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Comparison of virtual colonoscopy and colonoscopy in diagnosis of colorectal neoplasia

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Abstract: The diagnostic value of virtual colonoscopy versus colonoscopy was compared in detection of colorectal neoplasia. Virtual colonoscopy was performed on 29 patients with suspected colorectal diseases, Results were compared with colonoscopy for each case. Virtual colonoscopy was successfully performed on each patient. All patients tolerated virtual colonoscopy well, had no complications. All colorectal malignance were identified both by virtual colonoscopy and colonoscopy. Twenty-five polyps were detected with colonoscopy, whereas only 16 polyps were defined by virtual colonoscopy. Detection rates of polyps greater than 1.0 cm, between 0.5－0.9 cm and less than 0.5 cm in size were 90%, 62.5% and 28.6% respectively. Virtual colonoscopy is fast, minimally invasive and well tolerated. This technique is a valuable clinical method in diagnosis of colorectal malignance and polyps larger than 0.5 cm in size.

Key words: Colorectal neoplasia, Virtual colonoscopy, Colonoscopy
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INTRODUCTION

Colonoscopy has been considered to be the most effective test for the screening , diagnosis, and treatment of colorectal polyps and carcinoma. However , It is relatively uncomfortable, invasive, time-consuming. In addition, in up to 10% of patients the complete colon is not shown. Virtual colonoscopy is a new tool for detecting colorectal neoplasms. This technique uses standard helical CT images of the colon and advanced imaging software to produce reformatted two- and three dimensional views of the entire colorectum. Computer-rendered three-dimensional images simulate the endoluminal image seen by colonoscopy but in a minimally invasive manner. The purpose of this study was to compare virtual colonoscopy with conventional colonoscopy in detecting colorectal neoplasia.

MATERIALS AND METHODS

From May 1999 to December 1999, we conducted both colonoscopy and virtual colonoscopy on 29 patients who were strongly suspected to have colorectal neoplasia. Patients included 17 males and 12 females with ages ranging from 21 to 77 and average age of 58.1. Ten patients had abdominal pain, 13 had hematochezia, and six had diarrhea.

Conventional colonoscopy

Using Olympus model CF-140 scope, all patients underwent a standard colonoscopy procedure(Li, 1995) . Each patient was examined with virtual colonoscopy within one week after conventional colonoscopy examination.

Virtual colonoscopy

1. Equipments: Spiral CT scan model GE Hi-speed CT/i(GE Medical system, Milwaukee Wisconsin, USA).
Workstation: GE Advantage Windows 3.1.

2. Methods: Bowel preparations identical to conventional colonoscopy preparations. Five minutes prior to scanning, intramuscular injection of 20 mg anisodamine was giving to patient in left lateral decubitus position. Air was inflated into the anus until the patient felt abdominal dis-

tention. The patient was then asked to turn to a supine position for correcting scanning position and observation of adequate inflation of colon. When sufficient dilatation was achieved, continuous scanning was performed starting from 5 mm above the splenic flexure to the inferior border of the pubic symphysis (including the cecum, entire colon, and rectum). Scanning parameters were as follow: bean collimation thickness of 5 mm, table speed of 7.5 mm/s, pitch of 1.5, 120 kV of electric power with current of 220-250 mA, matrix of 512×512. The axial CT images were reconstructed at 1－mm intervals. Digital information from the scan were sent to the workstation and processed into 2D and 3D images using the software provided.

3. Analysis: In virtual colonoscopy colon malignance presents as local bowel-wall asymmetry or circumferential thickening, irregular shaped soft uneven density tissue protruding into the bowel lumen causing narrowing and strictures, stiffness of bowel wall and disappearance of peristalsis. colonic polyps present as regular sessile or non-sessile tissue shadows protruding into the lumen, whose surface is smooth, without apparent thickening of surrounding intestinal wall and immovable even after position change (Hara et al., 1996; Royster et al., 1997).

