

INCIDENTAL EXTRACOLONIC FINDINGS AT CT
COLONOGRAPHY

Amy K. Hara MD

C. Daniel Johnson MD

Robert L. MacCarty MD

Timothy J. Welch MD

Mayo Clinic

Rochester, Minnesota USA

INTRODUCTION

CT Colonography (CTC) is a technique providing air-filled CT images of the colon which is combined with imaging software to provide 2D multiplanar and 3D intraluminal images of the colon. Several studies have now demonstrated excellent results for detection of clinically significant polyps 1 cm and larger.

The standard axial CT images used in CTC are often used as the initial screening images of the colon while the multiplanar and 3D images are only used if needed to evaluate suspicious regions. Like the renal stone CT protocol, CTC often demonstrates findings outside the main organ of interest on the axial CT images. Although extracolonic organs are included in the images, their evaluation is undoubtedly limited by the low radiation dose and non-intravenous contrast CTC technique. Recently, we sought to determine the frequency of extracolonic findings at CTC and the subsequent impact on patient management and cost.

MATERIALS AND METHODS

From December 1996 through March 1998, 264 consecutive patients at high risk for colorectal carcinoma (previous polyp or cancer, positive family history, known colorectal lesion) were recruited for CTC. The patients consisted of 146 males and 118 females with a mean age of 64 years (range 33-88 yrs).

All CT scans were obtained using a single detector helical CT scanner (GE HiSpeed Advantage, Milwaukee, WI) with a 5 mm collimation, 3 mm reconstruction interval, 1.3 pitch, 120 kVp and 70 mA. No IV or oral contrast was administered. A prone and supine CTC exam was performed as previously described (1) in a fully cleansed colon using 0.5 cc of subcutaneous glucagon and colon insufflation with carbon dioxide gas by a registered nurse.

Each CTC exam was evaluated using customized software displaying enlarged, standard axial CT images (3). The observer scrolls through images using a mouse. Preset window/level settings were available (bone, soft tissue, lung) and could also be interactively adjusted by the observer. Intracolonic evaluation was not an aspect of this study but is available using this software.

Each CTC exam was assessed by two board-certified radiologists. Each observer worked independently while blinded to any patient medical history such as known malignancies or colonoscopy results. All extracolonic findings, whether reported by one or both radiologists were included.

Extracolonic findings were classified as high, moderate, or low significance. Highly significant findings were either indeterminate adrenal or pulmonary lesions of any size, indeterminate or likely malignant masses in solid organs (kidney, liver, spleen) measuring ≥ 1 cm, or lesions inclined to require relatively prompt medical or surgical treatment (e.g. abdominal aortic aneurysm, inguinal hernia containing bowel, pneumothorax). Moderately significant lesions were benign findings that may eventually require medical or surgical intervention (renal stones, gallstones). Lesions of low significance were unlikely to require any future treatment (renal cysts, calcified granulomas, tiny (< 1 cm) indeterminate lesions in solid organs). Letters were sent to the

primary physician for all highly significant lesions.

Clinical and radiologic follow-up was assessed through October 1998 from chart review and a computerized radiology information system. The number and results of radiologic or surgical procedures performed or recommended based directly on CTC findings were tabulated.

In an effort to discover any false-negative extracolonic findings by unenhanced CTC, all patient records were also reviewed to determine if any radiologic abdominal exam such as an enhanced CT or abdominal US was performed within a year of CTC. These included exams performed based on extracolonic CTC findings as well as any other symptoms such as hematuria or cancer staging.

RESULTS

The follow-up interval after CTC ranged from 7 to 22 months. The mean time between CTC and an additional imaging test was 86 days (approximately 3 months, range 1 day - 16 months). A total of 151 incidental extracolonic findings were reported in 109/264 patients (41%) (Tables 1,2). Forty-two patients had more than one finding. Of these findings, 23% were considered highly significant, 32% moderately significant, and 45% of low significance.

Highly significant lesions were found in 30 of 264 patients (11%) and are listed in Table 1. Two lesions were known prior to CTC (2 AAA) and had no additional work-up. Three findings were recommended for follow-up studies in 6-12 months (2 AAA, 1 indeterminate pulmonary nodule) and four findings were recommended for repeat follow-up after the first follow-up exam (2 indeterminate adrenal masses, 2 indeterminate pulmonary nodules). Ten findings including indeterminate renal, adrenal and pulmonary lesions have had no further work-up to date.

