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RESIDUAL/RECURRENCE RATE AND FINDINGS IN POST-OPERATIVE EVALUATION OF COLORECTAL CARCINOMA WITH THE ROLE OF CT AND PET-CT IN EARLY DETECTION

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ABSTRACT

Objectives: To find residuals/recurrence rates in colorectal carcinoma patients who have undergone surgery and to compare the effectiveness of CT and PET/CT in diagnosing the disease.
Study Design: Cross-sectional diagnostic accuracy study.
Place and Duration of Study: Radiology Department of Chaudhary Muhammad Akram Teaching and Research Hospital, Lahore, Pakistan, from 13 May to 13 August 2026
Methodology: 120 patients of colorectal adenocarcinoma aged 16-65 years were selected through a non-probability consecutive sampling technique. All of the patients underwent CT followed by FDG-PET/CT. Histopathology was used as a reference standard wherever feasible. Results of CT scan versus PET/CT scan were evaluated by calculating the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of the diagnostic process.
Results: The median age was recorded as 56 years (IQR=9.25). According to the histopathological findings, 44 (36.7%) subjects were diagnosed with recurrent/residual disease. CT provided sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of 93.2%, 77.6%, 70.7%, 95.2%, and 83.3%, respectively. PET/CT exhibited sensitivity of 90.9%, specificity of 92.1%, PPV of 87.0%, NPV of 94.6, and total diagnostic accuracy of 91.7%.
Conclusion: Although the sensitivity of CT is slightly higher, we can observe the higher specificity and total accuracy of PET/CT, making it a better imaging technique used for recurrent or residual colorectal carcinoma diagnosis.

KEYWORDS: Colorectal Neoplasms; Histopathology; Positron Emission Tomography Computed Tomography; Recurrence

INTRODUCTION

Colorectal carcinoma (CRC) is still one of the most prevalent cancers worldwide, ranking third in terms of occurrence and second in terms of deaths due to it globally(1,2), and research by the Global Burden of Disease 2021 on the incidence of CRC shows that it will continue on the upward trend until 2050 as populations age and take up a Western diet type(3). In Asia, the age-standardized incidence of CRC is 17.30 per 100,000, and it is expected to see a 71.1% rise in incidence and a further 85.1% rise in the mortality of cases by 2040, exposing the future heavy burden developing health systems will bear in treating CRC patients(4,5). Regionally, colorectal cancer is rated among the five most common cancers in Pakistan, contributing about 4.9–6.8% of all cancer cases while nearly 30% of patients present themselves with advanced stage III/IV diseases(6).
Regardless of having undergone curative surgical procedures, the doctor sees the lack of the patient's cure to be the major cause of death. Although the use of CT scans has been employed for a long time, their ability to detect the tumor is insufficient since it fails to tell the difference between post-surgical scar tissue and tumor. A study showed that PET/CT outperformed regular imaging modalities by showing a much higher percentage of true positives during tests involving measuring the area under the receiver operating characteristic curves (0.885 vs 0.753) as well as in showing recurrence in unclear cases(7). The results obtained through meta-analysis support a higher degree of success in using PET/CT than in detecting recurrences using PET/MRI technology(8).

Previous studies have evaluated FDG-PET/CT utility in detecting recurrence in CRC patients with elevated CEA. However, large-scale population-based studies evaluating CT and PET/CT performance across tumor stages, sidedness, and histological types remain limited, especially in resource-constrained settings like Pakistan, where access to advanced imaging and local recurrence data is scarce. This study aims to evaluate the prevalence and patterns of recurrence/residual disease rates in CRC patients and assess the diagnostic performance of CT and PET/CT in early detection in a local cohort.

