



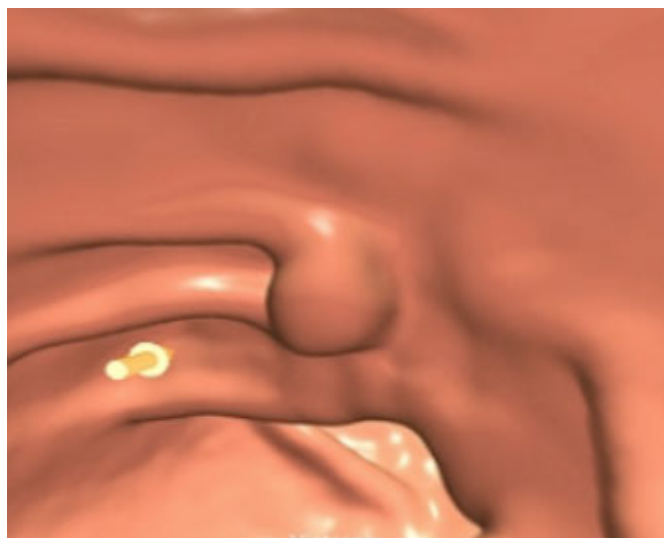
## CT Colonography

- Colorectal cancer (CRC) is the third most common form of cancer and the second leading cause of cancer related deaths in the United States
- Periodic screening is recommended to detect pre-malignant lesions and prevent development of CRC
- The American Cancer Society recommends CT colonography (CTC) every 5 years as a screening option for asymptomatic adults who are at average risk of developing colorectal cancer starting at age 50
- CTC requires purgative bowel cleansing but not conscious sedation
- The accuracy of CTC is comparable to optical colonoscopy
- If large polyps (>10 mm) or intermediate polyps (6-9 mm) are found, optical colonoscopy and polypectomy is recommended

In the United States, colorectal cancer (CRC) is the third most common form of cancer in both men and women and the second leading cause of cancer deaths. The likelihood that an individual will develop CRC at some point in life is estimated to be 6%. Periodic screening and the removal of pre-malignant lesions can prevent most CRCs and early detection and treatment of CRC is known to improve prognosis. Although periodic screening is recommended for all adults over 50 years, only about half of patients comply with the recommendations and only about 39% of colorectal cancers are detected while the disease is still localized.

Most CRC arises from adenomatous polyps. It is estimated that as many as 30-50% of the population may develop an adenomatous lesion at some point in their lives; however, the vast majority of all polyps <10mm in size are either non-neoplastic or lack the histologic changes that would indicate likely transformation to malignancy. Larger polyps (>10 mm) are considered to harbor the most significant risk and there is consensus that these lesions should be removed. Recent studies also show that CRC can also arise from flat and depressed colorectal neoplasms. While the prevalence of these non-polypoid lesions has been reported to be 9.4%, this figure reflects a heterogeneous (non-screening) study cohort and a very inclusive definition of 'flat'. In a screening population, the prevalence of high grade dysplasia or invasive cancer due to these lesions was 0.32%.

The American Cancer Society, the US Multi-Society on Colorectal Cancer, and the American College of Radiology recently issued new guidelines for the screening and surveillance of CRC and adenomatous polyps. The panel expressed the strong opinion that prevention should be the primary purpose of CRC



CT Colonography exam demonstrates an 8 mm polyp, subsequently demonstrated to be a tubular adenoma. The yellow arrow is a computer-aided detection (CAD) mark helping the interpreting radiologist to identify the lesion.

