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The Usefulness of Computed Tomographic Colonography for Colorectal Cancer in the Elderly

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The gold standard for detecting colorectal cancer is total colonoscopy（TCS）. However, the physical burden of TCS is great in elderly individuals with poor performance status and numerous underlying diseases. Computed tomographic colonography（CTC）is a suitable examination method in the elderly because it is simple, less invasive, and requires no special skill. On the other hand, it is inferior to TCS for detecting 0-II type colorectal cancer. We investigated 21 patients aged ≥ 75 years with resectable colorectal cancer who underwent CTC at our hospital from January 2013 to March 2014. CTC was well tolerated by elderly colorectal cancer patients and was able to detect lesions on the oral side of stenotic colorectal cancer. In addition, although fusion images of 3-dimensional（3D）-CT angiography and CTC were useful in disease staging of colorectal cancer and navigation-guided surgery, CTC was not effective in the detection of 0-II type colorectal cancer.

Key words: CT colonography, Colorectal cancer, Elderly

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INTRODUCTION

Computed tomographic colonography（CTC）is a diagnostic imaging technique designed to detect colorectal cancer lesions. The technique involves abdominal insufflation with carbon dioxide（CO_2）and obtaining multi-slice computed tomography（CT）images of the abdomen. The abdominal image data obtained then undergoes 3-dimensional（3D）image processing. CTC is being increasingly used as a new screening tool for colorectal cancer in the Europe and the United States［1,2］. However, CTC is not yet widely used in Japan. However, apart from the risk of radiation exposure, CTC is a safe procedure. In addition, compared with total colonoscopy（TCS）or barium enema（BE）, CTC is a simple procedure because it does not require any special skill. Therefore, it is highly useful for the diagnosis of colorectal cancer in elderly patients. A *PubMed* search using the keywords “elderly,” “colorectal cancer,” and “CT colonography” revealed only 3 papers in which simple pretreatment regimes for the elderly were examined［3,4,5］. In the present study, in addition to a review of the associated literature, we report the results of our investigation of the usefulness of CTC for the pathological diagnosis of colorectal cancer among patients aged ≥ 75 years.

MATERIALS AND METHODS

In this study, we included 21 patients with resectable colorectal cancer who underwent CTC at

our institution from January 2013 to March 2014. Pretreatment consisted of a low-residue diet, along with 180 mL of magnesium citrate as a hypertonic solution and 90 mL of Gastrografin® as a negative contrast medium, both of which were ingested the evening before the CTC. In order to pretend complications such as bowel-preparation-induced dehydration, we gave patients guidance on enough water replacement or we administer intravenous drip to patients in hospital if they were poor performance status or difficult to receive water replacement. Patients were placed in the prone position and a transanal tube was placed. Abdominal insufflation with CO_2 was then performed using an automated CO_2 injector and multi-slice CT scans were obtained. By multiplanar reconstruction of 2-dimensional images, 3D air images, lumen images, and virtual colonoscopy were obtained using analysis software (Ziostation 2; Ziosoft Inc., Tokyo, Japan).

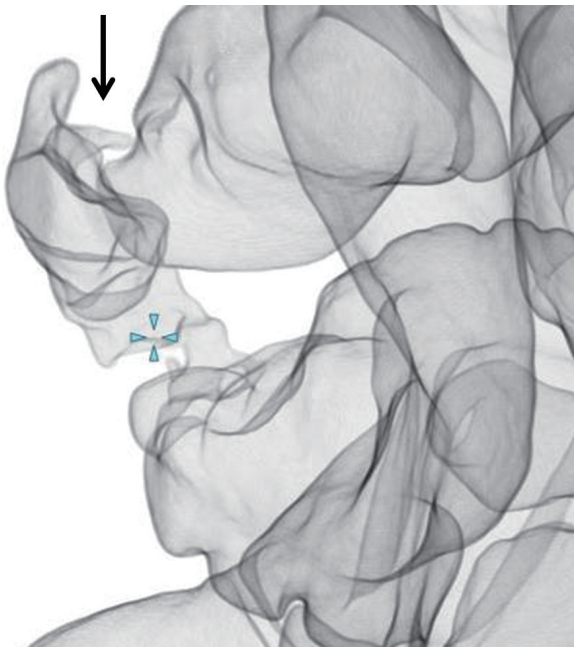

Fig. 1. Stenotic lesions can be seen in the hepatic flexure (arrow head) and ascending colon (arrow) on the CTC air image.

