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Virtual colonoscopy: What is its role in cancer screening?

1 multicenter study found that virtual colonoscopy compared well with traditional colonoscopy; 2 others did not

Practice recommendations

- Computed tomography colonography should be evaluated on a case-by-case basis, given the lack of consensus over the number of false positive/negative results it generates, and its lack of widespread acceptance by major insurance companies (C).
- CTC is a useful screening alternative for patients who have had an incomplete colonoscopy or who have an obstructing carcinoma (C).

plans not to cover the procedure, deeming it “experimental.”⁴

More research is undoubtedly needed, and some is already underway. The American College of Radiology Imaging Network has conducted a large scale, double-blind study,⁵ with results expected later this year. In the meantime, though, counseling your patients on their options will hinge on your knowledge of the advantages and disadvantages of the CTC and what the research—to date—tells us about its usefulness.

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Strength of recommendation (SOR)

- A Good quality patient-oriented evidence
- B Inconsistent or limited-quality patient-oriented evidence
- C Consensus, usual practice, opinion, disease-oriented evidence, case series

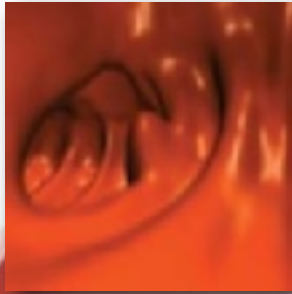
The virtual colonoscopy (CT colonography, or CTC) could make life just a little bit easier when it comes to discussing colorectal cancer screening options with your patients. After all, what patient wouldn't like to hear that there is an alternative to the colonoscopy that doesn't require sedation, IV injections, or a scope?

The reality, though, is that a number of roadblocks stand between the CTC and its inclusion in the battery of colorectal screening tools we typically discuss with our patients. Among the barriers: Mixed results from research studies evaluating the sensitivity and specificity of the CTC¹⁻³ and a decision by many insurance

Like a colonoscopy, it offers a fly-through view

The CTC, which uses helical CT to capture 2D axial images that can be converted into a 3D view, allows the radiologist the same type of colon “fly through” view that a gastroenterologist would see using a colonoscopy (FIGURE).⁶ Among its pluses: It requires no anesthesia and is non-invasive, so it's likely to appeal to patients who have a strong fear of colonoscopy. (See “What patients can expect during a CTC” on page 188.) Another potential plus: While full bowel cleansing is still required, recent investigations have studied new “prep-less” CTC options consisting of a low residue diet with multiple doses of liquid barium without catharsis.⁷⁻⁹

CTC also offers a viable screening option for certain patient populations.



“Fly-through” via virtual colonoscopy

A 2D color reconstruction “fly-through” showing a large pedunculated polyp (left) and a large sessile polyp (right).

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FAST TRACK

A virtual colonoscopy can be used to screen elderly patients who can't undergo conscious sedation

Specifically, it's already regularly being used in those who have had an incomplete colonoscopy or who have an obstructing carcinoma.¹⁰⁻¹² CTC can also be used to screen elderly patients who have contraindications to conscious sedation or medical problems that preclude them from invasive procedures.

On the downside, there is always a concern about the possible deleterious effects of radiation whenever an imaging technology is involved. The average person in the US gets about 3 mSv of radiation per year from the environment. This compares with about 10 mSv from a CT of the abdomen, 0.1 mSv from a chest x-ray, 0.7 mSv from mammography, or 5 to 7.8 mSv from CTC.^{13,14} Even though the radiation dosage currently used in CTC is safe, studies examining CTC with lower ionization have produced very

hopeful results.¹⁵ In fact, a recent study by Brenner et al found that in terms of radiation from CTC and its ability to detect polyps, the benefits far outweigh any risks.¹⁶

As you might expect, the cost of a CTC is on the higher end of the colorectal cancer screening spectrum, though it is comparable with a colonoscopy. Fecal occult blood testing is the cheapest, with a cost, on average, of \$10 to \$20. Flexible sigmoidoscopy is about \$150 to \$300, double-contrast barium enema is about \$250 to \$500, and both colonoscopy and CTC are about \$800 to \$1600. However, CTC is currently not covered under most insurance plans, but it's starting to gain acceptance as a reimbursable procedure. In fact, the Centers for Medicare and Medicaid Services has recently published CPT codes for CTC and even

What patients can expect during a virtual colonoscopy

The protocol for CT colonography has become considerably more standardized over the past few years, and official American College of Radiology standards will soon be in place. Typically, though, a patient getting a screening CTC can expect the following:

The night before the procedure, he'll need to cleanse the bowel completely, using an enema. The next day in the CT suite, a tube will be inserted into his rectum, and the rectum will be insufflated

with carbon dioxide (about 1.5 L).^{29,30} Usually, the CT scans will be done while the patient is in both the supine and prone positions. The amount of radiation is comparable to that of a double-contrast barium enema.³⁰ The 2D data is then analyzed using specialized workstations that can create both 2D and 3D views.

