EVALUATION OF COMPARATIVE ROLE OF CT SCAN AND MRI IN LOCAL STAGING OF RECTAL CANCER

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ABSTRACT

BACKGROUND

Accurate staging of rectal cancer is helpful in improving the prognosis. CT scan and MRI are performed for staging of rectal malignancy, to assess the response to nonsurgical treatment, and for follow up. Imaging provides crucial information for the appropriate management of these cancers.

METHODS

50 patients were selected for the study for which they underwent computed tomography (CT) and MRI examination after explaining the entire procedure and the risks involved.

RESULTS

In our study, comparative role of CECT and MRI is examined in 50 patients with rectal cancer in which we found that CT scan has sensitivity of 88% in detecting rectal masses and MRI has sensitivity of 94% in detecting rectal masses. CT was able to correctly T stage 80% of patient with rectal masses and MRI was able to correctly T stage 94% of patient with rectal masses. Ability of CT was poor in detecting T1 and T2 tumours, however MRI was able to detect T2 tumours.

CONCLUSIONS

CECT being less expensive and faster investigation, is the first line investigation in patients of rectal cancers but MRI is the investigation of choice as it is the superior diagnostic imaging modality with improved detection and characterization of tumour and hence contributes to better diagnostic accuracy.

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BACKGROUND

The incidence of rectal cancers has been increasing following industrialisation and economic development.

Adenocarcinoma comprises vast majority of rectal cancers. However, Squamous cell carcinoma and its variants account for about 70% of all anal cancers in the United States.[1] More than a third of these occur in rectum near the anal verge[2,3]

There are multiple risk factors are related to rectal cancer including: Obesity (especially in men), Low fibre and high fat and animal protein diet, Family history of benign/malignant colorectal tumours, History of endometrial/breast cancer, Pelvic irradiation and colonic adenoma, Inflammatory bowel disease (IBD) (Chronic colitis and Crohn disease).

Recognized hereditary syndromes are- Gardner syndrome variant, Familial adenomatous polyposis syndrome (FAP), Peutz-Jeghers syndrome, Turcot syndrome variants and Hereditary non-polyposis colon cancer syndrome (HNPCC).

Role of imaging is to define the extent of tumour and lymph node involvement, evaluate the response to nonsurgical treatment and for follow up.

Contrast enhanced CT scan and MRI pelvis are the imaging techniques performed to evaluate rectal masses. Barium enema is uncommonly performed nowadays.

The advantages of MRI over CT include superior soft tissue contrast, absence of beam hardening artefacts, absence of ionizing radiation and ability to acquire images in multiple planes- axial, coronal and sagittal or any degree of obliquity.

AJCC TNM Staging of Colorectal Carcinoma (11)

The staging system most often used for colorectal cancer is the American Joint Committee on Cancer (AJCC) TNM system is as follows[4]-