METHODOLOGY

A cross-sectional diagnostic accuracy study was conducted at Chaudhary Muhammad Akram Teaching and Research Hospital, Raiwind Road, Lahore, for 03 months after approval of the synopsis(13 May 2026 to 13 August 2026).
The sample size came up to 120 cases after using the sensitivity and specificity calculator averting a 95% confidence level, which showed an expected recurrence prevalence of 69%, CT scan sensitivity at 52% with a margin of error of 12%, and specificity at 80% with an error margin of 13%(9). Non-probability consecutive sampling was used for selecting the patients.
Inclusion criteria: Both male and female patients aged between 16 and 65 years who had surgical treatment for colorectal adenocarcinoma and visited the center for follow-up were included in the study.
Exclusion criteria: Tumor patients suffering from appendiceal and neuroendocrine tumors, multiple primary tumors, and patients with incomplete imaging or results were excluded from the study.
Once the ethical approval was obtained from both the hospital ethical review board and the CPSP, the eligible patients were recruited from the OPD. An organized format was made use of to jot down the demographic and clinical data such as age, sex, BMI, history of diabetes and hypertension, type of cancer, TNM staging, and type of surgery. All patients underwent a CT scan, followed by an FDG-PET/CT scan. The recurrence status was established using both forms of imaging. Whenever required, fine needle aspiration cytology was carried out, and the results were sent for histopathological assessment, which served as the reference for recurrence diagnosis. The type of recurrence, i.e., local, regional, or distant, was also noted down. In the case of CT and PET/CT, diagnostic outcomes depended on the histopathology reports, where they were derived from true positive, true negative, false positive, and false negative.
The analysis was done using SPSS(Statistical Package for Social Sciences) version 26.0, where categorical variables were displayed in terms of frequency and percentage. The Shapiro-Wilk test was used to assess the normality of continuous variables. BMI(p-value=0.610) and duration since surgery(p-value=0.072) were expressed as mean ± SD. Age(p-value<0.001) was expressed as median and interquartile range(IQR). To evaluate the diagnostic efficiency of CT and PET/CT, the sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were achieved through the use of 2x2 tables, with histopathology being the gold standard.

RESULTS

The research involved 120 individuals suffering from colorectal cancer who had completed their postoperative assessment. The average age among these individuals was 56 years (interquartile range = 9.25). The average body mass index (BMI) amounted to 26.41±3.03kg/m2, while the average time span after the operation was 15.16±6.48 months (Table I).

Table I: Baseline continuous characteristics of the study participants (n=120)

Variable	Mean±S.D
Age	56(9.25)
BMI	26.414±3.03
Duration since surgery(months)	15.16±6.48

BMI= Body Mass Index. Age was expressed as median(IQR) due to non-normal distribution.

There were a total of 65 (54.2%) females and 55 (45.8%) males among the participants. Both diabetes and hypertension were observed in 42 (35.0%) and 41 (34.2%) participants, respectively. The number of colon cancer cases was slightly higher than that of rectal cancer cases, with 66 (55.0%) participants being diagnosed with colon cancer and 54 (45.0%) participants diagnosed with rectal cancer. The majority of individuals who participated in the research (64; 53.3%) had not received any adjuvant therapy, while 56 (46.7%) patients underwent adjuvant care. Concerning the disease stages, Stage I occurred most often (34.2%), followed by Stage II (27.5%), Stage III (25.8%) and Stage IV (12.5%). Histopathological assessment proved the presence of recurrent residual disease in 44 (36.7%) cases, whereas 76 (63.3%) cases did not have positive findings. CT revealed positive results in 58 (48.3%) patients, while PET/CT results were positive in 46 (38.3%) cases. The majority of the participants (63.3%) did not show any signs of relapse, while local, regional, and distant recurrences occurred in 20 (16.7%), 14 (11.7%), and 10 (8.3%) individuals, respectively (Table II).

Table II: Baseline categorical characteristics of the study participants (n=120)

Variable	Category	n (%)
Gender	Female	65 (54.2)
	Male	55 (45.8)
Diabetes	No	78 (65.0)
	Yes	42 (35.0)
Hypertension	No	79 (65.8)
	Yes	41 (34.2)
Cancer type	Colon	66 (55.0)
	Rectum	54 (45.0)
Adjuvant therapy	No	64 (53.3)
	Yes	56 (46.7)
TNM stage	Stage I	41 (34.2)
	Stage II	33 (27.5)
	Stage III	31 (25.8)
	Stage IV	15 (12.5)
Histopathology	Negative	76 (63.3)
	Positive	44 (36.7)
CT scan	Negative	62 (51.7)
	Positive	58 (48.3)
PET/CT	Negative	74 (61.7)
	Positive	46 (38.3)
Recurrence type	Distant	10 (8.3)
	Local	20 (16.7)
	None	76 (63.3)
	Regional	14 (11.7)

According to the results from CT scan, histopathology displayed a total of 41 true positive cases and 59 true negative cases along with 17 false positive cases and 3 false negative cases, leading to a CT scan sensitivity of 93.2%; specificity of 77.6%; positive predictive value of 70.7%; negative predictive value of 95.2% and overall diagnostic accuracy of 83.3%.