The entire exam takes less than 20 minutes and the scanning sessions last only a few minutes and require two 10-second breath holds.^{29,30}

more recently made the professional components of both diagnostic and screening CTC fully reimbursible.

Widespread reimbursement in the private sector is not here yet, however, since many major insurance companies consider CTC an experimental procedure.⁴ This hesitance on the part of the private sector is understandable, as we found when we undertook a search of the literature.

■ Methods

We conducted a thorough and systematic search of PubMed for English-language articles from 1994 to 2006. Search terms included "CT colonography," "virtual colonoscopy," "CT colonoscopy," "colography," and "CT pneumocolon."¹⁷ The general focus was on original research articles, but meta-analyses and review articles were also considered. In addition, we conducted general Internet searches to discern the general public's view on this technology.

The research is mixed—specificity/sensitivity values vary

Research has shown that colorectal cancer arises in adenomatous polyps and that detection and removal reduces mortality for this cancer.^{18,19} Since 1994, when Vining et al first described the concept of CTC,⁶ numerous studies have compared

its polyp detection rate with the gold standard, colonoscopy. The most recent are 3 large, multicenter prospective trials comparing the sensitivity and specificity of CTC against colonoscopy for adenomatous polyp detection.¹⁻³ These 3 studies have not been consistent in their findings. One study showed very favorable results,¹ but the other 2 showed unfavorable results (TABLE).

In December 2003, Dr Perry Pickhardt and his colleagues published the first multicenter prospective study comparing CTC with colonoscopy on a large, asymptomatic population.¹ That study was performed in 3 medical centers and included 1233 subjects with a mean age of 57.8 years. All of the subjects underwent same-day CTC and colonoscopy. Each CTC was interpreted using both 2D and 3D imaging techniques. The results were very encouraging. CTC had a 93.8% sensitivity for adenomatous polyps at least 10 mm in diameter, 93.9% sensitivity for those at least 8 mm in diameter, and 88.7% sensitivity for those at least 6 mm in diameter. (For more on polyp size, see "Remove that polyp? With virtual colonoscopy, it's not automatic," page 191.) The specificity for those polyp size categories was 96.0%, 92.2%, and 79.6%, respectively. The study concluded that CTC compared well with colonoscopy in the detection of adenomatous polyps in asymptomatic adults.

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The first multicenter prospective trial found that virtual colonoscopy compared well with traditional colonoscopy in the detection of polyps

TABLE

Multicenter trials compared colonoscopy and virtual colonoscopy polyp detection rates

	PB COTTON ET AL ² (JAMA)	PJ PICKHARDT ET AL ¹ (NEJM)	DC ROCKEY ET AL ³ (LANCET)
Number of sites	9	3	14
Dates of study	April 2000–Oct 2001	May 2002–June 2003	Dec 2000–Feb 2004
Number of patients	615	1233	614
Patient age (mean)	61	57.8	57.4
Sensitivity & specificity of detecting lesions ≥ 6 mm	Sensitivity: 39.0% Specificity: 90.5%	Sensitivity: 88.7% Specificity: 79.6%	Sensitivity: 51.0% Specificity: 89.0%
Sensitivity & specificity of detecting lesions ≥ 10 mm	Sensitivity: 55.0% Specificity: 96.0%	Sensitivity: 93.8% Specificity: 96.0%	Sensitivity: 59.0% Specificity: 96.0%

In April 2004, Dr Peter Cotton and his colleagues published the second multicenter, prospective study comparing CTC and colonoscopy in terms of adenomatous polyp detection for a screening population.² The study took place at 9 medical centers and had 615 patients ages 50 and older who had both CTC and colonoscopy done on the same day. The researchers found that CTC had a sensitivity of 55% for those at least 10 mm in size and 39% for polyps at least 6 mm in size. They concluded that CTC technology was not ready for mainstream clinical use until a significant amount of enhancement took place in the use of this technology.

In January 2005, Dr Don Rockey and his colleagues published a multicenter study comparing CTC and colonoscopy at 14 sites.³ They had 614 patients with an average age of 57.4. They also found CTC to be significantly less sensitive for detecting polyps both >10 mm and >6 mm when compared with colonoscopy.

