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The Predictive Value of F18 FDG PET/CT and Diffusion Weighted MRI Derived Functional Parameters in Prediction of Response to Neoadjuvant Therapy in Patients with Locally Advanced Colorectal Cancer

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Abstract

Background: Rectal cancer is one of the most common malignancies globally, when it comes to locally advanced cases typically a patient undergoes neoadjuvant treatment followed by surgery with curative aim. But, in the new era of more customised care, tailored medicine and treatment, it is necessary to study the possibilities for assessing response accurately before surgery in order to provide the optimum treatment for each patient especially with the rise of a wait and see strategy and less intrusive surgery.

Aim of Study: The purpose of this prospective study was to investigate and compare the ability of different PET CT and DWMRI functional parameters in assessing response to neoadjuvant treatment in patients with locally advanced rectal cancer (LARC).

Patients and Methods: A total 30 patients with proven LARC in the national cancer institute (NCI) underwent both pre- and post-neoadjuvant therapy FDG PET/CT and pelvic DW-MRI scans. For each patient initial and post therapy SUVmax, MTV, TLG, ADC as well as ΔSUVmax, ΔMTV, ΔTLG and ΔADC were calculated, post therapy pathological results were assessed and results were correlated.

Results: In post neoadjuvant therapy scans the SUVmax, SUVpeak, SUL in PET/CT and ADC values were significantly correlated with pathological response. Regarding % change in all functional parameters the % ΔSUV max was the sole parameter that owes a statistically significant correlation with pathological response. The final MRI tumour length and thickness as well as % changes in tumour length showed statistical significance in predicting response to neoadjuvant therapy. The initial ADC value is the only factor that could predict response in initial assessment.

Conclusion: Both F18 FDG and DW-MRI diagnostic imaging modalities with their functional parameters can predict neoadjuvant therapy response ($p<0.05$) in patients with advanced colorectal cancer, however overall DW-MRI showed a relatively better specificity, positive predictive value and overall accuracy in predicting response to neoadjuvant therapy.

Key Words: *Locally advanced rectal cancer – Assessment of response – PET/CT – DW-MRI – SUVmax – ADC.*

Introduction

COLORECTAL cancer (CRC) ranks as the third most prevalent cancer among both genders globally. As reported by the American Cancer Society (ACS), colorectal cancer (CRC) ranks as the second leading cause of cancer-related mortality in the United States in 2024 **[1]**.

In early-stage colorectal cancer, curative surgery is the primary treatment. For locally advanced rectal cancer, neoadjuvant therapy is the preferred option to reduce pelvic recurrence before surgical intervention, as opposed to a wait-and-see approach aimed at organ preservation **[2]**.

While the gold standard in assessing response to neoadjuvant therapy is post treatment pathological examination, both DW MRI and FDG PET/CT have emerged as powerful non-invasive modalities

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in assessing response to treatment through microstructural and functional assessment however association between both diagnostic modalities is still advised in some studies to achieve better assessment and to achieve the best outcome **[3]**.

Patients and Methods

1- *Patients:*

This is a prospective study conducted in the National Cancer Institute (NCI) of Cairo University after being approved by the clinical research ethical committee of Cairo university. The study was conducted between August 2021 and August 2023 in the nuclear medicine and radiology departments. Initially 53 patients were enrolled after providing consents, however only 30 patients were included in final analysis after meeting all inclusion criteria. All patients who were enrolled initially had locally advanced colorectal cancer (T2-4, N0-2) that was established by pathological analysis of endoscopic biopsy and preoperative diagnostic imaging modalities, mainly MRI. Besides, all were non metastatic as proved by initial FDG PET/CT study, supported by exclusion of metastases in doubtful lesions by other imaging modalities.

Inclusion criteria:

- Adult patients (>18 years) with pathologically proven colorectal cancer.
- Locally advanced nonmetastatic tumors: Locally advanced rectal cancer (LARC) is characterized as stage II (T3-4, node negative) or stage III (any T, node positive).
- MRI and PET/CT imaging are utilized for initial staging before the implementation of the neoadjuvant therapy protocol at NCI.
- MRI and PET/CT 4-8 weeks post neoadjuvant therapy for evaluation of local tumor response and for restaging.
- Had surgical removal of the primary tumor with available detailed post operative pathology report.
- Provided consent.
- Normal hepatic and renal functions.

Exclusion criteria:

- Pregnant females.
- Double primary or metastatic lesions.
- Patients having a contraindication to MRI or IV contrast agent.
- Patients who received any form of previous therapy for colorectal cancer.

2- *Imaging protocol:*

• *FDG PET/CT:*

Patients were given written instructions to fast 4-6 hours pre-injection and to avoid rigorous activity and high carbohydrate meals the day before exam.

FDG PET/CT was done by the following technique:

- Post confirming normal serum glucose level, patients were injected intravenously by a dose of FDG dose of 5 MBq/Kg.
- Then the acquisition was done approximately 45-60 minutes after IV injection.
- Low dose non contrast CT was acquired for both better anatomic localization and attenuation correction.
- PET is acquired from skull mid-thigh.
- Data were processed and displayed and fused images are displayed in trans-axial, sagittal and coronal projections.