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AJCC Stage	Stage Grouping	Stage Description*
0	**Tis N0 M0**	The cancer is in its earliest stage. This stage is also known as carcinoma in situ or intramucosal carcinoma (Tis). It has not grown beyond the inner layer (mucosa) of the colon or rectum.
I	**T1 or T2 N0 M0**	The cancer has grown through the muscularis mucosa into the submucosa (T1), and it may also have grown into the muscularis propria (T2). It has not spread to nearby lymph nodes (N0) or to distant sites (M0).
IIA	**T3 N0 M0**	The cancer has grown into the outermost layers of the colon or rectum but has not gone through them (T3). It has not reached nearby organs. It has not spread to nearby lymph nodes (N0) or to distant sites (M0).
IIB	**T4a N0 M0**	The cancer has grown through the wall of the colon or rectum but has not grown into other nearby tissues or organs (T4a). It has not yet spread to nearby lymph nodes (N0) or to distant sites (M0).
IIC	**T4b N0 M0**	The cancer has grown through the wall of the colon or rectum and is attached to or has grown into other nearby tissues or organs (T4b). It has not yet spread to nearby lymph nodes (N0) or to distant sites (M0).
IIIA	**T1 or T2 N1/N1c M0**	The cancer has grown through the mucosa into the submucosa (T1), and it may also have grown into the muscularis propria (T2). It has spread to 1 to 3 nearby lymph nodes (N1) or into areas of fat near the lymph nodes but not the nodes themselves (N1c). It has not spread to distant sites (M0).
	OR	
	T1 N2a M0	The cancer has grown through the mucosa into the submucosa (T1). It has spread to 4 to 6 nearby lymph nodes (N2a). It has not spread to distant sites (M0).
IIIB	**T3 or T4a, N1/N1c M0**	The cancer has grown into the outermost layers of the colon or rectum (T3) or through the visceral peritoneum (T4a) but has not reached nearby organs. It has spread to 1 to 3 nearby lymph nodes (N1a or N1b) or into areas of fat near the lymph nodes but not the nodes themselves (N1c). It has not spread to distant sites (M0).
	OR	
	T2 or T3 N2a M0	The cancer has grown into the muscularis propria (T2) or into the outermost layers of the colon or rectum (T3). It has spread to 4 to 6 nearby lymph nodes (N2a). It has not spread to distant sites (M0).
	OR	
	T1 or T2 N2bM0	The cancer has grown through the mucosa into the submucosa (T1), and it may also have grown into the muscularis propria (T2). It has spread to 7 or more nearby lymph nodes (N2b). It has not spread to distant sites (M0).
IIIC	**T4a N2a M0**	The cancer has grown through the wall of the colon or rectum (including the visceral peritoneum) but has not reached nearby organs (T4a). It has spread to 4 to 6 nearby lymph nodes (N2a). It has not spread to distant sites (M0).
	OR	
	T3 or T4a N2b M0	The cancer has grown into the outermost layers of the colon or rectum (T3) or through the visceral peritoneum (T4a) but has not reached nearby organs. It has spread to 7 or more nearby lymph nodes (N2b). It has not spread to distant sites (M0).
	OR	
	T4b N1 or N2 M0	The cancer has grown through the wall of the colon or rectum and is attached to or has grown into other nearby tissues or organs (T4b). It has spread to at least one nearby lymph node or into areas of fat near the lymph nodes (N1 or N2). It has not spread to distant sites (M0).
IVA	**Any T Any N M1a**	The cancer may or may not have grown through the wall of the colon or rectum (Any T). It might or might not have spread to nearby lymph nodes. (Any N). It has spread to 1 distant organ (such as the liver or lung) or distant set of lymph nodes, but not to distant parts of the peritoneum (the lining of the abdominal cavity) (M1a).
IVB	**Any T Any N M1b**	The cancer might or might not have grown through the wall of the colon or rectum (Any T). It might or might not have spread to nearby lymph nodes (Any N). It has spread to more than 1 distant organ (such as the liver or lung) or distant set of lymph nodes, but not to distant parts of the peritoneum (the lining of the abdominal cavity) (M1b).
IVC	**Any T Any N M1c**	The cancer might or might not have grown through the wall of the colon or rectum (Any T). It might or might not have spread to nearby lymph nodes (Any N). It has spread to distant parts of the peritoneum (the lining of the abdominal cavity), and may or may not have spread to distant organs or lymph nodes (M1c).

* The following additional categories are not listed in the table above:

- **TX:** Main tumour cannot be assessed due to lack of information.
- **T0:** No evidence of a primary tumour.
- **NX:** Regional lymph nodes cannot be assessed due to lack of information.

Aims and Objectives

- To evaluate the role of CT scan and MRI in diagnosis of rectal cancer and its characteristics.
- To evaluate the role of CT scan and MRI in staging of rectal cancer to determine surgical resectibility and their prognosis.

METHODS

This study was conducted on 50 patients with suspected rectal malignancy during the period of January 2018 to January 2019. All patients were scanned in the SIEMENS EMOTION 16, a sixteen slice CT scanner and 0.4 Tesla Hitachi Aperto MRI scanner. The study was conducted in Department of Radiology of Gujarat Cancer Research Hospital and BJ medical college, Asarwa, Ahmedabad.

Inclusion Criteria

All patients diagnosed and suspicious of masses arising from rectum on ultrasonography or clinical examination.

Exclusion Criteria

Patients having allergy from contrast material used in CT and MRI.

The patients having contraindicated to MRI will be excluded from the study, such as patients with Aneurysmal clips, Cardiac pacemaker, Implanted cardiac defibrillator, Cochlear implant, Metallic stent, Insulin pump, IUCD, diaphragm, pessary, Wire mesh implant and Claustrophobia.