Eighteen patients with lesions classified as highly significant did undergo 22 additional imaging exams including 13 CT, 8 US, and 1 intravenous pyelogram (IVP). The most common lesion was an indeterminate renal mass in 9 patients, two of which were malignant. These two patients with renal cell carcinomas measuring 5 cm and 8 cm were asymptomatic, underwent nephrectomy, and had no metastases. One patient with a known inguinal hernia underwent surgery based on the CTC finding that the hernia contained nonstrangulated bowel. Overall, results were malignant and surgical in 2 patients (renal cell carcinoma, Figure 1), non-malignant but surgical in 3 patients (2 AAA - Figure 2, 1 pneumothorax.), indeterminate in 4 patients (2 pulmonary nodules, 2 probable adrenal adenomas), and benign in 9 patients (4 renal cysts, 1 calcified pulmonary granuloma, 1 liver with focal fat, 1 AAA measuring 4.2 cm, 1 hepatic cyst, and 1 splenic cyst).

Lesions classified as moderately significant were found 17% of patients and are listed in Table 2. No patient in this group had further radiologic imaging based on CTC findings. Lesions classified as of low significance were found in 21% of patients and are also listed in Table 2. Only two of the 68 findings prompted limited renal ultrasounds to confirm a simple and a hemorrhagic renal cyst.

A separate evaluation of CTC patients included a review of all abdominal radiologic tests performed within a year of the CTC exam. These exams, therefore, included those performed for non-CTC related reasons (ie hematuria, rule out metastases,

abdominal pain), as well as for work-up of indeterminate, extracolonic CTC findings. Twenty-four patients fit this criteria, having had an enhanced complete abdominal CT (11), abdominal US (9), or IVP (6) within a year of the CTC exam. Ten patients had the exams due to findings discovered at CTC while the remaining 14 patients had exams for non-CTC related reasons. Enhanced CT demonstrated extracolonic findings in 3 patients that were not reported at CTC including a gastric adenocarcinoma (proven by endoscopic biopsy), a psoas muscle metastasis (biopsy proven), and a simple renal cyst. Two patients at US had ovarian cysts and cholelithiasis not reported at CTC. One patient at IVP had an invasive transitional cell carcinoma of the bladder not identified at CTC. CTC, however, identified multiple findings including a renal cyst, renal stone, adrenal mass and liver cyst, which were not reported at US. CTC also identified a renal cyst in one patient with a negative IVP.

DISCUSSION

The majority of extracolonic findings reported in our study were considered of low or moderate significance since they were clearly benign and judged by the referring physician as unlikely to become a symptomatic or surgical problem. In spite of the low radiation dose (70 mA) and unenhanced technique, CTC did not prompt unnecessary and costly additional testing for these findings of doubtful clinical significance. Only two of the 79 patients in this group had additional imaging to confirm renal cysts, while the remaining 77 patients had no further work-up. It is possible that other institutions may take a more aggressive approach in the work-up of these small, incidental findings subsequently increasing added costs.

A minority of patients (11%, 30/264) had extracolonic findings classified as highly significant. Of those patients, 18 underwent additional imaging, which demonstrated similar numbers of patients with malignant or surgical findings (5/18), benign findings (9/18), or indeterminate (4/18) findings. The results in the remaining 12 patients were either known (n=2), recommended for follow-up imaging at a later time (n=3), or did not have any documented additional work-up (n=10). Therefore, it appears that the work-up for highly suspicious lesions seen on unenhanced CTC is relatively infrequent but when performed is commonly beneficial. Most importantly, perhaps, overall only a small number of patients with high, moderate or low significance lesions had additional imaging for benign disease (4%, 11/264).

Many advantages of detecting extracolonic incidental findings exist. The most beneficial situation would be the discovery of an asymptomatic early process, which could be cured by early treatment. For example, the mortality associated with abdominal aortic aneurysms is much lower for elective early surgery (5%) compared to surgery after rupture (85-95%) (6). Even if an untreatable condition is serendipitously found, patients may appreciate the advanced warning to organize their lives (7). Finally, early treatment may in fact decrease costs due to less complicated surgical procedures and reduced hospital courses for patients with minimally advanced disease. The final judgment concerning incidental findings will likely ultimately depend on long-term studies of patient outcome.

