

## Evaluation of contrast-enhanced computed tomographic colonography in detection of local recurrent colorectal cancer

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### Abstract

**AIM:** To evaluate the diagnostic accuracy, sensitivity, specificity of contrast-enhanced computed tomographic colonography in detecting local recurrence of colorectal cancer.

**METHODS:** From January 2000 to December 2004, 434 patients after potentially curative resection for invasive colorectal cancer were followed up for a period ranging from 20 to 55 mo. Eighty of the four hundred and thirty-four patients showing strong clinical evidence for recurring colorectal cancer during the last follow-up were enrolled in this study. Each patient underwent contrast-enhanced computed tomographic colonography and colonoscopy on the same day. Any lesions, biopsies, identified during the colonoscopic examination, immediate complications and the duration of the procedure were recorded. The results of contrast-enhanced computed tomographic colonography were evaluated by comparing to those of colonoscopy, surgical finding, and clinical follow-up.

**RESULTS:** Contrast-enhanced computed tomographic colonography had a sensitivity of 100%, a specificity of 83% and an overall accuracy of 94% in detecting local recurrent colorectal cancer.

**CONCLUSION:** Conventional colonoscopy and contrast-enhanced tomographic colonography can complement each other in detecting local recurrence of colorectal cancer.

### INTRODUCTION

Colorectal cancer has the third highest incidence of all cancers worldwide. Approximately 70% of colorectal cancer patients can undergo potentially curative surgical resection. Unfortunately, colorectal cancer recurs in 30% of these patients. With the advent of more aggressive surgical resection for recurrent colorectal cancer<sup>[1]</sup>, early detection of recurrent cancers while they are still limited to a local site is important to improve the patient's survival. If radical resection of locally recurrent colorectal cancer is performed before distant metastatic or unresectable disease develops, one-third to one-half of patients can increase their survival time. However, potentially curative surgery is followed by a period of uncertainty as to whether the operation has successfully cured the cancer. Treatment failure is usually apparent during the first 3 years after surgery. The precise post-operative surveillance procedures<sup>[2]</sup> are based on clinical assessment, CEA, colonoscopy, ultrasound and computerized tomography depending on the site of primary tumor. The role of follow-up in the early diagnosis of recurrent colorectal cancer in patients having undergone resection has been investigated extensively. A large array of screening tests is available for detecting recurrent colorectal cancer, but each test has its particular limitations. Computed tomographic colonography is a new method to exploit recent developments in image acquisition which applies algorithms of virtual-reality systems to build three-dimensional models of the inner surface of the colon tube thereby simulating the conventional colonoscopic view<sup>[3-5]</sup>. The colon wall and pericolonic structures can also be detected at the same time. Computed tomographic colonography has a high accuracy in detecting colonic neoplasia<sup>[6-8]</sup>. Like computed tomography, contrast-

enhanced computed tomography is performed after a patient receives an air enema, and uses a narrow collimation and reconstruction interval to detect colonic lesions. Contrast-enhanced computed tomographic colonography theoretically has the ability to detect local cancer recurrence by examining both the colonic mucosa and the pericolic tissue. The use of IV contrast material in contrast-enhanced computed tomographic colonography facilitates a thorough examination of metastatic disease in solid organs. Contrast-enhanced computed tomographic colonography can display both mucosa and extramucosal local recurrence, metachronous polyps and cancers, hepatic and peritoneal metastasis<sup>[9]</sup>. This study aimed to assess the diagnostic accuracy, sensitivity, and specificity of contrast-enhanced computed tomographic colonography in detecting local recurrence of colorectal cancer following curative resection.

## MATERIALS AND METHODS

### Patients

From January 2000 to December 2004, 434 patients who underwent potentially curative resection for invasive colorectal cancer (181 stage B, 253 stage C) were followed up for a period ranging from 20 to 55 mo. Eighty of the four hundred and thirty-four patients showed strong clinical evidence for recurring colorectal cancer at the last follow-up. Patients with an end or diverting colostomy or those who had contraindications for IV contrast dye were excluded.

