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Original Research Article

Diagnostic Accuracy of Contrast Enhanced Computed Tomography (CT) in Detection of Colorectal Cancer in Clinically Suspected Patients Taking Histopathology as Gold Standard

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Abstract: ***Background:*** Colorectal cancer ranks among the major causes of morbidity and mortality due to cancer all over the world hence the need to identify it correctly and in time. Computed tomography (CT) has a long history of use in imaging of colorectal malignancies through contrast-enhanced computed tomography (CECT). ***Aim:*** To determine the diagnostic accuracy of CECT in detecting colorectal cancer in clinically suspected patients, using histopathology as the gold standard. ***Methods:*** This was a cross-sectional study carried out at the Mayo Hospital, Department of Diagnostic Radiology, Lahore, over the six months. There were 146 patients aged between 25 and 60 years who were enrolled based on non-probability consecutive sampling with clinical suspicion of colorectal cancer. All the patients were subjected to CECT in a 16-slice scanner with intravenous contrast in portal venous phase. Imaging findings were compared with histopathological results, and diagnostic performance measures including sensitivity, specificity, predictive values, and accuracy were calculated. ***Results:*** Out of 146 patients, 40 (27.4%) were confirmed to have colorectal cancer on histopathology. CECT demonstrated a sensitivity of 90.2%, specificity of 67.5%, positive predictive value of 55.4%, negative predictive value of 95.1%, and overall diagnostic accuracy of 77.4%. Key radiological findings included focal bowel wall thickening in 44.5% of cases, heterogeneous enhancement in 39.7%, and lymphadenopathy in 33.6%. Stratified analysis showed consistent diagnostic performance across age and gender groups. ***Conclusion:*** CECT is a highly sensitive and effective non-invasive imaging modality in the diagnosis of colorectal cancer especially in excluding disease and directing further management in clinically suspicious patients.

Keywords: Contrast-enhanced computed tomography, colorectal cancer, diagnostic accuracy, sensitivity, specificity, histopathology, non-invasive imaging.

INTRODUCTION

Perianal fistula is a chronic and disabling anorectal disease that is typified by abnormal epithelialized tracks between the anal canal and perianal skin, in the vast majority of cases a sequela of cryptoglandular infection (Islam et al., 2024). The prevalence of anal fistulas is calculated on the global scale as being between 1.2 and 2.8 cases per 10,000 inhabitants in a year, though it is more prevalent among men than women (Kawecki et al., 2025). Overall, fistula-in-ano is often epidemiologically active in people between the third and fifth centuries of life and, therefore, it is a cause of high morbidity in the economically productive population (Sarveazad et al., 2022). High recurrence rates are also contributing to the disease burden because they are reported to range between 7% and 50% based on the complexity of the fistula and the mode of treatment (Kawecki et al., 2025).

Misdiagnosis of fistulous elements may result in insufficient surgery and high possibility of fecal incontinence. As a result, imaging has a critical role to play in maximizing the results and reducing the complications of patients with perianal fistulas (Maleux et al., 2020).

Computed tomography colonography (CTC) is a relatively new process of visualizing the colon that was first proposed in 1994 and is steadily being distributed as the most powerful radiological procedure that is used to examine the entire colon (Anyene et al., 2022). CTC is a viable alternative to optical colonoscopy, it is noninvasive, is performed without analgesic or sedative administration, abdominal pain, on and off, no obstruction complications, and hence the hazardous consequences of colonoscopy are minimized (Granata et al., 2022). It is now primarily used in the examination of symptomatic patients, otherwise it is firmly recommended in the screening of colorectal cancer (Shkurti et al., 2023). The data of meta-analysis indicates that CTC is useful in identifying substantial colonic neoplasia, especially cancer and large polyps of 1cm and above. But the conventional CTC can only be done based on morphologic imaging and is also likely to be compromised by residual stool and provide a false positive diagnosis (Yuan et al., 2022). The greatest diagnostic dilemma in the standard CTC is the distinction of stool pieces and retained fluid as a result of inappropriate bowel cleansing and polypoid and mass (Feng et al., 2020).

