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Role of Enhanced CT Combined with CT Virtual Colonoscopy Compared to Colonic Endoscopy in Detection of Colorectal Pathology

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ABSTRACT

Background: Colorectal pathology is the study of diseases affecting the colon, rectum, and anus, encompassing a range of conditions from benign to malignant. It includes common disorders such as polyps, inflammatory bowel disease [IBD], diverticulosis, and colorectal cancer. The aim of this study was to assess Clinical Value of Enhanced computed tomography [CT] Combined with CT Virtual colonoscopy compared to colonic endoscopy in detection of colorectal pathology.

Methods: This prospective study included 30 patients at the National Liver Institute, Menoufia, Egypt.

Results: Our study showed excellent agreement between computed tomography colonography [CTC] and conventional colonoscopy [kappa = 0.792, P < 0.001], with CTC demonstrating high sensitivity [95.83%] and specificity [83.33%]. CTC detected a slightly higher number of pathologies, identifying 40.0% of masses or suspicious thickening compared to colonoscopy's 33.33%. For IBD, CTC identified 26.66% of cases, marginally surpassing colonoscopy's 23.33%, and both methods equally detected diverticulosis in 13.33% of cases. CTC achieved 100.0% accuracy for rectosigmoid and sigmoid lesions, and 96.67% accuracy across other locations, with minor discrepancies overall. Additionally, CTC had a lower complication rate, with fewer patients experiencing abdominal distension [16.66%] compared to conventional colonoscopy [36.67%].

Conclusion: The strong performance of Enhanced CT Combined with CT Virtual colonoscopy in this study, particularly its high sensitivity and specificity, suggests it could be a valuable tool in colorectal pathology detection, offering a less invasive alternative with fewer complications compared to conventional colonoscopy.

Keywords: Computed Tomography; Colonic Endoscopy; Colorectal Pathology; CT Virtual Colonoscopy; Detection; Enhanced CT.

INTRODUCTION

Colonoscopy is the gold standard for detecting colorectal pathology; however, it is an invasive procedure that can cause bleeding and perforation of the bowel. Following a routine checkup, a colonoscopy is recommended every ten years to further detect, sample, and remove precancerous or cancerous growths as well as to lengthen the time between screenings [1-3].

Although computed tomography [CT] colonoscopy can detect large polyps in both asymptomatic and symptomatic patients, it may not be the best choice because it produces images from outside the organ [4-6]. Non-invasive CTC relies on a thin-section CT scan of the colon and data analysis using two- and three-dimensional images [7].

Cathartic bowel preparation and air insufflation to the highest level tolerated [approximately two liters of room air or carbon dioxide] are necessary for the procedure to be successful in causing colonic distension. Oral contrast agents have recently been administered to patients, which has benefits such as relative safety, ease of performance, and good safety overall, though the risk of radiation is still up for debate. Computer-based enhancement techniques are frequently used in conjunction with one another to improve visualization, and it has shown to be very accurate and specific [8-9]. As artificial intelligence [AI]-based technologies continue to advance, it is not surprising that cancer and pathology diagnostic tools have begun to incorporate methods to improve patient diagnosis with more accuracy and precision. AI's ability to process massive amounts of data and uncover information that experts miss are additional benefits. Other tools that can enhance medical imaging include those that enhance image quality through the integration of 3D technologies into image extraction [10].

The objective of this investigation was to evaluate the clinical value of enhanced CT combined with CT virtual colonoscopy in the detection of colorectal pathology in comparison to colonic endoscopy.

METHODOLOGY

This was a prospective study to be carried out on patients in National Liver Institute, Menoufia, Egypt and was conducted on 30 patients.

All patients in the study were subjected to the following:

- Consent taking.
- Revision of the patient's laboratory investigations, which include renal function tests [primarily serum creatinine].