• DW-MRI:

- All patients underwent examination with a 1.5 Tesla MRI machine utilizing the following MR sequences:
- Multiplanar MRI sequences, including T1 and T2-weighted images.
- Axial diffusion-weighted imaging (DWI) employing various *b*-values. For each diffusion-weighted (DW) sequence, an apparent diffusion coefficient (ADC) map will be calculated automatically on a pixel-by-pixel basis using multiple *b*-values.
- The axial T2-weighted and diffusion-weighted image sequences are oriented in the same planes, perpendicular to the rectal lumen at the tumor location.
- Contrast-enhanced T1 and fat-suppressed T1-weighted sequences.

Image analysis:

MRI:

MRI images were read on NCI PACS system in NCI, structural data and measurements were obtained and additionally diffusion data and ADC values were obtained and tabulated for analysis.

PETCT:

Processing and imaging analysis:

PET/CT images were analyzed qualitatively and quantitatively on GE ADW workstation, whole body images were analyzed and 3D ROI (region of interest) were placed over entire lesion to obtain quantitative data, the ROI was placed using a semi quantitative software, however the margins were

adjusted manually to avoid overlap with adjacent structures with physiological FDG activity.

Calculated functional metabolic parameters in PETCT:

These parameters include SUVmax, and SUVmean (normalized to the body weight), SUL (SUV normalized by lean body mass), SUL peak (highest possible mean value of a 1cm^3 spherical VOI positioned within the tumor), MTV (metabolic tumour volume) and TLG (Total lesion glycolysis).

Imaging response:

- Parameters collected from initial and post neoadjuvant FDG and PET/CT including SUV max pre, SUVmax post, % change in SUVmax, MTV pre, MTV post and % change in MTV, TLG pre, TLG post and % changes in TLG, ADC pre, ADC post and % change in ADC were correlated with pathological data. Post operative pathological analysis:
- The AJCC TRG system categorizes the pathological response to neoadjuvant treatment as follows: TRG 0 = no viable cancer cells (complete response); TRG 1 = single cells or rare small groups of cancer cells (near complete response); TRG 2 = residual cancer with evident tumor regression, but more than single cells or rare small groups of cancer cells (partial response); TRG 3 = extensive residual cancer with no evident tumor regression (poor or no response) [4].
- In our study, patients with post-surgical AJCC pathological TRG (tumor regression grading system) 0, 1 were considered responders and 2 and 3 were considered non responders.
- The collected MRI data were tabulated and statistically correlated with post-operative pathological data.

3- *Statistical analysis:*

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the non-parametric Kruskal-Wallis and Mann-Whitney tests [5]. For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5 [6]. ROC curve was constructed with area under curve analysis performed to detect best cutoff value of significant parameters for detection of pathological major response. Standard diagnostic indices including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic efficacy were calculated as described by (Galen, 1980) [7]. *p*-values less than 0.05 were considered as statistically significant.

Results

A total of 30 patients were incorporated into the final dataset. Based on post-surgical pathological data, patients were categorized into responders and non-responders according to AJCC pathological TRG, with scores of 0 and 1 classified as major responders, and scores of 2 and 3 as poor responders

The mean age of the patients was 50.3±12.54 years old (range 29 to 70 years old). The study included 15 females (50%) and 15 males (50%). Patients were classified according to the site of the primary into purely rectal lesions (56.7%), anorectal (36.7%) and rectosigmoid (6.7%). Most of the lesions were adenocarcinoma; 25 patients (83.3%), while only 2 were mucinous adenocarcinoma (6.7%), 2 signet cell carcinoma (6.7%) and 1 poorly differentiated (3.3%). Most patients have T3 primary lesion (93.3%) and N2 found in 20 patients (76.7%).

Regarding post-surgical pathological AJCC TRG, only 7 out of the 30 patients (23.3%) were considered major responders (including TRG 0 and 1), while the remaining 23 (76.7%) patients were poor responders (including TRG 2, 3) (Table 1).

Table (1): Pathologic Response to neoadjuvant treatment (n=30).

(n=30)			
Responders (n=7) (23.3%)	TRG 0	N=5	(16.7%)
	TRG 1	N=2	(6.7%)
Non-responders (n=23) (76.7%)	TRG 2	N=9	(30.0%)
	TRG 3	N=14	(46.7%)

Initial PET/CT and MRI Parameters analysis:

Regarding PET parameters, initial lesion thickness (mean 2.3cm), initial SUVmax (mean 17.6, range from 4 to 44), MTV (mean 27, range from 10 to 138), TLG (mean 255.3, range from 40 to 1500) & SUVpeak (mean 13.6, range from 3.2 to 36) and SUL peak (mean 9.9, range from 3.2 to 36) were correlated with pathologic response (Table 2-A). For MRI Parameters, the length of lesion (mean 7.3cm ±2.5), initial lesion thickness (mean 2.6cm ±1.5), and initial ADC (mean 0.79±0.2x 10^{-3} mm^2/s) were used for the correlation with pathologic response (Table 2-B).