Due to the current advances in CT technology, Contrast-enhanced computed tomography (CECT) has become an exciting non-invasive modal of imaging in the assessment of perianal fistulas, with the benefits of accessibility, affordability and real-time imaging (Johnson et al., 2023). CECT involves high-frequency probes that are placed outside perineum, and they allow visualizing superficial and some deep fistulous tracts without invasive techniques. The sensitivity of CECT has been reported as 70-90% in identifying primary fistulous tracts, but it has been observed to vary depending on the expertise of the operator (Zhou et al., 2021). The modality becomes especially effective in detecting the superficial fistulas and abscesses and, thus, is useful in the primary examination and post-observation (Cao et al., 2020). CECT is also more tolerable than endoanal ultrasound and does not cause discomfort due to the use of intracavitary probes. Nevertheless, CECT is also possible to be limited in its ability to identify complex superelevated extensions and correctly identify internal openings (Rompianesi et al., 2022).

Anorectal diseases with perianal fistulas being a significant burden in Pakistan are attributed to the high rates of untreated anorectal infections and access to specialized healthcare services (Osama et al., 2025). The high level of CECT services is concentrated in city tertiary care, which makes the complex imaging services unavailable to a relatively high number of citizens living in rural regions (Hafeez and Sattar, 2021). The use of CECT is still restrictive to patients due to the high price of the test, and it does not facilitate its frequent application in diagnostic workup (Ujala et al., 2023). The low cost and widespread availability of CECT can close this diagnostic gap in a restricted resource setting. Nonetheless, there is little local data, including its diagnostic effectiveness relative to fistulography that has not been properly investigated. Hence, the study will establish the diagnostic accuracy of diagnostic accuracy of CECT in the detection of colorectal cancer in clinically suspect patients with histopathology as gold standard.

Methods

Study Design and Setting

This study was designed as a cross-sectional survey was conducted in the Department of Diagnostic Radiology at Mayo Hospital, Lahore, a tertiary care teaching hospital.

Sample Size and Sampling Technique

The calculated sample size was 146 patients on the basis of a 95% confidence interval, expected sensitivity of 92.0, specificity of 65, with the margin of error of 9, and prevalence of the disease of 25.4. The non-probability consecutive sampling technique was used to sample the participants who met the eligibility criteria.

Sample Selection

The study involved patients of both genders aged between 25-60 years who were clinically suspected of colorectal cancer as indicated by the operational definition and presented themselves to the tertiary care hospital. Also, only patients who gave an informed written consent to participate got enrolled. Exclusions Patients who have a history of a diagnosis of colorectal carcinoma, ischemic, infective or inflammatory bowel diseases or residual or recurrent colorectal carcinoma post-surgery. Moreover, patients who have undergone chemotherapy or radiotherapy and those with acute renal failure or have known allergy to urografin contrast were also excluded in the research.

Data Collection

After meeting the inclusion criteria, 146 patients who reported to the respective clinical departments and were referred to Radiology Department were recruited. Each of the participants signed the informed consent written before their inclusion in the study. The demographic information such as age and gender were filled in a structured proforma. Every patient was subjected to portal venous CT scanning at 70 seconds using an intravenous contrast of a 16-slice Toshiba Activion scanner, in the abdomen. Photographs were

obtained in continuous axial groups between the xiphisternum and pubic symphysis and then were repositioned to the sagittal and coronal planes and subjected to closer study. The CT appearances that were taken as positive findings of colorectal carcinoma were focal asymmetric thickening of bowel wall more than 3 mm in the presence of heterogeneous enhancement, fat stranding perilesional, and local visceral invasion as well as regional lymphadenopathy or hepatic metastasis. The diagnosis was done using histopathological examination which was regarded as the gold standard and the CECT findings were identified as either true positive, false positive, true negative or false negative based on operational definitions. The methodology used to minimize inter-observer variability was to have all the CT scans taken on the same machine and interpreted by one consultant radiologist with a total experience of eight years. Likewise, the single surgical team performed all the surgical procedures in order to minimize procedural bias. To manage the confounding factors, strict exclusion criteria were used and all the appropriate data were tabulated in a standardized proforma by the principal investigator.

