Original Article

Accuracy of Computed Tomographic Colonography for Detection of Colorectal Polyps in Asymptomatic Adults at Phramongkutklao Hospital

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Background: Colorectal cancer is the global health problem and its incidence is still rising. Detection by colorectal cancer screening and removal of advanced adenomas have been shown to reduce both the incidence of cancer and cancer-related mortality. Computed tomographic (CT) colonography is a non-invasive technique, with no need for sedation, and low risk of procedure related complications. CT colonography for colorectal cancer screening is not widespreadly used in Thailand, because of the low prevalence of colorectal polyps in the screening setting and the published studies of CT colonography in average-risk individuals have not been well established in Thai populations.

Objective: To assess the accuracy of CT colonography for colorectal cancer screening and detecting colorectal polyps in asymptomatic adults at Phramongutklao hospital.

Materials and Methods: The present study was a cross-sectional study. The participants were recruited among all asymptomatic adults at Gastroenterology Unit, Department of Medicine, Phramongutklao Hospital. Frome July 2013 to November 2014, 74 participants underwent CT colonography followed by conventional colonoscopy as the reference standard on the same day. Accuracy of CT colonography was evaluated for detecting colorectal polyps of at least 10 mm in size and at least 6 mm in size.

Results: The accuracy, sensitivity and specificity of CT colonography for detection of colorectal polyps of 10 mm or larger were 100% in all aspects. CT colonography for detection of colorectal polyps of 6 mm or larger had accuracy of 97.8%, a sensitivity of 82.4%, specificity of 98.4%, positive predictive value of 66.7% and negative predictive value of 99.3%.

Conclusion: A potentially effective use of CT colonography as an alternative to conventional colonoscopy for colorectal cancer screening and detecting colorectal polyps in asymptomatic adults.

Keywords: Colorectal cancer, CT colonography, Accuracy, Phramongkutklao Hospital

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Colorectal cancer has a high incidence rate and become an important problem worldwide. It is the third most common cancer diagnosed in both men and women in the United States of America[1]. According to the statistics of the National Cancer Institute in Thailand, it is the second most common cancer in men (after lung cancer) and the third most common cancer in women (after breast and cervical cancers). It has been found that the incidence rate of colorectal cancer is increasing[2]. Screening of colorectal polyps and removing them before they develop into cancers help decrease the incidence and mortality rates caused by this type of cancer.

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At present, there are various procedures used to screen colorectal cancer and each of them has different advantages and disadvantages. Conventional colonoscopy is still a standard examination used to screen and monitor colorectal cancer in spite of some limitations. This method requires the deep insertion of the instrument via the rectum, the use of anesthesia, time consumption and procedure related complication such as colonic perforation[3-5]. Lastly, the colonoscope may not be able to be passed through the entire colon due to colonic tortuosity or obstruction. Computed tomographic colonography (CTC) is the new procedure performing with effectiveness and become widespread attention because of its non-invasiveness. In addition, it does not require much time, tool insertion, sedation, pain relief medication and recovery time.

Because of the low prevalence of colorectal polyps in the screening setting and the published studies of

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CT colonography in average-risk individuals have not been well established in Thai population, so CT colonography for colorectal cancer screening is not widespreadly used in the country. The present study is aimed to evaluate the accuracy of CTC used to screen colorectal cancer in people who have no symptoms. This may be another alternative used for colorectal cancer screening in that group and lead to diagnosis and treatment at the early stage.

Objective

To study the accuracy of computed tomographic colonography in comparison with conventional colonoscopy for screening colorectal cancer and polyps in those who have no symptoms at Phramongkutklao Hospital.

Materials and Methods

This was a cross-sectional study which approved by the Institutional Review Board of the Royal Thai Army Medical Department. The definition of those who have no symptoms in the present research referred to those who had no signs of colorectal cancer such as abdominal pain, change in bowel habits, melena or hematochezia, weight loss or iron-deficiency anemia. All of the participants were scheduled to undergo routine colonoscopy at the section of Gastroenterology, Phramongkutklao Hospital from July 2013 to November 2014. The inclusion and exclusion criteria were as follow:

Inclusion criteria

1. Participants were adults at above 50 years of age who had no family history of colorectal cancer, and ones those above 40 years of age who had a family history of colorectal cancer but no symptoms.

