

# The Diagnostic Accuracy of Virtual Colonoscopy

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**Abstract:** *Virtual colonoscopy (CTC) is considered investigational or experimental, for patients with inflammatory bowel disease, including Crohn's, ulcerative colitis, or diverticulitis and cancerous lesions. The aim of the study was to determine the accuracy of computed tomography colography (virtual colonoscopy) in detecting colorectal polyps and colorectal cancer. Conventional colonoscopy identified 109 polyps in 47 patients; 28 of these polyps, in 20 patients, were identified by virtual colonoscopy. Sensitivity of virtual colonoscopy for detecting polyps was 93% for polyps with diameter  $\geq 10$  mm. Multidetector computed tomography-based virtual colonoscopy has a high sensitivity for the detection of clinically important colorectal polyps.*

**Keywords:** Colon, computed tomography (CT), multidetector CT, colonoscopy

## 1. Introduction

Colorectal cancer is a major cause of morbidity and mortality in Western countries (1). Early stages of colorectal cancer are associated with a relatively high 5-year survival rate, whereas late stages, characterized by nodal and distant metastasis, are associated with poor survival, despite the use of intensive and costly chemotherapeutic protocols (2). Despite its relatively low sensitivity for colorectal cancer detection, fecal occult blood test screening has nonetheless been shown to reduce colorectal cancer mortality in controlled trials, underlining the importance of cancer detection (3). Screening tests that aim to depict colorectal cancer directly, including both endoscopic and radiologic methods, would be expected to be more sensitive than the fecal test and therefore depict proportionately more early stage cancers, with a contingent beneficial effect on disease-specific mortality (4). Computed tomographic (CT) colonography is a minimally invasive imaging examination of the colorectum that has been endorsed by several key medical organizations for colorectal cancer screening and diagnosis (5). Most published studies of CT colonography have focused primarily on detection of colorectal polyps, using optical colonoscopy (OC) as the reference standard test. Because of the low prevalence of invasive cancer, especially in a screening setting, test sensitivity for invasive cancer cannot be properly evaluated in single studies owing to the small numbers of cancers identified in the screening group. Furthermore, the two most recent systematic reviews of CT colonography diagnostic performance (6) dealt only with polyps and not cancer. Owing to the lack of an independent reference standard, the sensitivity of OC for colorectal cancer has been mainly assessed indirectly by evaluating the rate of interval cancers diagnosed within a short interval after the index examination (7). Blinding of CT colonography results during subsequent OC, with either segmental or posttest unblinding of CT colonography results, allows for immediate retesting and thus creates an enhanced reference standard by which CT colonography and conventional OC can both be compared (8). Such a study design is primarily intended to minimize the likelihood of false negative OC diagnoses masquerading as CT colonography false-positive diagnoses but has the added benefit of allowing a less biased estimate of OC sensitivity

itself. The aim of the study was to determine the accuracy of computed tomography colography (virtual colonoscopy) in detecting colorectal polyps and colorectal cancer.

## 2. Material and Methods

Between January 2017 and June 2018, we recruited 47 patients with colorectal polyps (31 men and 16 women; mean age, 61 years; range, 48 to 79 years). Patients were considered to be at high risk if they were 50 years of age or older and if they had a history of adenomatous polyps, recent sigmoidoscopic evidence of one or more polyps, a positive finding on fecal occult-blood testing, or a history of colorectal cancer in one or more first-degree relatives. Patients underwent virtual colonoscopy followed by conventional colonoscopy. Examination results were compared with conventional colonoscopy, which served as the gold standard. Main outcome measures: Presence and size of polyps and other lesions; certainty of polyp identification on virtual colonoscopy (on 100-point visual analogue scale); sensitivity and predictive values of virtual colonoscopy.

### Statistical analysis

The overall (i.e., any lesion size) sensitivity and specificity of CTC for identifying patients with colorectal polyps or masses relative to CC were calculated and 95% confidence intervals computed for these parameters. By grouping patients according to lesion size as measured by CC (e.g.,  $>5$  mm,  $>10$  mm and so on), a range of relative sensitivities and specificities (i.e. at least 1 true lesion of size  $>$  cutoff value) were computed with respective 95% confidence intervals. Similarly, the sensitivity of CTC for identifying individual colorectal lesions was calculated with confidence intervals. Because a total number of true-negative lesions cannot reasonably be ascertained without assumptions, specificity for individual lesions cannot be calculated (i.e., no unit of measure).

## 3. Results

Conventional colonoscopy identified 109 polyps in 47 patients; 28 of these polyps, in 20 patients, were identified by virtual colonoscopy. Sensitivity of virtual colonoscopy

for detecting polyps (using supine plus prone scans) was 93% for polyps with diameter  $\geq 10$  mm (95% CI, 39%-94%) and 89% for smaller polyps (95% CI, 70%-98%) ( $P < 0.001$ ); corresponding figures for supine-only scans were 97% (95% CI, 78%-99%) and 91% (95% CI, 84%-94%), respectively. Four polyps identified at virtual colonoscopy were considered false-positive findings (8%). The value of finding a polyp on virtual colonoscopy (with thresholds of 5 mm for diameter and 30 points for certainty score) was assessed as a predictor of finding a polyp (diameter  $> 5$  mm) on conventional colonoscopy (fig. 1). Positive and negative predictive values were 88% and 89%, respectively, for supine plus prone scans.

