Original Article

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Accuracy of Computed Tomographic Colonography for Detection of Colorectal Adenomas and Cancers in Average-risk Patients

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ABSTRACT

Background: We evaluated the performance characteristics of computed tomographic (CT) colonography for the detection of colorectal neoplasia in an average-risk screening population. In addition to an early detection of cancer-precursor lesions, the treatment of early stage cancer can help reduce cancer related death rate from advanced colorectal cancer.

Methods: A total of 43 asymptomatic adults (mean age, 64.88 years) underwent CT colonography followed by conventional colonoscopy on the same day. Two-dimensional endoluminal display was employed for the initial detection of polyps on CT colonography. As for total colonoscopy, the colonoscopist was not aware of CT colonography findings. The sensitivity and the specificity of CT colonography were calculated based on the conventional colonoscopic findings as the reference standard.

Results: The sensitivity of CT colonography for detection of adenomatous polyps was 84.2% for polyps of all sizes, 66.67% for polyps 6 mm or larger in diameter, and 86.7% for polyps smaller than 6 mm diameter. The specificity of CT colonography for detection of adenomatous polyps was 89.3% for polyps of all sizes. The accuracy of CT colonography for detection all polyps was 87.2%, 66.67% for polyps 6 mm or larger in diameter, and 76.47% for polyps smaller than 6 mm diameter. A large ulcerative mass lesion in one patient was malignant.

Conclusions: CT colonography with the use of a two-dimensional approach is an accurate screening method for the detection of colorectal neoplasia in asymptomatic average-risk adults, and compares favorably with conventional colonoscopy in terms of the detection of clinically relevant lesions.

Key words : CT colonography, colorectal adenoma, colon cancer

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BACKGROUND

Colorectal cancer is a global health problem and is the second leading cause of cancer-related death in the United States. Its incidence is still rising. It is which estimated that in the United States, the member of newly diagnosed colorectal cancers in 2009 was as high as 147,000 persons, and 50,000 persons died from this cancer[1]. An age-standardized incidence rate of colorectal cancer in the United States was 61.2 /100,000 male population and 44.8/100,000 female populations[1].

Between the years 1998 and 2000, the estimated age-standardized rate of colorectal cancer Thailand was 8.8/100,000 male population and 7.6/100,000 female population[2] and the trend was rising. According to hospital-based cancer registry in 2003 at the National Cancer Institute of Thailand, the number of new colorectal cancer cases from January to December, 2003 was 6.9 percent (4.4% in the male population and 2.5% in the female) of all new patients with malignancies[3]. In 2008, the number of new colorectal cancer cases was totally 12.1%, 6.6% in the male population and 5.5% in the female population, making it the most common cancer in male and the third most common cancer in female[4].

According some previous studies, colorectal cancer screening in average-risk patients can detect early stage cancer, leading to curative treatment and a reduced mortality rate in this group of patients[5,6]. Furthermore, most colorectal cancers are believed to arise within benign adenomatous polyps that develop over the course of many years[7]. Therefore, screening strategy for early detection and removal of cancer-precursor lesions can reduce the incidence of colorectal cancer and colorectal cancer related death[8-10].

Up to date, there are several strategies for screening colorectal cancer that have varying benefits and limitations. The various strategies have differing sensitivity, specificity, complexity of examination, and related complications[11,12].

Virtual colonoscopy is a rapidly evolving technique in which data from computed tomography (CT) are used to generate both two-dimensional and three-dimensional displays of the colon and the rectum[13]. This minimally invasive method for the examination of the whole colon, also called CT colonography, could provide an attractive alternative for use in widespread screening, since it requires no intravenous administration of sedatives, analgesia, or recovery time. Although the performance characteristics of CT colonoscopy have been encouraging in trials involving cohorts of patients with an increased number of polyps[14,15], the results in populations with a lower prevalence of polyps have been disappointing, and the large studies conducted to date have not evaluated an asymptomatic, average-risk screening population[16-20]. Especially, there is no study conducted in Thai populations.

We conducted a prospective study to evaluate the performance characteristics of CT colonography in a typical asymptomatic screening population. A two-dimensional approach was chosen in this study in the interpretation of radiographic images. This technique may provide an alternative method for screening colorectal cancer in the asymptomatic group. In addition to an early detection of cancer-precursor lesions and treatment of early stage cancer, this new imaging may help reduce cancer related death rate.

METHODS

Study group

The study protocol was approved by the review board of The Gastrointestinal Association of Thailand. Asymptomatic patients were recruited at Phramongkutklao Hospital, Bangkok, for screening colonoscopy. Written informed consent was obtained from all patients. Adults aged 50 or over with an average risk of colorectal cancer, as well as adults aged 40 or over with a family history of colorectal cancer, made up the study group. Exclusion criteria are listed in Table 1. Between June 2009 and February 2011, 43 asymptom-

Table 1. Criteria for exclusion.