2. Individual who agreed to participate in the research and signed inform consent.

Exclusion criteria

1. People who had a history of the following symptom;
   - -iron-deficiency anemia the last 6 months.
   - -melena or hematochezia the last 12 months.
   - -weight loss more than 3 kilograms for the last 3 months.
   - -polyp detection.
   - -colorectal cancer or inflammatory bowel disease.
   - -familial adenomatous polyposis or hereditary nonpolyposis cancer syndromes.
   - -had been screened by conventional colonoscopy and found normal for the last 3 years.
   - -had restrictions or could not tolerate conventional colonoscopy.
   - -Pregnancy.

Sample size determination

Daniele et al[9] have conducted a study called "Diagnostic Accuracy of Computed Tomographic Colonography for the Detection of Advanced Neoplasia in Individuals at Increased Risk of Colorectal Cancer", and found that the sensitivity of Computed Tomographic Colonography was 0.853, thus:

$$n = \frac{Z^2_{\alpha/2} PQ}{d^2}$$

$$= \frac{1.96^2 (0.853)(1-0.853)}{0.10^2}$$

$$= 48.17$$

This research must then include at least 49 samples.

Note: Confidence level 95%, $\alpha = 0.05$ (two-side test)

$Z_{\alpha/2} = 1.96$

d = margin of error = 0.05

The researcher offered CTC to those who had met the inclusion criteria and been sent to try conventional colonoscopy at the Section of Gastroenterology, Phramongkutklao Hospital by their own physicians in the same day. Each participant provided written informed consent before enrollment.

Each participant received standard bowel preparation two days before the CTC examination by laxative purgation without fecal and fluid tagging. Manual colonic insufflation was obtained with room air until adequate colonic distention or around 40puff of air was used. Phillips Brilliance 190p 64-slice MDCT was operated with supine and prone positions. The scanner was set at 120 kVp, 50 mAs for the prone position and 100 mAs for the supine position, with pitch of 1.078, 0.625mm collimation, 0.4 second rotation time, 1.5mm slice thickness and 0.8 mm slice increment. Collected CTC data were analyzed and depicted as both two-dimensional and three-dimensional images (Figure 1). Right after that, a radiologist with 20-year expertise in gastrointestinal

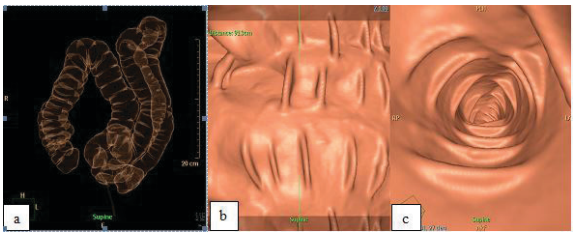

Figure 1. **(a)** 3D colon overview the image similar to barium enema study. **(b)** Virtual colon dissection view (Filet view). **(c)** 3D endoluminal view which mimic image from conventional colonoscopy.

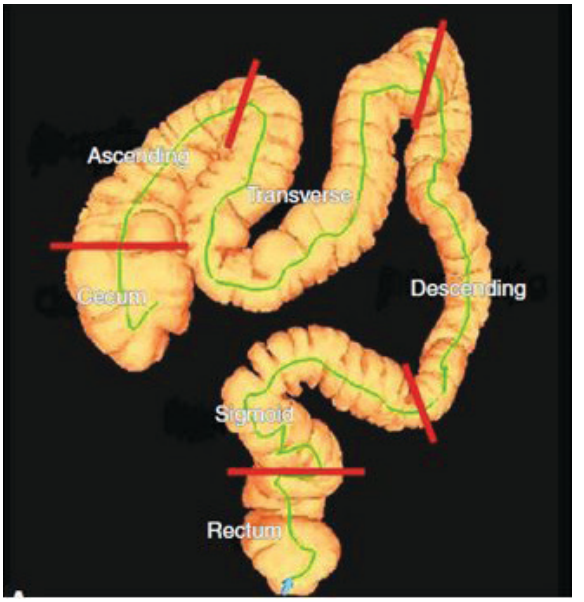

Figure 2. Colonic segmentation that include cecum, ascending colon, transverse colon, descending colon, sigmoid colon and rectum.

