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Original Research Article

Role of ^{18}F-FDG PET/CT in the Detection of Recurrent Colorectal Carcinoma

Angel Hemrom[1], Tushar Kumar Mohapatra[2]

[1]Assistant Professor, Department of Nuclear Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

[2]Senior Consultant and HOD, Department of Nuclear Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

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Corresponding Author: Dr. Tushar Kumar Mohapatra

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Abstract:

Background: Early and accurate detection of recurrent colorectal carcinoma (CRC) is crucial for timely treatment planning and improving patient outcomes.

Aim: To evaluate the role of ^{18}F-FDG PET/CT in detecting recurrent CRC and its impact on patient management.

Methodology: This retrospective observational study included 65 previously treated CRC patients who underwent ^{18}F-FDG PET/CT for suspected recurrence, rising CEA levels, or equivocal conventional imaging. PET/CT findings were analyzed and correlated with clinical data and subsequent changes in management.

Result: PET/CT detected local recurrence in 21.5%, distant metastases in 40%, and both in 18.5% of patients, while 20% showed no evidence of disease. The most common metastatic sites were liver and lymph nodes. PET/CT findings led to a change in treatment strategy in 29.2% of cases.

Conclusion: ^{18}F-FDG PET/CT is a valuable imaging modality for detecting recurrent CRC and significantly influences patient management.

Keyword: Colorectal Carcinoma, FDG PET/CT, Recurrence, Metastasis, Restaging.

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Introduction

Rare tumors known as uterine sarcomas make about 3–7% of uterine cancers and 1% of female genital tract cancers [1]. Most cases are known to be aggressive, but their rarity and histological variation have made it difficult to reach a consensus on the best course of action, prognostic variables, and suitable post-therapy monitoring [2].

Histologically, uterine sarcomas were first divided into four categories: leiomyosarcomas (40%), endometrial stromal sarcomas (10–15%), carcinosarcomas (malignant mixed Mullerian tumors), and undifferentiated sarcomas (5–10%). Carcinosarcoma has recently been categorized as either a metaplastic or dedifferentiated type of endometrial cancer. However, carcinosarcoma is still included in many retrospective investigations of uterine sarcomas and in the WHO classification due to its more aggressive biological makeup when compared to endometrial carcinoma [3].

It is a cancer entity that affects a growing number of younger individuals in addition to the elderly [4]. Dietary, genetic, and environmental variables are risk factors for colorectal cancer (CRC). These factors cause genetic mutations and epigenetic changes to gradually accumulate over decades, driving the formation of tumors. Adenomatous polyps cause about 80% of colorectal cancers (CRCs), yet less than 1% of adenomatous polyps smaller than 1 cm ever turn malignant [5].

Improvements in the detection of developing colorectal cancer (CRC) have started to improve the available prognostic data and identify patient populations who are most likely to benefit from targeted medicines or systemic therapy [6]. Guidelines state that the diagnostic work-up of patients with colorectal cancer should use a multimodality approach that includes CT, MRI (rectal cancer only), and ultrasonography, including endoscopic ultrasonography. The UK National Institute for Health and Clinical Excellence recommended positron emission tomography (PET) using 18-fluorlabeled fluorodeoxyglucose (FDG) as "an emerging technology that may prove useful" in a 2004 cancer service guideline on "Improving outcomes in colorectal cancer" [7].

Since then, scanners that combine PET and computed tomography (PET/CT) have largely replaced standalone PET scanners. While there is growing evidence of the incremental value of PET/CT in a

variety of solid tumors, no conclusive research has been found regarding colon cancer [8]. Up to 25% of individuals with colon cancer first present with hepatic involvement, making the liver the most prevalent location of metastases.

Although extrahepatic disease has been shown to increase mortality and has historically been considered a contraindication to liver metastasis resection, this is no longer an absolute contraindication to surgery; instead, a wider operative field or, if technically possible, a second operation are required to enable a truly curative surgical resection [9]. Within the first two years following colonic resection or rectal amputation, approximately one-third of patients experience a recurrence of colorectal cancer (CRC), which is most common in the region next to the operation.

Patients with transmural or node-positive colorectal cancer often have loco-regional failure despite aggressive surgery. Both positron emission tomography (PET) and computed tomography (CT) are reliable techniques for assessing patients with suspected colorectal cancer recurrence (CRCR) [10]. Due to the well-known high absorption of 18F-fluorodeoxyglucose (FDG) in primary colorectal carcinomas and subsequent recurrences, FDG-PET offers precise information about alterations in glucose metabolism, but it is not very useful for anatomical localization and morphological representation. Even in cases where the recurring tumor is modest, integrated imaging utilizing both modalities enhances the diagnosis of CRCR with strong anatomical and structural delineation of the tumor and surrounding tissues.

