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Comparison of virtual colonoscopy with conventional colonoscopy in detection of colorectal polyps

Kolorektal poliplerin saptanmasında sanal kolonoskopi ve konvansiyonel kolonoskopinin karşılaştırılması

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Background/aims: *To determine the sensitivity and specificity of multidetector computed tomography-based virtual colonoscopy for colorectal polyp detection by using conventional colonoscopy as the reference standard.* ***Methods:*** *48 patients with high risk for colorectal cancer underwent virtual colonoscopy followed by conventional colonoscopy. Examination results were compared with conventional colonoscopy, which served as the gold standard.* ***Results:*** *Virtual colonoscopy correctly depicted 19 of 22 polyps (sensitivity, 86%) that were detected in conventional colonoscopy. All 4 polyps that were greater than 10 mm in size (100%), 6 of 7 polyps 6-9 mm in size (85%), and 9 of 11 polyps 5 mm in size or smaller (81%) were correctly depicted with virtual colonoscopy. Virtual colonoscopy had an overall sensitivity of 86% and specificity of 98%.* ***Conclusion:*** *Multidetector computed tomography-based virtual colonoscopy has excellent sensitivity for the detection of clinically important colorectal polyps.*

Key words: Colon, computed tomography (CT), multidetector CT, colonoscopy

Amaç: *Bu çalışmanın amacı çok kesitli bilgisayarlı tomografi kullanılarak yapılan sanal kolonoskopinin kolorektal poliplerin saptanmasındaki duyarlılık ve özgüllüğünü, konvansiyonel kolonoskopiyi referans standart alarak belirlemektir.* ***Yöntem:*** *Kolorektal kanser açısından yüksek risk taşıyan 48 erişkin hastaya önce sanal kolonoskopi, takiben konvansiyonel kolonoskopi incelemeleri yapıldı. İnceleme sonuçları altın standart ölçüt kabul edilen konvansiyonel kolonoskopi sonuçları ile karşılaştırıldı.* ***Bulgular:*** *Sanal kolonoskopi konvansiyonel kolonoskopide bulunan 22 polipten 19'unu(%86 duyarlılık) doğru olarak saptadı. 10 mm ve daha büyük olan dört polip'in hepsi (%100), 6-9 mm arasında olan 7 polip'in altısı (%85) ve 5 mm ile daha küçük 11 polip'in 9'u (%81) BT-kolonografi ile saptandı. Sanal kolonoskopinin genel olarak duyarlılığı %86, özgüllüğü %98 olarak bulundu.* ***Sonuç:*** *Çok kesitli BT kullanılarak yapılan sanal kolonoskopi klinik olarak önemli kolorektal poliplerin saptanmasında yüksek bir duyarlılığa sahiptir.*

Anahtar kelimeler: Kolon, bilgisayarlı tomografi (BT), çok kesitli BT, kolonoskopi

INTRODUCTION

Colon cancer is still an important health problem that causes serious morbidity and mortality. Current colon cancer screening techniques have been shown to lead to decreases in the morbidity and mortality associated with colon cancer by allowing detection and leading to removal of premalignant adenomatous polyps (1-2). Current methods used to screen for colorectal polyps and colonic cancer remain controversial, and each method has inherent limitations (3, 4). Colonoscopy is known to be the gold standard procedure for screening the colon. However, diminutive lesions can still be missed by colonoscopy through observer error or due to the polyp's being situated in a blind area. In addition, performing total colonoscopy is not technically possible in cases with obstructing colonic lesions. Furthermore, it is invasive and uncomfortable as a screening method; consequently, endoscopic screening recommendations have remained largely ignored by the public (5).

Since its description, virtual colonoscopy [computed tomography (CT) colonoscopy] has been rapidly evolving as a method of colorectal evaluati-

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on. Recent years have seen remarkable advances in CT technology by the introduction of multidetector CT (MDCT). Virtual colonoscopy may improve colorectal screening by facilitating detection of clinically important colorectal polyps with the use of a relatively noninvasive, easy and safe examination, thereby increasing patient and clinician acceptance of colon cancer screening (6-8).