Informed Consent

All patients were subjected to scanning after explaining the entire procedure and the risks involved. They were made aware of the methodology in their own language and their queries answered. Imaging done in the presence of a radiologist with standby anaesthetic support.

RESULTS

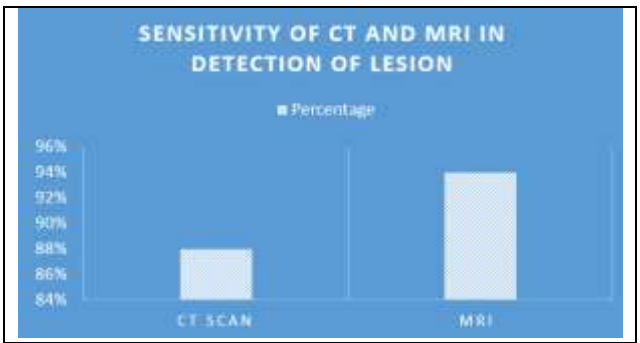
The present study included 50 cases of suspected rectal malignancy from January 2018 to January 2019 which were carried out at Gujarat Cancer and research institute, Ahmedabad following observation made according to CT and MRI appearance of masses and study data were analysed.

Modality	No. of Patient (n=50)	Percentage (%)
CT	44	88
MRI	47	94

Table 1. Sensitivity of CT Scan and MRI in Detection of Lesion

In my study MRI was able to detect lesion in 47 out of 50 patients and CT was able to detect lesion in 44 out of 50 patients.

So in my study CT has sensitivity of 88% in detecting rectal cancer and MRI has sensitivity of 94% sensitivity in detecting rectal cancer. These results correlate with study by Kwok H et al[5] which showed 78% sensitivity for CT and 89% sensitivity for MRI in detecting rectal cancer.



Graph 1

CT Appearance

In my study in 42 patients (84%) the lesion showed asymmetric wall thickening and 2 patients (2%) showed asymmetric wall thickening on CT scan.

In 38 patients (76%) the lesion showed heterogeneous post contrast enhancement and in 6 patients (12%) the lesion showed homogenous post contrast enhancement.

These results correlate with study by EJ Balthazaret al[5] in which out of 90 most lesions had an uneven, asymmetric wall thickening, and only four showed perfectly symmetric wall thickening.

		No. of Cases	Percentage
Wall Thickening	Symmetric	2	4
	Asymmetric	42	84
Post Contrast Enhancement	Homogenous	6	12
	Heterogeneous	38	76

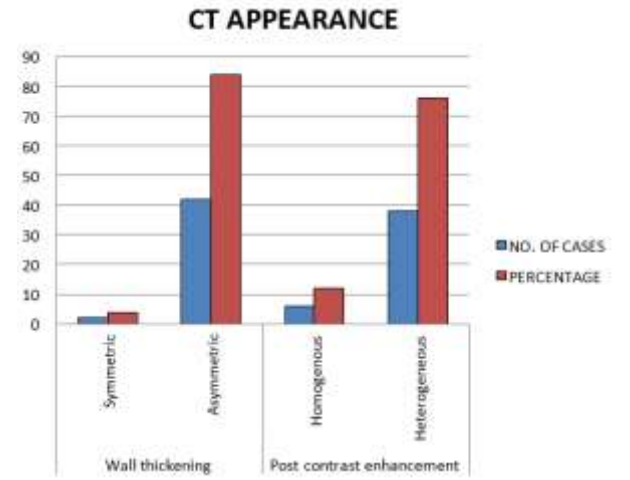
Table 2

Signal Characteristics

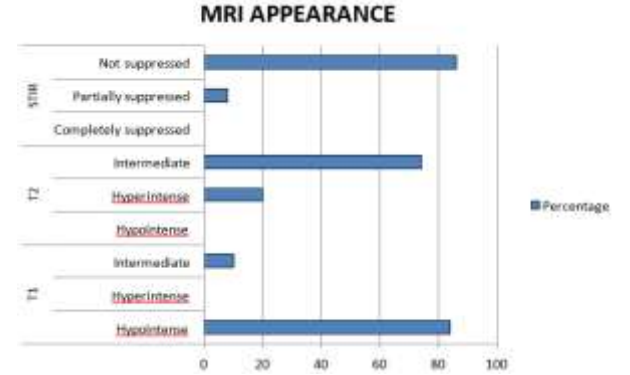
In this study, most of tumours were hypointense on T1w images (84%) and Intermediate on T2w images (74%). Few appeared intermediate signal intensity on T1w (10%) and hyper intense on T2w (20%) images. On STIR sequences, most of tumours were not suppressed (86%) and the rest were partially suppressed (8%).