Computed tomography (CT) is now utilized to identify recurrence; however, it has a high false-positive rate for pulmonary lesions and a high false-negative rate for extrahepatic intra-abdominal lesions (such as para-aortic nodes). Due to this drawback, 18F-fluorodeoxyglucose (18F-FDG)-positron emission tomography (PET)/CT is now more often used as an imaging modality for both preoperative evaluation and follow-up. Recurrent and metastatic colorectal cancer may be detected with good accuracy by 18F-FDG PET [11].

The most reliable technique for tumor staging, restaging, and therapeutic response evaluation is integrated FDG-PET/CT imaging, which was introduced in clinical practice and integrates both morphological and functional data [12]. Due to its high cost and radiation exposure, FDG-PET/CT is typically not utilized to diagnose colorectal cancer.

In a single session, FDG-PET/CT offers precise preoperative whole-body tumor staging with accurate assessment of the local extent (T) of the tumor and of the regional lymph nodes (N). This is crucial for the planning of the best course of treatment, considering the numerous therapeutic options that are available, such as radical or limited resection, palliative derivative surgery, local excision, laparoscopic surgical approach, preoperative neoadjuvant chemotherapy, and/or radiation [13].

The current study's objective was to examine the clinical effects of adding FDG PET-CT to the preoperative work-up of patients with possibly resectable metastatic colorectal cancer in a large-volume tertiary referral facility. to ascertain if the FDG-PET/CT scan affected the first treatment plan recommended by traditional staging techniques in individuals with recently diagnosed colorectal cancer.

Methodology

Study design: F-fluorodeoxyglucose positron emission tomography/computed tomography (F-FDG PET/CT) was used in this hospital-based observational study with a retrospective analytical design to assess its role in the detection and evaluation of recurrent colorectal carcinoma and its effect on patient management.

Study Area: The study was conducted in the Department of Nuclear Medicine at tertiary care centre in India.

Study Duration: The study was conducted over a period of one year.

Sample Size: A total of 65 patients with histopathologically proven colorectal carcinoma who underwent, ^{18}F-FDG PET/CT scanning for suspicion of disease recurrence or restaging were included in the study.

Study Population: The study population comprised adult patients previously diagnosed and treated for colorectal carcinoma, who were referred to the Department of Nuclear Medicine for PET/CT evaluation due to suspected recurrence based on clinical findings, rising tumor markers, or equivocal results on conventional imaging modalities.

Data Collection: The Department of Nuclear Medicine at the Kalinga Institute of Patient Sciences in Bhubaneswar's PET/CT workstation archives, imaging databases, and hospital patient records provided retrospective data for this investigation. Clinical indications for PET/CT, primary tumor features, previous treatment history, patient demographics (age and sex), and results from traditional imaging modalities were all obtained. The pattern and location of aberrant radiotracer uptake were noted, along with other details of the F-FDG PET/CT imaging. Additionally, recorded was follow-up information, histological confirmation where available, and any future modifications to clinical care based on PET/CT results. To protect patient privacy, all information gathered was anonymized.

Inclusion Criteria

- Patients with histopathologically confirmed colorectal carcinoma
- Patients who have completed primary treatment (surgery ± chemotherapy/radiotherapy)
- Patients referred for ^{18}F-FDG PET/CT with suspicion of tumor recurrence or for restaging
- Patients aged ≥18 years
- Patients with complete clinical and imaging records

Exclusion Criteria

- Patients with incomplete medical or imaging records
- Patients with uncontrolled hyperglycemia at the time of PET/CT imaging
- Pregnant or lactating women
- Patients who did not provide consent for use of their medical data (where applicable)

Study Procedure: F-FDG PET/CT imaging was performed on eligible patients in accordance with established institutional practice. Before the radiotracer injection, patients were told to fast for at least six hours, and their blood glucose levels were checked to make sure they were within acceptable ranges. Depending on body weight, an intravenous dosage of F-FDG was given. Using a specialized PET/CT scanner, whole body PET/CT acquisition was carried out from the base of the cranium to the mid-thigh following an uptake of around 60 minutes. PET images were obtained after CT images were obtained for anatomical localization and attenuation correction. Experienced nuclear medicine doctors and radiologists collaborated to analyses the reconstructed PET, CT, and fused PET/CT images. Any aberrant FDG uptake that deviated from physiological distribution was linked to clinical signs and follow-up data and was regarded as suspicious for residual, recurring, or metastatic illness.