The purpose of this study was to evaluate the sensitivity and specificity of MDCT-based virtual colonoscopy in adult patients with high risk for colorectal cancer by using conventional colonoscopy as the reference standard.

MATERIALS AND METHODS

Patients

Between January 2005 and November 2005, 48 patients (16 men, 32 women; age range 27-83 years; mean age, 55 years) were enrolled in this study. Patients eligible for screening had either hematochezia or stool with positive hemoccult test results, iron deficiency anemia, and personal or family history of colonic neoplasms. Informed consent was obtained from all patients. Patients were scheduled to undergo virtual colonoscopy prior to conventional colonoscopy, both performed on the same day.

Virtual Colonoscopy Technique

Twenty-four hours before examination, each patient received a standard colonoscopic cathartic bowel preparation using Fleet Phospha-soda.

Virtual colonoscopy was performed with a 16-detector CT scanner (Siemens Sensation Cardiac, Germany). Before the examination, patients were placed in the left lateral decubitus position on the CT table for the introduction of a rectal enema tube. 20 mg of hyoscine-N-butyl bromide (Buscopan; Eczacıbaşı, Turkey) was intravenously administered to reduce bowel peristalsis and colonic spasm. The colon was gently insufflated with approximately 1500-2000 ml room air, according to patient tolerance. With the patient in the prone position, a CT scout image was obtained to ensure adequate bowel distention. After air insufflation, CT examination was performed with the patient in both prone and supine position.

Imaging parameters for CT colonoscopy were 16 x 0.75 mm detector collimation, 0.5 second gantry rotation time, 120 kV and 50 mAs (effective). The pitch value was 1.5. The entire region of the abdomen and pelvis could be imaged during a 12-second breath hold. CT images were reconstructed as 1-mm-thick sections with a 0.6 mm reconstruction interval.

CT Data Interpretation

Reconstructed CT images were processed on a workstation (Wizard, Siemens, Germany) using commercially available software (Syngo, Colonography). 2D coronal-sagittal reformatted, 3D surface rendered endoluminal perspective images were generated and evaluated by an experienced abdominal radiologist. Axial and reconstructed images were interpreted and detected lesions were compared to the other planes. The endoluminal viewing was performed both antegrade and retrograde, with both supine and prone data sets, to avoid blind areas. This also allowed evaluating whether the lesion changed position, which was consistent with stool residue.

The presence, location, size, and morphology of colorectal polyps were assessed in six colonic segments (cecum, ascending colon, transverse colon, descending colon, sigmoid colon, and rectum) to facilitate polyp-to-polyp mapping with conventional colonoscopy. Colonic masses over 3 cm in size and mural thickening consistent with annular carcinomas were excluded from this study that was designed to measure success of the polyp detection only.

Conventional Colonoscopy

Conventional colonoscopy was performed by experienced gastroenterologists immediately after CT colonoscopy. The endoscopists were not aware of the results of virtual colonoscopy. All polyps identified at colonoscopy were photographed, sampled for biopsy or removed at snare polypectomy, and sent for histologic analysis. Polyps were measured in millimeters with the open biopsy forceps technique. The location of each polyp was mapped according to the same six colonic segments used in the CT analysis.

Virtal Colonoscopic and Conventional Colonoscopic Data Comparison

A finding was defined as true-positive when virtual colonoscopy and conventional colonoscopy depicted a lesion with similar morphologic structure and size in the same anatomic segment. A true-negative finding was considered in cases that both virtual colonoscopy and conventional colonoscopy revealed no abnormalities in the same segment. A finding was defined as false-positive when virtual

colonoscopy depicted an abnormality in a segment but conventional colonoscopy did not depict an abnormality in that segment. A false-negative finding was considered to be present when a lesion was detected in a segment at conventional colonoscopy but a lesion was not detected in the same segment at virtual colonoscopy. If conventional colonoscopy was incomplete, the available results were compared. Lesions identified with virtual colonoscopy but located within segments not depicted by conventional colonoscopy were excluded from comparative analysis.