The inclusion criteria include the following: 1] Patient age > 18 years; 2] Patients of either sex who exhibit symptoms or findings indicative of colonic or rectal mass lesions, including hemorrhage per rectum, melena, stools with a positive hemoccult test, iron deficiency anemia, and changes in bowel patterns; 3] Family or personal history of colonic tumors; 4] Patient with history of colonic disease such as inflammatory bowel disease. **The exclusion criteria were** 1] Patients with renal impairment; 2] Patients with known hypersensitivity to contrast media; 3] Pregnant females due to risk of radiation.

CT Protocol

Examination Preparation: The most critical aspect of the entire examination process is bowel preparation. Patients were required to consume a minimal quantity of fluids for breakfast and lunch on the day preceding the examination, and to abstain from eating dinner. It was also important to inject air into the intestinal tract as a preparation step. Either room air or carbon dioxide [CO2] can be administered in this way using a manual pump or an automated pressure-controlled insufflator. The procedure began with injecting approximately 500 mL of gas into the anus of patients who were lying on their left sides on the surgical table with their knees bent. Patients were subsequently positioned on their right sides with their knees bent, and 500 mL of gas was injected once again. Injections should be temporarily halted and the abdomen massaged gently to alleviate abdominal distention if the patient experiences it. Sometimes, injecting a negative contrast can also cause gas in the colon to expand.

Image Acquisition Protocol: Using a Siemens Definition 64 slice spiral CT scanner, all patient images were obtained. To conduct the enhanced scanning, a double-syringe power injector [MEDRAD Company, USA] was used in conjunction with Ultravist intravenous contrast medium. After injecting 1.5 mL/kg of Ultravist contrast medium, the patient was placed in the supine position for the scan. The scanning delay time for the arterial phase was 25 seconds and for the venous phase it was 45 seconds. At last, the scan was carried out beginning at the diaphragm's top and ending at the pubic bone's lower margin. After transferring the CT images to the post-processing workstation software, they were all reconstructed as 1-mm slices with a 1-mm reconstruction interval.

Image Interpretation: Experienced radiologists independently evaluated both the CTVE reconstructions and sectional enhanced CT images of the 30 cases. A combined evaluation of enhanced CT and CTVE formed the basis of the final interpretations, which included the detection, classification, location of the pathology, and surrounding conditions. 3D endoluminal colonic images, 3D colonic maps, VRT images, MPR, and maximum intensity projection [MIP] were the primary methods used for post-processing the images. Other methods included 2D images of the lungs and soft tissues, as well as axial, coronal, and Saggittal cuts.

Statistical Analysis: The SPSS v27 software, developed by IBM [Armonk, NY, USA], was used for statistical analysis. The normality of the data distribution was assessed using the Shapiro-Wilk test and histograms. The mean and standard deviation [SD] were used to display the quantitative parametric data. The percentage and frequency counts of the qualitative factors were given. Statistical significance was determined by a two-tailed P value less than 0.05. Based on the Kappa Interpretation, a level of agreement ranging from 0.0 to 0.20 is considered slight agreement, 0.21 to 0.40 is fair agreement, 0.41 to 0.60 is moderate agreement, 0.61 to 0.80 is substantial agreement, and 0.81 to 1.00 is practically perfect agreement.

RESULTS

Regarding Colonic Endoscopy findings [Table 1], 10 [33.33%] patients had colonic mass, 7 [23.33%] patients had features suggestive of IBD, 3 [10.0%] patients had Polyp, 4 [13.33%] patients had Diverticulosis and 6 [20.0%] patients were normal.

Concerning CT virtual findings [Table 2], 12 [40.0%] patients had masses or suspicious wall thickening, 8 [26.66%] patients had CT features of inflammatory bowel disease IBD, 4 [13.33%] patients had colonic diverticulosis and 6 [20.0%] patients were normal.

