WHICH SCREENING TEST FOR WHICH RISK?

Mass screening. Today, CTC is defined as “an emerging, promising screening tool.” But it is still not on the list of official diagnostic options for the epidemiological surveillance and early detection of colorectal cancer. Currently, the American College of Radiology recommends a DCBE every five years. It is probable that CTC will soon follow the same recommendation. In the “average risk” population, screening should be done in compliance with sigmoidoscopy, DCBE, or CTC, as CT colonography should be considered.

In the pre-risk population, in cases of personal or family history of CRC, OC is the recommended screening test, but CTC could be an option for patients unwilling or unable to undergo this test. In case of known polyps after 15 years of evolution, optical colonoscopy with biopsies every two years should be the only tests performed.

In very high risk cases, screening will include sigmoidoscopy, colonoscopy, and current endoscopic colonoscopies or prophylactic colectomy.

Individual screening. As it takes 10 years for an adenoma to become an adenocarcinoma, if a screening test is performed during this time, the adenoma can be resected and the cancer prevented.

Thus, personal and family history must be investigated, as screening should have begun five years before the onset of cancer in a first-degree relative.

Fifty-year-old patients at average risk should be informed of their risk and about the various possible screening tests. Indeed, any abdominal symptom could be the opportunity to run one of these tests, which will have to be repeated every seven to 10 years.

Optical colonoscopy is the gold standard, although it is an operator-dependent procedure that sometimes fails to explore the whole colon and seldom explores the whole surface of the colonic mucosa. In addition, this procedure requires hospitalization, and is expensive, and is not 100% safe. These are probably the reasons why healthy patients facing a 4% risk of CRC are often unwilling to undergo the test. For the remaining patients, CTC is indicated, being an outpatient and absolutely safe procedure, well tolerated, and less costly than OC.

Moreover, with the fast image reconstruction and transfer times now available, and thanks to the performance of dedicated software programs, immediate reading is possible. While the patient is still fasting it is possible to proceed directly to the resection of the possible adenomatous polyps without the need to repeat the bowel-clearing process.

CTC is also the procedure of choice in case of incomplete OC, with indication to anaesthesia, and bleeding factors. Similarly, old and frail patients, in whom anaesthesia should be avoided as much as possible, could benefit from CTC, particularly since the bowel preparation can be adapted to their condition.

Indeed, they often have a fragile, adherent and redundant colon, rendering OC impossible and frequently resulting in incomplete studies.

CONCLUSION

CTC is a safe, outpatient procedure that offers a full study of the colon and may be directly followed by optical colonscopy for polyt resection. Although it has not yet been included among the traditional methods of colorectal cancer screening, CTC has been shown to be equivalent to optical colonscopy and more accurate than DCBE in diagnosing lesions of significant size. Since the generalization of multislice CT and of highly efficient dedicated software, this procedure is no longer experimental and is part of the daily practice of many radiologists.

As CTC involves minimal discomfort and is well accepted, it will certainly prove useful in convincing patients to undergo CRC screening and, hopefully, will increase still the few-thousand cases of often avoidable cancer-related deaths.

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Open enrollment of this activity, participants should be able to:
• Describe the pathophysiology and epidemiology of colorectal cancer (CRC)
• Explain the preparation for CTC and how it is performed
• Compare the performances of CTC with optical colonoscopy and double-contrast barium enema
• Understand indications for the various CRC screening tests

Learning objectives

Dr. R. Materne is a radiologist specializing in GI tract and abdominal studies at the CHG. Drs. Ouhadi and Materne are radiologists specializing in GI tract and abdominal studies at the CHC. Dr. Hock is head of the abdominal imagers of the Centre Hospitalier CHC in Liège, Belgium.

By Dr. Danielle Hock, R. Ouhadi, M.D., and R. Materne, M.D.

C colonoscopic polyps. CTC is the second leading cause of cancer-related deaths worldwide. Its incidence is spiked in industrialized countries and is continuing to rise.