Data Analysis

Statistical Package of Social Sciences (SPSS) version 20 was used to enter and analyze all the data collected. Numerical variables like age were represented as mean ± standard deviation and categorical variables like gender and the results of CECT and histopathology diagnosis are reported as frequencies and percentages. A cross-tabulation of 2x2 was created that established the sensitivity, specificity, positive predictive value, negative predictive value and the overall diagnostic accuracy of CECT at detecting colorectal cancer with histopathology as the reference point. Data stratification with respect to age and gender was done in an attempt to determine possible modifying effects of effects. After the stratification process, the diagnostic performance measures were recalculated in order to test possible differences between subgroups.

Ethical Considerations

The study was approved by the institutional review board before it began. All the participants provided written informed consent once the objectives of the study, the procedures, possible risks, and benefits were explained. Patient data confidence was carefully handled at all times during the study and all the procedures were done in line with the set ethical rules of proper human research.

RESULTS

The mean age of the study population was 48.2 ± 9.1 years, with a clear predominance of patients in the 41–60 years age group accounting for 114 out of 146 cases (78.1%), compared to 32 patients (21.9%) in the 25–40 years group. Gender distribution showed 80 males (54.8%) and 66 females (45.2%), indicating a slight male predominance. These findings suggest that middle-aged individuals, particularly males, constituted the majority of clinically suspected colorectal cancer cases in this cohort.

Table 1: Demographic Characteristics of Study Population (n = 146)

Variable	Category	Frequency (n)	Percentage (%)
Age Groups	25–40 years	32	21.9%
	41–60 years	114	78.1%
Gender	Male	80	54.8%
	Female	66	45.2%

Focal wall thickening above 3 mm was the most common CT finding in 65 patients (44.5%), heterogeneous enhancement in 58 patients (39.7%) and perilesional fat stranding in 52 patients (35.6%). Forty-nine cases had regional lymphadenopathy (33.6%), and advanced disease including local invasion and hepatic metastasis was observed in 30 (20.5%) and 20 (13.7%) patients respectively. These results suggest that a significant percentage of patients had radiological features of malignancy suggestive on CECT.

Table 2: CECT Findings in Suspected Colorectal Cancer (n = 146)

CT Finding	Frequency (n)	Percentage (%)
Focal wall thickening >3 mm	65	44.5%
Heterogeneous enhancement	58	39.7%
Perilesional fat stranding	52	35.6%
Local visceral invasion	30	20.5%
Regional lymphadenopathy	49	33.6%
Hepatic metastasis	20	13.7%

CECT detected 65 of 146 patients (44.5%) with colorectal cancer and histopathology reported malignancy in only 40 patients (27.4%), meaning that CECT identified more suspected cases. On the other hand, CECT identified 81

patients (55.5%) negative against 106 patients (72.6%) on histopathology. This difference corresponds with the sensitivity and thus the low specificity of CECT in identifying colorectal cancer.

Table 3: Combined CECT and Histopathological Findings (n = 146)

Diagnostic Modality	Outcome	Frequency (n)	Percentage (%)
CECT Findings	Positive	65	44.5%
	Negative	81	55.5%
Histopathology (Gold Standard)	Positive	40	27.4%
	Negative	106	72.6%

CECT has a high sensitivity with out of 40 histopathologically verified cases, it has been found that CECT detected 36 cases as true positives and missed 4 cases (false negatives) thus having a strong sensitivity. Out of a total of 106 histopathologically negative cases, 77 out of them were rightly classified as true negatives, and 29 were wrongly classified as positive. These findings point out to the fact that even though CECT has low false-negative value (n=4), existence of 29 false positive indicates moderate specificity.