Table (2-A): Parameters of initial PET/CT and their association with pathological Response.

	Pathological response										*p*-value
	Responders					Non responders					
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Age	55.71	10.73	62.00	41.00	67.00	48.70	12.79	49.00	29.00	72.00	0.245
Thickness (PET/CT)	2.22	0.55	2.15	1.60	3.00	2.38	0.64	2.30	1.50	4.30	0.682
SUV max (Initial PET/CT)	17.39	10.31	16.00	4.00	31.00	17.86	10.09	15.60	7.70	44.00	0.924
MTV (Initial PET/CT)	23.33	14.94	20.00	12.00	54.00	30.70	26.97	24.00	10.00	138.00	0.441
TLG (Initial PET/CT)	213.86	153.74	206.00	50.00	500.00	296.83	314.61	213.00	40.00	1500.00	0.532
SUV peak (Initial PET/CT)	13.50	7.63	13.00	3.20	21.00	13.72	8.00	11.80	6.30	36.00	0.924
SUL peak (Initial PET/CT)	9.94	6.11	9.80	2.50	18.50	9.85	6.10	7.90	3.70	29.00	0.924

Table (2-B): Parameters of initial MRI and their association with pathological response.

	Pathological response										*p*-value
	Responders					Non responders					
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Length /longest diameter of mass (initial MRI)	7.27	2.55	7.40	4.00	12.00	7.67	3.55	6.70	2.80	19.00	0.962
Thickness (initial MRI)	2.60	1.53	2.00	1.60	5.80	2.57	1.15	2.10	1.50	5.60	0.685
ADC Lesion (initial MRI)	0.90	0.31	0.90	0.40	1.40	0.67	0.20	0.60	0.40	1.20	0.027

As illustrated in Table (2 A&B), all initial PET/CT parameters failed to attain statistical significance when correlated with pathological response, only initial ADC was statistically significant in predicting pathological response, as responders had higher initial ADC lesion value compared to non-responders with a statistically significant difference (*p*~0.027). The best calculated cut-off value of initial ADC equals 0.8 x 10^{-3} mm^2/s, with sensitivity and specificity of 71.4% and 78.3% respectively (Fig. 1).

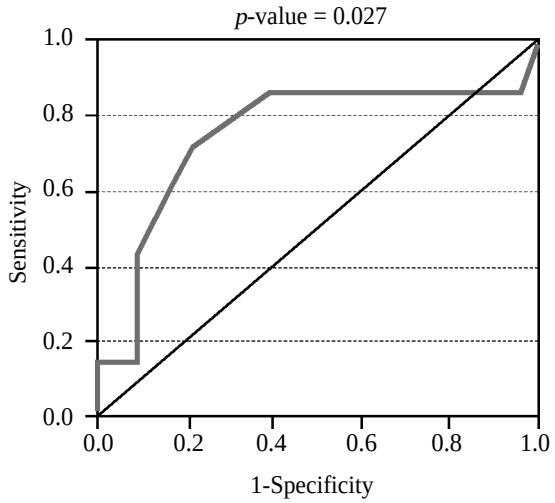

Fig. (1): ROC curve for initial ADC in prediction of tumor response to neoadjuvant therapy AUC = 0.748 (95% CI: 0.500 – 0.996). Best cutoff value = 0.80 x 10^{-3} mm^2/s (with Sensitivity = 71.4%, and specificity = 78.3%).

Post neoadjuvant PET/CT and MRI Parameters analysis:

- Post neoadjuvant FDG PET/CT parameters, including post lesion thickness (mean 1.6 range 0.9 to 5), post SUVmax (mean 8.67, range from 2 to 36), post SUVpeak (mean 6.21, range from 3.2 to 36) and post SUL peak (mean 4.45 range 1.2 to 16). The former (post SUVmax) showed statistically significant predictive value (*p*-value <0.001), post SUVpeak and post SUL peak also showed positive predictive values (*p*-value 0.001). Other parameters including post MTV (mean 18.4, range from 5 to 141), post TLG (mean 97.8, range from 20 to 1748) showed no statistical significance (Table 3-A).
- Table (3-B) shows a summary of the main post MRI measurements of the rectal lesion in the population of the study including length (mean 4.8cm ±3.6), thickness (mean 1.53±0.5), and post ADC (mean 0.29±0.2 x 10^{-3} mm^2/s), post MRI length, thickness of tumor and post ADC showed statistically significant positive value in predicting pathological response (Table 3-B).

In a ROC curve for assessment of response using post ADC values, a cut off value of 1.05 x 10^{-3} mm^2/s adequately differentiated responders and non-responders, with sensitivity 83.3% and specificity 69.6% (Fig. 2).

In the current study the percent of change (% Δ) between main initial and post PET/CT and MRI functional parameters were calculated. Only % Δ of SUVmax showed a significant positive correlation with pathological response (*p*:0.003), while for all other % Δ (those of MTV, TLG and ADC) this significant correlation was lacking with a *p*-value >0.05. (Table 3-A,B).

Table (3-A): Parameters of post neoadjuvant PET/CT and their association with pathological response.