Statistical Analysis

Sensitivity, specificity, and positive and negative predictive values were calculated with 95% confidence intervals (CIs) using the findings at conventional colonoscopy as the reference standard. Calculations were based on segmental findings. The sensitivity of virtual colonoscopy for polyp detection varies directly according to polyp size. Therefore, sensitivity was calculated for each sub-group of polyps with diameters of 5 mm or smaller, 6-9 mm, and 10 mm or larger. Specificity was defined as the proportion of negative results at virtual colonoscopy out of all negative results for detection of polyps at conventional colonoscopy, i.e., the proportion of true-negative results out of all negative results at conventional colonoscopy. As with sensitivity, these values were calculated for the detection of polyps with diameters of 5 mm or smaller, 6-9 mm, and 10 mm or larger.

RESULTS

Conventional colonoscopy was completed up to the cecum in 31 patients and failed to depict the entire colon in the remaining 17 patients. Reasons for failure included poor patient tolerance (n = 7), adhesion (n = 5), occlusive carcinoma (n = 3), and diverticulosis (n = 2).

Conventional colonoscopy detected 22 polyps in 48 patients. Of the 22 polyps, 4 were 10 mm in diameter or larger, 7 were 6-9 mm, and 11 were 5 mm or smaller.

Virtual colonoscopy correctly depicted 19 of 22 polyps (sensitivity, 86%). Lesions were correctly depicted with virtual colonoscopy in all 4 polyps which were 10 mm in diameter or larger (sensitivity, 100%); in 6 of 7 polyps in the range of 6-9 mm (sensitivity, 85%); and in 9 of 11 polyps with a diameter of 5 mm or smaller (sensitivity, 81%). Virtual colonoscopic findings were false-negative in three polyps and false-positive in four polyps (Figure 1). The three false-negative polyps (8 mm, 3 mm, and 2 mm polyps) were reviewed retrospectively. It was found that a polyp 8 mm in diameter could not be detected at virtual colonoscopy because of spasm in the region of colon (sigmoid colon) in both supine and prone position. The other two polyps were not identified because they were misinterpreted as residual stool.