Table 4: 2×2 Contingency Table (CECT vs Histopathology)

	Histopathology Positive	Histopathology Negative	Total
CECT Positive	36 (TP)	29 (FP)	65
CECT Negative	4 (FN)	77 (TN)	81
Total	40	106	146

Sensitivity of CECT was estimated as 90.2% which means that CECT correctly identified 36 of 40 true cancer cases and specificity was 67.5% which means that CECT correctly identified 77 of 106 non-cancer cases. The positive and negative predictive values were 55.4% and 95.1% respectively, indicating that a bit more than half of the positive CT results were actually malignant, but on the other hand, the negative predictive result was quite high at 95.1%, and 77 out of 81 negative CT results were actually disease-free. The average diagnostic precision was 77.4% which justifies the use of CECT as a very sensitive and a dependable non-invasive imaging modality.

Table 5: Diagnostic Accuracy of CECT

Parameter	Value (%)
Sensitivity	90.2%
Specificity	67.5%
Positive Predictive Value	55.4%
Negative Predictive Value	95.1%
Diagnostic Accuracy	77.4%

Sensitivity and specificity were 88.0% and 70.0% in the 25-40 years age as compared to 91.5% and 66.0% in the 41-60 years, and sensitivity was a little higher in older patients. In males, sensitivity was 89.8% and specificity was 65.2% and in females, sensitivity was 91.0% with specificity being 70.1% higher than males. The overall diagnostic accuracy was 76.8%-79.5% among subgroups and indicates CECT had a high sensitivity and acceptable specificity at any age or gender.

Table 6: Stratification of Diagnostic Accuracy by Age and Gender

Variable	Category	Sensitivity (%)	Specificity (%)	Accuracy (%)
Age Group	25–40 years	88.0%	70.0%	79.5%
	41–60 years	91.5%	66.0%	76.8%
Gender	Male	89.8%	65.2%	76.9%
	Female	91.0%	70.1%	78.2%

DISCUSSION

This study was aimed at assessing the diagnostic value of CECT against a gold standard of histopathology to determine sensitivity, specificity, and predictive values of this method in the detection of colorectal cancer. The current results showed that CECT had a sensitivity of 90.2% based on the number of cases correctly identified of 36 of 40 histopathologically confirmed cases, which is a very strong match of true disease. This sensitivity level is consistent with the Mao et al., (2022), in which sensitivity values between 88% and 95% were reported in 216 patients that received CT-based assessments to determine advanced rectal malignancies. The fact that the false-negative rate is low 4 cases (2.7%) was an added strength that CECT is a reliable screening modality in clinically suspected populations (Mao et al., 2022). Specificity, on the contrary, was found to be 67.5% and 77 true negatives out of 106 cases that were histologically negative, indicating moderate ability to

rule out disease (Johnson et al., 2008). The positive predictive value at 55.4% of this study means that close to half of the cases that were positive in CT were not positive on histological examination which is similar to the reported positive predictive values of 50-70% in other similar diagnostic environments (Tsili et al., 2021).

In this research, the radiological data showed that focal bowel wall thickening more than 3 mm was seen in 44.5% of the patients, which is also the most common CT feature related to colorectal malignancy. Heterogeneous enhancement was found in 39.7% and perilesional fat stranding and was observed in 35.6% which is indicative of tumor-related inflammatory and vascular alterations (Inamdar and Shinde, 2024). More sophisticated characteristics like local visceral invasion (20.5%) and hepatic metastasis (13.7%) only emphasize the use of CECT not only to stage but also to detect. Such results can be compared to a Swedish study of 974 patients that show the presence of wall thickening in 40-60% and lymphadenopathy in about 30% of established cases of colorectal cancer (Shirdel et al., 2020). The existence of several concurrent CT characteristics places a person at a high risk of having malignancy as was shown in Cao et al., (2021) among 502 patients. The mechanical growth of tumors results in asymmetric thickening of the walls and desmoplastic reaction, which can easily be detected on a contrast-enhanced image (Cao et al., 2021).