	Pathological response										*p*-value
	Responders					Non responders					
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Thickness (Post PET CT)	1.39	0.45	1.20	0.90	2.00	1.84	0.82	1.60	1.00	5.00	0.110
SUV max (Post PET CT)	4.67	2.31	4.30	2.00	9.00	12.67	7.37	11.00	4.50	36.00	<0.001
MTV (Post PET CT)	16.61	10.94	14.00	7.30	40.00	20.26	28.17	13.00	5.00	141.00	0.666
TLG (Post PET CT)	44.14	26.62	39.00	20.00	94.00	151.48	351.55	62.00	24.00	1748.00	0.054
SUVpeak (Post PET CT)	3.51	1.45	3.50	1.80	6.20	8.91	5.24	7.50	1.70	22.00	0.001
SUL peak (Post PET CT)	2.47	1.11	2.30	1.40	4.60	6.43	3.78	5.70	1.20	16.00	0.001
% ΔSUVmax	-66.74	14.89	-63.13	-87.39	-50.00	-20.22	38.31	-18.82	-71.15	50.00	0.003
% SUVmax reduction	66.74	14.89	63.13	50.00	87.39	20.22	38.31	18.82	-50.00	71.15	0.003
% ΔMTV	-23.21	35.56	-25.93	-53.33	50.00	-36.28	31.53	-40.00	-76.56	23.81	0.266
% MTV reduction	23.21	35.56	25.93	-50.00	53.33	36.28	31.53	40.00	-23.81	76.56	0.266
% ΔSTLG	-70.75	15.91	-71.43	-95.80	-54.55	-48.39	37.94	-56.79	-92.87	26.05	0.207
% TLG reduction	70.75	15.91	71.43	54.55	95.80	48.39	37.94	56.79	-26.05	92.87	0.207

Table (3-B): Parameters of post neoadjuvant MRI, and % of change in length their association with pathological response.

	Pathological response										*p*-value
	Responders					Non responders					
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
length/longest diameter if mass	2.60	1.37	2.60	0.00	4.50	7.01	3.58	6.00	2.00	16.00	<0.001
Thickness (Post MRI)	1.29	0.47	1.30	0.40	1.80	1.78	0.49	1.70	1.00	2.70	0.036
ADC of lesion (Post MRI)	1.18	0.22	1.20	0.80	1.40	0.95	0.24	0.90	0.50	1.40	0.047
ADC pre- ADC post	-0.30	0.15	-0.35	-0.40	0.00	-0.28	0.22	-0.30	-0.70	0.00	0.694
ADC% increase	43.95	33.13	36.65	0.00	100.00	47.20	38.84	44.40	0.00	140.00	1.000
% decrease in longest diameter	58.27	22.50	56.76	36.11	100.00	8.88	21.31	9.33	-41.79	48.57	<0.001

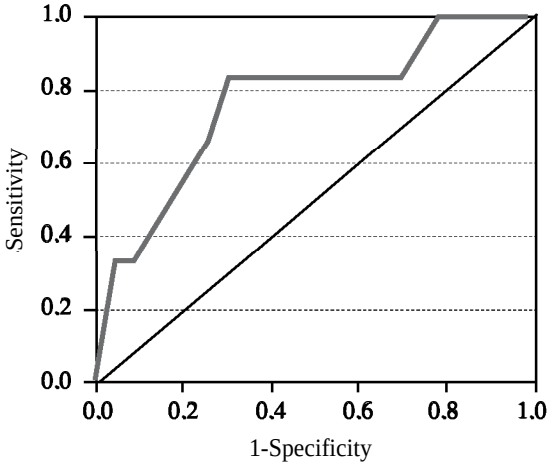

Fig. (2): ROC curve for post ADC in prediction of tumor response to neoadjuvant therapy AUC = 0.764 (95% CI: 0.542 – 0.987). Best cutoff value = 1.05 x 10^{-3} mm^2/s (with Sensitivity = 83.3%, and specificity = 69.6%).

Table (4) shows the significant correlation between post SUV max and its % change with response prediction to neoadjuvant therapy with a p value of <0.001 and 0.003 respectively. In a ROC curve for assessment of response using SUVmax in differentiation between responders and non-responders a cut-off value of 6.05 was reported with a sensitivity and specificity of 85.7% and 87% respectively. On the other hand for % change of SUV max, a cut off value of reduction of 49% was demonstrated to adequately differentiate between responder and non- responders, with sensitivity 100% and specificity 65% (Table 4, Fig. 3).

The percent of change (% Δ) between main initial and post MRI length and thickness parameters were calculated. Only % Δ of length showed a significant positive correlation with pathological re-

sponse (p<0.001) (Table 5-A). In a ROC curve for assessment of response using % change in length, a cut off value of 33% was demonstrated that it can adequately differentiate responders and non-responders with sensitivity 100% and specificity 95% (Table 5-B) (Fig. 4).

