz} \equiv$ Small sample size

The sample size estimation is in accordance with unknown parameter: Rule of thumb which is statistically 150 cases.

E. Data Processing and Analysis

The data collected were cleared and made ready for the analysis. Afterwards, these data were entered into SPSS v21: Statistical package version 21 in which the analysis was performed.

Those data were presented in tables and charts and major correlational variable were summarized.

F. Ethical considerations:

The ethical clearance was obtained from not only from SPHMMC Ethical Review Board (ERB), but also department of Radiology. Data will be kept confidentially and used for research only.

limitation of the study

1. To correlate down staging of patients with therapeutically post chemoradition.
2. No data of Pathological biopsy staging
3. Records are most incomplete either MRI staging with absence Pathologic biopsy investigation or vice versa.
4. No Pathologic T staging found on record data.

Dissemination of results

The finding of this study will be published and submitted to SPHMMC department of surgery, research center of SPHMMC, library and other concerned bodies.

Operational definition

The term “bleeding” frank blood per rectum and “mass” mean heaviness and fullness felt in rectum different which could be subjectively and reproducibly.

Also MRI diagnosis of rectal cancer and its Locoregional staging In addition to pathologic biopsy diagnosis.

G. Variables

1. Independent variables

- MRI pattern of colorectal cancer:
- Polypoid mass
- Circumferential thickening
- MRI diagnosis
- MRI TNM staging
- CRM TNM stage
- Post chemoradition down staging
- Extraneous Age
- gender
- presenting symptom

2. Dependent variables

Correlation of Biopsy and MRI investigations

V. RESULTS: PRESENTATION & INTERPRETATION

The results that emerged from this study research are arranged in social demographic characteristics, clinical presentation, Radiologic MRI diagnosis as well as Pathologic Biopsy diagnosis.

A. Social demographic characteristics of the study population

The **table V.1** shows the descriptive analysis of the study population social demographic characteristics.

A total number of 116 patients' files were accessed. The mean ($\pm$ SD) age of the patients was 46 ± 14.4 , whereas the youngest patient was 18 years of age, the oldest was of 82 years. Of the patients; above 35 years of age were majority which stood at 70%, females were 48% and no patients from rural estimated at 0%. All came from urban areas.

Table V. 1: Social demographic characteristics

Variables	N=116	Percent
Gender		
Males	68	58.6
Females	48	41.4
Residency of living		
Urban	116	100.0
Rural	0	0.0
Age Group		
≤ 35	34	29.3
≥ 36	82	70.7

B. Clinical presentation

The **table v.2** illustrates patients symptoms, the duration of the symptoms and whether the patients were previous operated.

Of the study research population; 98.3% have reportedly had rectal bleeding with duration of three to 12 months, 61.2% were bleeding for six months.

Out of 116 patients with rectal bleeding, 97.4% have not been operated. Whereas 2.6% have been surgically operated, 2.6% because they have been diagnosed with advance rectal cancer.

Table V. 2: Clinical presentation

Variables	n=116	Percent
Clinical symptoms		
rectal bleeding	114	98.3
rectal fullness	2	1.7
Duration in months		
3	2	1.7
4	17	14.7
5	22	19.0
6	32	27.6
7	5	4.3
8	28	24.1
9	2	1.7
12	8	6.9
Duration in quarters		
1	2	1.7
2	71	61.2
3	35	30.2
4	8	6.9
Previous surgery		
No	113	97.4
Yes	3	2.6
Indication of previous surgery		
rectal cancer	3	2.6
Others	113	97.4

C. Radiologic MRI diagnosis

The **table V.3** shows magnetic resonance imaging (MRI) diagnosis of colorectal pattern as well as tumor location from anal verge and staging of rectal cancer.

Eighty seven point one percent of total number of 116 study populations have got circumferential wall thickening of colorectal patterns. The tumor has mostly situated at mid rectum which represents 51.7. This was followed by the tumor located at lower rectum which is estimated at 36.2%.

MRI staging of the disease was available in 86.2% of the cases.

Of the patient with colorectal disease, only 12.0% were T1/T2 and 46.0% were T3 and 42.0% were T4.

