Role of ^{18}F-FDG PET/CT in Follow up Patients with Rectal Carcinoma: Single Institute Based Study

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ABSTRACT

Introduction: F-18 Fluorodeoxyglucose Positron Emission Tomography (^{18}F-FDG PET/CT) is a hybrid non-invasive imaging tool that integrates PET and CT into a single imaging device. It is used to detect and measure metabolic activity in a cancer cell and, hence, can provide anatomic and metabolic information. ^{18}F-FDG PET/CT is useful for the detection of loco-regional recurrence, distant metastases, and monitoring therapy response in patients with rectal carcinoma. This study was done to see the usefulness of ^{18}F-FDG PET/CT in the follow-up evaluation of patients with rectal carcinoma.

Materials and Methods: This retrospective study was done in the PET/CT division of the National Institute of Nuclear Medicine & Allied Sciences (NINMAS) between January 2021 and December 2022. A total of 26 patients with rectal carcinoma, requested for an F-18 FDG PET-CT scan were enrolled in this study. Image findings were analyzed and properly documented in a predesigned format to evaluate the results.

Results: Total 26 patients with an average age of 47.69 and a follow up period of 6 months to 5 years were enrolled in this study. Histologically adenocarcinoma was seen in 21 patients, four patients were mucinous, two were papillary, and carcinoid tumor was found in one patient. On PET/CT imaging, no metastases were found in 17 (65.4%) out of 26 patients and metastases was seen in 9 (34.6%) patients. Among them four (44.5%) had lung, two (22.2%) had lymph nodes, one (11.1%) had liver and lymph node metastases, one (%11.1) had skeletal metastases, and one (11.1%) had peritoneal metastases. No significant association was observed with histopathology or treatment protocol. CEA was higher in patients with metastases and lower in those without.

Conclusion: ^{18}F-FDG PET/CT is an effective tool in follow up patients with rectal carcinoma as it can accurately detect locoregional recurrence or distant metastases.

Key words: Rectal carcinoma, F-18 FDG PET/CT, metastases, follow up.

Bangladesh J. Nucl. Med. Vol. 25 No. 2 2022

Doi:https://doi.org/10.3329/bjnm.v25i2.64646

INTRODUCTION

Colorectal cancer is the world's third most common malignancy and the second leading cause of cancer-related death (1). In relation to incidence, in men it is behind lung and prostate carcinoma, and in women it is second after breast cancer. In relation to mortality, in men is behind lung, liver and stomach cancer and in female third in mortality following breast and lung carcinomas. Significant variation is seen in patients with rectal carcinoma like complete regression, stationary appearance, tumor progression during the treatment with variable rates of local recurrence (2,3).

Five-year survival rate is about 60% despite proper surgical management in combination with chemotherapy and radiotherapy. Prognosis is better when recurrences are detected early (4). ^{18}F-FDG PET/CT scan which is a non-invasive imaging modality is an important tool for early detection of local recurrence, distant metastases, and evaluation of therapy response. It can detect metabolic changes of cancer cell due to chemo or radiotherapy better than other imaging modalities like CT or MRI (5). In addition to anatomical changes metabolic changes provide more predictive value. This study was done to see the follow up results of patients with rectal carcinoma and impact of ^{18}F-FDG PET/CT in management of rectal carcinoma patients.

PATIENTS AND METHODS

This retrospective study was done in PET/CT division of National Institute of Nuclear Medicine & Allied Sciences (NINMAS). A total of 26 patients with rectal carcinoma were enrolled in this study who were referred to NINMAS from January 2021 to December 2022 for ^{18}F-FDG PET/CT scan after obtaining proper permission. The study patients were informed about the nature and the purpose of the study. Confidentiality was maintained. Detailed history was taken. Data were

collected in a predesigned format and findings of the scans were evaluated.