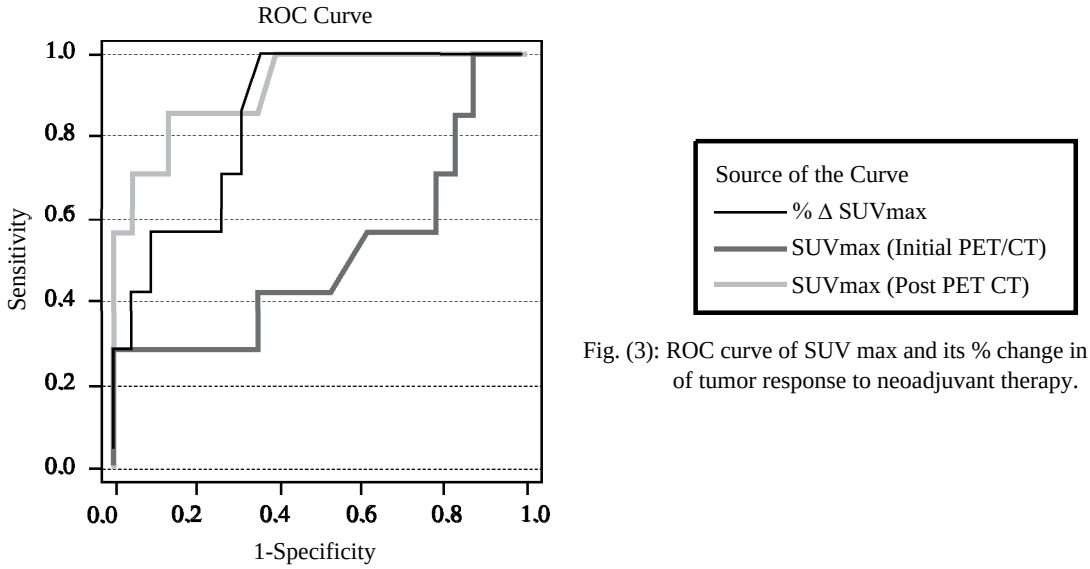

Fig. (3): ROC curve of SUV max and its % change in prediction of tumor response to neoadjuvant therapy.

Table (4): Cut- off values of post SUV max and its % change in in prediction of response to neoadjuvant therapy.

	Area Under the Curve	*p*-value	%95 Confidence Interval		Cut off	Sensitivity %	Specificity %
			Lower Bound	Upper Bound			
SUV max (Initial PET/CT)	0.516	0.913	0.236	0.795	–	–	–
SUV max (Post PET CT)	0.922	<0.001	0.812	1.033	<6.05	85.7	87
%Δ SUVmax	0.854	0.003	0.713	0.995	<-49.14	100	65.2

Table (5-A): Correlation between % difference in MRI thickness and length and response to neoadjuvant therapy.

	Pathological major response										*p*-value
	Yes					No					
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
% decrease in length	58.27	22.50	56.76	36.00	100.00	8.88	21.31	9.33	-41.79	48.57	<0.001
% decrease in thickness	45.26	20.34	40.91	25.00	76.47	23.39	27.89	29.29	-50.00	71.43	0.092

Table (5-B): Cut-off value of % difference in MRI detected tumor length.

	Area Under the Curve	*p*-value	%95 Confidence Interval		Cut off	Sensitivity %	Specificity %
			Lower Bound	Upper Bound			
% decrease in length	0.986	<0.001	0.950	1.022	33.4545	100	95

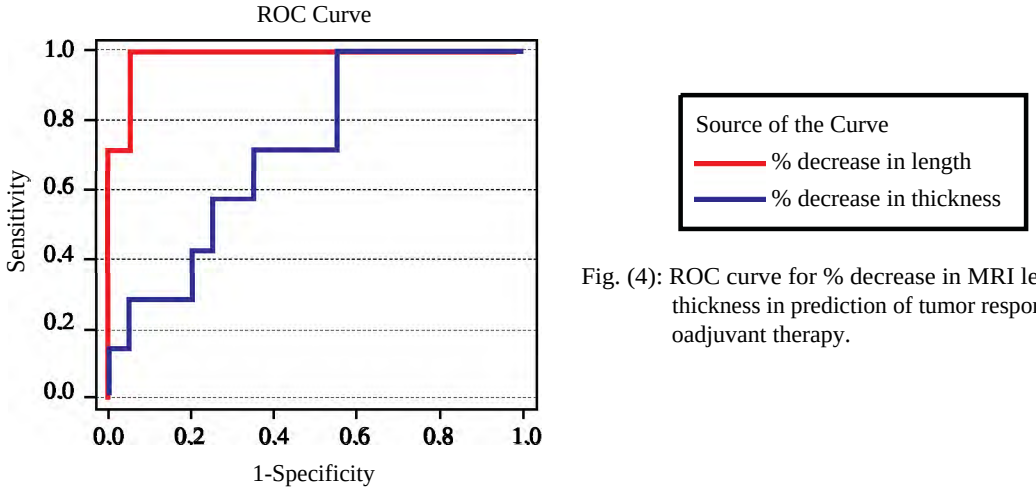

Fig. (4): ROC curve for % decrease in MRI length and thickness in prediction of tumor response to neoadjuvant therapy.