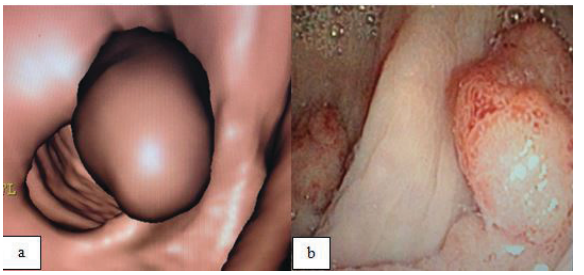

Figure 3. **(a)** endoluminal view of CT colonography demonstrate a 11mm pedunculated polyp at sigmoid colon. **(b)** Conventional colonoscopy shows the matching lesion.

radiology examinations analyzed and interpreted the result. After having completed this procedure, the participants were screened by the conventional colonoscopy at the Section of Gastroenterology on

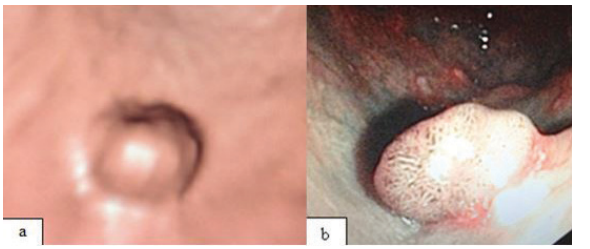

Figure 4. **(a)** 3D endoluminal view of CT colonography that demonstrate a 8 mm sessile at sigmoid colon. **(b)** The same polyp detected by conventional colonoscopy in the same location and same size.

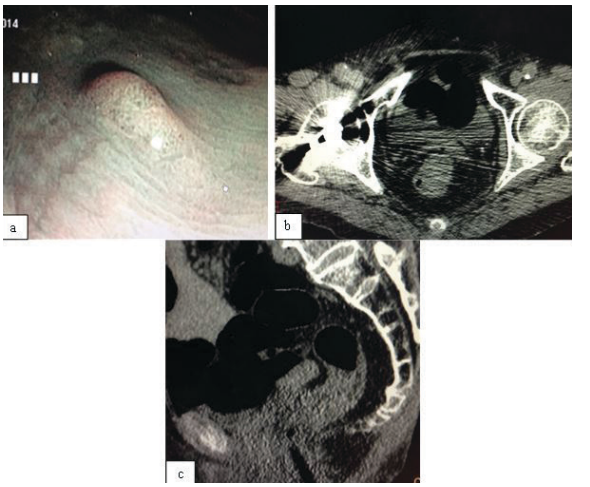

Figure 5. **(a)** Conventional colonoscopy demonstrates a 6mm sessile polyp at the rectum which is not depicted by CT colonography. **(b)** Supine 2D axial view and **(c)** sagittal reconstruction view illustrate false negative finding due to luminal collapsed and residual content at the rectum.

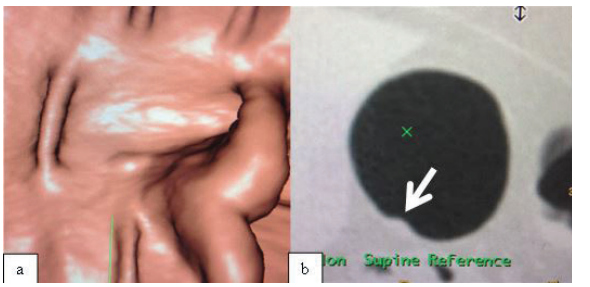

Figure 6. **(a)** 3D Filet view and **(b)** supine 2D axial view illustrate a 7mm flat polyp (white arrow) at ascending colon, but could not be detected by conventional colonoscopy.

the same day. In addition, the doctor who performed the latter examination did not know the result of the former one which was conducted earlier.