Potential disadvantages are of equal magnitude. At the worst extreme, patient

mortality or morbidity could increase due to invasive diagnostic testing or nonessential surgery. Other disadvantages include unnecessary patient anxiety as well as higher costs and extra patient radiation exposure from superfluous additional tests. Online physician monitoring could minimize patient inconvenience by immediately identifying patients needing IV contrast instead of having patients return at a later date for a diagnostic exam. In a busy clinical practice, however, this may not be feasible for logistical reasons.

In our small subset of 24 patients with enhanced abdominal CT, US or IVP within 1 year of CTC, the same extracolonic findings were reported in 15 of 24 patients. Highly significant extracolonic findings, however, were missed in three patients including a gastric carcinoma, a 2.5 cm psoas muscle metastasis, and an invasive transitional cell carcinoma of the bladder. Even in retrospect, these lesions could not be identified on the unenhanced CTC exam. It appears from this small subset that important low contrast lesions in solid organs can be overlooked using this low radiation dose technique without IV or oral contrast. On the other hand, high contrast lesions such as calcifications or cysts in solid organs are commonly and accurately differentiated at CTC.

In conclusion, since it appears CTC can adequately classify extracolonic findings as high or low clinical significance, evaluation of these extracolonic structures is a valuable part of this exam. Although unenhanced CTC at one-fourth the standard mA is not adequate for screening of the solid abdominal and pelvic organs, significant and common asymptomatic disease such as renal cell carcinomas and abdominal aortic aneurysms can be detected. Most extracolonic findings at CTC are of low significance and do not instigate further work-up. The small subset of patients who were recommended for additional work-up of extracolonic findings often demonstrated significant disease. The ability to visualize the entire abdominal and pelvic contents in the course of a routine screening exam holds the promise of detecting select diseases earlier in a more curable stage.

BIBLIOGRAPHIES

1. Hara AK, Johnson CD, Reed JE et al. Colorectal polyp detection using CT Colography: Initial assessment of sensitivity and specificity. *Radiology* 1997; 205:59-65.
2. Fletcher JG et al. Optimization of CT Colonography Technique: Prospective Trial in 180 Patients. *Radiology* 2000 216: 704-711.
3. Hara AK, Johnson CD, Reed JE, Harmsen WS. Reducing diagnostic time for CT Colography. (Abst.) SGR Annual Meeting, Rancho Mirage, CA 1998, p178.
4. Fenlon HM, Clark PD, Ferrucci JT. Virtual colonoscopy: imaging features with colonoscopic correlation. *AJR* 1998;170(5):1303-9.
5. Dachman AH, Kuniyoshi JK, Boyle CM, et al. CT colonography with three-dimensional problem solving for the detection of colonic polyps. *AJR* 1998;171(4):989-996.
6. Nevitt MP, Ballard DJ, Hallett JW. Prognosis of abdominal aortic aneurysms: a population-based study. *N Engl J med* 1989;321:1009-1014.
7. Westbrook JI, Braithwaite J, McIntosh JH. The outcomes for patients with incidental lesions: serendipitous or iatrogenic? *AJR* 1998;171:1193-1196.

Table 1. Findings with additional work-up

Finding	No. findings with work-up/ total number of findings	Work-up	Future work-up**	Results	surgery
HIGHLY SIGNIFICANT					
1. Renal mass	6/9	3 CT, 3 US, 1 IVP		2 renal cell cancers, 4 cysts	2
2. Lung nodule	3/8	4 CT	3 CT	1 granuloma, 2 indeterminate nodules	
3. AAA (> 4 cm)	3/7	3 US	2 US	3 AAA > 4 cm	2
4. Adrenal mass	2/5	3 CT	2 CT	2 probable adenomas	
5. Hepatic mass	2/2	2 CT, 1 US		1 focal fat, 1 cyst	
6. Splenic mass	1/1	1 US		cyst	
7. Pneumothorax	1/1	1 CT		50% pneumothorax, large bulla	1
8. Inguinal hernia with bowel	0/1				1
LOW SIGNIFICANCE					
1. Renal cyst	2/25	2 US		renal cysts	

** Future work-up = follow up imaging in 6-12 months, AAA = abdominal aortic aneurysm, CT = computed tomography, US = ultrasound, IVP = intravenous pyelogram