Table 1. Success and failure of the total colonoscopy in 21 patient's.

patient	age	sex	chief complaint	PS	location	size(mm)	form	depth	TCS	
1	92	F	abdominal mass	2	C	130×120	4	SE	**	
2	83	F	abdominal pain	2	Rb	60×45	3	A	**	
3	88	F	melena	2	P	28×18	1	MP	**	
4	93	F	anemie	3	T	75×50	3	SE	**	
5	95	F	abdominal pain	1	D	50×35	2	SS		***
6	79	F	fecal occult blood	1	Rs	40×35	3	SS		***
7	77	F	anemie	1	T	60×50	3	SS		***
8	75	M	fecal occult blood	1	S	40×20	3	SS		***
9	83	F	melena	1	A	67×40	2	SS		***
10	84	M	anemie	2	T	55×35	3	SE		***
11	86	F	anemie	1	T	45×25	2	SS		***
					A	40×35	2	SE		
12	97	M	fecal occult blood	2	A	65×30	2	SE		***
					A	20×14	IIa	M*		
13	93	F	melena	1	T	41×33	2	SE		***
					A	20×20	IIa	M*		
14	77	F	fecal occult blood	1	A	43×33	1	SS		
15	75	F	fecal occult blood	0	C	35×30	3	SS		
16	81	F	abdominal pain	0	C	50×50	1	SS		
17	77	M	fecal occult blood	1	Ra	60×55	1	MP		
18	75	M	anemie	1	Rb	42×40	1	MP		
19	84	M	anemie	1	S	60×45	1	MP		
20	88	M	melena	0	Ra	48×37	1	MP		
21	79	F	astriction	0	Rb	24×23	2	MP		

*: The lesion was not be visualized.
**: TCS could not be achieved because of poor general condition.
***: TCS was unsuccessful because of a stenotic lesion.

RESULTS

Patients were aged 75-97 years (median: 83 years) with a male-to-female ratio of 7:14. The chief complaints were an abdominal mass and constipation in 1 patient each, abdominal pain in 3 patients, fecal occult blood in 6 patients, melena in 4 patients, and anemia in 6 patients. The performance status (PS) was 0 in 4 patients, 1 in 11 patients, 2 in 5 patients, and 3 in 1 patient. Eighteen patients had underlying cardiopulmonary disease, cerebrovascular disease, or orthopedic conditions. Four patients underwent CTC because TCS could not be achieved because of poor performance status with cardiac disease, pulmonary disease, cerebral vascular disturbance. Nine patients underwent CTC for confirmation of the lesion on the oral side of a stenotic lesion after TCS was unsuccessful. Among these, 5 patients didn't force to introduction of an endoscope into oral side of a stenotic lesion because of their antithrombotic medication. CTC was successful without any complications in all 21 patients. Of the 24 lesions, 22 were detected by CTC, all of which had invaded deeper than the submucosa and with a diameter of ≥ 21 mm. The 2 lesions that could not be detected were both at an invasion depth of the mucosa and had diameters of < 20 mm (Table 1). TCS was not possible in patient 11 because of a stenotic lesion in the transverse colon; however, an oral side lesion was detected by CTC (Fig. 1). CTC of patient 12 revealed ascending colon cancer. However, a 0-II type tumor in the pathological specimen was not detected by CTC because the ascending colon cancer was overlying the lesion (Fig. 2). Patient 13 was unable to undergo TCS because of stenotic lesion in the transverse colon. In this patient, a cecal cancer of 0-II type confirmed in the pathological specimen was not detected by CTC (Fig. 3). We built composite images of 3D-CT angiography and 3D air images and used these for navigation-guided surgery (Fig. 4).