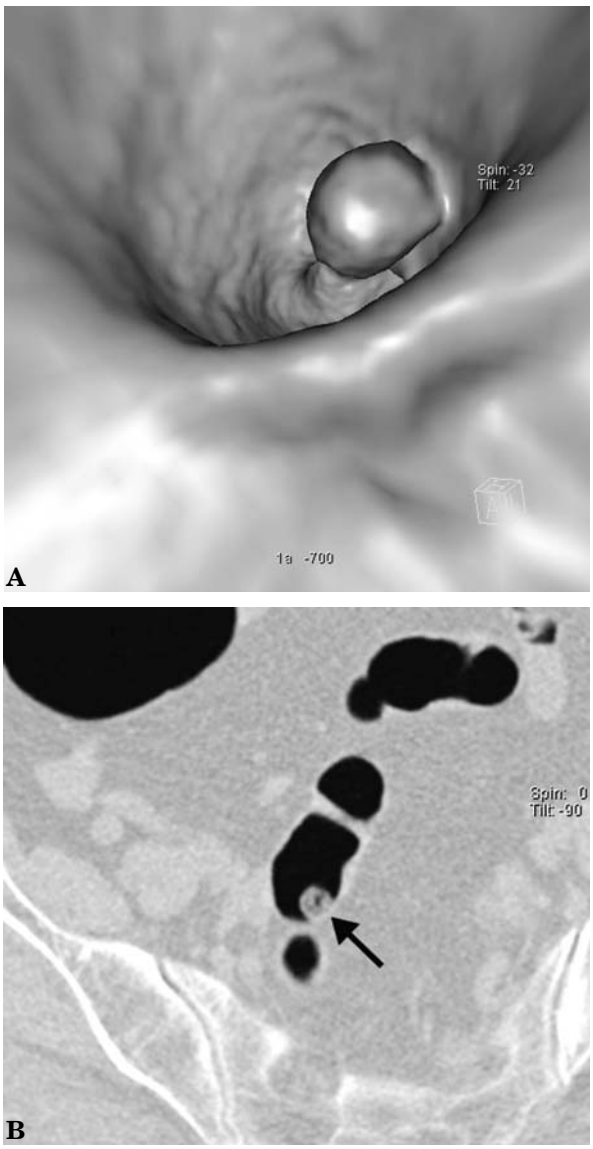

Figure 1. A) Virtual colonoscopy image shows a polypoid lesion in the sigmoid colon. **B)** Wide-window-setting axial CT image showed air density in the lesion, diagnosed as residual stool. Conventional colonoscopy verified that there was no lesion in this segment

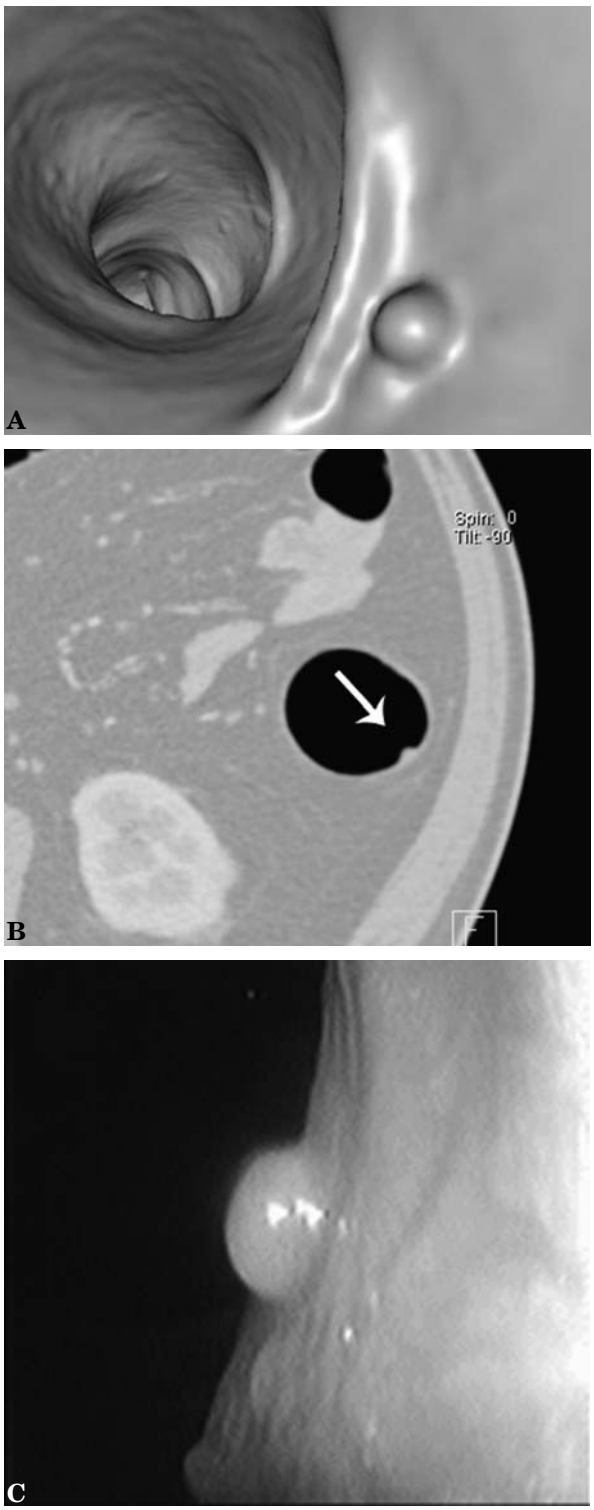

Figure 2. A) Images of a 5-mm true-positive finding in a 55-year-old man. a) Virtual colonoscopy image shows small polyp in descending colon **B)** Wide-window-setting axial CT image is suggestive of a polyp (arrow). **C)** Conventional colonoscopic view of the same lesion. Histologic evaluation showed this to be a hyperplastic polyp

The sensitivities of virtual colonoscopy for the detection of polyps 10 mm or larger, 6-9 mm, and 5 mm or smaller in diameter were 100%, 85%, and 81%, respectively. Virtual colonoscopy had overall sensitivity of 86% and specificity of 98%. Positive predictive value was 75% for polyps smaller than 5 mm, 100% for 6-9 mm, and 100% for greater than 10 mm. Negative predictive value was calculated as 98%.