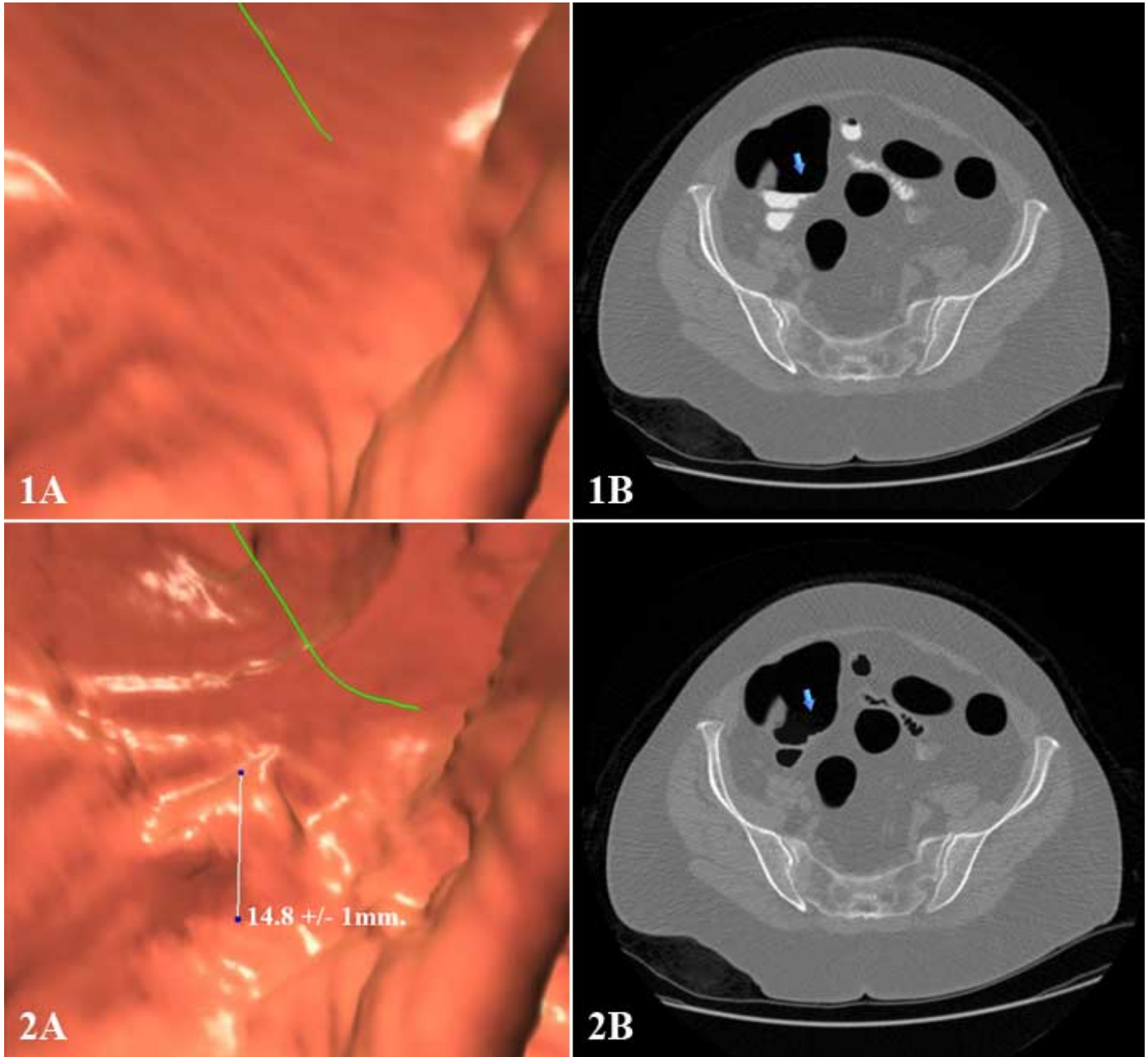
screening and, for the first time, recommended CT colonography (CTC) every 5 years as one of the screening options for the detection of adenomatous polyps or early stage cancer in asymptomatic adults who are at average risk of developing colorectal cancer.

CTC is a short procedure that is less invasive than colonoscopy and does not require conscious sedation. Therefore, no recovery time is required, there is no need for a chaperone to provide transportation after the procedure, and patients can return to work or other normal activities without delay.

**Table 1. Comparison of Optical Colonoscopy and CT Colonography**

	<b>Optical Colonoscopy</b>	<b>CT Colonography</b>
Patient preparation	Purgative bowel cleansing	Purgative bowel cleansing
Anesthesia	Conscious sedation	None; minimal patient discomfort
Radiation	None	~3 mSv (equivalent to annual background radiation)
Lesion localization	Inferred from length of colonoscope	Directly localized on 3-D images
Lesion characterization	Concurrent removal of polyps and histological analysis	Significant lesions require follow-up with optical colonoscopy, surgery, or imaging surveillance
Complications	0.06% perforation*	0.005% perforation

\*For colonoscopy without biopsy or polypectomy



**Figure 1A & B** - 3D and 2D tagged, uncleaned images of CT colonography study show gas distended colonic loops with layering contrast material in the right colon.

**Figure 2A & B** - 3D and 2D tagged electronically cleansed images of CT colonography study show the appearance of a flat cecal lesion confirmed by optical colonoscopy and biopsy to be a tubulovillous tumor with dysplastic changes.