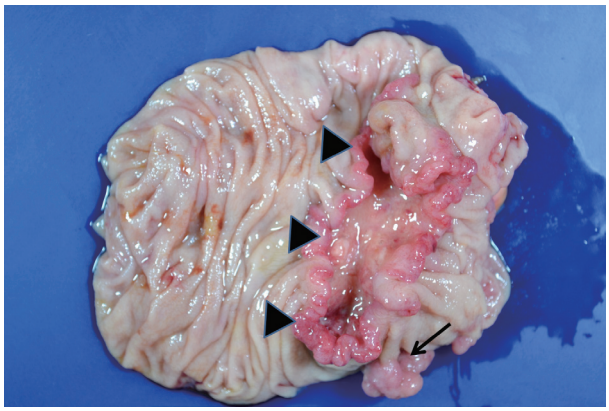

Fig. 2. An ascending colon cancer of II type (arrow head) and a neighborhood colon cancer of 0-II type (arrow) were observed in the ileocecal pathological specimen.

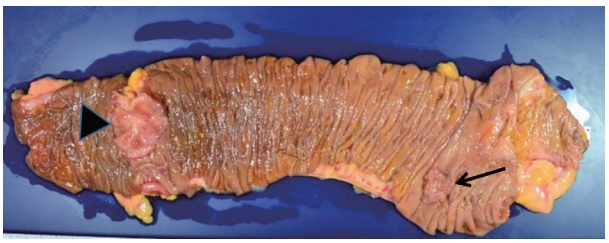

Fig. 3. A transverse colon cancer of II type (arrow head) and an ascending colon cancer of 0-II type (arrow) were observed in the right hemicolectomy specimen.

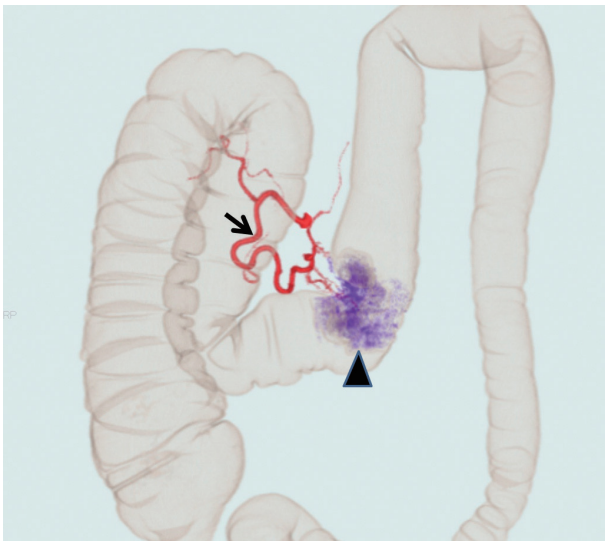

Fig. 4. CTC air image and 3D-CT angiography fusion image. The stenotic lesion showed as a purple fog (arrow head) in the transverse colon is being fed by the left branch of the middle colic artery (arrow). Laparoscopic left hemicolectomy and D2 dissection were performed under navigational guidance.

DISCUSSION

Recently, colorectal cancers in the old-old and oldest-old has been increased, however, many patients visit to the hospital in advance disease with chief complaints of bleeding or obliteration because cancer screening has not been prevailed enough. It goes without saying that TCS is the diagnostic standard for colorectal cancer. However, elderly tend to have many factors such as cardiac disease, pulmonary disease, cerebral vascular disturbance, orthopedic condition and antithrombotic medication which interrupt to achieve TCS. The diagnostic method which is safety, simple and superior in sensitivity and specificity is required given the fact that most of patients with colorectal cancer visiting our hospital are the elderly. CTC is characterized by its simplicity and safety. The procedure requires only 1 position change from prone position to the supine position and can be completed within 10 min. Furthermore, CTC requires no special skill, unlike TCS and BE. There is also no risk of damage to the circulatory and respiratory systems because of sedatives that are often used in TCS; moreover, the feeling of fullness after the examination is suppressed because of the use of CO_2, which is absorbed through the intestinal wall at approximately 130 times the speed of absorption of air and the use of automated CO_2 injector which maintains safety intraintestinal pressure. As a result, CTC is an excellent modality in the elderly.