Data processing and statistical analysis:

Collected data were analyzed using the Statistical Package for Social Sciences version 26.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Quantitative data was provided as mean, standard deviations, and ranges. Chi-Square test was used to analyze the categorical variables. The confidence interval was set at 95% with a 5% acceptable margin of error. A P-value <0.05 was considered statistically significant.

RESULTS

A total of 26 patients were enrolled in this study (M = 13 and F = 13), with ages ranging from 22 to 78 (47.69 ± 17.59) years (Table 1). Follow up period ranged from six months to five years. Histologically, adenocarcinoma was seen in 21 patients. Four patients had mucinous adenocarcinoma, two patients had papillary adenocarcinoma, and a carcinoid tumor was found in one patient. Among the 26 patients, three came prior to surgery; one after adjuvant radiotherapy; two after adjuvant chemo and radiotherapy to see therapy response; and 23 came after surgery either for evaluation or to see therapy response. Surgery included a) anterior resection and low anterior resection (n=12) b) abdominoperineal resection (n=4) c) intersphincteric resection (n=2) d) resection and anastomosis (n=4) and e) Hartman procedure (n=1) (Table 1). No evidence of metastasis was found in 17 (65.4%) patients. Other 9 (34.6%) patients showed metastases in following locations: a) only lung (n= 1), b) lung and lymph nodes (n=2), c) lung and liver (n=1), d) lung, liver and lymph nodes (n=1) e) only lymph nodes (n=2) f) skeletal metastases (n=1) and g) peritoneal metastases (n=1) (Table 2). No significant association was seen in males or females with metastases or sites of metastases; liver metastases were seen more in females than in males. (Table 2). No statistically significant association of metastases was observed with histopathology or treatment protocols either (Table 3 & 4). CEA was found to be higher in patients with metastases and lower in patients who had no metastases (CEA average: 12.04 vs. 4.0).

Table-1: Demographic and disease characteristics of study subjects (n=26)

Age	Range: 22 to 78 years	(47.69 ± 17.59)
Sex	Male	13
	Female	13
Histopathology	Adenocarcinoma	19
	Mucinous adenocarcinoma	04
	Papillary adenocarcinoma	02
	Carcinoid tumor	01
Treatment		
Surgical management	Anterior resection and low anterior resection	12
	Abdominoperineal resection	04
	Intersphincteric resection	02
	Resection and anastomosis	04
	Hartman procedure	01
	No surgery	03
Therapeutic management		
	Chemotherapy	03
	Radiotherapy	03
	Combined	18
	No therapy	02

Table-2: F-18 FDG PET/CT findings according to gender in follow up patients of rectal carcinoma

Findings	Male	Female	p-value
No metastases	09	09	1
Lymph node metastases	02	04	0.641
Liver metastases	01	03	0.586
Lung metastases	02	02	1
Skeletal metastases	01	00	1
Peritoneal deposits	01	00	1

**Fisher exact test was done.*

Table 3: Relation of histopathology and F-18 FDG PET/CT scan findings of patients with rectal carcinoma

Findings	Adenocarcinoma (n=19)	Mucinous adenocarcinoma (n=4)	Papillary Adenocarcinoma (n=2)	Carcinoid tumor (n=1)	p-value
No metastases	12	02	02	01	0.562
Lymph node metastases	04	01	00	00	0.839
Liver metastases	03	00	00	00	0.741
Lung metastases	03	01	00	00	0.841
Skeletal metastases	01	00	00	00	0.943
Peritoneal deposits	01	00	00	00	0.943

**Chi-Square test was done.*

Table 4: Relation of treatment protocol with F-18 FDG PET/CT findings in follow up patients with rectal carcinoma

Findings	Chemotherapy (n=3)	Radiotherapy (n=3)	Combined chemo-radiotherapy (n=18)	No therapy (n=2)	p-value
No metastases	02	03	11	01	0.516
Lymph node metastases	00	00	04	01	0.427
Liver metastases	01	00	02	00	0.561
Lung metastases	01	00	02	01	0.336
Skeletal metastases	00	00	01	00	0.927
Peritoneal deposits	00	00	01	00	0.927