Image Sequence	Signal Intensity	Percentage
T1	Hypointense	84
	Hyperintense	0
	Intermediate	10
T2	Hypointense	0
	Hyperintense	20
	Intermediate	74
STIR	Completely suppressed	0
	Partially suppressed	8
	Not suppressed	86

Table 3



Graph 2



Graph 3

Signal intensity of lesions in my study correlates with findings by Supreeta Arya, et al.[6] T staging is decided by examining the T2W signal intensity of the normal rectum and of the tumour extending into the layers of the rectal walls and the mesorectal fat. The tumour usually has intermediate signal intensity on T2W MR images.

Post Contrast Enhancement

Post contrast study was performed in all patients. Majority (82%) of the lesion were heterogeneously enhancing while rest (12%) were homogenously enhancing. On strength wise there were 74% of moderately enhancing lesion, 12% mildly enhancing lesion and 8% were markedly enhancing lesion. Overall most of the tumours were moderately and heterogeneously enhancing as most of the malignancy has propensity towards some amount of internal necrosis.

		No. of Cases	Percentage
Homogeneity	Homogenous	**6**	**12**
	Heterogeneous	**41**	**82**
Strength	Mild	**6**	**12**
	Moderate	**37**	**74**
	Marked	**4**	**8**

Table 4

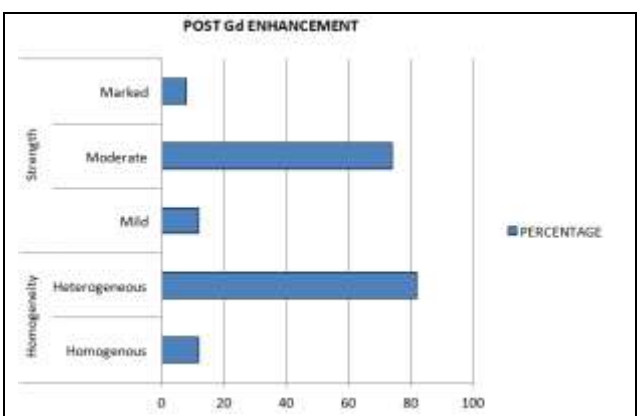
Mesorectal Fascia Invasion

Modality	No. of Patients (n=50)	Percentage (%)
CT	41	82
MRI	47	94

Table 5

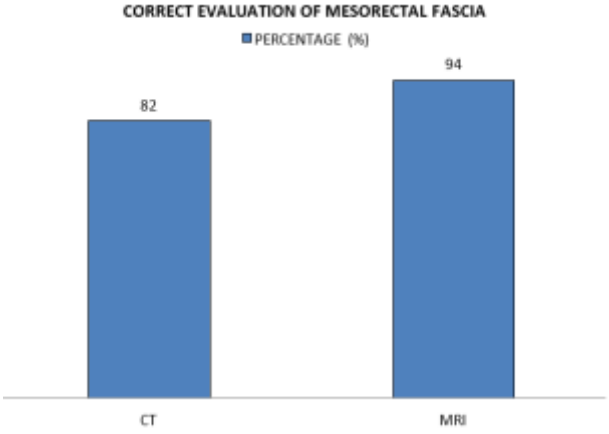
CT correctly evaluated invasion of mesorectal fascia in 41 patients and MRI correctly evaluated invasion of mesorectal fascia in 47 patients.

Study revealed that MRI is the best investigation to correctly evaluate invasion of mesorectal fascia, when the lesion was large that CT scan was able to point towards invasion of mesorectal fascia.



Graph 4

Our findings correlate with study by Maizlin ZV, et al[7] which showed that CT cannot replace MRI to evaluate mesorectal fascia invasion in rectal cancer stag in.