Colorectal cancer is a curable disease if detected and treated early. Screening may decrease the morbidity and mortality rates associated with colorectal cancer by enabling detection and removal of premalignant adenomatous polyps before they become invasive cancers. Despite the consensus on the need for colon cancer screening and the multiple options currently available, there are many new cases of colorectal cancer diagnosed every year. Optical colonoscopy allows complete examination of the large bowel whilst simultaneously providing a method of biopsying or removing suspicious lesions. Although colonoscopy is highly effective in the diagnosis and treatment of colorectal polyps, it is associated with small but definite risk for complication due to its invasive nature and patients frequently refuse to undergo screening programs. Since its first report in the literature, CTC has attracted progressively increasing interest as possible future alternative to CC in the diagnostic of colorectal polyps and cancer. Researchers (9) reported that colonoscopic examination is an effective method for surveillance of colonic lesions due to its combined diagnostic and therapeutic effect. Nevertheless, it is important to realize that there is an error rate inherent in flexible colonoscopy. This is due in part to the fact that the cecum is not reached in a significant proportion of colonoscopies additionally; there are significant endoscopic blind spots in the colon, such as rectosigmoid junction, both splenic and hepatic flexures resulting in overlooked polyps as demonstrated on double-contrast enema (10). Another drawback of conventional colonoscopy is the evaluation of the colon proximal to a stenotic lesion which is not an uncommon condition where undetected proximal lesions would affect the therapeutic decision. Also, one should not disregard the fact that flexible endoscopy has failed to reach one very important goal which is acceptance among the general population, especially as a screening method, or when clinical data are doubtful. This would delay the diagnostic benefits for conventional colonoscopy carrying the risk of delayed diagnosis of the colonic neoplasm in advanced stages (11). Virtual colonoscopy has developed as a convergence of the extensive image data acquired with the advancing multislice CT and computer graphic technology to permit evaluation of the internal as well as external appearance of the colon, and creating 3D reconstructed images producing endoscopic like view without the use of an endoscope (12). Comparison between virtual colonoscopy and conventional colonoscopy as regards their results and sensitivity for colonic lesion detection has been the goal for several studies in order to assess the accuracy of virtual colonoscopy. The results of virtual colonoscopy in

the detection of polyps according to polyp size were compared to the studies in literature and the results were nearly comparable to our results. Our study included 47 subjects. Comparative results between virtual and conventional colonoscopy, for total number of lesions showed that virtual colonoscopy is a little bit ahead in front of virtual colonoscopy, yet the results are more or less comparable to each other. Also in our study, a comparative study for the sensitivity of polyp detection according to size was done between virtual colonoscopy and conventional colonoscopy. And so, we found that the results of virtual and conventional colonoscopy are almost comparable, especially in masses and the so called clinically significant polyps ( $> 1$  cm). Side findings are defined as relevant extra colonic abdominal findings, discovered in the axial CT images. This point is one of the advantages of virtual colonoscopy as compared to conventional colonoscopy, which has no role in extra luminal findings. CTC specificity is very homogeneous, but the reported sensitivities for CTC vary widely, even for larger polyps. There are some factors that may account for the wide range of sensitivities. First, scanners that used thinner collimation has higher sensitivity. Secondly, the mode of the imaging also appears to be important. However this latter finding must be interpreted with caution as it is based on only two studies and considerable heterogeneity was found for the other types of image used (13-15). The use of intravenous contrast medium may therefore enable an increase in the specificity of this technique, but the added risks and cost of administering intravenous contrast medium probably preclude its use as part of screening CTC protocols for large populations (16).

#### 4. Conclusion

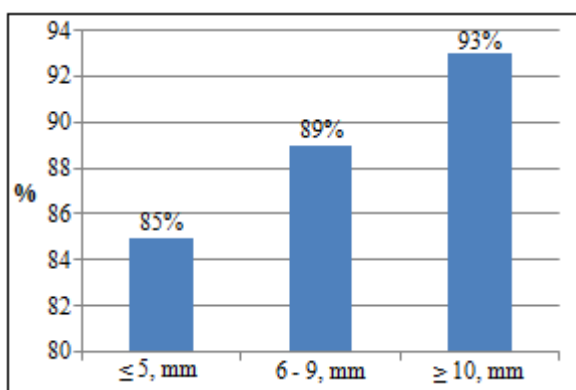
In conclusion, the results of this study support that MDCT-based virtual colonoscopy is a sensitive and specific method for detecting colorectal polyps. It is a relatively noninvasive method available for colorectal screening; thus, more patients may prefer undergoing virtual colonoscopy screening, thereby leading to increased detection and removal of clinically important adenomas.

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**Figure 1:** The sensitivity of virtual colonoscopy