### Methods

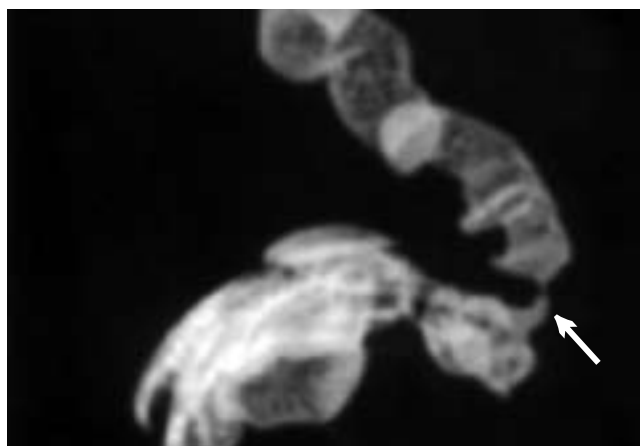
Eighty patients who were sent for conventional colonoscopy and agreed to receive contrast-enhanced computed tomographic colonography were enrolled in this study. Written informed consent forms for both conventional colonoscopy and contrast-enhanced computed tomographic colonography were obtained from each patient. The average age of the patients was 64 years (range, 28-82 years). The ratio of male to female was 43:37. The clinical manifestations of local recurrence included bloody stools, increased serum CEA level ( $\geq 50$  ng/mL), abdominal mass and colonic obstruction. Previous resection for invasive colorectal cancer included stages B and C of rectal cancer and colon cancer. Each patient underwent contrast-enhanced computed tomographic colonography and colonoscopy. The endoscopist was not informed of the radiological results on the same day. The average time between previous resection and contrast-enhanced computed tomographic colonography was 32 mo (range, 20-55 mo). Twenty-four hours before contrast-enhanced computed tomographic colonography, each patient received a standard bowel preparation<sup>[10,11]</sup> consisting of 4 L of polyethylene glycol solution and 25 mg bisacodyl tablets. Prior to computed tomographic scanning, patients were placed in a left lateral decubitus position on the computed tomographic table for the introduction of a rectal enema tube. After insertion of the rectal tube, the colon was inflated with room air to patient tolerance. To reduce bowel peristalsis and colon spasms, 20 mg of buscopan was administered intravenously immediately before air

insufflation. Patient's tolerance with regard to the volume of insufflated air was measured (range, 1 500-2 000 cm<sup>3</sup>). Adequate colonic distention was checked with a computed tomographic scout. If inadequate distention developed at any colon segment, idiosyncratic positioning or additional air insufflation was performed to improve colonic distention in the collapsed regions. Contrast-enhanced computed tomographic colonography was performed employing 150 mL of Isovue-300 (Bracco Diagnostics, Princeton, NJ, USA) IV contrast medium injected at a rate of 3-5 mL/s. Images were acquired 70 s after the injection.

Computed tomographic examinations were conducted with Sightspeed Plus and Sightspeed QX/i computed tomographic scanners (General Electric Medical Systems). The patient was first examined in the supine position, and then in the prone position. Images were acquired with a 5-mm beam collimation (table speed of 10 mm/s, and reconstruction slice overlap of 2.5 mm, 230-260 mA, 120 kV). A gastrointestinal radiologist with experience in computed tomographic colonography analyzed the volumetric computed tomographic datasets using a Sun Advantage Windows (General Electric Medical Systems)<sup>[12,13]</sup> and the General Electric Navigator program that reformats the axial two-dimensional multiplanar and three-dimensional endoluminal images<sup>[14,15]</sup> and allowed for comparison of supine and prone datasets. Local recurrence was rated as either present, absent or indeterminate. Local recurrence was recorded as present when the characteristic appearance of an enhancing, primary extracolonic mass on intraluminal masses at or near the surgical anastomosis with or without adjacent adenopathy was identified by the contrast-enhanced computed tomography. Predominantly intraluminal abnormalities at the anastomosis were considered indeterminate for local recurrence. The liver, peritoneum, retroperitoneum, lung bases, and lymph nodes were also evaluated for the presence of metastatic disease. The colonoscopic examination was performed 2 h after contrast-enhanced computed tomographic colonography. The incidence of lesions, immediate complications, and the overall duration of the colonoscopic examination were recorded. Examination reports being indeterminate for local recurrence on contrast-enhanced computed tomographic colonography but negative colonoscopic examinations were counted as false positive examinations in statistical analysis. The sensitivity, specificity, and accuracy of contrast-enhanced computed tomographic colonography for post-operative detection of local recurrence and metastatic colorectal cancer were estimated.

## RESULTS

All the 80 patients completed the contrast-enhanced computed tomographic colonography successfully. No patients had pain or complications during the procedures. Table 1 presents the findings of the contrast-enhanced computed tomographic colonography. Examination results were as follows. Local recurrence was found in 51 patients. Seventy-five of the eighty patients had adequate colonic inflation throughout the entire colon. Two of the five remaining patients had inadequate transverse colon distention and three had inadequate sigmoid colon distention though additional



**Figure 1** Virtual double contrast of the colon in a patient with local recurrence at previous anastomotic site.

air was insufflated and the positions of the patient were changed. In contrast-enhanced computed tomographic colonography, all the five patients showing thickened segmental colon wall and external luminal tumor mass compression (Figure 1) were classified as present local recurrence. The colonoscopic findings in these corresponding segmental regions showed only lumen stenosis, but no mass or mucosal lesions were found in the lumen in all the five patients. All the five patients received laparotomy for local recurrence based on a clinical presentation of three abdominal palpable masses and two colon obstructions. Surgical findings showed external colon lumen recurrent masses at previous anastomotic sites in all the five patients. Two of the five patients also had peritoneal metastasis. They all received resection of the local recurrent tumor and the colon segment with or without colostomy diversion.

Of the 51 patients with local recurrence, colonoscopic findings showed a tumor or a stricture with friable mucosa at the anastomosis, prompting a biopsy for recurrent adenocarcinoma. All the 51 patients with positive findings on both contrast-enhanced computed tomographic colonography and colonoscopy received laparotomy for local recurrence. Surgical findings showed local recurrence in all 51 patients, 35 of the 51 patients underwent segmental resection of the recurrent colorectal cancer with anastomosis, the remaining 16 patients underwent segmental resection of the colorectal cancer with colostomy diversion. All the 51 patients with local recurrence with or without liver metastasis or peritoneal metastasis received adjuvant chemotherapy after surgery.