Graph 5

Correct Evaluation of Anal Sphincter Involvement

Evaluation of sphincter complex status is important to decide sphincter-sparing surgery as well as the need for preoperative RT. MRI proved to be best investigation to evaluate anal sphincter involvement. CT scan was poor when compared with MRI.

My findings correlate with study by Supreeta Arya et al[6] which showed that the accuracy of MDCT to predict anal sphincter status is difficult to predict compared to MRI.

Modality	No. of Patient (n=50)	Percentage (%)
CT	45	90
MRI	50	100

Table 6

T Staging

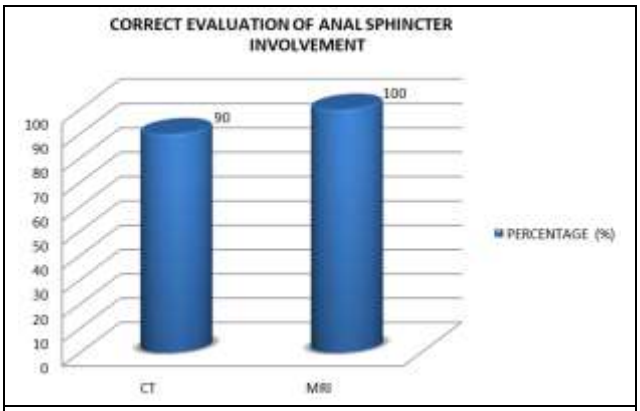
Ability of CT was poor in detecting T1 and T2 tumours, however MRI was able to detect T2 tumours.

On CT scan 40 out of 50 patients were T staged accurately for local tumour extent with over all sensitivity of 80% and on MRI 47 out of 50 patients were T staged accurately for local tumour extent with over all sensitivity of 94%.

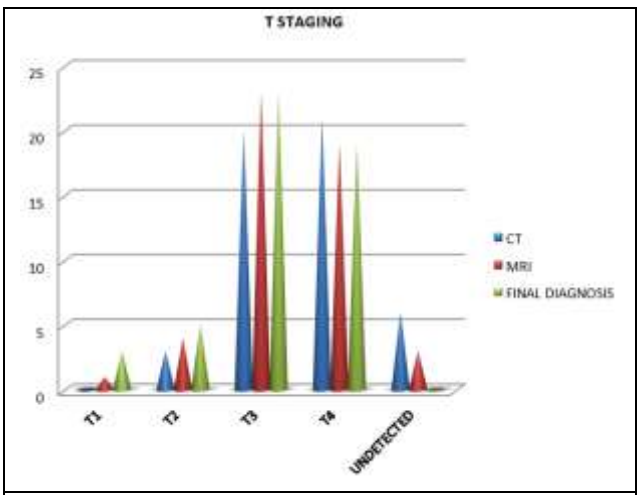
The findings of my study correlate with study by Beets-Tan at el[8] which showed 70% sensitivity for CT and 97% sensitivity for MRI in T staging for local tumour extent in rectal cancer.

T Staging	CT	MRI	Final Diagnosis
T1	0	1	3
T2	3	4	5
T3	20	23	23
T4	21	19	19
Undetected	6	3	0

Table 7



Graph 6



Graph 7

Lymph node Involvement

Modality	No. of Patient (n=10)	Percentage (%)
CT	7	70
MRI	9	90

Table 8

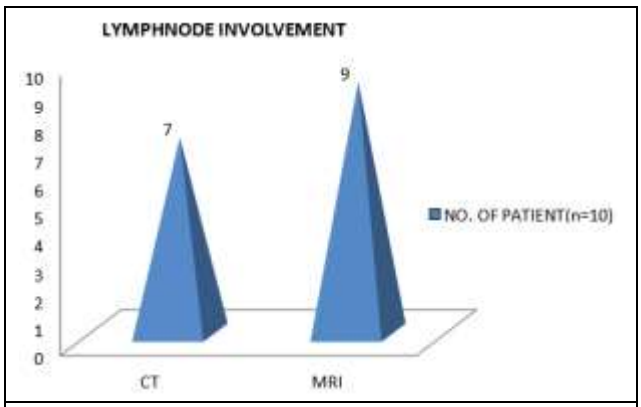
CT scan was able to detect nodal involvement in 7 patients with sensitivity of 70% and MRI was able to detect nodal involvement in 9 patients with sensitivity of 90%. MRI was not able to detect nodal involvement in one patient which was found post operatively.