Table V. 3: Radiologic MRI diagnosis

Variables	N=116	Percent
MRI colorectal patterns		
Polypoid	15	12.9
circumferential wall thickening	101	87.1
MRI tumor location from anal verge		
upper rectum	14	12.1
mid rectum	60	51.7
lower rectum	42	36.2
MRI staging of the disease		
not available	16	13.8
Available	100	86.2
t2 n0 mx	4	3.4
t2 n1 m1	1	.9
t2 n1 mx	5	4.3
t2 n2 mx	1	.9
t3 n0 m0	1	.9
t3 n0 m1	2	1.7
t3 n0 mx	27	23.3
t3 n1 m1	1	.9
t3 n1 mx	11	9.5
t3 n2 m1	1	.9
t3 n2 mx	3	2.6
t4 n0 m0	1	.9
t4 n0 m1	1	.9
t4 n0 mx	8	6.9
t4 n1 mx	16	13.8
t4 n2 m1	4	3.4
t4 n2 mx	9	7.8
t4 ni m1	1	.9
t4 no m0	1	.9
t4 n1 m	1	.9
MRI staging of the disease*		
T2	12	12.0
T3	46	46.0
T4	42	42.0
MRI post radiation staging of disease		
not written	116	100.0
Qualification of doctor who reported the MRI		

Radiologist	116	100.0
Radiology Resident	0	0.0

* n=100

D. Pathologic Biopsy diagnosis

The **table V.4** presents Pathologic Biopsy diagnostic decision, the availability of the staging and operability of rectal carcinoma.

Of the study populations; 91.4% were adenocarcinoma, 100% have had no Pathological staging, and 55.2% were staged by MRI to be operable.

Table V. 4: Pathologic Biopsy diagnosis

Variables	n=116	Percent
Pathologic Biopsy diagnosis		
Adenocarcinoma	106	91.4
Adenoma	5	4.3
GIST	1	0.9
IBD	3	2.6
TB	1	0.9
Pathologic Biopsy staging		
not available	116	100
Available	0	0
MRI stage operability of rectal carcinoma		
Nonoperable	52	44.8
Operable	64	55.2
Qualification of doctor who reported the Biopsy		
Consultant	116	100
Residency	0	0

E. Correlation of Biopsy and MRI investigations

MRI investigations

The **table V.5** illustrates bivariate analysis of demographic characteristics, clinical presentation, colorectal staging, indication for operation and others

which determine relation with MRI investigation. The cross tabulations were performed in which Spearman correlation was conducted.

Majority of patient with age of greater than or equal to 36 years [82 (70.7%)] clinically presented with rectal mass or bleeding had visited St. Paul's Hospital MMC for both radiologic diagnosis: MRI and pathologic diagnosis: Biopsy. Of those patients, only 12 (13.8%) did not have MRI staging. The finding of this study research indicated that this was statistically insignificant with odds ratio (OR) of 0.550 (0.540 - 0.559) and p-value of 0.180.

Of this study's participants, males accounted for 68 (58.6%) while females stood at 68 (41.4%). This was also statistically insignificant with odds ratio (OR) of 1.000 (1.000 - 1.100) and p-value of 0.220.

About MRI colorectal staging correlation to operability, the results of this research demonstrated that only 3 (2.6%) of the cases were operable with 3 (100%) unavailable MRI staging with OR = 0.002; 95% CI = (0.001 -0.003); p-value = 0.002. Since this p-value is less than .05, there is statistically significant correlation.

Furthermore, the results of this study illustrated that there was a statistically significant correlation of MRI staging with indication for operation [OR=0.002, 95% CI = (0.001 -0.003), p-value = 0.002]; with MRI diagnosis [OR=0.000, 95% CI = (0.000 -0.000), p-value = 0.000].

Biopsy investigations

For the data did not vary, no any statistics can be performed. Hence, the sensitivity, specificity, accuracy NPV and PPV results for both staging of **MRI** and staging of **Biopsy** are hardly obtainable.