In regard to location of pathology [Table 3], 8 [33.33%] patients had rectal pathology, 1 [4.16%] patient had ascending colon pathology, 7 [29.16%] patients had sigmoid pathology, 5 [20.83%] patients had rectosigmoid pathology and 3 [12.5%] patients had pathology in the whole colon. Colonic Endoscopy complications [Table 4] were abdominal distension in 11 [36.67%] patients. Enhanced CT Combined with CT

Virtual colonoscopy complications were abdominal distension in 5 [16.66 %] patients.

Regarding Agreement [Tables 5], there was a perfect agreement between CT Combined with CT Virtual colonoscopy and Colonic Endoscopy in diagnosis of colorectal pathology [kappa = 0.792 and P value < 0.001].

Regarding Accuracy [Table 6], CT Combined with CT Virtual colonoscopy can diagnose colorectal pathology as Colonic Endoscopy with 95.83% Sensitivity, 83.33% specificity, 95.83% Positive Predictive Value [PPV], 83.33% Negative Predictive Value [NPV] and 93.33 % Accuracy. Enhanced CT Combined with CT Virtual colonoscopy agree with Colonic Endoscopy in diagnosis of rectal pathology in 7 cases [while disagree in one case [Enhanced CT Combined with CT Virtual colonoscopy detect it as normal so it is considered as false negative case]]. There was disagreement in detection of location of pathology in splenic flexure case as Enhanced CT Combined with CT Virtual colonoscopy [Enhanced CT Combined with CT Virtual colonoscopy detect it as false positive [as normal by colonic endoscopy]. As regard to hepatic flexure and ascending colon there was disagreement as Enhanced CT combined with CT Virtual colonoscopy considered the location of the pathology in the hepatic flexure while the colonic endoscopy considered the location as distal part of the ascending colon Enhanced CT Combined with CT Virtual colonoscopy agree with Colonic Endoscopy in diagnose of rectosigmoid colon cancer in 5 cases with 100.0% accuracy. Enhanced CT Combined with CT Virtual colonoscopy agree with Colonic Endoscopy in diagnose of sigmoid colon in 6 cases. Enhanced CT Combined with CT Virtual colonoscopy agree with Colonic Endoscopy in diagnose of the whole colonic affection in 3 cases while disagree in one case.

Table [1]: Colonic Endoscopy findings of the studied patients

Variable	N = 30
Colonic mass	10 [33.33%]
Features suggestive of IBD	7 [23.33%]
Polyp	3 [10.0%]
Diverticulosis	4 [13.33%]
Normal	6 [20.0%]

IBD: Inflammatory bowel disease.

Table [2]: CT virtual findings of the studied patients

Variable	N = 30
Masses or suspicious wall thickening	12 [40.0%]
CT features of IBD	8 [26.66%]
Colonic diverticulosis	4 [13.33%]
Normal	6 [20.0%]

IBD: Inflammatory bowel disease.

Table [3]: Location of pathology of the studied patients

Variable	N = 24
Rectal	8 [33.33%]
Ascending	1 [4.16%]
Sigmoid	7 [29.16%]
Rectosigmoid	5 [20.83%]
The whole colon	3 [12.5%]

Table [4]: Complications of Colonic Endoscopy and Enhanced CT Combined with CT Virtual colonoscopy of the studied patients

Variable		N = 30
Colonic Endoscopy	Abdominal distension Negative	11 [36.67%] 19 [63.33%]
Enhanced CT Combined with CT Virtual colonoscopy	Abdominal distension Negative	5 [16.66 %] 25 [83.33 %]

Table [5]: Agreement and accuracy of CT Combined with CT Virtual colonoscopy compared to Colonic Endoscopy in diagnosis of colorectal pathology of the studied patients

Variable		Colonic Endoscopy		P value
CT Combined with CT Virtual colonoscopy		**Negative [n=6]**	**Positive [n=24]**	
Negative		5 [83.33%]	1 [4.166%]	Kappa=0.792 **P value<0.001***
Positive		1 [16.66%]	23 [95.83%]	
Sensitivity	**Specificity**	**PPV**	**NPV**	**Accuracy**
95.83%	83.33%	95.83%	83.33%	93.33%

