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Role of MRI in Detection and Local Staging of Rectal Cancer

Thesis

Submitted for Partial Fulfillment of Master Degree in Radio Diagnosis and Intervention

Presented By

Ahmed Hassan Hassan Bek

M.B. B.Ch.

Under Supervision of

Prof. Dr. Mohamed Abd El-Aziz Aly

Professor of Radio diagnosis and Intervention

Faculty of Medicine - Ain Shams University

Dr. Shaymaa Hassan Mohamed Salah

Lecturer of Radio diagnosis and Intervention

Faculty of Medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

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Role of MRI in Detection and Local Staging of Rectal Cancer

Ahmed Hassan Hassan Bek, M.Sc.; Shaymaa Hassan Mohamed Salah, M.D. and Mohamed Abd El-Aziz Aly, M.D.

The Department of Radio-diagnosis and Interventional Radiology, Faculty of Medicine, Ain Shams University

Abstract

Background: Colorectal cancer is one of the most frequent causes of cancer-related death worldwide. An accurate preoperative rectal cancer staging is crucial to the correct management of the disease. Despite great controversy around this issue, pelvic magnetic resonance is said to be the standard modality.

Aim of study: The aim of this study is to assess the role of MRI in detection and local staging of rectal cancer

Patients and methods: 30 patients with rectal carcinoma were included with MRI and histopathological assessment of cancer staging to evaluate MRI accuracy. All patients received preoperative neoadjuvant chemotherapy.

Results: T3 staging with MRI, calculation of sensitivity, specificity, Negative and positive Predictive value were 73.3%, 40%, 60% and 55% respectively. T4 staging with MRI, calculation of sensitivity, specificity, Negative and positive Predictive value were 100%, 77%, 100% and 40% respectively.

Conclusion: MRI has a good sensitivity for tumor staging and nodal staging.

Keywords: colorectal cancer, MRI, T and N staging.

Introduction:

Colorectal cancer (CRC) is a heterogeneous disease that occurs in the colon and the rectum ***[1]***. The colon has 4 sections; the ascending, transverse, descending, and sigmoid colon, and the latter is where most CRC arise ***[2].*** The majority of CRC develop slowly from adenomatous polyps or adenomas ***[3]***. Recently, several studies suggested that CRC is a result of many factors, which are not only inherited but also acquired over the life course of the individual ***[4].***

CRC incidence and mortality rates vary markedly around the world. Globally, CRC is the third most commonly diagnosed cancer in males and the second in females according to the World Health Organization. Rates are substantially higher in males than in females ***[5].*** The highest incidence rates are in Europe, and North America, and the lowest rates are found in Africa and South-Central Asia. These geographic differences appear to be due to differences in dietary and environmental exposures ***[6,7].***

Low socioeconomic status is also associated with an increased risk for the development of CRC, potentially modifiable life style factors such as physical inactivity, unhealthy diet, smoking, and obesity are thought to account for a major proportion (estimates of one-third to one-half) of the socioeconomic role in development of CRC ***[8,9].***

Magnetic Resonance Imaging (MRI) is a powerful imaging technique for producing accurate anatomical images ***[10].*** As compared to other cross-sectional imaging modalities, MRI provides superior soft-tissue contrast and has no ionizing radiation exposure ***[11,12]***. MRI scanners use strong magnetic

fields, magnetic field gradients, and radio waves to generate images of the organs in the body. Magnetic resonance imaging is a medical application of nuclear magnetic resonance (NMR) ***[13,14].***

Patients and methods:

This was a cross sectional study that included 30 patients diagnosed with rectal cancer. The patients were selected from those attending the Radio diagnosis and Intervention department, Ain Shams University hospital in the period between June 2019 and March 2020.

Ethical considerations:

The study was approved from the Ethical committee of the department of Radio diagnosis and intervention, Faculty of Medicine, Ain Shams University. An informed consent was obtained from each patient.

Inclusion Criteria:

1- Patients over 18 years old.

2- Patients with biopsy-proven rectal cancer.

Exclusion Criteria:

A) Presence of general contraindications for MRI:

While in-situ metal implants are considered as absolute contraindication for MRI, there are other situations that possess relative contraindication for MRI.

I- Absolute contraindications for MRI *[15]*:

1- Pacemaker, defibrillator or wires other than sternal wires.