**Chi-Square test was done.*

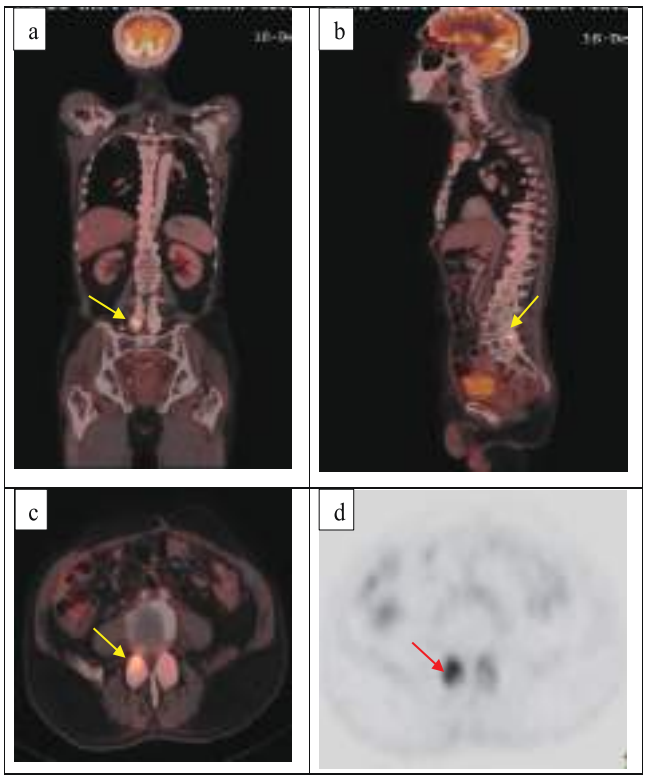

Figure 1: F-18 FDG PET CT image showing hypermetabolic metastatic lesions (arrow) at L5 vertebrae without any local recurrence in a) coronal b) sagittal c) axial hybrid PET/CT image and d) axial PET image

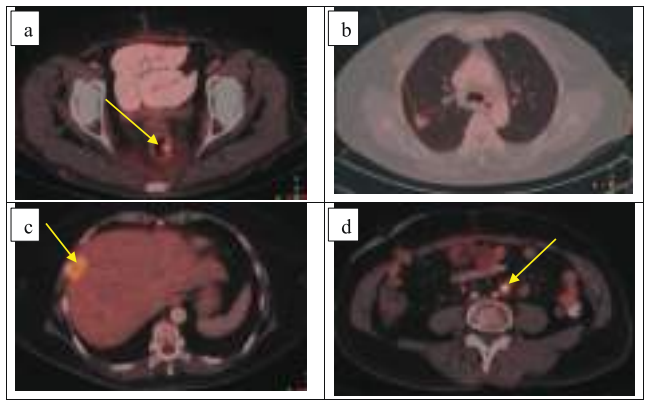

Figure-2: F-18 FDG PET-CT scan axial image showing a) hypermetabolic eccentric rectal wall thickening (arrow) representing local recurrence b) hypermetabolic lesion in posterior segment of upper lobe of right lung c) another lesion in segment VIII of liver and d) enlarged hypermetabolic left common iliac lymph node representing metastases.

DISCUSSION

Colorectal cancer is the third-leading cause of cancer worldwide. Recurrence occurs in roughly one-third of patients during the first two years after surgery (6). ^{18}F-FDG PET/CT directly measures the metabolic activity of the cancer cell, thus playing a crucial role in the early detection of recurrence in patients with rectal carcinoma. It can detect metabolically active small LNs, local operative bed recurrence, small metastases, early skeletal deposits, and post-therapeutic evaluation of viable and non-viable malignant lesions.