Analysis and interpretation of CTC result were as follows:

1. Detection or not detection of colonic polyps

2. Number, morphology (sessile, pedunculated and flat) and size of the polyps:

The size is measured by considering the largest diameter in two-dimensional image. The stalk of the polyp was not included in the measurement. All polyps less than 6 mm were neither analyzed nor reported.

3. Location of polyps in the colon:

The colon was divided into six segments including the cecum, the ascending colon include hepatic flexure, the transverse colon include splenic flexure, the descending colon, the sigmoid colon and the rectum, (Figure 2).

4. Extracolonic findings:

Regarding the conventional colonoscopy, detection of polyps and their location in the colon were taken into consideration. The six colonic segments as mentioned above were referred. The lesion matching between the CTC and the conventional colonoscopy was when the polyp was detected in the same or the similar location in the colon and the difference of size was not over 50%[6].

The statistical analysis was made using the SPSS (Statistic Package for Social Science for Window) software version 22, the STATA (Statistics and Data) software version 14, and the hypothesis testing accepted a statistical significance of 0.05.

In terms of data analysis, descriptive statistics were used to analyze general data such as number, percentage, mean and standard deviation. Concerning data on detection (positive result) or non-detection (negative result) of the polyps, the accuracy of CTC was analyzed, in comparison with conventional colonoscopy. The sizes of detected polyps were classified into at least 10 mm and at least 6 mm. Following values were evaluated: sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV] and accuracy with 95% confidence interval [CI].

Results

Data were collected from 74 participants who had no symptoms and received treatment at the Section of Gastroenterology, Phramongkutklao Hospital from July 2013 to November 2014. Demographic data are provided in Table 1. Their age were ranged from 47-83 years, mean age was 63.93 ± 8.48 years. Most of them were at 60-69 years (45.95%) and the ratio between males and females was the same.

The present research had shown that 33 participants (44.59%) out of 74 had polyps detected by conventional colonoscopy. In total, there were 54 polyps, categorized according to their size as under 6mm, 6-9mm and over 10mm and their number as 37 polyps, 13 polyps and 4 polyps respectively. With regard to their location, most of the polyps were detected in the sigmoid colon and followed by the descending colon and the transverse colon respectively (Table 2).

Table 1. Demographic characteristics of the participants (total n = 74)

Variable		Number	(Percentage)
sex			
	male	37	(50)
	female	37	(50)
Age (years)			
	<60	23	(31.08)
	60-69	34	(40.95)
	>70	17	(22.97)
Range 47-83 yr, Mean age 63.93±8.48 yr			

Table 2. Distribution of the lesions detected on conventional colonoscopy according to location and size

Colonic segment	Number of lesion detected			
	≤6 mm	6 to 9 mm	≥10 mm	Total
Cecum	4	1	0	5
Ascending	3	0	2	5
Transverse	6	2	0	8
Descending	11	2	1	14
Sigmoid	11	7	1	19
Rectum	2	1	0	3
Total	37	13	4	54

Table 3. Per-polyp by location analysis of CT colonography for detection of colorectal polyp of at least 10 mm in size.

CT		Conventional colonoscopy Yes	No	
		size ≥10 mm	size <10 mm	total
CT colonography	Yes size ≥10 mm	4	0	4
	No size <10 mm	0	440	440
	Total	4	440	444

Table 4. Per-polyp by location analysis of CT colonography for detection of colorectal polyp of at least 6 mm in size

		Conventional colonoscopy		
		size ≥6 mm	size <6 mm	total
CT colonography	size ≥6 mm	14	7	21
	size <6 mm	3	421	424
	total	17	428	445

The analysis of accuracy in which data were categorized according to the lesion of polyps over 10mm in size had illustrated that CTC was able to detect this type of polyps and provide details regarding size and location as correctly as conventional colonoscopy total of 4 positions (Figure 3). With regard to the lesion of polyps under 10mm in size and the normal finding, CTC could identify 444 positions from all of the participants, exactly the same number as conventional colonoscopy (Table 3). The values of sensitivity, specificity, positive predictive value, negative predictive value and accuracy were all 100%.