- Iron deficiency anemia within previous 6 months
- Rectal bleeding or hematochezia within previous 12 months
- Unexplained weight loss more than 3 kilograms within previous 3 months
- History of colorectal polyps, cancers, or inflammatory bowel disease
- History of familial adenomatous polyposis, or hereditary non-polyposis cancer syndromes
- Acute or chronic kidney disease with serum creatinine more than 1.5 mg/dL
- Respiratory failure or heart failure
- Pregnancy

atic adults underwent CT colonography followed by conventional colonoscopy on the same day.

Study design

The enrolled patients completed a detailed questionnaire regarding their personal and family medical history. Patients underwent standard 24-hour colonic preparation with oral administration of 1 bag of Niflec® powder (macrogol-4000 118 g, KCL 1.485 g, NaCl 2.93 g, Na bicarbonate 3.37 g, anhydrous Na sulfate 11.37 g) or Swiff® (monobasic Na phosphate 2.4 g, diphasic Na phosphate 0.9 g) and 1 Fleet® enema and 10 mg of oral bisacodyl as part of their clear-liquid diet.

CT colonoscopic images were displayed in two dimensional views and were interpreted by one experienced board-certified gastrointestinal radiologist. The polyps were measured with electronic scale and recorded with respect to the segment of location (cecum, ascending colon, transverse colon, descending colon, sigmoid colon, or rectum). Extracolonic findings on CT were also recorded. Conventional colonoscopic examinations were performed by 4 experienced fellow colonoscopists under staff supervision. All colonoscopists were initially unaware of the results of the CT colonography. The sizes of polyps were estimated in comparison with the diameter of an open biopsy forceps and their locations recorded (cecum, ascending colon, transverse colon, descending colon, sigmoid colon, or rectum). Removed polyps from different segments were sent separately for pathological examination. Post-colonoscopic adverse events and the complications were also evaluated.

Statistical analysis

Colonoscopy findings served as the reference standard with which the results of CT colonography were compared. Of primary interest were adenomatous polyps measuring 6 mm or larger in diameter. Advanced neoplasia was defined as any adenoma measuring 10 mm or more in diameter, or with high-grade dysplasia, a prominent villous component, or a focus of cancer[21]. Adenomas and cancers smaller than 6 mm larger than 9 mm in diameter and the pathology of polyps of all sizes were of secondary interest. General data were analyzed as mean and standard deviation and percentage. Sensitivity, specificity, accuracy, negative predictive value, and positive predictive value were calculated.

RESULTS

A total of 43 patients (24 males and 19 females) underwent the same-day computed tomographic colonography (CT colonography) and conventional colonoscopy. A mean age of 64.98 ± 8.6 years was noted in the study population. Eight patients (18.6%) had an underlying disease (hypertension 5, diabetes mellitus 2, hypertension and diabetes mellitus 1) (Table 2).

Of the 43 patients, polyps were detected by CT colonography in 18 patients (41.86%, 21 polyps) and in 15 patients (34.88%, 21 polyps) by conventional colonoscopy. More polyps were located in the left side of the colon than in the right side, the most common location being the descending colon (38.09% by CT colonography, 28.57% by conventional colonoscopy) (Table 3).

The accuracy of CT colonography for detecting polyp location was 100%, when compared with conventional colonoscopy findings. Most polyps were smaller than 6 mm (66.67% by CT colonography and 85.71% by conventional colonoscopy), and most were

Table 2. Demographic data.

	Number (N = 43)	Percentage (%)
Age, yrs. (mean ± SD)	64.98 ± 8.6	
Gender		
Male	24	55.8
Female	19	44.2
Underlying disease		
No	35	81.4
Yes	8	18.6

Table 3. The number of polyps classified by location.

Location	Polyp number (%)	
	CT colonography	Conventional colonoscopy
Rectum	1 (4.76)	-
Sigmoid	4 (19.05)	6 (28.57)
Descending	8 (38.09)	6 (28.57)
Transverse	3 (14.29)	4 (19.05)
Ascending	2 (9.52)	1 (4.76)
Cecum	2 (9.52)	4 (19.05)
Total	**21 (100)**	**21 (100)**

Table 4. The number of polyps classified by size.

Size (mm)	Polyp number (%)	
	CT colonography	Conventional colonoscopy
2	-	1 (4.76)
3	7 (35)	10 (47.62)
4	1 (4.76)	1 (4.76)
5	6 (28.57)	6 (28.57)
6	2 (9.52)	1 (4.76)
7	4 (19.05)	-
8	-	1 (4.76)
Total	**21 (100)**	**21 (100)**

3 mm (33.33% by CT colonography and 47.62% by conventional colonoscopy) (Table 4). One patient had a large ulcerative mass lesion at the descending colon size 5.8 cm detected by CT colonography and 8.0 cm by conventional colonoscopy (data not shown).