*Significant as P value≤0.05, PPV: Positive predictive value, NPV: Negative predictive value

Table [6]: Accuracy of CT Combined with CT Virtual colonoscopy compared to Colonic Endoscopy in diagnosis of colorectal pathology locations of the studied patients

Locations	Colonic Endoscopy [Positive]	CT Combined with CT Virtual Colonoscopy [Positive]	Accuracy
Rectal	8	7	96.67%
Splenic flexure	0	1	96.67%
Hepatic flexure	0	1	96.67%
Ascending colon	1	0	96.67%
Sigmoid colon	7	7	100.0%
Rectosigmoid colon	5	5	100.0%
The whole colon	3	4	96.67%

DISCUSSION

Our study demonstrated excellent agreement between CTC and conventional colonoscopy [kappa = 0.792, P < 0.001]. The high sensitivity [95.83%] and specificity [83.33%] of CTC are particularly noteworthy and compare favorably with international standards. CTC demonstrated strong performance in detecting various pathologies. It identified 12 cases [40.0%] of masses or suspicious wall thickening, while colonoscopy detected 10 cases [33.33%] and 3 [10.0%] patients had Polyps. For inflammatory bowel disease [IBD] features, CTC detected 8 cases [26.66%] One case later on was false positive case, 7 cases [23.33%] identified by colonoscopy. Both methods showed comparable detection rates for diverticulosis, each identifying 13.33% of cases.

These findings align with recent studies by **Tang *et al***. [11] they set out to determine how well 128-slice spiral CT and virtual colonoscopy could detect colorectal cancer. Compared to colonoscopy, CTC has a higher detection rate of colorectal cancer with liver metastasis [100 percent], invasion of adipose tissue surrounding the intestinal wall [90 percent], and lymph node metastasis [89.7 percent]. In our study we detected 6 cases [50.0%] had lymph nodal and hepatic deposits outperforming the colonoscopy in this point so this gives better results in the surgical and curative plan of the affected patients.

In 2013 research by **Fini *et al***. [12] All 304 1st degree relatives had thorough CTC and CC. There were 133 lesions discovered. 101 [75.9%] of the 133 polyps were small, 22 had at least one polyp measuring 6 mm at minimum, and 2.9% had at least one polyp measuring 10 mm at minimum.

Regarding our study 8 [26.66%] patients had CT features of IBD in the form of Mural wall thickness and was the most common CT finding found in 5 cases [62.5%]. Aside from mural wall thickness other findings were pericolic fat stranding and regional lymphadenopathy. 2 cases were found to have findings suggestive of chronic IBD in the form of multiple pseudoplyps formation and loss of colonic haustration. One case was false positive for having IBD as detected by CTC splenic flexure segment affection but later on was negative by both Colonoscopy and histopathology. **Singh *et al***., [13] identified seven instances of ulcerative colitis, three of which were acute and four of which were chronic. The results of CTC in ulcerative colitis are discussed. The rectum was the most commonly affected in both acute and chronic UC. Diffuse mural thickening was the most common CT coronographic abnormality detected. Aside from mural thickness, other observations in chronic ulcerative colitis were haustration loss and loss of mucosal granularity. All of the patients showed peri colonic stranding, mesenteric lymphadenopathy, and luminal constriction. The findings were verified by CC. With CTC, all of the lesions were accurately located. They showed the sensitivity for detecting acute and chronic ulcerative colitis of CTC is 66.6% and 100.0%, respectively. They found the CTC had a sensitivity and specificity of 97.56 percent and 100 percent in identifying lesions, respectively.