Statistical Analysis: Microsoft Excel was used to enter all the data, and statistical programs like SPSS (version 27) were used for analysis. The imaging results and patient characteristics were summarized using descriptive statistics. While continuous variables were displayed as mean ± standard deviation, categorical variables were reported as frequencies and percentages. Descriptive analysis was done on the diagnostic value of FDG PET/CT in identifying recurrence and its influence on patient care. A p value of less than 0.05 was deemed statistically significant, and statistical significance was evaluated when appropriate."

Result

In Table 1, the demographic characteristics of the research population, which consisted of 65 patients with previously treated colorectal carcinoma who underwent ^{18}F FDG PET/CT imaging, are summarized. The patients' mean age was 58.6 ± 11.4 years, and most of them were middle-aged or older, suggesting that colorectal cancer recurrence is more often assessed in this age range. There were 38 male patients (58.5%) as opposed to 27 female patients (41.5%), indicating a male preponderance. This male preponderance indicates a greater disease burden or monitoring required among male patients in the study community and is consistent with the established epidemiological pattern of colorectal cancer.

Table 1: Demographic Characteristics of the Study Population (n = 65)

Variable	Frequency (n)	Percentage (%)
Age (years)		
Mean ± SD	58.6 ± 11.4	—
Range	32–81	—
Sex		
Male	38	58.5
Female	27	41.5

Table 2 displays the distribution of primary tumor sites within the sample population. Eighty percent of patients had colon cancer, and twenty percent had rectum cancer. In line with referral patterns observed in tertiary care facilities, this data implies that colon cancer cases are more likely than rectal cancer cases to undergo PET/CT assessment for suspected recurrence or restaging.

Table 2: Primary Site of Colorectal Carcinoma

Primary Tumor Site	Number of Patients (n)	Percentage (%)
Colon	52	80
Rectum	13	20
Total	**65**	**100**

Table 3 delineates the clinical indications for PET/CT. Rising carcinoembryonic antigen (CEA) levels in 32.3% of patients was the second most prevalent indication, followed by clinical suspicion of recurrence in 36.9% of cases. Thirty-eight percent of referrals were due to unclear results on

conventional imaging. These findings demonstrate how FDG PET/CT may be used to solve problems.

Table 3: Indications for ^{18}F-FDG PET/CT		
Indication for PET/CT	**Number of Patients (n)**	**Percentage (%)**
Suspicion of recurrence on clinical grounds	24	36.9
Rising tumor markers (CEA)	21	32.3
Equivocal findings on conventional imaging	20	30.8
Total	**65**	**100**

Table 4 summarizes imaging data from ^{18}F FDG PET/CT. Distant metastases alone were observed in 40% of instances, whilst local recurrence alone was reported in 21.5% of patients. In 18.5% of patients, both distant metastatic disease and local recurrence were found. Twenty percent of patients showed no signs of current illness. These results show that PET/CT may reliably rule out active illness in a subgroup of individuals and identify both systemic and localized disorders.

Table 4: PET/CT Findings in the Study Population		
PET/CT Findings	**Number of Patients (n)**	**Percentage (%)**
Local recurrence only	14	21.5
Distant metastases only	26	40
Both local recurrence and metastases	12	18.5
No evidence of disease	13	20
Total	**65**	**100**

In Table 5, the distribution of metastatic sites detected on PET/CT is illustrated. The most frequent location of metastasis was the liver (35.4%), which was followed by the lungs (23.1%) and lymph nodes (27.7%). Skeletal and peritoneal metastases were also seen, but less often. These patterns highlight the benefit of whole-body PET/CT in assessing disease spread and are consistent with the established metastatic routes of colorectal cancer.

Table 5: Sites of Metastatic Disease Detected on PET/CT		
Site of Metastasis	**Number of Patients (n)**	**Percentage (%)**
Liver	23	35.4
Lung	15	23.1
Lymph nodes	18	27.7
Peritoneum	7	10.8
Bone	4	6.2

Table 6 illustrates the influence of ^{18}F FDG PET/CT on clinical management. PET/CT results led to a modification in the intended course of therapy in 19 out of 65 patients (29.2%), whereas the management stayed the same in 46 patients (70.8%). The tremendous clinical usefulness of PET/CT in guiding proper treatment decisions is highlighted by the high percentage of patients where therapy was changed. PET/CT increased physician confidence in the current care approach by providing confirmatory data in circumstances when therapy remained constant.