Result of my study correlates with study by Meyenberger C et al[9] which showed 77% sensitivity of CT scan and 86% sensitivity of MRI in detecting nodal involvement.

Modality	No. of Patient (n=50)	Percentage (%)
CT	44	88
MRI	47	98

Table 9. Decision on Operability

Due to high spatial resolution and soft tissue contrast MRI appears to be better for evaluation of extension of tumour and thereby remains investigation of choice for decision on operability.



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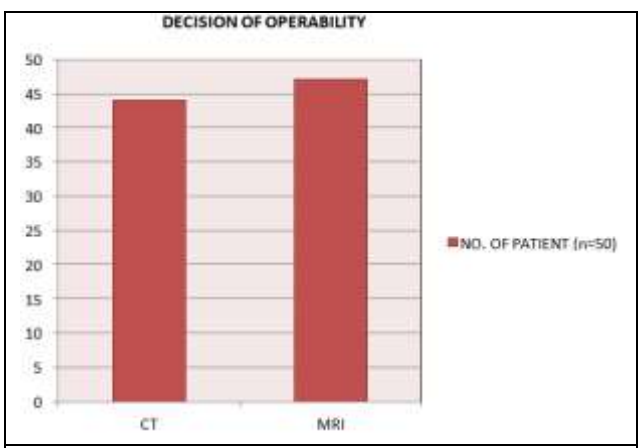

Graph 9

DISCUSSION

Total 50 patients of rectal mass lesion were studied using 16 slice CT scan machine and 0.4 Tesla MRI scanners.

Technically adequate images were obtained in all patients and there was excellent demonstration of the relevant anatomy, MPR images on CT scan and signal characterization of each tumour on MRI.

Lesions were staged using TNM classification.

Adenocarcinoma comprises vast majority of rectal masses (92%). Other reported histopathological masses are squamous cell carcinoma (4%), carcinoid (2%) and GIST (2%). Squamous cell carcinoma and its variants account for about 70% of all anal cancers in the United States.[1]

CT scan has sensitivity of 88% in detecting rectal masses and MRI has sensitivity of 94% sensitivity in detecting rectal masses.

Most rectal masses present as asymmetric circumferential wall thickening with heterogeneous post contrast enhancement on CT scan.

Most rectal masses appear hypo intense on T1w, intermediate signal intensity on T2w and are not suppressed on STIR images. On post Gadolinium study most rectal masses appear heterogeneous and shows moderate post contrast enhancement.

MRI is better as compared to CT scan in evaluation of mesorectal fascia involvement, evaluation of anal sphincter involvement and nodal extension. Rectal cancer is particularly known to have high frequency of micro metastases in normal-sized nodes[10,11,12,13]

CT was able to correctly T stage 80% of patient with rectal masses and MRI was able to correctly T stage 94% of patient with rectal masses. Ability of CT was poor in detecting T1 and T2 tumours, however MRI was able to detect T2 tumours.

MRI is better in assessment of lymph node involvement as compared to CT scan. MRI is better in taking decision of operability of rectal masses as compared to CT scan.

CT scan had 82% accuracy in TNM staging of rectal masses and MRI had 92% accuracy in TNM staging of rectal masses.

T1 and T2 tumours are treated with surgery. T3 tumours are given pre-operative radiotherapy followed by surgery or chemotherapy. T4 lesions are primarily treated with chemo radiation.

Most of residual/recurrent lesion were found in stage III and IV lesions. None were found in stage I lesions.

CONCLUSION

Both modalities CT and MRI are useful for characterisation of features of rectal carcinoma. CECT examination is useful as initial cost and time are less. It is an effective tool for diagnosing and staging rectal malignancy but there are certain characteristics of rectal tumours such as initial stage of rectal malignancy (T1, T2), mesorectal fascia involvement and lymph node assessment in which MRI is superior compared to CT.

Case 1. Adenocarcinoma Rectum (T3N0M0)

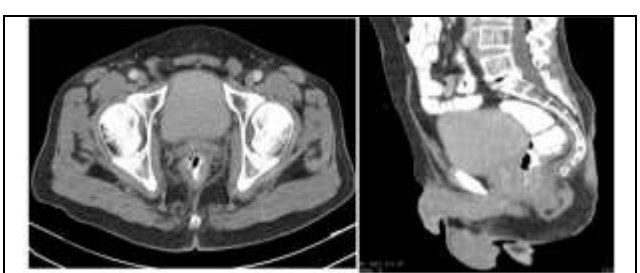

Image 1

On CT scan, heterogeneously enhancing asymmetric wall thickening involving rectum with fat stranding in mesorectal fascia.