Table V. 5: Results of relation between colorectal predictors and MRI investigaion

Variables	MRIStaging		Total: n (%)	OR (95% CI)	P-value
	available: n (%)	unavailable: n (%)			
AgeGroup				0.550 (0.540 - 0.559)	0.180
≥ 36	70 (85.4%)	12 (14.6)	82 (70.7)		
≤ 35	31 (91.2)	3 (8.8)	34 (29.3)		
Gender				1.000 (1.000 - 1.1000)	0.220
females	42 (87.5)	6 (12.5)	48 (41.4)		
males	59 (86.8)	9 (13.2)	68 (58.6)		
Residency					
urban	101 (87.1)	15 (12.9)	116 (100.0)		
rural	0 (0.0)	0 (0.0)	0 (0.0)		
Clinical presentation				0.245 (0.236 - 0.253)	0.227
rectal fullness	1 (50.0)	1 (50.0)	2 (1.7%)		
rectal bleeding	100 (87.7)	14 (12.3)	114 (98.3)		
Duration of symptoms				0.411 (0.402 - 4.21)	0.160
≥ 7 months	39 (90.7)	4 (9.3)	43 (37.1)		
≤ 6 months	62 (84.9)	11 (15.1)	73 (62.9)		
Operable MRI colorectal staging				0.002 (0.001 -0.003)	0.002*
yes	0 (0.0)	3 (100.0)	3 (2.6)		
no	101 (89.4)	12 (10.6)	113 (97.4)		
Indication for operation				0.002 (0.001 -0.003)	0.002*
others	101 (89.4)	12 (10.6)	113 (97.4)		
rectal cancer	0 (0.0)	3 (100.0)	3 (2.6)		

MRI colorectal patterns				0.102	(0.096 - 0.108)	0.079
circumferential thickening	90 (89.1)	11 (10.9)	101 (87.1)			
polypoid mass	11 (73.3)	4 (26.7)	15 (12.9)			
MRIDiagnosis				0.000	(0.000 - 0.000)	0.000*
others	3 (23.1)	10 (76.9)	13 (11.2)			
Recurrent	1 (25.0)	3 (75.0)	4 (3.4)			
rectal cancer	97 (98.0)	2 (2.0)	99 (85.3)			
Post-chemoradiation MRISTaging				0.000	(0.000 - 0.000)	0.000*
No	100 (98.0)	2 (2.0)	102 (87.9)			
Yes	1 (7.1)	13 (92.9)	14 (12.1)			
Qualification of DR reported MRI						
Radiologist	101 (87.1)	15 (12.9)	116 (100.0)			
Resident	0 (0.0)	0 (0.0)	0 (0.0)			

* P-values is < 0.05

VI. DISCUSSION

This study aimed at correlating magnetic resonance imaging (MRI) and biopsy diagnostic investigations of patients with colorectal bleeding and patients with colorectal mass. In this chapter, the discussions is made in connection with other relevant studies while placing emphasis on areas of importance.

A. Clinical presentation

Of the study research population; 98.3% have reportedly had rectal bleeding with duration of three to 12 months, 61.2% were bleeding for six months.

Out of 116 patients with rectal bleeding, 97.4% have appeared to have not been operated previously. Whereas 2.6% have been surgically operated, all have been diagnosed with rectal cancer.

B. Radiologic MRI diagnosis

Eighty seven point one percent of total number of 116 study populations have got circumferential wall thickening of colorectal patterns. The tumor has mostly situated at mid rectum which represents 51.7 %. This was followed by the tumor located at lower rectum which is estimated at 36.2%.

In comparison to tumor location in other research which was 62.5% in upper rectum, 17.5% in mid rectum and 20% in lower rectum, So there were most common location is mid rectum in this research Rather than upper in research done in Egypt (43)

Of the patient with colorectal disease, only 12.0% were T1 and 46.0% were T3 and 42.0% were T4. In comparison to Research done in Egypt T1 staged were 7.32%, T2 staged were 65.9 %, T3 staged were 26.8% and no mention of staged T4. Its noted that due to screening and early detection of cancer, in contrast to our institution that's why most of our institution cases are advance (43).

C. Pathologic Biopsy diagnosis

Of the study populations; 91.4% were adenocarcinoma, 100% have had no MRI staging, and 55.2% were staged by MRI to be operated. Our institution which have just started pathological staging with limited data, So most of data were Endoscopic biopsies.

D. Correlation of Biopsy and MRI investigations

This section illustrates bivariate analysis of demographic characteristics, clinical presentation, colorectal staging, indication for operation and others which determine relation with MRI investigation. The cross tabulations were performed in which Spearman correlation was conducted.