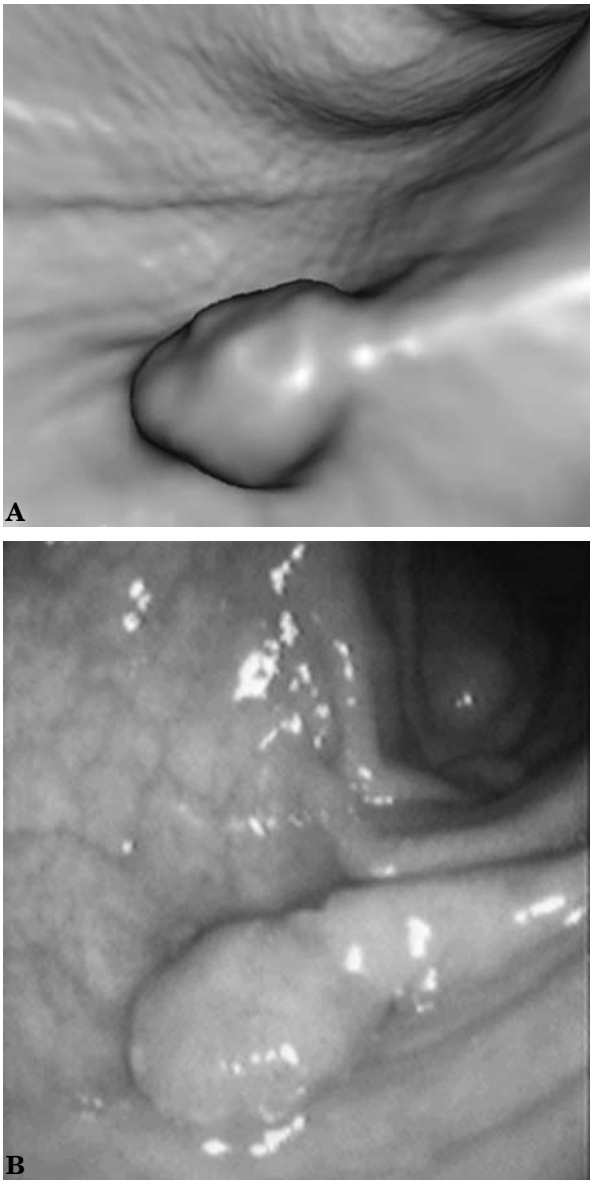

Figure 3. A) A pedunculated polyp image is well demonstrated on virtual colonoscopy. **B)** Note the similarity between the colonoscopic view and the virtual colonoscopy image of this polyp. Histologic evaluation showed this to be a tubulovillous adenoma

Five polyps were 5 mm in diameter: two turned out to be tubular adenomas, two were hyperplastic polyps (Figure 2), and the last one was diagnosed as inflammatory polyp at histopathologic analysis. Three polyps 4 mm and one polyp 3 mm in diameter were hyperplastic polyps at histopathologic analysis. Two polyps were 2 mm in diameter inflammatory polyps at histopathologic analysis.

Two polyps were 6 mm in diameter: one was tubular adenoma and the other hyperplastic polyp at histopathologic analysis. Two polyps were 7 mm in diameter: one was tubular adenoma and the other hyperplastic polyp at histopathologic analysis. Three polyps were 8 mm in diameter: two were tubular adenomas and the last one was tubulovillous adenoma at histopathologic analysis.

Analysis of the four polyps 10 mm or larger showed that two polyps were adenocarcinomas, one polyp was tubulovillous adenoma (Figure 3), and one polyp was dysplastic polyp.