Table 6: Impact of PET/CT on Patient Management		
Impact on Management	**Number of Patients (n)**	**Percentage (%)**
Change in treatment plan	19	29.2
No change in treatment plan	46	70.8
Total	**65**	**100**

Discussion

In the diagnosis of colorectal cancer recurrence (CRCR), PET/CT is not yet considered an evidence-based tool. Few studies have emphasized the significance of FDGPET/CT as a new integrated imaging modality for the assessment of local CRCR, even though several research have examined the diagnostic utility of CT, MRI, and FDG-PET in the primary staging and/or recurrence of colorectal tumors [14]. The current study examined the use of PET-CT in the preoperative evaluation of patients with metastatic colorectal cancer who are being considered for curative resection. 93% of patients had liver metastases; the remaining individuals had lung and peritoneal deposits. In 65 (64%) individuals,

PET-CT results agreed with those of conventional imaging. This is consistent with earlier research in comparable patient populations, where PET-CT and conventional imaging concordance rates are often reported to be between 60 to 80% [15]".

ET-CT significantly changed the course of treatment for 65 patients, mostly by identifying more primary tumors, expanding the surgical field, down-staging to possibly operable disease, and up-staging and preventing a potentially pointless laparotomy. Similar results have been shown in several other studies. For example, PET reduced the rate of unnecessary laparotomies in patients with metastatic colorectal liver metastases from 45% to 28%. More recently, FDG-PET was shown to improve diagnostic performance and reduce unnecessary laparotomies by 38% [16]. Furthermore, since minimal extra-hepatic illness is no longer seen as a contraindication to attempted curative surgery, the added benefit of PET-CT in down-staging disease or in changing surgical planning by expanding the operating field is becoming increasingly important.

When assessing presacral fibrotic tissue in individuals who have had rectal amputation, FDG-PET/CT appears to be the preferred technique. We accurately reported recurrence in the presacral area in all 10 patients, which was later validated histologically, in line with previous publications [17]. High-resolution MRI of the pelvis with distension of the rectum by positive contrast agent is an investigation of choice for local staging of rectal cancer because of its superior soft tissue contrast resolution. Cross-sectional imaging modalities, such as computed tomography (CT) and magnetic resonance imaging (MRI), are typically the first tool for evaluation. Except for the T1 and T2 stages, when both have similar accuracy, MRI is better to CT in local staging [18].

The current study has several shortcomings that should be noted. Cases from many distinct referring regional hospitals were included due to the retrospective nature of data collection from a tertiary-referral institution that serves patients from a broad geographic area. The corresponding data for the previous CECT was varied and was obtained at multiple sites utilizing a range of different acquisition techniques and CT systems, while the technical characteristics for the PET-CT investigations were consistent. These were imported for examination into the local PACS system, although data analysis may be biased due to the variability.

This study add to the growing body of evidence that ^{18}F FDG PET/CT is a valuable addition to conventional imaging in the assessment of suspected recurrent and metastatic colorectal carcinoma, particularly in the preoperative phase. The capacity of PET/CT to give integrated metabolic and anatomical information offers significant advantages in some clinical circumstances, even though it is not yet widely regarded as an evidence-based regular tool for colorectal cancer recurrence. PET/CT greatly aids in the proper selection of patients for curative surgical intervention and helps to prevent needless or pointless surgeries by precisely detecting latent metastatic illness, ruling out non-viable lesions, and determining the extent of disease. The results demonstrate the significant influence of PET/CT on staging accuracy and treatment planning, despite the inherent limitations of this retrospective analysis, such as heterogeneity in earlier imaging methods and referral bias. To confirm these results and develop more precise evidence-based recommendations for the regular use of FDG PET/CT in the evaluation of colorectal cancer recurrence, future prospective, multicenter studies with standardized imaging protocols and larger patient populations are necessary.

Conclusion

FDG PET/CT is a highly effective imaging technique for evaluating recurrent colorectal cancer. PET/CT made it possible to accurately detect distant metastases and locoregional recurrence, including lesions that were occult or unclear on traditional imaging, by integrating metabolic and anatomical data. The modality proved very useful in detecting nodal involvement and extrahepatic illness, both of which are essential for proper restaging. Crucially, in almost one-third of patients, PET/CT results significantly altered clinical management, impacting choices about surgery, systemic therapy, or palliative care. These findings demonstrate the critical importance of FDG PET/CT as an all-encompassing, whole-body problem-solving tool in colorectal cancer post-treatment monitoring. More precise staging, better treatment planning, and better patient outcomes can result from routinely including PET/CT into the assessment of patients with suspected recurrence.

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