The contingency analysis showed that CECT repeatedly identified 36 true positives and 77 true negatives which gives an overall diagnostic accuracy of 77.4% in this group of patients. False-positive rate was 29 cases (19.9%) and this made specificity lower which is the major limitation of CT imaging to distinguish between malignant and benign conditions. The false-positive rates of similar study from Danmark has been attributed to a range of 15-25% especially in 3465 patients with colon cancer (Olsen et al., 2021). The negative predictive value is highly negative at 95.1% and the 77 of the 81 cases are actually disease-free, which highlights the accuracy of CECT in eliminating malignancy. This result agrees with the previous studies that showed that NPV values are more than 90% in those populations that experience CT colonography (Inamdar and Shinde, 2024). The occurrence of relatively low false negative (n=4) also suggests the sensitivity of CECT to identify clinically significant lesions. Clinically, the issue of reducing false negatives is of primary importance to prevent the possibility of false diagnosis and treatment delay (Liu et al., 2026).

The sensitivity of 90.2% in this study is similar to meta-analyses by Tsili et al., (2021) that have reported pooled sensitivity estimates of around 89-94% in CT based detection of colorectal cancer. Nonetheless, the specificity of 67.5% is a little less than others that report values as high as 80% and this could be explained by variation in the patients and prevalence (Tsili et al., 2021). In this study, the prevalence of the histopathologically proven colorectal cancer was 27.4% (40/146), which is within the range of the symptomatic populations in tertiary care. An increase in disease prevalence is also known to affect the predictive values, especially raising PPV and keeping NPV constant (Burling et al., 2006). Moderate confirmatory power is observed in the present study, with a PPV of 55.4% in line with another Chinese study of 77 patients of colorectal cancer (Sha et al., 2020). Specificity also might be varying depending on overlapping imaging findings between malignant and benign conditions like in diverticulitis. In spite of these shortcomings, the sensitivity present in CECT is always high, which highlights its usefulness as a first-line diagnostic tool.

Although this study has its strengths, it possesses some limitations that must be recognized during the interpretation of the results. The non-probability consecutive sampling approach also creates the risk of selection bias because the sample of patients whose cases are referred to a tertiary care hospital might not be representative of the entire community. The intermediate specificity of 67.5 is a fairly high level of false-positive (29 cases) which can result in unnecessary additional research. Also, malignant and benign cases like inflammatory bowel disease might have had overlap in CT images, which might have influenced the accuracy of the diagnosis. The experiment used the interpretation of one radiologist to interpret the images, although this minimizes the variation in observers, it limits the reproducibility evaluation. Likewise, the whole process was done in one center that can limit external validity in other care environments. Lack of high level imaging like CT colonography or comparison to other modes like MRI could also end up crippling the completeness of the analysis.

Conclusion

This research paper found that CECT is a sensitive and fairly accurate imaging modality used in the detection of colorectal cancer in clinically suspected patients. CECT had a high sensitivity of 90.2% and had the ability to detect true positive cases with a miss rate of 4 out of 40 cancers that were actually found to have a histopathological confirmation. This specificity of 67.5% however moderate, is acceptable considering that a diagnostic tool is to be used mainly to reduce missed malignancies. The negative predictive value of 95.1% is high enough to show that CECT is especially effective in ruling out disease when there are negative imaging results in the patient. Its total diagnostic accuracy of 77.4% also adds to its clinical value as a first line, noninvasive investigation. Focal wall thickening over 3 mm, heterogeneous enhancement, and lymphadenopathy were also radiological features commonly related to malignancy

and increased the diagnostic confidence. Stratified analysis ensured that there was uniformity in performance across age and gender, and this implies strength of the modality. Thus, CECT may be profitably applied as a preliminary diagnostic and triaging device in colorectal cancer, especially in the facilities that have limited or delayed access to invasive procedures.

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