The discrepancy may be a matter of software and protocols

Dr Pickhardt and his colleagues attribute part of their success in CTC to the particular software they used, which can render 3D images better than almost any other program available.²⁰ A report issued by the American Gastroenterological Association says that Pickhardt et al's use of primary 3D interpretation differs from

most currently performed protocols.²¹ If Pickhardt et al's results can even partly be attributed to use of new software, then it seems prudent to change the protocols to whatever works best in light of the evolving technology. The protocols must remain flexible until appropriate results are achieved and repeatable.

In addition, there are many other variables that could account for these results including a younger screening population, mostly composed of military families, the use of stool and fluid tagging (advanced techniques that improve accuracy and decrease the need for a completely clean bowel), or the aggressive, double-bowel preparations given before the procedure.¹

Both Dr Pickhardt and Dr Joseph Ferrucci criticize the Cotton et al study because it primarily used 2D images and their trial ended in October 2001, whereas Pickhardt et al's started in May 2002.²² With so much dependent on software issues, the interval is significant. In addition, the study by Dr Cotton and his colleagues used older CT and insufflation technology and several of the centers involved in the studies only had to show familiarity with the procedure, but no demonstrated ability in reading CTC images.²² Thus, both technical and reader issues were significant. Similarly, in the study by Rockey et al, the issue of reader inexperience was present, as was the fact that neither stool nor fluid tagging was used.²²

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Dr Pickhardt and his colleagues attribute part of their success with the procedure to the software they used

Remove that polyp? With virtual colonoscopy, it's not automatic

When an adenomatous polyp of any size is found during a colonoscopy, the polyp is removed. Thus the diagnostic and therapeutic functions are married in colonoscopy. However, CTC only allows detection of these polyps, thus raising the question as to which size polyps should be reported and then removed by doing an additional colonoscopy. The issue of what size polyps have malignancy potential has been discussed extensively in the literature.³¹⁻³³

It's also a hotly debated topic in the literature for colorectal cancer screening, especially when any mention of CTC comes up. Every year, about 1% of polyps larger than 10 mm progress

to colorectal cancer and there is agreement that these should be removed.³⁴ However, there is considerable debate over the 6 to 9 mm category.³⁴⁻³⁶ Several trials have shown that the incidence of polyps between 6 to 9 mm progressing into colorectal cancer approaches, but is definitely less than 1%.³⁷ Even the American Gastroenterological Association acknowledges that the risk of developing colorectal cancer from a polyp 6 to 9 mm remains uncertain.²¹

Thus, while it's clear that polyps larger than 10 mm pose a significant enough risk to warrant removal, the data is equivocal—or absent—on what to do about polyps in the 6 to 9 mm category.

Another important variation between Pickhardt et al's study and those by Drs Cotton and Rockey and their colleagues is the use of oral contrasts for stool tagging.²³ A unique aspect of Pickhardt et al's study was the aggressive bowel preparation using 2 types of oral contrast (water soluble and barium) for stool tagging. This allowed the computer to electronically separate and subtract residual stool from soft tissue structures improving image quality dramatically.¹ This elaborate patient preparation has not been done by anyone else. Many contend that what Pickhardt et al achieved was a paradigm of the best CTC can be under ideal circumstances, technology, and expert interpretations and if not done in this manner, the results would get murky with diffuse application.²³ This again emphasizes the importance of recognizing the evolving technology and protocol for CTC.

■ Much-needed research is underway

Until results of the caliber that Pickhardt et al achieved are reproducible locally, many insurance companies will delay

coverage for screening CTC. For most areas, CTC would be about \$1000 out of pocket cost for the patient. It seems likely that most patients would *not* opt for CTC when insurance companies cover other screening procedures.

The American College of Radiology Imaging Network has conducted a very large-scale double-blind study of CTC effectiveness in a screening population involving 15 institutions and 2300 participants.⁵ The results of this trial, expected out this summer, will surely influence CTC's acceptance both by the medical community and by third party payers. Until then, family physicians will need to consider the use of CTC on a case-by-case basis. ■

Disclosure

The authors reported no financial conflicts of interest.

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The results of a very large-scale virtual colonoscopy study are due out this summer

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American Cancer Society guidelines

Colorectal cancer mortality can be significantly reduced through proper screening.^{18, 24–27} The American Cancer Society's guidelines for screening²⁸ indicate that beginning at age 50, both men and women with average risk factors should have one of the following:

- yearly fecal occult blood test
- flexible sigmoidoscopy every 5 years
- yearly fecal occult blood testing and flexible sigmoidoscopy every 5 years
- double-contrast barium enema every 5 years, or
- colonoscopy every 10 years.

A positive finding for any of the first 4 should prompt a colonoscopy.

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For patient information, go to the ACS Website at www.cancer.org/docroot/home/index.asp and search for “frequently asked questions about colon cancer”