Pathologically, most polyps were shown to be tubular adenomas with low grade dysplasia (16/21, 76.19%), the remaining being tubulovillous adenomas with low grade dysplasia (3/21, 4.29%). All but one (15/16), tubular adenoma polyps with low grade dysplasia were less than 6 mm in diameter. Among the tubulovillous adenomas, 2 were 5 mm in diameter and 1 was 7 mm. One sigmoid colon polyp was an inflammatory polyp. The one large ulcerative sigmoid mass was well-differentiated adenocarcinoma.

The sensitivity and the specificity of CT colonography in the detection of all polyps were 84.2 and 89.3%. The positive predictive value and the negative predictive value were 84.2 and 89.3%, while the accuracy was 87.2%, respectively. The sensitivity of CT colonography for detecting adenomatous polyps 6 mm in diameter or larger was 66.67%, and that for polyps smaller than 6 mm was 86.67%. The accuracy of CT colonography for polyps 6 mm or more in diameter was 66.67%, and that for polyps smaller than 6 mm was 76.47%, respectively.

Colonic deverticuli were noted at CT colonography in 10 patients (detected at conventional colonoscopy in only 5 cases). In one patient, colonic diverticuli was detected by conventional colonoscopy but not at CT colonography. Other extracolonic findings included renal cysts (2 patients), mild fatty liver (1 patient) and posterior wall gastric diverticulum (1 patient). Neither significant adverse events nor serious complications were noted in this study.

DISCUSSION

Worldwide, colon cancer remains a potentially lethal disease. Early detection provides an opportunity for less invasive curative treatment and helps improve the prognosis. CT colonography is an option for screening colonic adenomas and cancers. Our study showed that the prevalence of colorectal adenomas in average-risk patients was 34.88%, a figure similar to the 37% reported by Arayasakulwong N *et al*[22].

Johnson CD *et al*. in a study with a sample size of 2,531 average-risk patients reported a 90% accuracy of CT colonography for detecting polyps 10 mm or greater in diameter, with a false positive rate of 14%[23]. Perry J *et al*. in another study in 1,233 average-risk patients reported the sensitivity of CT colonography of 93.8% and 88.7%, the specificity of 96% and 79.6% for detecting polyps size ≥10 mm and ≥6 mm in diameter, respectively[24].

Liedenbaum MH *et al*. found a 91% sensitivity and 69% specificity of CT colonoscopy for detecting colorectal polyps size ≥6 mm[25]. David H. Kim *et al*. showed that colorectal examination by CT colonography and conventional colonoscopy both yielded similar results in the detection of advanced colorectal neoplasm[26].

In our study, we found that the sensitivity and specificity of CT colonography for detecting polyps of all sizes were 84.2% and 89.3%, while the accuracy was 87.2%. The sensitivity of CT colonography for detecting adenomatous polyps was 66.67% for polyps 6 mm or more in diameter, and 86.67% for polyps smaller than 6 mm in diameter. The accuracy of CT colonography was calculated at 66.67% for polyps 6 mm or more in diameter, and 76.47% for polyps smaller than 6 mm. In our study, the lower sensitivity and lower accuracy of CT colonography for larger polyps might be due to the small number of large polyps detected (only 3 out of 21 polyps).

Our study suggested that CT colonography can detect other significant colonic findings such as diverticulosis better than conventional colonoscopy. The explanation may be that the diverticuli were distended with air which can be detected more easily by CT colonography than be conventional colonoscopy.

Most polyps in our study were tubular adenomas with low grade dysplasia, and nearly all were smaller than 6 mm. We could not say that polyps 6 mm or bigger were associated with more advanced pathology, as the number of polyps in this category was too small.

In contrast, in the study by David Lieberman et al. with a study the population of 13,922 average-risk patients undergoing colonoscopy, in which showed that colorectal polyps were found in 45% of patients, polyps 6-9 mm and 10 mm or greater were more likely associated with on advanced histology 6.6% and 30.6% respectively[27].

Colorectal examination by CT colonography and conventional colonoscopy yield similar result regarding the detection of advanced colorectal neoplasm. Complications from CT colonography are less likely than conventional colonoscopy[26], considering reported post-colonoscopic complications of 3-5/1,000 examinations[28-31]. In our study, neither significant complications nor serious adverse events were noted.

At the present time, no consensus or guideline exists for the management of colorectal polyp 6-9 mm in diameter. Some suggested that patients with polyps 6 mm or greater as detected by CT colonography should undergo colonoscopy and endoscopic polypectomy[32]. With the cut-off point at 6 mm or greater, 15-25% of patients with colorectal polyps should undergo colonoscopy[27,33,34].

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