The existence of complaints such as rectal bleeds and alteration in gut habit, which lead patients to visit a physician early, is likely to explain the high incidence of rectal and distal cases [14]. An analysis of CT colonography's sensitivity in identifying cases of acute and chronic ulcerative colitis was carried out by **Anderson *et al***., [15] the sensitivity levels they reported were 63.6% and 100.0%, respectively. The discovery of polyps and masses is a possible indication to examine using CT colonography in patients with IBD. This is because it is well recognized that IBD increases the risk of colorectal cancer. In CTC research by **Horvat *et al***., [16] detected in 35.4% of patients, with 40 synchronous colorectal polyps measuring 5 mm or larger located just proximal to the occlusive tumor. A total of 65 occlusive CRCs were found during CTC, in addition to four other proximal synchronous colon tumors in other patients: one in the cecum, two in the ascending colon, and one in the rectum. These tumors had been detected during incomplete preoperative colonoscopy. Further proximally, CTC discovered a synchronous appendiceal tumor. Colorectal polyps more than 5 mm were identified with a sensitivity of 88.9% and a specificity of 83.3% using preoperative CTC. When only polyps smaller than 10 mm were examined [n = 9], the sensitivity was 36.4%. However, when all polyps 10 mm or larger were taken into account [n = 28], the sensitivity was 100.0%. **Devir *et al***., [17] found that, CTC demonstrated 83 percent sensitivity and 95 percent specificity, with a PPV of 95 percent and a NPV of 83 percent for the identification of colorectal polyps and masses, independent of size.

The enhanced CT scan can better detect lesions by delineating the contents of the intestines and any abnormalities therein. For instance, an enhanced nodular protrusion on the intestine wall suggests a high likelihood of a lesion, whereas a nodule without enhancement is more likely to be intestinal contents. Additionally, tumor lesions showed clear enhancement at the artery phase and reduction at the venous phase. Another advantage is that after CT enhancement, the maximum density projection [MIP] can be utilized to clearly observe the vascular anatomy and understand the blood supply. This aids in lesion localization and understanding the tumor's blood supply. When combined with CTVE, enhanced CT significantly improves the accuracy of colorectal cancer diagnoses and has significant clinical value [18]. **Osama *et al***. [19] included 35 individuals. Every significant polyp [>1 cm] was found using virtual colonoscopy. Two false positive polyps [>1 cm] were discovered by virtual colonoscopy that were not detected by traditional colonoscopy. Inadequate colonic distension or collapsed colonic segments, as well as inappropriate preparation using leftover feces and water lakes, were the primary reasons for both positive and negative false positive outcomes.

Virtual and traditional colonoscopies had nearly identical findings, particularly for masses and so-called clinically important polyps [>1 cm]. **Ivanov *et al*.**, [20] Virtual colonoscopy [VC] was found to detect colorectal lesions in 115 patients [83.0% of cases], with a specificity of 94.0% and a sensitivity of 98.0%. The results of OC and VC were similar [p>0.05], demonstrating that VC was a reliable diagnostic tool for colorectal cancer [CRC] and colon polyps. It was also effective in identifying pathology in relation to the size of the lesion.

Sha *et al*. [9] contrasted the efficacy of colonoscopy with computed tomography colonography in diagnosing colorectal cancer. Both diagnoses revealed 27 individuals with polyps measuring 10 mm or larger, whereas 50 patients with polyps measuring less than 10 mm but still raising suspicions. Consequently, seventy-seven individuals had surgery. The sensitivity of computed tomographic colonography was 0.961 and that of colonoscopy was 0.831 in relation to surgical pathology. The benefit score for computed tomographic colonography was 0-0.906 for diagnostic confidence and for colonoscopy it was 0.035-0.5 for the discovery of polyps measuring 10 mm ø or more. Computerized tomographic colonography and colonoscopy were unable to identify polyps less than 10 mm in diameter, as well as polyps less than 0.6 mm and less than 2.2 mm in diameter, respectively.