2- Metallic foreign body in the eye – these might move or heat during scanning resulting in serious eye injury.

3- Deep brain stimulator.

4- Bullets or gunshot pellets – near great vessels or vital organs.

5- Magnetic dental implants.

6- Drug infusion devices.

II- Relative contraindications for MRI *[15]*:

1- Other types of implants; surgical clips, wire sutures, screws or mesh, ocular prosthesis, penile prosthesis, joint replacement or prosthesis.

2- Morbidly obese patients might find it difficult to fit into the bore of the MRI.

3- Claustrophobic patients (might require sedation).

4- Surgery in the previous 6 weeks.

5- Significant pain might limit a patient's ability to lie still.

B) Presence for contraindications for administration of contrast media:

In patients with poor renal function, there is a risk of nephrogenic systemic fibrosis (NSF) associated with gadolinium chelate injections. Patients with known, or at risk of, renal impairment need to have their renal function assessed

before MRI in order to determine whether administration of gadolinium contrast is safe or not ***[3].***

Other acute reactions to gadolinium may be classified into major or severe and minor, and subdivided into local and general. The total incidence of adverse reactions to MRI contrast agents ranges approximately between 2% and 4%. Most frequently, minor, general reactions are nauseas, emesis, hives, headache, while local reactions are: skin irritation, itching and coolness .Cases of major acute adverse reactions to gadolinium, such as laryngospasm and anaphylaxis rarely occur ***[3].***

Study procedure:

1- Full history taking.

2- Full clinical examination to exclude any contraindication to MRI.

3- Magnetic resonance imaging:

- Pelvic MRI was performed on a 1.5 T magnet (Philips Acheiva, Guildford Business Park, Guildford, Surrey, Netherlands) with pelvic phased array coil and rectal gel administration.
- Only 2D T2-weighted (T2W) sequences were recommended for both primary and restaging.
- All patients underwent imaging while in the prone position following the placement of a small Foley catheter in the rectum and insufflation of approximately 200 to 300 cm^3 of room air. No bowel preparation was used. A sagittal fast-spoiled gradient echo sequence was used to localize

the lesion. This was followed by axial, conventional, spin echo T2-weighted images.

- Coronal and sagittal fast, spin echo T2-weighted images was obtained. All images were interpreted by the same radiologist. Specific comment was made regarding depth of invasion of the rectal wall, adjacent organ involvement, and the presence of lymphadenopathy.

MRI interpretation criteria:

A) T staging interpretations [16]:

- T1 was staged if the tumor be confined to the mucosal layer of the rectal wall.
- T2 was staged if there is invasion of the rectal layer up to the muscularis propria, with no penetration of the muscularis propria or perirectal fat.
- T3 was staged if there is invasion of all rectal layers with perirectal fat infiltration yet without pelvic organ involvement.
- T4 was staged if there is invasion of mesorectal fascia and visceral peritoneum or surrounding organ infiltration.

B) Lymph node staging interpretations [16]:

- N0 was diagnosed if there is no lymph node metastasis.
- N1 was diagnosed if there is metastasis in one to three lymph nodes.
- N2 was diagnosed if there is metastasis in four or more perirectal lymph nodes.

C) Main Outcome Measures:

Calculation of sensitivity, specificity, and accuracy for invasion through the bowel wall and lymph node status.

Surgical and Pathological plan-up:

All cases were operated upon usually after 1 month from the last MRI and the postoperative specimens were compared with preoperative MRI results.

All patients underwent anterior perineal resection, low anterior resection, or pelvic exenteration according to the location, and extension of previously diagnosed rectal cancer**.**

Post-operative pathological staging was correlated with the preoperative MRI findings.

Data management and Analysis:

The collected data was revised, coded, tabulated and introduced to a computer using Statistical package for Social Science **(IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp).** Data was presented and suitable analysis was done according to the type of data obtained for each parameter.

Results:

I- Epidemiological data:

The current study include 30 patients diagnosed with colorectal cancer. The patients were 18 (60%) males and 12 (40%) females. The patients' minimum age was 21 years and maximum was 75 years with mean of 48 ± 14 years old.

II- Clinical characteristics of patients' malignancies:

Location of the rectal cancer in the included patients was as follows: 3 (10%) in upper rectum, 7 (23%) in middle rectum and 20 (67%) in lower rectum.