Table III: Comparison of CT scan findings with histopathology for detection of residual/recurrent colorectal carcinoma (n=120)

CT scan	Histopathology Negative	Histopathology Positive	Total
Negative	59	3	62
Positive	17	41	58
Total	76	44	120

For PET/CT, histopathology showed 40 true positive cases and 70 true negative cases. There are six false positive cases and four false negative cases as well. Therefore, PET/CT has a sensitivity of 90.9%, specificity of 92.1%, positive predictive value of 87.0%, negative predictive value of 94.6%, and overall diagnostic accuracy of 91.7%.

Table IV: Comparison of PET/CT findings with histopathology for detection of residual/recurrent colorectal carcinoma (n=120)

PET/CT	Histopathology Negative	Histopathology Positive	Total
Negative	70	4	74
Positive	6	40	46
Total	76	44	120

DISCUSSION

This research revealed a significant postoperative residual/recurrence load in colorectal cancer patients, with histopathology indicating residual disease in 36.7% and overall free of relapse in 63.3% cases, while local, regional, and distant recurrence made up 16.7%, 11.7%, and 8.3%, respectively. As for diagnostics, PET/CT had a clear advantage over CT, producing sensitivity rates of 90.9% versus 93.2%, specificity 92.1% versus 77.6%, PPV 87.0% versus 70.7%, NPV 94.6% versus 95.2%, and accuracy 91.7% versus 83.3%, respectively.

The recurrence pattern that we observed in this research conforms with the previously established knowledge of the risk present after surgical extraction, particularly in the early postoperative period. According to a 2023 study involving a systematic review of relevant literature, nearly one-third of studied people (i.e., those who have undergone surgical combination therapy) will go through cases of relapse, with the use of PET being the least effective one (0.95) in contrast to CT (0.77)(10). Having estimated the residual disease to be 36.7% in our study, we have found it a bit higher than in previously published studies, but it can probably be explained by the fact that the treated patients were selected specifically for the purpose of our study(11).

The fact that in our research PET/CT has better specificity than its competitors makes a great difference in medical practice because false positive results of CT may make patients feel anxiety about their condition and expose them to needless imaging procedures. Modern empirical studies follow such rules: the research conducted in 2024 shows a PET/CT sensitivity score of 94.4% and specificity score of 82.5% in patients suffering from CRC, and the 2023 meta-analysis shows that PET is more efficient than CT with regard to recurrence monitoring(12). PET/CT adopted by us scored 92.1%, which is higher than mentioned above, and therefore, it may be supposed that in our research PET/CT appeared to work better than PET/CT in more complex cases to distinguish postoperative changes from processes with efficacy of the like cannot be applied to our case because the studies have used different standards, case mix and follow-up rules(13).

In the current research, the computed tomography (CT) sensitivity was observed to be 93.2%, which is better than the data assessment of 0.77 made in a meta-analysis performed in 2022, whereas the observed CT specificity was reported to be 77.6%, reflecting the previously identified issue related to the problem of postoperative anatomical imaging inaccurately diagnosing scar tissue, inflammation, or other forms of distortion as tumor recurrence(14). Similarly, 2022 study aimed at the evaluation of all-body imaging of recurrent CRC revealed CT to be the worst diagnostic tool among PET, PET/CT, and CT, due to its low accuracy when identifying extrahepatic and local relapses, which explains its low CT specificity and general inaccuracy(15). The utilization of PET/CT mitigates this issue thanks to its possibility to combine information of both metabolic and morphologic nature, making it easier to ascertain the presence of a tumor as opposed to postoperative changes.