In our study [3 cases had polyp all detected by colonoscopy] .one case of rectal polyp measuring about 4 mm which CTC could not detect unlike colonoscopy. This agrees with above mentioned studies in ability of polyp detection by CTC. **Mohammad *et al*.**, [21] found that out of five cases of stomach discomfort, two had diverticulum [no finding] and three had either a mass or a polyp, according to the link between clinical presentation, colonoscopy, colonographic findings, and histological results. For the identification of colon masses, colonography outperformed colonoscopy in every respect: sensitivity [100.0%], specificity [93.75%], positive predictive value [PPV] [100.0%], and accuracy [96.88%]. The corresponding criteria for identifying colon polyps were 75%, 100%, and 87.50%. Finally, for any irregularity in the colon or diverticulum in the colon, the outcome was 100.0%. Among 9 cases presented with chronic constipation [mass was the common finding in 4 cases and diverticulum in 1 case. Among 11 cases presented with Bleeding per rectum [the majority of them also, had ulcer [4 cases, Ulcerative Colitis – active & Non-specific colitis], 3 cases had mass. Finally, among 5 cases with Chronic Diarrhea Colonoscopy finding showed [the majority [3 cases] had Ulcer [Ulcerative Colitis – active] & No finding [no finding].

As regard to our study the correlation between clinical presentation, colonoscopy, coronographic findings revealed among the 17 abdominal pain cases [7 cases had IBD, 6 cases had cancer, 4 had diverticulosis and others with no findings]. Among the 19 cases of alteration of bowel habits [7 cases were IBD, 8 had cancer and other no finding]. Among the 8 cases of iron deficiency anemia 6 cases had cancer while 2 cases no findings. Among the 5 cases of fecal occult blood 2 cases had cancer and 2 were IBD. Among the 5 cases of bleeding per rectum 3cases had cancer. **Nimako** [22] found that CT colonography was less successful than conventional colonoscopies in detecting colorectal cancer.

Jefferson *et al*. [23] CT colonoscopy detected six malignancies with a sensitivity and specificity rate of one hundred percent, according to research that compared it to conventional colonoscopy. On one occasion, a CT colonoscopy revealed peri colonic fat stranding and numerous perirectal nodes, while a conventional colonoscopy probe was unable to pass beyond the rectum due to an ulcer proliferative lesion that was blocking the rectum's lumen. Of the 50 patients who underwent a Chol lithotomy, 1 had hepatic metastases, 2 had ascites, 5 had renal calculi, 2 had renal cortical cysts, 2 had inguinal hernias, 1 had gall bladder wall thickening, 1 had cholelithiasis, 1 had hiatal hernia, and 1 had cirrhosis with portal hypertension; these findings accounted for 38.0% of the total findings.

According to our study, among the 12 cases who had finding suggestive of malignancy 6 cases [50.0%] had lymph nodes and hepatic deposits which would not be detected by conventional colonoscopy. One case, which proved to be normal by both CTC and Colonoscopy, on the post contrast CT images showed that the patient had hepatic focal lesion which was diagnosed later on as HCC. This proves the importance of combining both enhanced CT with CT virtual colonoscopy. **Wesp *et al*.**[24] investigated the differentiation of premalignant from benign colorectal polyps detected by CT colonography using deep learning. They emphasized the ability of CT colonography [CTC] to detect colonic polyps and differentiate between types [premalignant vs. benign in the provided study, and detection with strong agreement with colonoscopy].

Our findings on the sensitivity and specificity of CT colonography compared to traditional colonoscopy were consistent with prior research by **Pickhardt *et al*.**, [25] CT colonography has a sensitivity of 96.1% for colorectal cancer, whereas traditional colonoscopy has a sensitivity of 94.7%.