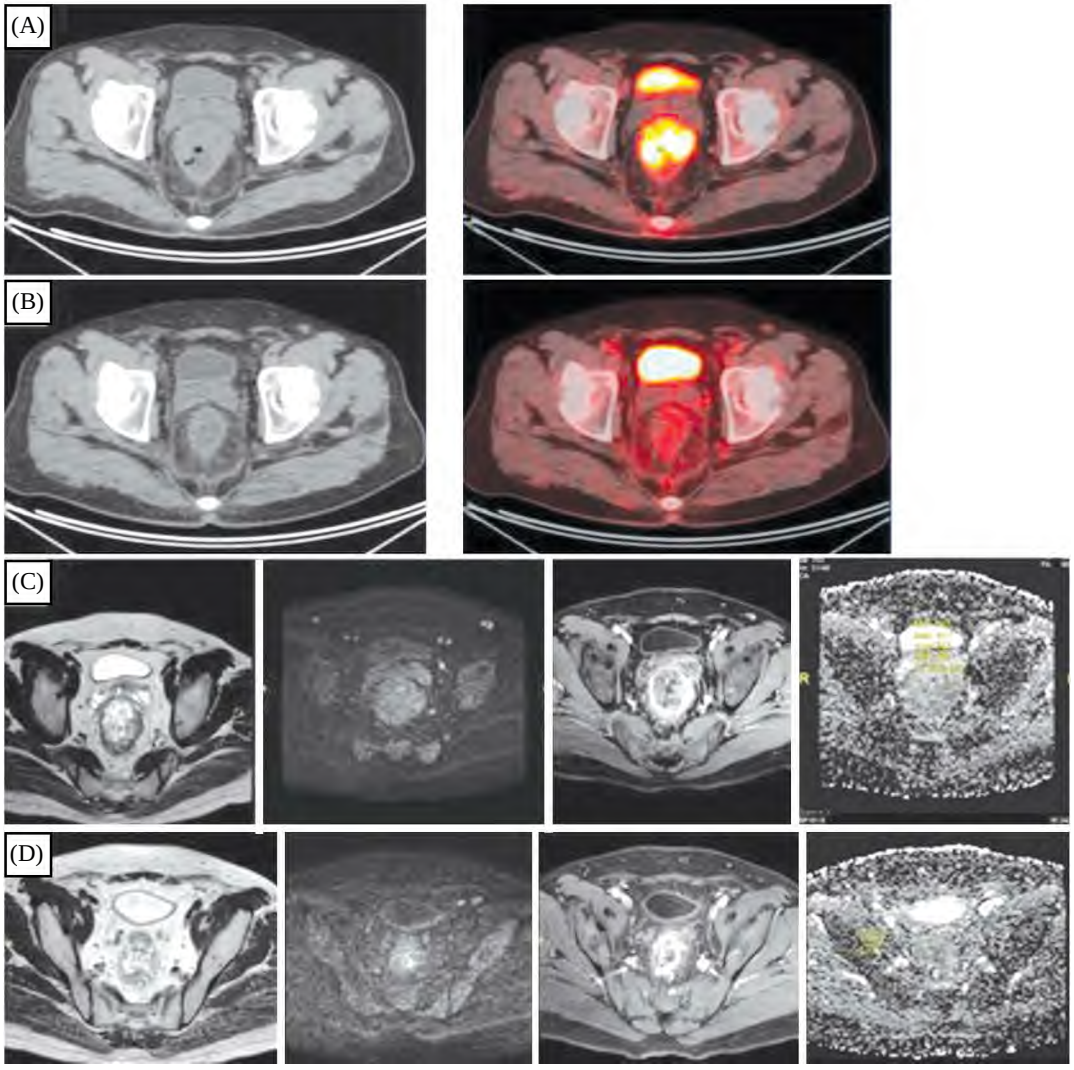

Fig. (5): 44 years old male patient with pathologically proven rectal adenocarcinoma. Received neoadjuvant therapy (CTH & RTH). After which he underwent surgical resection of the primary neoplasm.

(a) Pre neoadjuvant therapy FDG PET/CT study with SUVmax~18, MTV~32 and TLG ~270

(b) Post neoadjuvant therapy FDG PET/CT with SUVmax~9, MTV~7.5 and TLG~45.

- %Δ SUVmax (the change of SUVmax before and after chemotherapy) = -50%, %Δ MTV = -77% & %Δ TLG = -83%. These values predicted good pathological response.

(c) Pre neoadjuvant therapy MRI with diffusion shows Length / dimensions 8 cm, Maximum thickness 3 cm, ADC of rectal lesion 0.9 x 10^{-3} mm^2/s.

(d) Post neoadjuvant therapy MRI with diffusion shows Length / dimensions 5 cm, Maximum thickness 2 cm, ADC of rectal lesion 1.2 x 10^{-3} mm^2/s.

- Pathology after surgical excision revealed good response with evident tumour regression TRG 1 so we can conclude that SUVmax, MTV and TLG in PET/ CT and ADC values in DW MRI were in agreement and showed good response simulating pathological response.