RESULTS

Virtual colonoscopy was successfully performed on all 29 patients with no complications. The patients tolerated the procedure well. Conventional colonoscopy failed to reach the ileocecal valve in 6 patients due to strictures and/or torsion. Both conventional and virtual colonoscopy revealed the existence of colon carcinoma to similar extent at the same location in 14 patients. Diagnostic coincidence rate was 100% (Table 1). Of these 14 patients, 9 had evidences of serious coat and peripheral tissue invasion in 2D images from virtual colonoscopy. These results were consistent with surgical findings. Three patients had evidences suggesting liver metastasis.

Using conventional colonoscopy, 25 polyps were detected. Pathological diagnosis confirmed 23 adenomas, one juvenile polyp, and one inflammatory polyp. Only 16 polyps were defined by virtual colonoscopy. Diagnostic rate of polyps with diameters greater than 1.0 cm was 90% (with diameters of 0.5 to 0.9 cm was 62.5%) and for less than 0.5 cm polyps, the detection rate was 28.6% (Table 2). Nine polyps were missed in virtual colonoscopy showing one with diameter greater than 1.0 cm; three with diameter between 0.5 cm and 0.9 cm and five with diameter of less than 0.5 cm. The polyp with diameter greater than 1.0 cm was missed due to poor bowel preparations and abundant residual fluids. The other seven polyps were all flattened lesions.

Table 1 Comparison of virtual colonoscopy and colonoscopy in diagnosis of colorectal neoplasia

Lesions	Colonoscopy (Num.)	Virtual colonoscopy (Num.)	Detection rate
Carcinoma	14	14	100%
Polyp	25	16	64%

Table 2 Comparison of the number of polyps seen by virtual colonoscopy and colonoscopy

Size of polyps	Colonoscopy (Num.)	Virtual colonoscopy (Num.)	Detection rate
>1.0 cm	10	9	90.0%
0.5－0.9 cm	8	5	62.5%
< 0.5 cm	7	2	28.6%

DISCUSSION

Colorectal carcinoma is one of the most common carcinomas in China, with colon polyp being its high risk factor. With the increasing incidence, more attention has been paid to genetic etiology (Lai et al., 2001) and diagnostic technique.

Conventional colonoscopy has been the "golden standard" in clinical diagnosis of colorectal tumors for many years. Its use still needs careful consideration because of some negative aspects such as patient discomfort, possibility of perforation. Barium enema is also used quite often in the diagnosis of colonic diseases, but the rate of missed diagnosis in colorectal neoplasia is high (Royster et al., 1997).

Vining's report on virtual colonoscopy has greatly increased medical workers' attention to

the value of non-invasive diagnosis of colorectal diseases. In virtual colonoscopy, colon malignance presents as local bowel-wall asymmetry or circumferential thickening, uneven density irregular shaped soft tissue protruding into the bowel lumen causing narrowing and strictures. The 2D images can show the depth of metastasis and invasion into surrounding structures and organs. Our study demonstrated that the diagnostic rate of colon malignance was similar between virtual colonoscopy and conventional colonoscopy, with a coincidence rate of 100%, suggesting that virtual colonoscopy has a higher differentiating ability when used to diagnose colon malignance. This result is consistent with the other literature reports (Sun et al., 2000). In this study, conventional colonoscopy failed to reach the ileocecal junction in six patients. In contrast, because air can pass through strictures and inflate the entire colon, virtual colonoscopy can examine the areas not observed by conventional colonoscopy and determine the affected area, which is valuable information for surgeons.

In virtual colonoscopy, colonic polyps show as sessile or non-sessile tissue shadows protruding into the lumen. The surface is smooth without apparent thickening of the surrounding intestinal wall. The ability to detect colonic polyps is related to the size of the polyp. Hara et al. (1996; 1997) reported that the detection rate for polyps >1.0 cm was 100%, for polyps with diameters between 0.5 and 0.9 cm was 71%, and for those with diameters of less than 0.5 cm only was 28%. Since polyps with diameters <0.5 cm only has a 0.1% chance of progressing to carcinoma, its clinical importance is less significant. Our studies showed that the detection rates were 90% for diameters > 1.0 cm, 62.5% for diameters between 0.5 and 0.9 cm, and 28.6% for diameters less than 0.5 cm. These data were similar to those in some other reports.