A comparative study by **Neri *et al*.**, [26] CT colonography outperforms traditional colonoscopy for a number of reasons, including the detection of colonic masses, the thoroughness of the colonic assessment, and the accurate localization of carcinoma segments. **Weinberg *et al*.**, [27] identified colorectal lesions in patients one year after curative surgical resection for colorectal cancer by comparing the clinical performance features of CT colonography [CTC] with optical colonoscopy [OC]. Among the 231 individuals who took part in the study, 116 [50.2%] had polyps detected by optical coherence tomography [OC], with 15.6% having conventional adenomas and/or serrated polyps measuring 6 mm or more. No malignancies inside the blood vessels were found. The CTC had a sensitivity of 44.0% [95.0% CI, 30.2-57.8] and a specificity of 93.4% [95.0% CI, 89.7-97.0] in identifying individuals with polyps measuring 6 mm or larger. Polyps of 10 mm or more were found with a sensitivity of 76.9% [95.0% CI 54.0-99.8] and a specificity of 89.0% [95.0% CI, 84.8-93.1] by CTC. Similar values were found when only adenomatous polyps were considered. On the one hand, CTC had a negative predictive value of 90.7 [95.0% CI, 86.7-94.5] for adenomas ≥6 mm and 98.6 [95.0% CI, 97.0-100] for adenomas ≥10 mm.

With a 100.0% sensitivity rate, CTC was shown to detect meta-chronous colorectal cancer in a population under surveillance, according to a meta-analysis [28].

In our study, in regard to location of pathology, 8 [33.33%] patients had rectal pathology, 1 [4.16%] patient had ascending colon pathology, 7 [29.16%] patients had sigmoid pathology, 5 [20.83%] patients had rectosigmoid pathology and 3 [12.5%] patients had pathology in the whole colon. Our study demonstrated excellent location-specific accuracy in detecting pathologies, with 100% accuracy for lesions in the rectosigmoid and sigmoid colon. It achieved 96.67% accuracy for pathologies located in the rectal, splenic flexure, hepatic flexure, and ascending colon regions. In assessing the entire colon, there were minor discrepancies, resulting in an overall accuracy of 96.67%. These results exceed those reported by **Tang *et al*.** [11] who indicated that the rate of diagnostic concordance between CT virtual endoscopy and pathological findings for mass type colorectal cancer was greater than for invasive, ulcer, and mixed types. The rationale for this is because CTVE can more objectively depict the overall shape of the lesion since it can display the mass in numerous directions and planes, and it is not limited by intestinal stenosis to view the lesion's shape in the intestinal lumen. As a result of CTVE's inability to discern lesion color, mucosal alterations in the intestinal wall, and

superficial ulcers, invasive, ulcer, and mix types of colorectal cancer are all difficult to diagnose. They demonstrated that CTVE is a reliable tool for assessing mass size, infiltration level, localization, categorization, and the presence or absence of metastasis to other organs.

Regarding the symptoms with respect to location of the tumor, **Ben-Ishay *et al*.** [29] observed that, bleeding per rectum and alteration of gut habits occurred at considerably greater rates in individuals with left colon cancers [P = 0.002 and 0.006, respectively]. Within the node-positive phases, there are substantial variations in the presentation of symptoms, with a higher incidence of stomach discomfort [P = 0.01], weight loss [P = 0.04], and a change in bowel habits [P = 0.03].

In our study with respect to location of the tumor in agreement with **Ben-Ishay *et al*.** [29] we found that the most common presenting symptom in patients with left colon neoplastic mass were alteration of bowel habits [8 cases] and bleeding per rectum [3 cases]. According to **Jefferson *et al*.**[23] research, the sigmoid colon was the most common site for lesions [40.5% of all lesions], followed by the rectum and colon [27.1% of lesions], the descending colon [16.2%], the transverse colon [10.8%], and the ascending colon and cecum [2.7%]. **Osama *et al*.**, [19] showed that, the lesions involving the sigmoid colon were the most common, making up 46.4% of all lesions. Lesions affecting the rectum, descending colon, splenic flexure, transverse colon, hepatic flexure, ascending colon, and cecum were each identified at 10.7%. In a meta-analysis by **Pickhardt *et al*.**, [25], the rectosigmoid colon was the most common site where CT colonography failed to detect malignancy. It is possible that difficulties with insufficient luminal distention are related to the relative rise in rectosigmoid tumors undetected at CT colonography. **Yucel *et al*.**, [30] revealed several inherent limitations of CTC. Flat lesions may be more difficult to identify with CTC since the conspicuity of flat lesions on 3D endoluminal imaging is decreased; altering soft-tissue window settings and employing fecal tagging may aid to enhance detection. In addition, **Yucel *et al*.**, [30] showed that, the majority of colonoscopies [62.0% to 26.0%] do not reach the cecum level, even when conducted by trained endoscopists using standard methods. A percentage of incomplete colonoscopies ranging from 22.0-33.0% has been seen in older adults. Patients presenting with advanced illness may explain the higher proportion of incomplete conventional colonoscopies in our research.