In terms of the accuracy in detecting polyps over 6mm in size, CTC detected this type of polyps and provided details regarding size and location as well as conventional colonoscopy, 14 positions (Figure 4) out of 17 positions. 3 positions were false negative (Figure 5). Regarding the lesion of polyps under 6mm in size and the normal finding, CTC was able to identify 421 positions out of 428 positions from all of the participants. 7 positions were false positive (Figure 6) as shown in Table 4. The values of sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 82.4% (95% confidence interval 56.6% to 96.2%), 98.4% (96.7% to 99.3%), 66.7% (43% to 85.4%), 99.3% (97.9% to 99.9%) and 97.8% (95.9% to 98.9%) respectively.

Discussion

The present study was aimed to evaluate the accuracy of CTC for screening colorectal cancer and polyps. Seventy-four participants (mean age of 63.93±8.48 years) were patients who had no symptoms at Phramongkutklao Hospital from July 2013 to November 2014. The analyse mainly focused on polyps of 10mm or more in size because this type of polyp had more potential to develop into colorectal cancer than others[7]. Polyps of 6 to 9 mm in size were also analyzed. However, there is still a debate over the treatment after the detection of polyps 6-9mm in size whether colonoscopy is needed to perform in order to remove this type of polyps or not.

Pickhardt PJ et al studied 1,233 patients who had no symptoms and found that CTC could detect polyps over 10mm and over 6mm in size with the values of sensitivity of 93.8% and 88.7%, respectively. The specificity values were 96.0% and 79.6% respectively[6].

In the study of Johnson CD et al 2,531 patients with no symptoms were also screened with CTC. The result showed that this procedure identified polyps over 10 mm in size with the values of accuracy and specificity of 90% and 86%. Its detection of polyps over 6mm had the values of sensitivity and specificity of 78% and 88%, respectively[8].

Daniele Regge, MD et al also studied the accuracy of CTC, compared with conventional colonoscopy, for screening 937 patients who had no symptoms but were at high risk of colorectal cancer. The detection of polyps over 6mm in size had the values of sensitivity and specificity of 85.3% and 87.8%, respectively[9].

The present study has shown that the use of CTC in detection polyps over 10mm in size had the values of sensitivity and specificity of 100%. In detecting polyps over 6mm in size, the values of sensitivity and specificity were 82.4% and 98.4%, respectively. According to the literature reviewed with regard to the accuracy of CTC in detection polyps over 10mm and over 6mm in size, the result of the present study resembles and accords with those conducted in other countries. Moreover, the use of fecal and fluid tagging together with CTC would help reduce both false positive and false negative[10] and increase the accuracy of CTC. However, this preparation is not included in the present research.

In the present study, there were still some limitations that may affect the variation in data. The studied group here were those who had no symptoms; therefore, the possibility to find their polyps over 10mm in size would be less than those who were at high risk. Due to time constraint, the small number of participant was also another factor that should be taken into consideration.

Conclusion

The accuracy of Computed Tomographic Colonography (CTC) in polyp detection is very high. As a result, CTC should be an alternative used to screen colorectal cancer and polyps in people who have no symptoms. Its accuracy in detecting polyps of 10 mm and more than 6mm is similar to the result from the studies conducted in other countries.

Acknowledgement

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What is already known on this topic?

The colorectal cancer is the global health problem and it's incidence is still rising. The screening reduces the burden of disease from colorectal cancer through early detection of cancerous lesions and removal of precancerous polyps. The previous published specificity estimates for CTC are consistently high (up to 96%) for large polyp (10mm and larger) but appear lower and more variable (80 to 88%) for smaller polyps (6mm or larger).

What this study adds?

This current study could provide the accuracy of CTC which have been conducted in the Radiology Department of Phramongkutklao Hospital. Especially in the detection of the significant size polyps (as least 10 mm) which could be precancerous lesions should be removed before turning to be advanced cancer.

The good performance of the current study could ensure the related physicians and patients to use the CT colonography as an option or alternative method for colorectal cancer screening in the asymptomatic populations.

Potential conflicts of interest

The authors declare no conflict of interest.

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