In conclusion, virtual colonoscopy is a non-invasive, painless, relatively more efficient way of examination with minimal complication and better tolerance by patients. Its ability to examine the intestinal wall from both anterograde and retrograde perspectives is useful for detecting diseases hidden behind colonic folds. Zhong et al. (2000) found four polyps hidden behind the colonic folds by using virtual colonoscopy. These polyps were not detected by conventional colonoscopy. Virtual colonoscopy can also examine the intestinal wall and adjacent structures, thus helping to localize the extent of disease; and so, may be used clinically to supplement conventional colonoscopy in the future. There are some few shortcomings associated with virtual colonoscopy. These include inability to examine the distributions of blood vessels, and color changes of mucosal membrane, time consuming in the image processing, low detection rate for less than 0.5 cm polyps and for flattened lesions. In our study, eight missed polyps were all flattened. Poor bowel preparations, high levels of residual fluids, and insufficient inflation can all affect the accuracy of virtual colonoscopy. In our study one polyp greater than 1.0 cm was missed due to voluminous residual stool. These problems are expected to be resolved with advancing technologies in CT scan and computer processing.

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NEWS

August 12－15, 2002 International String Theory Conference at Zhejiang University in Hangzhou, China

The International String Theory Conference was successfully held on August 12－15, 2002 at Zhejiang University in Hangzhou China, was suggested and organized by Prof. S.－T. Yau (Harvard University), the director of the center of Mathematical Sciences at Zhejiang University. About 100 participants from all over the world attended the conference. Among them, there were two winners of Fields Medal Prize: S.－T. Yau and E. Witten (Institute for Advanced Study, Princeton University), and a number of distinguished professors, academicians of sciences, and outstanding scientists from worldwide first rank universities and institutes.

Ideas from string theory have comprised one of the mainstreams of the developments in mathematics since the late 1980s. The conference aimed to provide an opportunity to promote the developments of research in string theory and mathematical aspects in string theory, and is intended to create a friendly, free environment to communicate the latest developments of string theory and its related fields.

The chair of scientific committee is Prof. Shing-tung Yau, and the chair of organizing committee is Prof. Shu-xing Chen. Eleven plenary speakers gave one－hour lectures. They addressed the latest developments and frontiers in string theory, proposed various interesting, challenging questions for future research. Speakers and titles of their lectures are:

Prof. E. Witten (Institute for Advanced Study, Princeton University): Easing into QFT; Prof. S. Hawking (University of Cambridge): M－Theory and Cosmology; Prof. D. Gross (Institute of Theoretical Physics, University of California, Santa Barbara): Perspectives on String Theory; Prof. A. Strominger (Jefferson Physical laboratory, Harvard University): Spacelike Branes; Prof. C. Nappi (Joseph Henry Laboratories, Princeton University): Strings and Non－communicativity; Prof. P. Candelas (Mathematical Institute, Oxford University): Rational Points of Calabi－Yau Manifolds; Prof. E. D'Hoker (Department of Physics and Astronomy, UCLA): Two－loop Superstring; Prof. D. Phong (Department of Mathematics, Columbia University): Supersymmetric Gauge Theories, Symplectic Forms, and Integrable Models; Prof. S. Ferrara (CERT, Switzerland): Spontaneously Broken Supergravity in String and M－Theory; Prof. T. Eguchi (Department of physics, University of Tokyo): CFT Analysis of Manifolds of Special Holonomy; Prof. G. Gibbons (Center for Mathematical Sciences, University of Cambridge): Some Recent Work on G-2 and Spin(7) Metrics in M－Theory.

In three 45－minute sections on Algebraic aspects of string theory, Geometric aspects of string theory and Duality, eleven invited lecturers presented their recent research results and works.

The conference attracted not only mathematicians, scholars from many countries and regions in the world, but also many graduates of Zhejiang University and other universities. There is no doubt that the conference will strongly influence many young scholars and graduate students and will motivate their interest in string theory The conference is resumes on August 17－19 at the Institute of Theoretical Physics in Beijing.

Report by Dai Jia-ling