Computed tomography colonography (CTC) was first devised some 12 years ago but created “experimental” for several years. At about the same time, optical colonoscopy (OC) came to be preferred over double-contrast barium enema (DCBE). In 2001, Yee et al. proved CTC to be highly effective in diagnosing colorectal polyps. Publication of this study immediately gave rise to great enthusiasm and expectations in the radiological world. CTC became “true worth”ing” and a favored topic for publication. Before the end of 2003, Pickhardt et al. demonstrated for the first time better performance for CTC than for optical colonoscopy in diagnosing 8 mm and 10 mm adenomatous polyps. Moreover, in his series of 1231 patients, two polyps were malignant, one of them identified by optical colonoscopy.

This was a true revolution and probably the real beginning of widespread use of CTC, coinciding with the large diffusion of multidetector CT and dedicated software. Now workshops are organized specifically so that radiologists can gather sufficient theoretical and practical formation to start their own practice.

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PATHOPHYSIOLOGY OF CRC
Polyps are common findings in the colon, and they are found in 10% to 12.5% of the population and their incidence increases dra-
matically with age. They become frequent after 50. Seventy percent of the polyps smaller than 5 mm and 50% of those between 5 mm and 9 mm are hyperplastic (always benign). Some polyps of 10 mm and a few of them will act as precursors to colorectal cancer. It generally takes 10 years for an adenoma to become an adenocarcinoma.

Actually, 3% of all adenomas and 1% of adenomas smaller than 10 mm will become malignant. The probability that a given polyp is an adenoma, that when discovered it harbors a cancer, or that it will become a cancer, depends on the size of the target lesion or polyp.

WHAT ABOUT MPN?
Removing small and medium-sized polyps is an outdated technology (5 mm collimation). Even small polyps, but provide a poor assess-
ment of low-contrast structures so that extraluminal lesions and use 3D images for problematic. Also, imaging of obese patients might be unfeasible.

IV contrast does not allow fine analysis of the colonic mucosa. It is a rather true screening tool for common CRC.

CTC is an outpatient procedure that requires no sedation or analgesia and is easy to perform than optical colonoscopy, as it takes hardly more than 10 minutes. It is, in fact, the study of the colonic lumen to depict nodules and masses of varying sizes corresponding to polyps and pro-
ductive tumors.

How often carcinomas develop in normal mucosa is unknown (20%).

RISK AND SYMPTOMS
The risk of developing a CRC before age 75 for someone with no personal or fam-
ily history of the condition is 4%. Eighty per cent of all CRCs will occur in this “average risk” population.

Two acquisitions are taken (in prone and supine positions or, for frail patients, in supine and left lateral positions). This high dose is necessary in order to mobilize the residual fluid to the point that the patient will tolerate complete colonic circumference. This rotation of the pa-
tients’ position is mandatory to guaran-
tee the collection of all possible find-
als to the opposite wall, thus helping to differentiate it from spurious findings.

A major limitation of CTC that prevents it from being used in screening programs for patients at risk for carcinomas is its high radiation exposure. The mandatory double acqui-
sions higher radiation dose delivered by multislice CT compared to single-slice and narrow slice collimation are all factors in this high exposure.

In an attempt to reduce the dose, CT manufacturers offer devices for automatic tube-current modulation, which can reduce the dose by 25% to 35% with no statistical difference in image noise.

There is also a trend toward using ultralow-dose protocols, which do not interfere with the diagnosis of tumors and provide a good assess-
ment of low-contrast structures. The extraluminal lesions and use 3D images for problematic.

EXTRA-COLONIC FINDINGS
An important issue for CTC, except when using ultralow-dose protocols (10 mAs), is the possibility of detecting extra-colonic abnormalities. This is, of course, impossible for optical colonoscopy, but very common for CTC. The high number of results due to differences

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PATHOPHYSIOLOGY OF CRC
Polyps are common findings in the colon. They are found in 10% to 12.5% of the population over 40 years of age. The distribution is dramatically so with age. They become frequent after 50. Seventy percent of the polyps smaller than 5 mm and 50% of those between 5 mm and 9 mm are hyperplastic (always benign). Some polyps and a few of them will act as precursors to colorectal carcinoma. It generally takes 10 years for an adenoma to become an adenocarcinoma. Actually, 3% of all adenomas and 1% of adenomas smaller than 10 mm will become malignant. The probability that a given polyp is an adenoma, that when discovered harbors a cancer, or that it will become a cancer 10 years later, is proportional to its size. Adenomas 10 mm and larger pose a higher risk of becoming malignant.