Discussion

Colorectal cancer is one of the most commonly diagnosed cancers worldwide, in locally advanced cases the main treatment is surgery following a course of neoadjuvant treatment. The neoadjuvant treatment is aiming at downstaging and decreasing pelvic recurrences, in addition to less invasive surgical approach or completely omitting surgery [2].

These data lead us to the importance of searching for an ideal imaging modalities to identify major responders as it will lead to less aggressive therapeutic strategy with less side effects and reduction of therapy related morbidities [8,9].

In the current study after analysing post-surgical pathological data according to AJCC TRG (pathological tumor regression grading) patients were categorized into major responders (including TRG 0 and 1) found in only 7 patients, while the remaining 23 patients were poor responders (including TRG2 and 3), with a response rate of 23.3%. Variable response rates were reported in different literatures, these reported differences are expected, being attributed to many factors including different patient population, various tumor pathological criteria, different protocols of neoadjuvant therapy as well as different methods of response assessment.

Conventional imaging techniques used in assessment of response in locally advanced rectal cancer are mainly endoscopy, MRI and CT, however these modalities face the traditional disadvantage of not being able to discriminate well between radiation induced fibrosis and cancer cells remnants and mainly relies on assessing changes in size [10]. FDG PET CT is a non- invasive diagnostic tool that measures the metabolic activity of the tumor mainly through semiquantification of its glucose metabolism while DW-MRI characterizes tissue and generates image contrast based on difference in water molecule Brownian motion within a voxel level [11].

In our single centre prospective study that took place in the national cancer institute of Egypt, 30 patients were subjected to initial and post neoadjuvant therapy FDG PET/CT, DW-MRI to evaluate the relationship between different parameters "mainly functional" and achieving major pathological response.

Maffione et al., stated that it is fruitless to expect imaging techniques as FDG PET/CT to differentiate between complete regression and presence of few cancer cells hence obviating the necessity of a major response criteria [12].

We concluded that no initial PET/CT or DW-MRI parameters were predictive of response except for initial ADC values with a *p*-value of 0.03. The best cut-off value of initial ADC to be 0.80 x 10^{-3} mm^2/s, with Sensitivity = 71.4%, and specificity = 78.3% for prediction of response. While, in post neoadjuvant therapy scans the SUVmax, SUVpeak, SUL peak in PET/CT and post ADC values were significantly correlated with pathological response. The post SUVmax superiorly exhibits a highly significant correlation with pathological response ($p<0.001$), a cut-off value of post SUV max <6.05 has a sensitivity of 85.7% and a specificity of 87% in prediction of tumor response. As regards the post ADC, it also exhibits a significant predictive value in correlation with pathological response (p:0.027). The calculated best cut-off value of post ADC is 1.05 x 10^{-3} mm^2/s having a sensitivity and specificity of 83.3% and 69.6% respectively.

Additionally, when the % change in all parameters were correlated with pathological response the % ΔSUV max was the sole parameter that owes a statistically significant correlation with pathological response with a cut off value of reduction of 49% of initial SUV max value, with sensitivity 100% and specificity 65%. Concerning the non-functional parameters, the final MRI tumour length and thickness showed statistical significance in predicting response to neoadjuvant therapy. The % changes in tumor length in DW MRI study also exhibits this significant correlation with response to neoadjuvant therapy ($p<0.001$).

Our data were concordant with conclusion reached by Chen et al., in a study done just to asses MRI in prediction of response in rectal cancer patients after CRT, the study was done on 56 patients and also concluded that pre therapy ADC values were superior in predicting response to neoadjuvant therapy [13].

In contrast to our results Besli et al., conducted a similar study on 20 patients but had also interim assessment, stated that initial MTV had a positive predictive value in predicting response, however initial MRI parameters were not significant [14]. These different data in various literature can be related to different patient population and variable MRI techniques in association with applying different response criteria.

Similar to our results, Besli et al., showed a significant predictive value of post SUVmax, SULpeak, SUVpeak and % change in SUVmax with prediction of pathological response. Yet, in contrast to our study, Besli's group reported a statistically significant correlation with post MTV,

post TLG as well as the % change in ADC however their study only included 20 patients ***[14]***.

In concordance with our results a systemic review by Amodeo et al., done to assess the strength of MRI based ADC values in predicting pathological response concluded that post treatment ADC was significantly higher in responders ***[15]***.

As regards the % change in ADC and SUV max, Ippolito et al., concluded that both %Δ ADC and %Δ SUVmax (% changes) between initial and post neoadjuvant treatment were not statistically significant in predicting major response ***[10]***.

Similar to our results Lambrecht et al., Jansen et al. and Sorenson et al., found similar results with our study, stating that there is significant predictive value of % change in SUVmax in predicting response which solidifies our results about the significance of %Δ SUVmax ***[11,8,16]***.

On the other hand, contrary to our results Murata et al., concluded a significance in % change in MTV and % change in TLG in a study conducted 36 patients, however in the study the response criteria was complete pathological response only, which is different from that employed in our study and may be accused for concordant results ***[17]***.