Our group exhibited significant comorbidities and variance in treatment, including percentages of those with diabetes (35.0%), hypertension (34.2%), no adjuvant therapy (53.3%), as well as the majority receiving stage 1 cancer. Again, these findings are noteworthy, owing to previous studies that show that metabolic comorbidities can lead to adverse results; for example, a large colon cancer study found diabetes and hypertension to be significantly associated with lower recurrence-free survivals with odds ratios of 1.25 and 1.22, respectively(16). BMI could have an influence as well; a meta-analysis conducted in 2022 suggested no effect of having a BMI of 25.01 – 29.99 on outcomes, while obesity and underweight were disadvantages in this regard, which is relevant on account of having the average BMI of 26.41, which means the vast majority of our cohort was overweight(17,18). Therefore, the recurrence burden presented in this study may stem not only from the tumor biology but also from the metabolic profile of the population, and several months post-surgery examination, when the recurrence could have developed without showing up in normal tests.

One of the important aspects of this research is the fact that it utilized histopathology as the reference point in the study. This fact adds credibility to the accuracy of diagnosis for both CT and PET/CT.

LIMITATIONS OF STUDY:

Nevertheless, due to the cross-sectional nature of the study, one cannot make any causal statements, but one can infer limitations of potential spectrum biases, since patients with greater concerns turned out to be more likely to get the imaging techniques and be sent for pathological examination after the surgery. The sample was rather small, and there was no possibility of analyzing the subgroups according to staging, site, type of adjuvant therapy, or time of being operated. Moreover, CEA correlation was absent in the study, and there was no follow-up period done, which affected the measure of external validity. Similar problems are common for studies on the imaging of patients after surgery, and recent reviews indicated that it depends on different factors such as selection of candidates for surveillance, imaging time, and the rate of relapses in the studied cases.

CONCLUSION

This research has shown that postoperative residual or recurrent colonic cancer can pose serious clinical problems, especially when more than a third of patients show histologically verified recurrence of the disease. Despite the fact that CT has slightly higher sensitivity than PET/CT, it is the latter, with its substantially better specificity, positive predictive value, and overall diagnostic accuracy, which makes it much more effective in differentiating between genuine recurrence and postoperative changes. It has been recommended to incorporate PET/CT into postoperative surveillance since it gives better diagnostic confidence and enables timely clinical decisions to take place, especially among patients with uncertain CT findings or strong indications that allow suspicion of recurrence. At the same time, it is known that early and accurate detection of the relapsing disease can lead to timely therapeutic interventions and

better patient prognosis. It is highly desirable to conduct further multicenter studies with a greater number of participants and a longer follow-up period.