Most of patient with age of greater than or equal to 36 years [82 (70.7%)] clinically presented with rectal mass or bleeding had visited St. Paul's Hospital MMC for both radiologic diagnosis: MRI and pathologic diagnosis: Biopsy. Of those patients, only 12 (14.6%) did not have MRI staging. The finding of this study research indicated that this was statistically insignificant with odds ratio (OR) of 0.550 (0.540 - 0.559) and p-value of 0.180.

Of this study's sample, males accounted for 68 (58.6%) while females stood at 68 (41.3%). This was also statistically insignificant with odds ratio (OR) of 1.000 (1.000 - 1.100) and p-value of 0.220.

About the MRI colorectal staging operability, the results of this research demonstrated that only 3 (2.6%) of the cases were operable with 3 (100%) unavailable MRI staging with OR = 0.002; 95% CI = (0.001 -0.003); p-value = 0.002. Since this p-value is less than .05, there is statistically significant correlation.

Additionally, the results of this study illustrated that there was a statistically significant correlation of MRI staging with indication for operation

[OR=0.002, 95% CI = (0.001 -0.003), p-value = 0.002]; with MRI diagnosis [OR=0.000, 95% CI = (0.000 -0.000), p-value = 0.000

CONCLUSION & RECOMMEDATIONS

E. Conclusion

MRI is a useful and reliable modality for assessing preoperative staging and CRM involvement, permitting the physicians to stratify the patients and determine the optimal therapeutic planning for individual patients who need surgery also the patients who were at risk of recurrence.

PET or PET-CT assessment is not yet available in our institution, which could be recommended when there is clinical, biochemical or radiological suspicion of systemic disease.

Restaging after neoadjuvant therapy, particularly CRT, is challenging with all modalities because it is difficult to reliably differentiate between radiation-induced changes and the tumor itself. However, in St. Paul's Hospital a combination of high-resolution MRI with DWI before surgery for patients who were treated with preoperative CRT for locally advanced rectal cancer.

F. Recommendations

1. To correlate down staging of patients with therapeutically post chemoradition data is needed for future researches.
2. Pathological biopsy staging not available, so as institution just started staging time is required for future next researches.
3. Records are most incomplete either MRI staging with absence Pathologic biopsy investigation or vice versa improvement of documentations is crucial for future researches.

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VIII. Appendices



A. Informed consent

The data collected from this facility will be for academic purpose for the proposed research on “*Correlation between MRI and biopsy investigations in diagnosis of colorectal cancer among patients presented with colorectal mass and associated factors at St. Paul’s Hospital Millennium Medical College.*”

The information will remain confidential in all process of data organization, documentation, analysis and dissemination.

B. Assessment questionnaire

Card number

MRI number.....

Part 1. Social demographic

1. 1.Age .
2. Sex: Male Female
3. Residency
4. The place where the patient lives A. urban B. rural
5. Marital status C. Divorced/Separated D. Widowed
6. Level of education?
 - A. Primary school 1st cycle

B. Primary school 2nd cycle

C. Grade 9-10

D. Preparatory school

E. college and above

7. 6. Status of job

A. unemployed

B. civil servant

C. NGO

D. involved in trade

E. farm

F. day worker

8. Monthly income

A. <600 birr

B. 601-1200

C. 1201- 1800

D. 1801-2400

E. 2401-3000

F. 3001-3600

G. 3601-4200

H. other

Part 2. Clinical

9. Clinical presentation

.....

10. Duration of symptoms (disease)

.....

11. Previous operation

.....

12. Indication for operation

.....

Part 3. Radiologic MRI Diagnostics

13. MRI colorectal patterns

A. Polypoid mass

B. Circumferential thickening

C. Tumor location from anal verge

14. MRI diagnoses

.....

15. MRI staging

A. Available

B. TNM stage

C. Not available

D. review the image for staging

16. MRI staging of post chemoradiation down staging

A. Available ☐

B. TNM stage

17. Senior doctor who reported the MR Name.....

18. MRI Doctor's qualification

A. Consultant ☐

B. Resident ☐

Part 3: Pathologic Biopsy Diagnostics

19. Pathologic biopsy

A. Endoscopic ☐

B. Excision surgical sample ☐

20. Pathologic biopsy diagnosis.....

21. Pathologic biopsy TNM stage

A. Available ☐

B. TNM stage

22. Senior doctor who reported the Pathology biopsy name.....

23. Biopsy doctor's qualification

A. Consultant ☐

B. Resident ☐

End: Thank you