In our study we also analysed non-functional parameters in both PET and MRI, only post MRI thickness and length established a significant predictive value in assessment of response with *p*-values 0.005 and 0.031 respectively. Also % change in length was predictive of response with (*p*-value <0.001). Consistent with our results was that reported by Xu et al., who stated that several MRI morphological parameters were predictive of pathological response ***[18]***. On the other hand Chen et al., showed that neither pre or post MRI structural parameters were statistically significant, yet, they reported that only % volume changes were of significance ***[13]***.

The observed variations in results may be attributed to institutional differences and interobserver variability in ADC measurements, influenced by factors such as the size and location of the region of interest (ROI). Diverse factors influence SUV determination, including ROI shape, partial-volume effects, reconstruction methods, scanner type parameters, tissue state factors (such as disease type and extent, vascularity), timing of SUV evaluation, body size, and competing transport effects (serum glucose and protein levels). The timing of PET/CT, MRI, and the various treatment protocols implemented in other centers may have influenced the results. Comprehending these factors and being aware of potential interpretive pitfalls will aid in preventing errors and necessitate the standardization of treatment protocols, imaging techniques, and processing procedures ***[19,20]***.

Finally, ADC as a functional parameter of initial DW-MRI was superior to initial PET/ CT parameters, representing the sole significant response predictor in initial studies. Both the post ADC and post SUVmax together with post SUV peak and SUL peak, % changes of SUV have a statistically significant predictive value in predicting pathological tumour response. Non-functional MRI parameters including tumor length and thickness exhibit also significant correlation with response prediction, which is also detected for % change in tumor length.

The main limitation of our study is its small sample size, further studies with larger numbers are advised. Second is the inclusion of patients with different histopathologies, with two patients of mucinous adenocarcinoma, this may have an impact of results of PET/CT study Finally, a possible bias in this study is the biopsy taken prior to PET examination that may influence the actual FDG activity of the primary tumor.

We can state that both diagnostic modalities have a complementary role in predicting tumor response, with significant predictor values of ADC of MRI as an initial predictor prior to neoadjuvant therapy as well as both MRI and PET/CT functional parameters with non-functional MRI data in the post neoadjuvant state. The employment of these significant parameters have an overall aim of guiding proper therapeutic strategy for each individual patient achieving the concept of personalized medicine.

Conclusion:

In post neoadjuvant therapy PET/CT SUV max, SUV peak, SUL peak as well as % change in SUV max have a significant correlation with prediction of response to therapy while Initial functional PET/ CT parameters could not achieve a potential role in predicting response. Initial MRI ADC exhibits significant correlation with response to neoadjuvant therapy & in post neoadjuvant therapy both MRI, functional (ADC) & non- functional parameters as tumor length and thickness as well as the % change in tumor length have a significant correlation with prediction of response.

DW MRI proved to have a relatively better specificity, positive predictive value and overall accuracy in predicting response to neoadjuvant therapy.

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دور الماسح البوزيتروني المدمج بالاشعة المقطعية مقابل الرنين المغناطيسى الإنتشارى في تقييم الاستجابة للعلاج الاولي المساعد فى مرضى سرطان القولون المستقيم

يعتبر سرطان المستقيم أحد أكثر أنواع السرطان شيوعًا محليًا وعالميًا مع العديد من الوفيات السنوية المرتبطة بهذا المرض الخبيث، عندما يتعلق الأمر بالحالات المتقدمة محليًا، عادة ما يتلقى المريض دورة علاجية من الكيماوى والعلاج الاشعاعى تليها جراحة علاجية.

فى العصر الجديد للطب الأكثر تخصيصًا، من المهم التحقيق في خيارات تقييم الاستجابة قبل الجراحة العلاجية المحددة مع ظهور نهج الانتظار والترقب والعمليات الجراحية الأقل توغلاً التى تسمح للمريض بتقليل الأمراض المصاحبة وأسلوب حياة أفضل.

فى حين أن المعيار الذهبى فى تقييم الاستجابة للعلاج هو علم الباثولوجى بعد الجراحه، فقد ظهر كل من التصوير بالرنين المغناطيسى ودور الماسح البوزيترونى المدمج بالاشعة المقطعية كطرائق قوية غير جراحية فى تقييم الاستجابة للعلاج من خلال التقييم البيولوجى للبنية المجهرية والوظيفية، وبالتالى منح كل مريض فرصة لعلاج أكثر تحفظًا مع تقليل الاعتلال والوفيات.

تشمل هذه الدراسة المستقبلية التى أجريت فى المعهد القومى للاورام فى مصر ٣٠ مريضًا يعانون من سرطان القولون والمستقيم المتقدم محليًا، وهدفنا إلى دراسة قدرة دور الماسح البوزيترونى المدمج بالاشعة المقطعية مقابل الرنين المغناطيسى الإنتشارى فى تقييم الاستجابة للعلاج الاولى المساعد فى مرضى سرطان القولون اقترحت دراستنا أن بعض المعايير الخاصه بالماسح البوزيترونى المدمج بالاشعة المقطعية والرنين الانتشارى لها قيمة تنبؤية فى التنبؤ باستجابة ما بعد العلاج.