This study was conducted on 26 patients with ages ranging from 22 to 78 years old and a mean SD of 47.69 $\pm$ 17.59; they were 13 females (50%) and 13 males (50%). Based on lesion analysis, metastases were seen in 9 cases (34.62%) of the patient group. The study almost agreed with Hetta et al., who analyzed 60 instances and discovered that 22 cases (36.7 percent of the total evaluated cases) developed a local recurrence, and 38 cases did not (63.3 percent of the total studied cases) (7,8).

In this study, the number of patients with local nodal involvement was 05 cases (19.23%). while 21 patients did not develop nodal metastatic deposits (80.77%). The findings are consistent with those of O'Connor et al., who found that on PET/CT, enlarged and non-enlarged FDG-positive lymph nodes can be seen in the mesentery, indicating the existence of regional lymph node

metastases; this is shown when patients with rectal carcinoma are restaged (8, 9). While the specificity of FDG PET is 96%, it has been demonstrated to be only 29% sensitive for local lymph node metastases from colorectal carcinoma (10,11). On PET/CT, enlarged and nonenlarged FDG-avid lymph nodes in the mesentery can be seen, indicating the existence of regional lymph node metastases; however, this is more frequently seen when CRC patients are restaged rather than when they are initially staged (12).

The end diagnosis of distant metastases in follow-up patients with rectal carcinoma was visible in nine individuals (34.62%) of the patient group based on lesion investigation. Patients with hepatic metastatic deposits accounted for 2 instances (7.7%); those with pulmonary nodular deposits accounted for 4 instances (15.39%); those with osseous deposits accounted for 1 instance (3.85%); and those with peritoneal deposits accounted for 1 instance (3.85%). So, ^{18}F-FDG PET/CT was found useful in detecting hepatic and extrahepatic metastases. These findings are compatible with those of Kijima et al., who found that FDG-PET and PET/CT have high accuracy for the detection and staging of liver lesions in CRC patients, with a combined sensitivity and specificity of 93 percent (13). In this study, females had a higher rate of ^{18}F-FDG PET/CT detection of lymph nodes and hepatic metastases than males, with p-values of 0.641, and 0.586 respectively. These findings are not statistically significant which could be due to the small sample size. Elia et al. in their study showed that females had a statistically significantly higher rate of PET/CT detection of recurrence, local spread, and local lymph nodes than males, with p-values of 0.018, 0.018, and 0.002, respectively, whereas there was no statistically significant relationship between gender of the studied patients and the other findings, which could be due to small sample size (9). This study is partially compatible with our study.

In this study, a higher rate of FDG PET/CT detection of metastases was seen in a patient with adenocarcinoma than in other histological types, though it was not statistically significant. Kijima et al. showed that the percentage of ^{18}F-FDG PET/CT metastases detected in the adenocarcinoma group was statistically and significantly higher than in the mucinous group (65.4 percent, p-value = 0.014). In this study, nine patients with rectal carcinoma showed a higher CEA level (average 12.04), and 17 patients were without metastases; their average CEA level was 4.0. Mittal et al. (14), who studied 73 patients with CRC (55 males and 18 females; age range, 25 to 80 years), In 51 patients, rising CEA levels were found. ^{18}F-FDG PET/CT scans were positive in 13 patients (3 with liver lesions, 5 with lymph node involvement, 2 with bone metastases, 1 with local recurrence in the urinary bladder wall, 1 with lymph node and liver metastases, and 1 with lymph node and bone metastases). ^{18}F-FDG PET/CT is a viable approach in the evaluation of patients with rectal carcinoma and a normal CEA level who have a suspected recurrence or metastases (15).

CONCLUSION

The development of ^{18}F-FDG PET/CT has a considerable role in the follow-up of patients with rectal carcinoma. ^{18}F-FDG PET/CT has a greater impact on the detection of sites of metastatic disease, either hepatic or extrahepatic, and on the detection of local recurrence. ^{18}F-FDG PET/CT alone can diagnose local recurrence due to abnormal FDG uptake, whereas serial conventional CTs are often required to characterize recurrence as they provide anatomical as well as metabolic details.

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