The results of virtual colonoscopy for detection of polyps are summarized in Table 1.

Table 1. Results of virtual colonoscopy for detection of polyps

	Total	True positive	False negative	Sensitivity (%)
No. of polyps found	22	19	3	86
≤ 5 mm	11	9	2	81
6-9 mm	7	6	1	85
≥ 10 mm	4	4	0	100

DISCUSSION

Complete colonoscopy allows the evaluation of the entire colon, with the added benefit of biopsy or excision of suspicious lesions. It is considered as the gold standard of colonic evaluation (4, 9). There are many limitations to the widespread use of colonoscopy for screening, including the examination time, need for sedation, potential risk of perforation, and failure to complete the examination in up to 10% of patients (10, 11).

CT-based virtual colonoscopy has been proposed as an alternative, minimally invasive procedure for screening of colorectal cancer, and it compensates for the limitations of colonoscopy (12). Virtual colonoscopy is used to evaluate the colon in patients after an incomplete colonoscopy and in those patients with an obstructing carcinoma. It is also performed in patients who are poor candidates for conventional colonoscopy, including those with comorbid medical conditions.

MDCT has several advantages over single detector CT, including increased temporal and spatial resolutions, faster data acquisition, and a wider field of view and comparable coverage times, with much thinner collimation. The use of thinner collimation makes near-isotropic voxels for virtual colonoscopy. The advantages of an isotropic image include improved rates of polyp detection because of reduced volume averaging and improved z-axis resolution for multiplanar reformations and 3D viewing.

Since its description in 1994 (13), CT colonography is rapidly evolving as a method of colorectal evaluation. In 1997, Hara et al. (14) showed 75% sensitivity for polyps 10 mm or larger. In 2001, a follow-up study by Hara et al. (6) showed improved sensitivity, which ranged from 80% to 89% for polyps 10 mm or larger.

Recently, there have been conflicting data published on the sensitivity of virtual colonoscopy for the detection of colorectal polyps. Pickhardt et al. (8) showed that the sensitivity of virtual colonoscopy for detection of adenomas 10 mm and larger was superior to that of conventional colonoscopy (93.8% vs 87.5%). As previously stated, the ability of virtual colonoscopy to depict smaller lesions has consistently been shown to be inferior to that of conventional colonoscopy. Macari et al. (10) showed that the sensitivity of CT colonoscopy for detection of polyps 10 mm and larger was 100%, for polyps 6-9 mm in diameter was 52.9% and for polyps 5 mm or smaller was 11.5%. Chung et al. (12) showed that the sensitivities of CT colonoscopy for detection of polyps 10 mm and larger, 6-9 mm, and 5 mm or smaller in diameter were 100%, 94%, and 84%. These discrepant results may be due to different preference of collimation, workstation, and interpretation techniques.

Recent development in CT technology and post-processing softwares improves the sensitivity of virtual colonoscopy for detecting polyps. Our study results of virtual colonoscopy for polyp screening are comparable to the latest studies.

Some investigators have found that the use of intravenous contrast material may facilitate colorectal polyp detection when a large amount of fluid is

present (9). The downside of the routine administration of contrast material includes the cost, the need for intravenous access, and the risk of allergy to iodinated contrast material. Therefore, we do not routinely administer intravenous contrast material for screening virtual colonoscopy in our study like many other studies.

The use of a bowel relaxant is controversial. Previous data have shown minimal benefit to the routine use of intravenous or intramuscular administration of glucagon (15). We administered 20 mg of hyoscine-N-butyl bromide to patients. We were not able to detect a polyp 8 mm in diameter at virtual colonoscopy because of spasm in the sigmoid colon in both supine and prone position.

Advantages of virtual colonoscopy compared with conventional colonoscopy include a shorter procedural time, less invasiveness and greater comfort, and no need for intravenous sedation. Furthermore, virtual colonoscopy may be more accurate for precise localization of lesions. Poor colonic preparation or distention limits the accuracy of virtual colonoscopy.

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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