Table 2. Findings without further work-up

Finding	No. patients
MODERATELY SIGNIFICANT	
1. Gallstones	20
2. Renal stones	14
3. Coronary artery calcification	5
4. Uterine fibroids	5
5. Inguinal hernia without bowel	2
6. Situs inversus	1
7. Horseshoe kidney	1
8. Cirrhosis	1
LOW SIGNIFICANCE	
1. Hepatic cysts	8
2. Pulmonary granulomas	8
3. Hiatal hernias	8
4. Splenic granulomas	7
5. Fatty livers	3
6. Renal scars	3
7. Hepatic granulomas	3
8. Angiomyolipomas	2
9. Splenic cyst	1

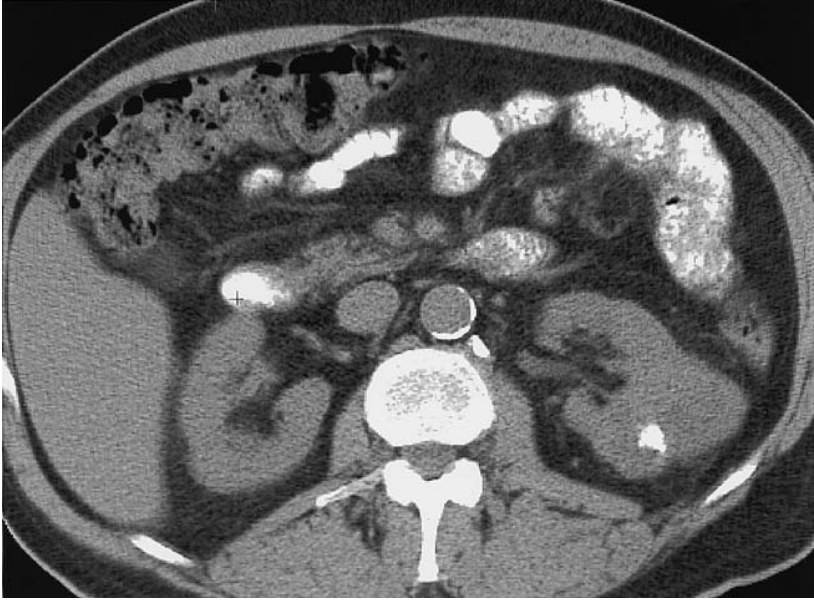


Figure 1. Unenhanced axial CT image obtained at 70 mA for CTC demonstrates an 5 cm exophytic left renal mass with calcification.

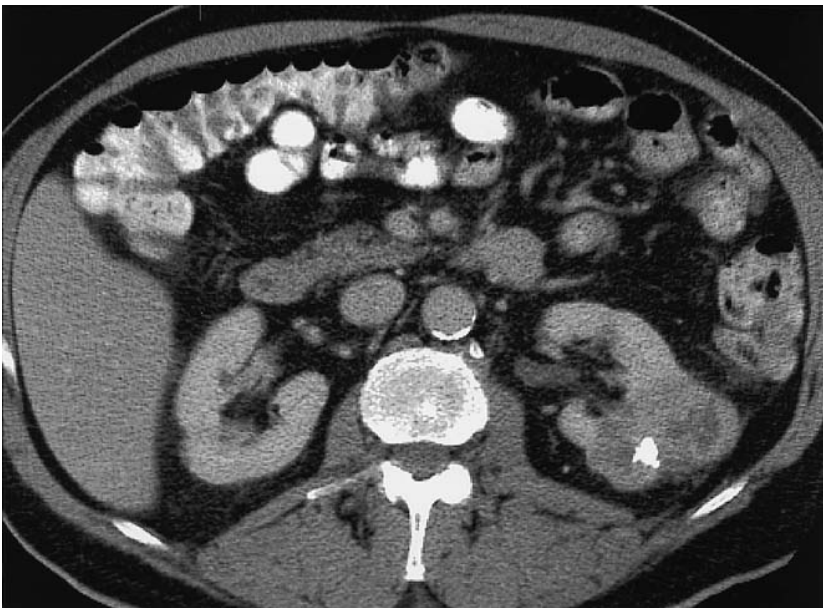


Figure 2. Standard enhanced axial CT image at 280 mA for staging of the same 5 cm left renal mass demonstrates heterogenous enhancement typical of renal cell carcinoma. Nephrectomy demonstrated renal cell carcinoma, stage 1, grade 2.



Figure 3. Unenhanced axial CT image obtained at 70 mA for CTC demonstrates an unsuspected 4.9 cm infrarenal abdominal aortic aneurysm (arrow). The patient underwent successful aneurysm repair 8 days later.