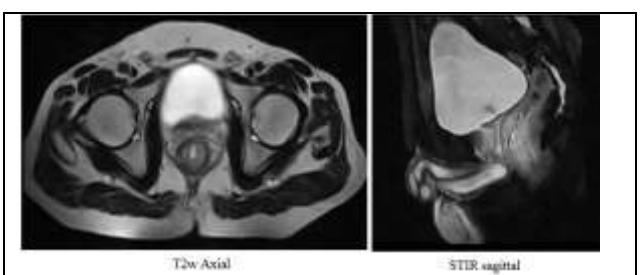

Image 2

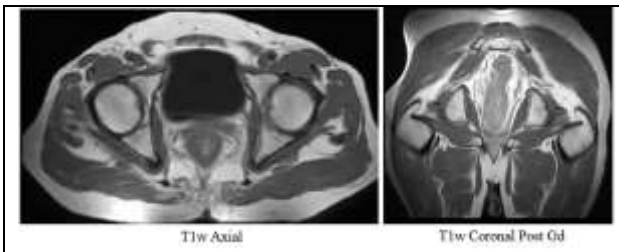

Image 3

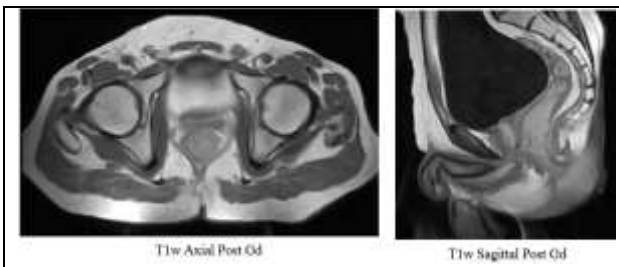

Image 4

On MRI, asymmetric wall thickening involving rectum with mesorectal fascia involvement. The lesion appears hypointense on T1W, intermediate intensity on T2W, not suppressed on STIR and shows moderate heterogenous enhancement on Post Gd study.

Case 2. Adenocarcinoma Rectum T2 Lesion

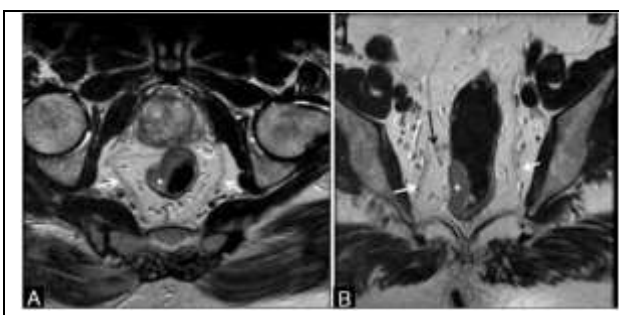

Image 5

Axial T2W MRI shows rectal tumour (*) from 7 'O'clock to 1 'O'clock position; T2 tumour (no spread into mesorectal fat). (B) Coronal T2W MRI. White arrows in (a and b) show mesorectal fascia; black arrow in (B) shows insignificant perirectal nodes (<3 mm).

Case 3. Adenocarcinoma Rectum T1 Lesion

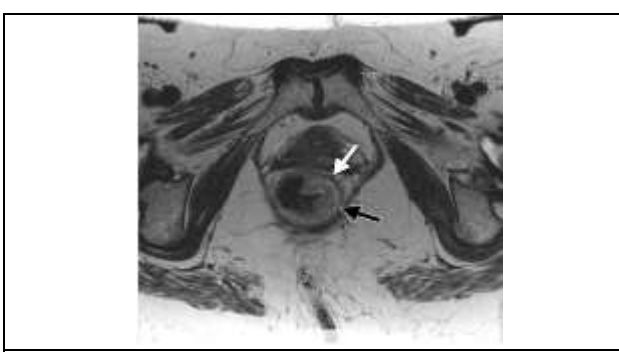

Image 6

Orthogonal axial 3D T2-weighted MR image (18-cm FOV, 256 × 256 matrix, 2-mm section thickness) has a superior SNR, which permits delineation of the submucosa as a thin hyperintense line (black arrow) between the tumour and an uninvolved muscularis propria (white arrow), allowing the correct diagnosis of a stage T1 tumour.