Regarding histopathological type, 20 (66.7%) patients suffered from adenocarcinoma and 10 (33.3%) patient suffered from mucinous adenocarcinoma.

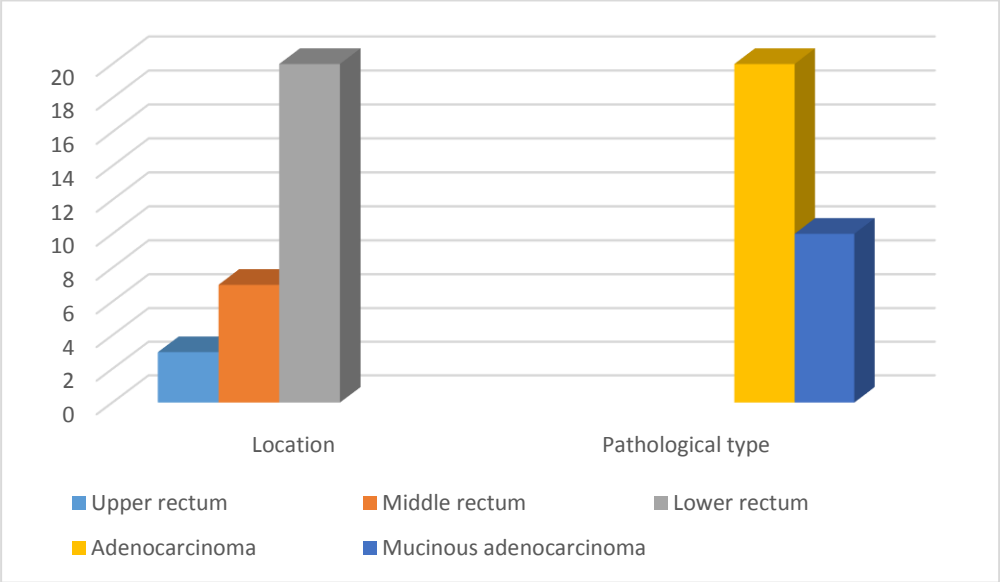

Figure (2): Clinical characteristics of patients' malignancies

III- MRI staging of included patients:

MRI T staging of the included patients revealed that 20 (66.7%) patients had T3 stage and 10 (33.3%) patients had T4 stage.

While, MRI N staging revealed that 2 (6.7%) patients had N0, 8 (26.7%) patients had N1 and 20 (66.6%) patients had N2 stage. **(Figure 3)**

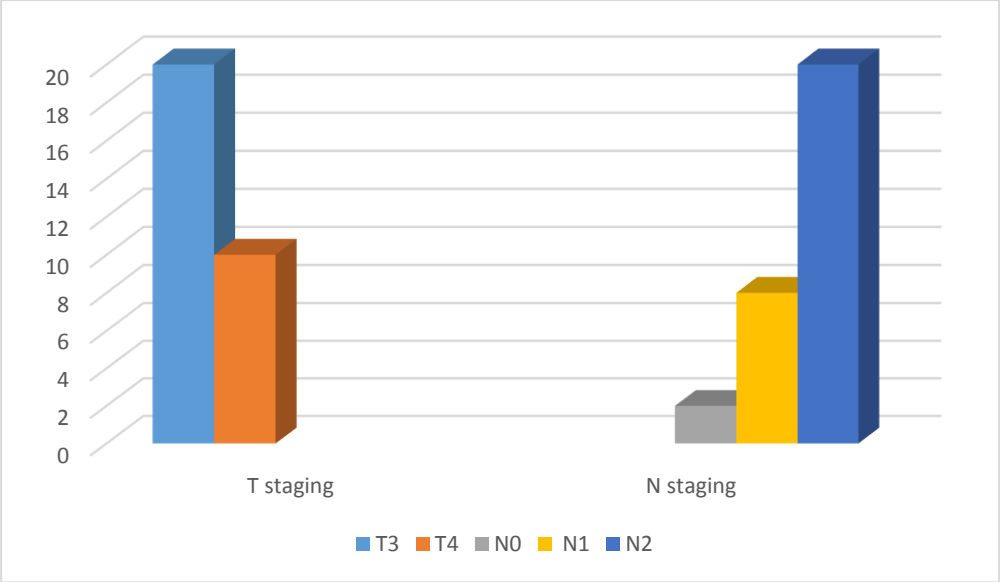

Figure (3): MRI staging of included patients