The colonoscopic findings in the five patients which were classified as indeterminate by contrast-enhanced computed tomographic colonography revealed mucosa swelling, erythema in two patients and multiple ulcers at anastomotic site in three patients.

All the five patients underwent both contrast-enhanced computed tomographic colonography and colonoscopy 6 months later. No local recurrence or distant metastases were found, and their anastomotic sites were normal.

The colonoscopic finding in one patient, whose contrast-enhanced computed tomographic colonography

**Table 1** Performance-based contrast-enhanced computed tomographic colonography findings in 80 patients

	Patients (n)
Local recurrence	
Present	51
Indeterminate	5
Not present	24
Metachronous cancer	1
Distant metastasis	
Liver	8
Peritoneal	5

showed no local recurrence but a metachronous mass at the ascending colon, revealed a tumor at the ascending colon. The patient with metachronous cancer underwent right hemicolectomy with anastomosis. No distant metastasis or local recurrence was found in this case. The remaining 23 patients whose contrast-enhanced computed tomographic colonography did not show local recurrence were negative for colonoscopy. All the 23 patients were routinely followed up. There was no true false-negative local recurrent cancer on contrast-enhanced computed tomographic colonography. However, the five patients classified as indeterminate for local recurrence in contrast-enhanced computed tomographic colonography reports were false positive. Contrast-enhanced computed tomographic colonography had a sensitivity of 100%, a specificity of 83%, and an overall accuracy of 94% in detecting local recurrent colorectal cancer.

## DISCUSSION

In patients who have undergone potentially curative colonic resections for invasive colorectal cancer, hematogenous metastases and local recurrence are the most important factors influencing prognosis. After surgery, however, there is a period of uncertainty as to whether the operation has cured the cancer or not. Treatment failure will usually be apparent during the first 2-3 years after surgery. Precise post-operative surveillance procedures, including clinical assessment, colonoscopy, abdominal computed tomography, are employed to detect recurrence of colorectal cancer. Although colonoscopy can detect intraluminal local recurrence, some local recurrences are not intraluminal and are endoscopically obscure. Abdominal computed tomography can detect hepatic and peritoneal metastases, but it is not reliable for detecting local recurrence except in those patients with a previous abdominoperineal resection. Unlike these two tests, contrast-enhanced computed tomographic colonography directly displays the anastomosis, luminal surface, colon wall and pericolic tissues. It has, therefore, a potential to detect mucosal, intramural and extracolonic local recurrences. In our study, the overall accuracy was 94%, which is similar to that in the study by Fletcher *et al*<sup>[16]</sup>. At the same time, it is also advantageous over the colonoscopy for detecting extracolonic local recurrence and peritoneal metastasis. In this study, 46 of the 51 local recurrences developed from the extraluminal soft tissue and local lymph nodes, nearly previous anastomotic area. At the same time, 40 of the 51 cases were rectal can-

cer and 47 of stage C at their original primary cancer. It may be the reasons that were related to high local recurrent rate of our samples. As shown in our study, 5 of the 51 patients (10%) who had local recurrence detected by contrast-enhanced computed tomographic colonography had no intraluminal recurrence by colonoscopic examination.

However, all the five patients received laparotomy for local recurrence of abdominal mass and intestinal obstruction. External colon lumen local recurrence with or without peritoneal metastasis was found during surgery. Contrast-enhanced computed tomographic colonography may also show the structure of the colon when colonoscopy is incomplete<sup>[17]</sup>. Although contrast-enhanced computed tomographic colonography has a high sensitivity (100%) for local recurrent colorectal cancer, its specificity is only 83% as shown in our study. This may be due to the inability of contrast-enhanced computed tomographic colonography to distinguish local recurrence from inflammation when enhancing soft tissue is present. Our results showed that five patients, classified as indeterminate by contrast-enhanced computed tomographic colonography, had colonoscopic findings of mucosa swelling, erythema or multiple ulcers. No local recurrence was identified in any of these five patients during the subsequent follow-up. These indeterminate conditions were then considered as false positive examinations. Another significant difference in this technique in comparison to colonoscopy is that a biopsy cannot be taken during contrast-enhanced computed tomographic colonography. However, it is recognized that contrast-enhanced computed tomographic colonography is more accurate in detecting extraluminal recurrent tumor than conventional colonoscopy.

In conclusion, contrast-enhanced computed tomographic colonography has several advantages over alternative tests in detecting local recurrent colorectal cancer. It can be a very helpful adjuvant method to colonoscopy in detecting extraluminal local recurrence, peritoneal carcinomatosis and distant metastasis. With regard to the threat of colorectal cancer and the early detection of local recurrence and distant metastasis in patients who have undergone potentially curative colonic resections for invasive colorectal cancers, conventional colonoscopy and contrast-enhanced tomographic colonography can complement each other.

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