**Table 2. CT Colonography Reporting and Data System****C0. Inadequate study/Awaiting prior comparisons**

- Inadequate prep: cannot exclude lesions  $\geq 10$  mm owing to presence of fluid/feces
- Inadequate insufflation: one or more colonic segments collapsed on both views
- Awaiting prior colon studies for comparison

**C1. Normal colon or benign lesion**

- No visible abnormalities of colon
- No polyp  $\geq 6$  mm
- Lipoma or inverted diverticulum
- Non-neoplastic findings, e.g., colonic diverticula

**C2. Intermediate polyp or indeterminate finding; colonoscopy or surveillance recommended\***

- Intermediate polyp,  $< 3$  in number
- Indeterminate findings, cannot exclude polyp  $\geq 6$  mm in technically inadequate exam

**C3. Polyp, possibly advanced adenoma; follow-up colonoscopy recommended**

- Polyp  $\geq 10$  mm
- $\geq 3$  polyps, each 6-9 mm

**C4. Colonic mass, likely malignant; surgical consultation recommended**

- Lesion compromises bowel lumen, demonstrates extracolonic invasion

*\*Evidence suggests surveillance can be delayed at least 1-3 years, subject to individual patient circumstance*

## How Good is CTC?

Advances in CTC techniques in recent years have substantially improved accuracy. Current CT technique includes: full bowel preparation, adequate insufflation of the bowel, very low dose prone and supine multidetector CT scanning, dedicated CTC software, and adequate training of the interpreting radiologist. In studies in which these standards were met, the *per* patient sensitivity and specificity was reported to be 93% (range 64-100%) and 97% (range 95-100%), respectively, for polyps  $> 10$  mm, and 86% (range 79-100%) and 86% (range 55-100%), respectively, for polyps  $\geq 6$  mm. In comparison, optical colonoscopy has been shown in back-to-back examinations to have a sensitivity of 94%, a figure that reflects inter-operator variability. When optical colonoscopy is compared to a separate reference standard that includes 3-dimensional CT colonography, the miss rate of optical colonoscopy is higher, estimated to be 10-14% of polyps that are  $\geq 6$  mm. Non-polypoid lesions are difficult to distinguish from normal mucosa by optical colonoscopy and are also harder to detect by CTC than polyps. However, once they grow to a size at which they are likely to harbor advanced neoplasia, they are more readily detectable by both CTC and optical colonoscopy, in the former case because they cause abnormal wall thickening of the colon.

## Patient Preparation and Procedure

The current CTC procedure at MGH requires a full cathartic preparation, using one of the standard, commercially available regimens.

At CTC, a small, soft catheter (approximately the caliber of a standard Foley catheter) is inserted into the rectum and the colon distended by computer controlled, pressure regulated CO<sub>2</sub> insufflation. Few patients report any more than minimal discomfort. Low radiation dose supine and prone images are acquired, to maximize visualization of the entire colon. Patients are asked to hold their breath during the scan to

minimize motion artifacts and with current scanners, the images are acquired in approximately 15 seconds. The entire procedure is complete within 15-20 minutes. Following image acquisition, the patient can resume normal activities immediately.

The radiologist examines the colon in both 2-D (Figure 1) and 3-D multiplanar reconstructed images of the colon interior (Figure 2), as well as axial images for any significant extra-colonic pathology, which have been observed in 4.5-11% of cases. The findings are reported following a system that is conceptually similar to the BI-RADS system for breast imaging (Table 2).

## Limitations

The principal limitation of CTC is that significant colonic lesions require follow-up, typically by optical colonoscopy and polyp removal. In a screening setting however, it is estimated that  $\geq 85\%$  patients can be screened by CTC alone. When colonoscopy is indicated, it is performed the same day, whenever possible, in order to avoid the need for another bowel preparation. However, because sedation is used during colonoscopy, the patient is required to have an escort to return home. The referral rate from CTC to therapeutic colonoscopy has been reported to be 6.4% when those with polyps  $> 10$  mm were referred to colonoscopy and those with 6-9 mm polyps are given the choice of colonoscopy or annual surveillance. Polyps that are  $\leq 6$  mm are unlikely to be cancerous and routine screening is sufficient for follow-up.

At this time most medical insurance covers CTC in patients who cannot complete optical colonoscopy because of discomfort or technical limitations. Ongoing discussions with insurance companies may result in coverage for screening in the future. CTC is also offered as a self-pay examination at a cost of approximately \$500.

## Indications and Scheduling

MGH guidelines developed with the Gastrointestinal Unit recommend consideration of CTC as an alternate to OC in asymptomatic average-risk subjects starting at age 50. Subjects who are at increased risk for CRC, namely those with personal or family history of CRC, those with pre-existing conditions which increase risk for CRC such as inflammatory bowel disease, and patients with symptoms such as rectal bleeding (including guiac positive FOBT x3) or change in bowel habits should have optical colonoscopy.

CTC examinations may be scheduled online through Radiology Order Entry (ROE) (<http://mghroe>) or by calling 617-724-2628.

## Further Information

For further questions, please contact [Michael E. Zalis, M.D.](#), Director of CT Colonography, Department of Radiology, Massachusetts General Hospital at 617-724-2628.

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