The incidence of perforation during CTC is reportedly 0.005%-0.03% [6,7,8]. Risk factors for perforation are obstructive colorectal cancer [9], long-term administration of steroids for inflammatory bowel disease [10], history of colonoscopic biopsy, history of colonoscopic polypectomy, old age, and colonic diverticula [11]. In a review of perforation rates of the various investigatory modalities for colorectal cancer, Khan *et al*. reported that perforation rate was higher during CS and BE (0.06%-0.19% and 0.02%-0.24%, respectively) than in CTC because of the use of automated CO_2 injector [12]. In the present study, we showed safeness and benefit of CTC for those with poor performance status. Other previous studies also warrant its safeness [6,7,8,9,10,11,12]. Therefore, CTC is considered to be useful for colorectal cancer in the elderly.

Coccetta *et al*. reported that TCS was unsuccessful in 5%-10% patients and identified the major cause of this as stenotic colorectal cancer [13]. They also reported that synchronous multifocal colorectal cancer accounted for 1.5%-9% of all colorectal cancers [13]. Moreover, Kim *et al*. reported colorectal cancer in the oral side of stenotic lesions in 4% of 75 stenotic colorectal cancer patients who underwent CTC because TCS could not be performed [14]. Examination of the oral side in stenotic colorectal cancer is very important because repeat surgery within a short period of time may be required if synchronous multifocal colorectal cancer is not diagnosed preoperatively. In the past, intraoperative CS was performed in stenotic colorectal cancer cases when preoperative TCS was impossible. However, problems, such as difficulties with patient repositioning, prolonged surgical time, risk of intra-abdominal contamination due to fecal leakage, and the insufflated abdomen interfering with the surgical field of view, remain in intraoperative CS. Preoperative CTC was thus considered an alternative procedure to intraoperative CS. In a comparison of CTC and BE, Fenlon *et al*. reported that CTC was superior to BE because in cases of stenotic colorectal cancer, CTC detected 26 out of 29 lesions that were not detected by BE [15]. Furthermore, Hirata *et al*. reported that air images of CTC were better than BE at rendering lateral views of lesions and were useful for diagnosing invasion depth [16]. Nozaki *et al*. reported that in the case of CTC following failed TCS, good-quality images were easily obtained because fluid and residue in the bowel were aspirated with an endoscope and the bowel was only moderately distended. They therefore recommended using CTC instead of BE, which is not suited for imaging of the right side of the colon [17].

Other benefits of CTC include the ability to create images for navigation-guided surgery from multiphase fusion images of 3D-CT angiography and 3D air images as well as the usefulness of CTC in the staging of colorectal cancer using 3D-CT images [17]. Therefore, we recommend to create multiphase fusion images prior to surgery. A drawback of CTC is that 0-II type tumors are not rendered as well as 0-I type tumors. Abe *et al*. reported that in tumors

with a height of ≥ 2 mm and diameter of ≥ 20 mm, the height, in particular, is a factor affecting CTC rendering [18]. In the present study, 0-II type tumors with a diameter < 20 mm could not be rendered by CTC. On the other hand, all tumors that invaded deeper than the submucosa were detected. Particularly in emergency cases, such as those with bleeding and obstruction, the combined use of CTC and 3D-CT angiography was effective for determining the indications for surgery in elderly individuals in whom TCS is difficult because of cardiopulmonary disease, cerebrovascular disease, or orthopedic conditions.

A recent trend is the design of clinical trials that use a dedicated barium negative contrast media for CTC for improving the accuracy of surface lesion rendering. A computer-supported diagnostic system is also being developed to enhance the accuracy of imaging early-stage colorectal cancer. Techniques for decreasing radiation exposure are currently being developed following improvements in imaging workstations and image-processing methods. Further advancements in CTC for elderly colorectal cancer patients are expected.

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