The neoplastic process is different in longstanding inflammatory bowel diseases where there is a sequence of inflammation leading to dysplasia leading to carcinoma, making "blind" biopsy surveillance mandatory. How often carcinomas develop in normal mucosa is unknown (20%).

RISK AND SYMPTOMS
The risk of developing a CRC before age 75 for someone with no personal or family history of the condition is 4%. Eighty percent of all CRCs will occur in this "average risk" population. This risk rises to 10% for patients with a personal history of cancer or adenoma- ous colonic polyps and for their first-degree relatives (immediate family), as well as for patients with inflammatory colitis for many years. The second highest risk population represents 15% of all CRCs. The risk may exceed 50% for patients who may develop an autosomal dominant hereditary disease such as familial adenomatous polyposis (FAP) or hereditary nonpolyposis colon cancer (HNPCC). This high risk population represents 4% to 6% of all adenomas.

A CRC has a very insidious onset, presenting with change in bowel habit, weight loss, or bleeding.

HOW IS CTC PERFORMED?
The principle: CTC is not a new radiological study of the colon. It does not allow fine analysis of the colonic mucosa. It is rather a true screening tool for common CRC.

CTC is an outpatient procedure that requires no sedation or analgesia and is free to perform than optical colonoscopy, as it takes hardly more than 10 minutes. It is, in fact, the study of the colonic lumen to define nodules and masses of varying sizes corresponding to polyps and protruding tumors.

As with optical colonoscopy or DCBE, the colon has to be freed of its fecal content. For CRC, it is inhaled to make this possible. A CT scan is then performed and the thickness of axial slices will be represented by dedicated software to create an endoluminal reconstruction.

Colonic cleansing. The extent to which the colon has to be cleared of fecal residue depends on the size of the polyp or lesion the radiologist's reading habits. Means will depend on the patient's condition. It is of common sense that a good prep facilitates interpretation and helps the radiologist distinguish between the various types of filling defects. Cathartic cleansing with a clear liquid diet such as a sodium phosphate composition (Phospho-soda, Gastro-Gel, Dean's) or a magnesium citrate oral solution (Picolax, Ferring) at 4 p.m., and four bicarbonate tablets (Duocol, Boehringer Ingelheim) at 8 p.m. the day prior to the CTC is the most commonly used preparation protocol.

In frail patients or in cases where solid food ingestion is contraindicated, such as in congestive heart failure, renal insufficiency, or uncontrolled hypertension, this preparation may be replaced by two days of low-residue diet combined with bisacodyl or even a polyethylene glycol electrolyte solution (Golytely, Braintree Laboratories).

Residual fluid is unavoidable and problematic as its density is approximately the same as the colonic contents and it will thus obscure possible lesions on the dependent surface.

To measure residual fluid quantities, a "dry" colon prep (Phospho-soda) is preferred over the "wet" one (Golytely) currently used by 82.5% of radiologists. The main reason, a bisacodyl suppository is usually inserted one to two hours before the CTC as it will trigger an expelling bowel movement, thus helping to evacuate some of the remaining fluid.

To minimize its "masking" effect, the residual fluid is often rendered opaque through ingestion of 100 ml of Gastrografin the evening before a procedure. This solution will not only help visualization of possible polyps through the residual fluid in a 2D reading, but it also has a laxative effect.

Finally, residual feces may also be tagged by ingestion of 250 ml of diluted barium (2.1%) at 6 p.m. the day before the CTC. Since bowel cleansing is the most unpleasant and inconvenient aspect of colonoscopy, some patients choose to reduce or eliminate the need for cathartic drugs are under way. These preparations allow bowel preparation with fewer side effects to be more effective in the diagnosis of significant colonic distension. The colon may be dependently using either air, by manual squeeze-bulb insufflation, or with CO2, a totally automated device that can achieve a consistent and persistent insufflation.

CTC is not a new radiological study of the colon, it does not allow fine analysis of the colonic mucosa. It is rather a true screening tool for common CRC.

CTC is an outpatient procedure that requires no sedation or analgesia and is faster to perform than optical colonoscopy, which do not interfere with the patient's condition.

In an attempt to reduce the dose of CT, devices for automatic tube current modulation, which can reduce the dose by 37% to 35% with a statistical difference in image noise.