In another study by **Sali *et al*.** [31], CT colonography was found to be an effective method for accurately locating colorectal cancer in its specific segments, detecting other malignancies at the same time, polyps larger than 10 mm, and staging tumors reasonably accurately.

In our study, a significant advantage of CTC was its lower complication rate, with only 16.66% of patients experiencing mild abdominal distension compared to 36.67% of patients who reported this complication with conventional colonoscopy.

CTVE is a noninvasive, safe, quick, and patient-friendly exam that doesn't need sedation or anesthesia. It could be the gold standard for screening colorectal cancer in older patients or those who can't have colonoscopies. The multislice spiral CT virtual endoscope collects a lot of data, so it's easy to store and watch again and again. Reviewing patients' results allows you to compare them to those from earlier exams [32]. When the intestinal wall is visibly thickened or there is a huge tumor in the intestines, CTVE can also see the exact position and form of the lesion, which is helpful in determining how to treat the condition. However, CTVE has limitations such as not being able to take a sample of the lesion's mucosa or color, having a greater false positive rate if the intestinal preparation is inadequate, and not being able to identify smaller polyps due to a lack of tissue specificity [33].

Colonoscopy allows for direct visual observation of the mucosa color and the kind of lesion present. Crucially, the biopsy tissues may be collected from both the actual lesion and the suspected lesion while the inspection is being conducted. In minor lesions, it may have a therapeutic effect. Electronic colonoscopy, on the other hand, is an invasive technique that increases the risk of intestine perforation—something that is often intolerable in older and weaker patients, as well as those who have intestinal obstruction or intestinal lumen stenosis. **Tang *et al*.**, [11] revealed that six trial participants had too much pain during the electronic colonoscopy to continue with the detection.

Osama *et al*., [19] discovered one patient with peritoneal deposits and a small bowel concomitant lesion, as well as two individuals with hepatic deposits. In addition, one patient had a colon tumor that had spread to other parts of the body, including the spleen and pancreatic tail. Although another patient's colon was normal, tests revealed lymphoma and splenic focal lesion in addition to abdominal lymphadenopathy; there was no colonic affection in this patient. They also discovered various forms of hepatomegaly in seven individuals, as well as splenomegaly, ascites, calcified pleural thickening, bilateral renal stones, simple renal cysts, and one patient with cirrhotic liver. Contrarily, ten of the twenty-five patients who underwent traditional colonoscopies were administered sedatives and/or analgesics since eighteen of them reported discomfort or humiliation during the procedure.

In a study comparing virtual and conventional colonoscopies for the purpose of patient preference assessment, 236 patients were surveyed; 168 [or 71.0% of the total] rated conventional colonoscopies as extremely painful and embarrassing, while 168 [or 21.0% of the total] rated virtual colonoscopies as negligible and minor burdens. A total of 45 patients [19.0%] reported no significant difference in compliance between the two types of colonoscopies. Interestingly, when patients reported discomfort during virtual colonoscopy, verbal reassurance was enough in nearly all cases, and no sedatives or analgesics were administered. In contrast, 70 patients required injections of sedatives or analgesics in order to endure conventional colonoscopies [34].

Conclusion: Based on the results of this study, Enhanced CT Combined with CT Virtual colonoscopy has the potential to be a useful tool for detecting colorectal pathology. It offers a less invasive alternative to conventional colonoscopy and has fewer complications.

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