Case 4. Adenocarcinoma Rectum T3 Lesion

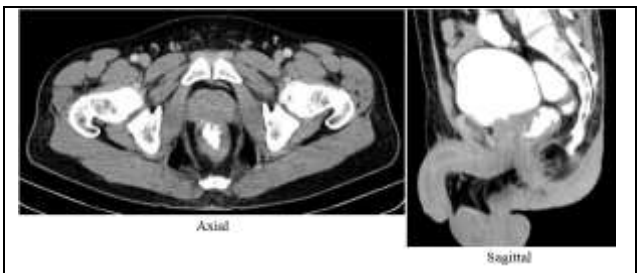

Image 7

On CT scan, homogenously enhancing asymmetric wall thickening involving rectum with fat stranding in mesorectal fascia.

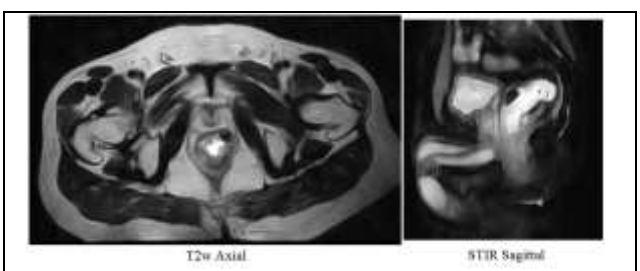

Image 8

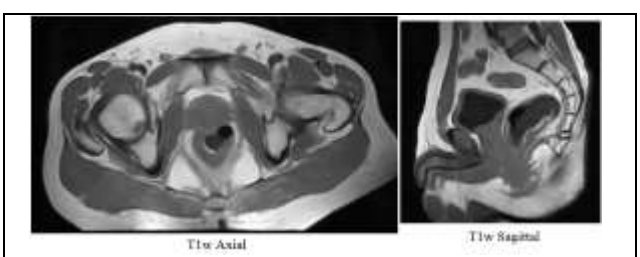

Image 9

On MRI, asymmetric circumferential wall thickening involving rectum with mesorectal fascia involvement. The lesion appears hypointense on T1W, intermediate intensity on T2W and not suppressed on STIR.

Case 5. Adenocarcinoma Rectum T4N2 Lesion

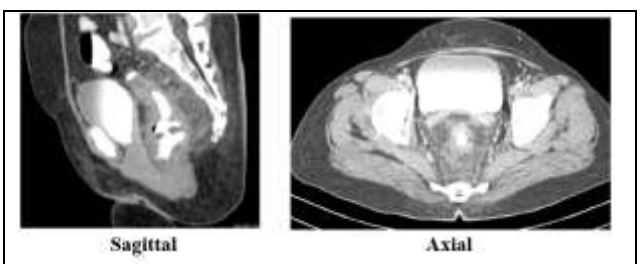

Image 10

On CT scan, heterogeneously enhancing asymmetric wall thickening involving rectum with fat stranding in mesorectal fascia in a post hysterectomy patient. Lesion abuts vault of vagina with loss of fat plane. Multiple enlarged necrotic mesorectal nodes noted.

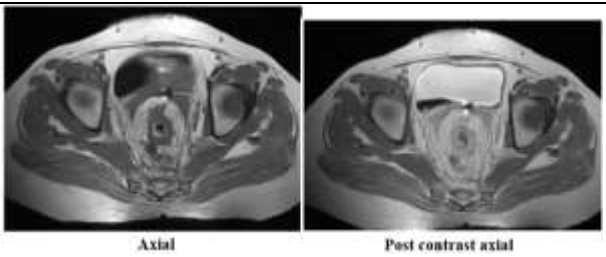

Image 11

On MRI, asymmetric circumferential wall thickening involving rectum with mesorectal fascia involvement. Lesion shows marked heterogenous Post Gd enhancement. The lesion abuts vault of vagina with loss of fat plane. There are multiple enlarged necrotic mesorectal nodes noted.

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