There is also a trend toward using ultralow-dose protocols, which do not interfere with the diagnosis of tumors and polyps. Indeed, two minutes after the ingestion of 100 ml of Gastrografin the evening before a procedure, residual fluid is often rendered opaque through ingestion of 100 ml of Gastrografin the evening before a procedure.

The principle: CTC is not a new radiological study of the colon, as it does not allow fine analysis of the colonic mucosa. It is rather a true screening tool for common CRC.

The patient will be asked to drink 2 litres of water to create an endoluminal reconstruction. The radiologist will then use CTC to look at the polyp.

ENDOLUMINAL VIEWS
Two acquisitions are taken (in prone and supine positions or, for frail patients, in supine and left lateral position). This high-dose imaging is used in order to mobilize the residual fluid from the colonic contents and to complete colonic visualization. This rotation of the patient's lengthy colon is made possible by automatic tube current modulation, which can reduce the dose by 37% to 35% with a statistical difference in image noise.

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WHICH SCREENING TEST FOR WHICH RISK?
Mass screening. Today, CTC is defined as “an emerging, promising screening tool.” But it is still not on the list of official diagnostic options for the major oncological and gastrointestinal societies. Currently, the American College of Radiology recommends a DCBE every five years. It is probable that CTC will soon follow the same recommendation. In the “average risk” population, screening should be based solely on a positive CTC, sigmoidoscopy, DCBE, or C. CTC could be considered.

In the high-risk population, in cases of personal or family history of CRC, CTC is the recommended screening test, but CTC could be an option for patients unwilling or unable to undergo this test. In case of inflammatory bowel disease after 15 years of evolution, optical colonoscopy with biopsies every two years should be the only tests performed. In very high risk cases, screening will include optical colonoscopy and frequent endoscopic colorectaloscopies or prophyactic colectomies. Individual screening. As it takes 10 years for an adenoma to become an adenocarcinoma, if a screening test is performed at the right time, the adenoma can be resected and the cancer prevented.

Thus, personal and family history must be investigated, as screening should have begun five years before the onset of cancer in a first-degree relative.

Fifty-year-old patients at average risk should be informed of their risk and about the various possible screening tests. Indeed, any abdominal symptoms could be the opportunity to run one of these tests, which will have to be repeated every seven to 10 years.

Optical colonoscopy is the gold standard, although it is an operator-dependent procedure that sometimes fails to explore the whole colon and seldom explores the whole surface of the colonic mucosa. In addition, this procedure requires hospitalization, and anesthesia, is expensive, and is not 100% safe. These are probably the reasons why healthy patients facing a 4% risk of CRC are often unwilling to undergo this test. For these reasons, CTC, if indicated, is an outpatient and absolutely safe procedure, well tolerated, and less costly than OC.

Moreover, with the fast image reconstruction and transfer times now available, and thanks to the performance of dedicated software programs, immediate reading is possible. While the patient is still fasting it is possible to proceed directly to the resection of possible adenomatous polyps without the need to repeat the bowel-cleansing process.

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CONCLUSION
CTC is a safe, outpatient procedure that offers a full study of the colon and may be directly followed by optical colonoscopy for polyt detection. Although it has not yet been included among the traditional methods of colorectal cancer screening, CTC has been shown to be equivalent to optical colonoscopy and more accurate than DCBE in diagnosing lesions of significant size. Since the generalization of multidetector CT and of highly efficient ded-
icated software, this procedure is no longer experimental and is part of the daily practice of many radiologists. As CTC involves minimal discomfort and is well accepted, it will certainly prove useful in convincing patients to undergo CRC screening and, hopefully, will increase still further the threat of often avoidable cancer-related deaths.

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LEARNING OBJECTIVES
Upon completion of this activity, participants should be able to:
• Describe the pathophysiology and epidemiology of colorectal cancer (CRC)
• Explain the preparation for CTC and how it is performed
• Compare the performances of CTC with optical colonoscopy and double-contrast barium enema (OC)
• Understand indications for the various CRC screening tests

By Dr. Danielle Hock, R. Ouhadi, M.D., and R. Matener, M.D.

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ologists specializing in GI tract and abdominal studies at the CHC. Drs. Hock, Ouhadi, and Materne have no significant financial arrangement or affiliation with any manufacturer of any pharmaceutical or medical device and are not affiliated in any manner with any provider of commercial medical or healthcare professional services.

Advances in CT Colonography

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