REFERENCES

1. Kee JX, Yau JNN, Kumar Muthuramalingam RP, Wang X, Chng WH, Lopez-Sanchez A, et al. Colorectal Cancer at the Crossroads: The Good, the Bad, and the Future of Platinum-Based Drugs. Chem Rev. 2025;125(21):10248-341. https://doi.org/10.1021/acs.chemrev.5c00041
2. Roshandel G, Ghasemi-Kebria F, Malekzadeh R. Colorectal Cancer: Epidemiology, Risk Factors, and Prevention. Cancers (Basel). 2024;16(8):1530. https://doi.org/10.3390/cancers16081530
3. Chang S, Chang Y, Li F, Xu Z, Han X, Liu Y, et al. Global, regional, national burden of colorectal cancer from 1990 to 2021, with projections of incidence to 2050: a systematic analysis of the global burden of disease study 2021. Front Oncol. 2025;15:1597847. https://doi.org/10.3389/fonc.2025.1597847
4. Pan H, Tang Y, Zhu H, Sun Y, Chi P, Huang Y. Global burden, trends, and risk factors of early-onset and late-onset colorectal cancer from 1990 to 2021, with projections to 2040: a population-based study. BMC Gastroenterol. 2025;25(1):486. https://doi.org/10.1186/s12876-025-04086-5
5. Mousavi SE, Ilaghi M, Hamidi Rad R, Nejadghaderi SA. Epidemiology and socioeconomic correlates of colorectal cancer in Asia in 2020 and its projection to 2040. Sci Rep. 2025;15(1):26639. https://doi.org/10.1038/s41598-025-12545-y
6. Bashir MI. Rising Early Onset Colorectal Cancer in Pakistan Demands Urgent Awareness and Prevention. Pak BioMed J. 2026;9(2):1-2. https://doi.org/10.54393/pbmj.v9i2.1347
7. Mihailović J, Roganović J, Starčević I, Nikolić I, Prvulović Bunović N, Nikin Z. Diagnostic Performance of F-18 FDG PET/CT in the Detection of Recurrent Colorectal Cancer: Correlation with Biochemical Markers and Conventional Imaging Modalities. J Clin Med. 2024;13(12):3602. https://doi.org/10.3390/jcm13123602
8. Lo HZ, Choy KT, Kong JCH. FDG-PET/MRI in colorectal cancer care: an updated systematic review. Abdom Radiol (NY). 2024;50(1):49-63. https://doi.org/10.1007/s00261-024-04460-z
9. Ogunbiyi OA, Flanagan FL, Dehdashti F, Siegel BA, Trask DD, Birnbaum EH, et al. Detection of recurrent and metastatic colorectal cancer: comparison of positron emission tomography and computed tomography. Ann Surg Oncol. 1997;4(8):613-20. https://doi.org/10.1007/BF02303744
10. Dawood ZS, Hamad A, Moazzam Z, Alaimo L, Lima HA, Shaikh C, et al. Colonoscopy, imaging, and carcinoembryonic antigen: Comparison of guideline adherence to surveillance strategies in patients who underwent resection of colorectal cancer - A systematic review and meta-analysis. Surg Oncol. 2023;47:101910. https://doi.org/10.1016/j.suronc.2023.101910
11. Wen X, Coradduzza D, Shen J, Scanu AM, Muroni MR, Massidda M, et al. Harnessing Minimal Residual Disease as a Predictor for Colorectal Cancer: Promising Horizons Amidst Challenges. Medicina (Kaunas). 2023;59(10):1886. https://doi.org/10.3390/medicina59101886
12. Dawood ZS, Alaimo L, Lima HA, Moazzam Z, Shaikh C, Ahmed AS, et al. Circulating Tumor DNA, Imaging, and Carcinoembryonic Antigen: Comparison of Surveillance Strategies Among Patients Who Underwent Resection of Colorectal Cancer-A Systematic Review and Meta-analysis. Ann Surg Oncol. 2023;30(1):259-74. https://doi.org/10.1245/s10434-022-12641-7
13. Milardovic R, Dzananovic L, Beslija S, Beslic N, Puhalovic A, Cavaljuga S. Statistical Modeling of Relations Between PET/CT Parameters and CEA in Recurrent and Metastatic Colorectal Cancer. Acta Inform Med. 2023;31(2):115-20. https://doi.org/10.5455/aim.2023.31.115-120
14. Simillis C, Taylor B, Ahmad A, Lal N, Afxentiou T, Powar MP, et al. A systematic review and meta-analysis assessing the impact of body mass index on long-term survival outcomes after surgery for colorectal cancer. Eur J Cancer. 2022;172:237-51. https://doi.org/10.1016/j.ejca.2022.05.020
15. Özkan ZG, Has Şimşek D, Kuyumcu S, Oflas M, Işık EG, Doğan İ, et al. Prognostic value of FDG PET-CT in suspected recurrence of colorectal carcinoma: survival outcomes of a 10-year follow-up: FDG PET in recurrent colorectal CA. Ann Nucl Med. 2022;36(1):52-60. https://doi.org/10.1007/s12149-021-01684-7
16. Mai DVC, Drami I, Pring ET, Gould LE, Rai J, Wallace A, et al. A Scoping Review of the Implications and Applications of Body Composition Assessment in Locally Advanced and Locally Recurrent Rectal Cancer. Cancers (Basel). 2025;17(5):846. https://doi.org/10.3390/cancers17050846
17. Himbert C, Ose J, Gigic B, Viskochil R, Santuci K, Lin T, et al. Associations of combined physical activity and body mass index groups with colorectal cancer survival outcomes. BMC Cancer. 2023;23(1):335. https://doi.org/10.1186/s12885-023-10695-8
18. China Z, Drmota J, Chowdhury A. 1208 Surveillance Strategy Following Curative Resection of Colorectal Cancer – What and When? BJS. 2024;111(Suppl 6):znae163.384. https://doi.org/10.1093/bjs/znae163.384