ELSEVIER

Seminars in
ULTRASOUND
CT and MRI

Current Issues in Computed Tomography Colonography

Lorna Woodbridge, FRCR, and Peter Wylie, MA, MRCS, FRCR

Computed tomography colonography has evolved over the past 2 decades to become the primary alternative to optical colonoscopy for detection of colonic neoplasia. With good technique in performance and reporting, accuracy is comparable to optical colonoscopy for cancers and larger polyps. This article discusses the current components of a high-quality examination including contemporary methods of bowel preparation and distension. Also described is the main trial data that have validated the examination. Finally, the use of the technique for nonneoplastic colonic pathology is discussed, and future directions are described including magnetic resonance colonography and wireless capsule colonic imaging.
Semin Ultrasound CT MRI 37:331-338 © 2016 Published by Elsevier Inc.

Introduction

Although first described in the early 1990s,[1] Computed tomography colonography (CTC) rose to worldwide prominence in 2003 with the seminal article of Pickhardt in the New England Journal of Medicine.[2] This suggested a test as accurate as optical colonoscopy (OC), with potential as a colorectal cancer–screening tool, and offering a safer, cheaper, and noninvasive whole colonic imaging alternative. CTC arrived as an imaging tool in the era of evidence-based medicine and has been extensively investigated by both gastroenterologists and radiologists alike. Further trials revealed variable performance results,[3,4] but technique, equipment, and radiologist's interpretation have been refined and standardised over the intervening years, and the latest trials reveal again the high accuracy of CTC for detection of colonic polyps and neoplasia.[5-7]

This article firstly focuses on the underlying components necessary for high-quality CTC. Later, we discuss the accuracy of the test, the nature of the target lesion, extension to other colonic diseases, and future directions in colonic imaging.

Technique

Performing modern high-quality CTC involves a combination of bowel preparation, fecal tagging, air insufflation, and scanning the entire large bowel in 2 patient positions. Although there are no standardized protocols, several local and international collaborations have produced guidelines to advise on the optimum strategies to obtain the best quality diagnostic images (International Collaboration for CTC,[8] European Society Of Gastrointestinal And Abdominal Radiology,[9] and American College of Radiology[10]) and these are outlined in the following paragraphs.

Bowel Preparation

Bowel preparation typically involves both a low-residue diet for up to 3 days before the examination and laxative use to minimize the amount of fecal residue remaining in the colon. The presence of fecal material in the large bowel may not only mask small colonic lesions, but can mimic polyps and tumors and prevent the possibility of same-day OC should this be necessary.

The aim of a low-residue diet helps to homogenize the contents of the bowel and aid the fecal tagging process, making it easier to distinguish between a true mucosal lesion and fecal residue. The duration of the low-residue diet varies among institutions and can be from 3 days to 24 hours before the procedure.

The laxatives used can be either "dry" laxatives, for example, magnesium citrate or sodium phosphate, or "wet" laxatives such as polyethylene glycol.[11] Traditionally, the "dry" preparations are preferred for CTC, as the "wet" laxatives leave significant watery residue in the bowel that may obscure pathology. Ultimately, the preparation used is often dependent on the local protocol and individual patient factors—these may

Department of Radiology, Royal Free Hospital, London, UK.
Address reprint requests to Peter Wylie, MA, MRCS, FRCR, Department of Radiology, Royal Free Hospital, Pond St, London NW3 2QG, UK. E-mail: peterwylie@nhs.net

http://dx.doi.org/10.1053/j.sult.2016.02.005
0887-2171/© 2016 Published by Elsevier Inc.

even include such practical considerations as the ability to send purgative and tagging preparations through the postal service. National guidelines in the use of such agents may exist, such as cautions in the use of such materials in patients with impaired renal function or physiological reserve in the United Kingdom.[12]

Fecal tagging involves adding iodine or barium-based solutions to the bowel preparation regimen allowing ready differentiation of residual fecal material from mucosal soft tissue.[13] The 2 most successful multicenter trials of CTC[2,5] to date used fecal tagging. A recent European consensus statement[9] by multinational members of the CTC working group concluded unanimously that fecal tagging was now mandatory for routine practice.

Many centers now use a "minimal prep" or "low prep" regimen where no additional laxatives are used in addition to the low-residue diet and fecal tagging solution (Fig. 1). These tagged solutions themselves can exert a significant cathartic effect because of their hyperosmolar nature. A recent UK study[14] showed no statistically significant difference between using laxatives and Gastrografin (Bracco Diagnostics Inc, Princeton NJ) in terms of nondiagnostic examinations. The solution was well tolerated with less diarrhea in the tagged-only regimen. The rate of false-positive lesions (>10 mm) was twice as large in the nontagged group although this was not statistically significant in this study ($n = 528$).

The proposed advantages of "laxative-free regimens" include greater patient acceptability, particularly for elderly patients, and reducing the side effect profile of traditional full purgative colonic cleansing. The potential disadvantage of not using laxatives is suboptimal bowel cleansing if same-day OC is required, although this has not been assessed as yet in any large-scale trial to the authors' knowledge.

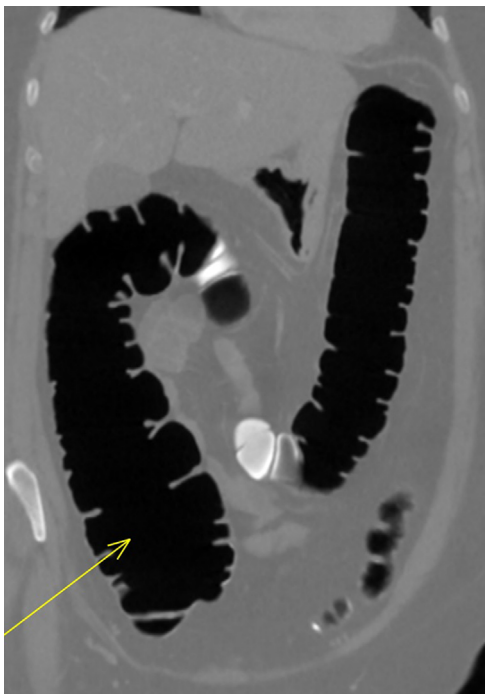

Figure 1 Coronal reformat from a CTC examination using automated carbon dioxide insufflation, intravenous contrast, and fecal tagging using Gastrografin. No bowel purgative agent is used. Note the excellent colonic distension achieved (eg, the cecum identified by yellow arrow) and the lack of any nontagged facal residue. Such low-residual volumes of retained fluid are typical of this minimal preparation regimen. (Color version of figure is available online.)

Distension

Good distension of all colonic segments is essential for accurate CTC. Insufflation with carbon dioxide using automated devices can improve the degree of colonic distension when compared to room air.[15,16] Carbon dioxide is readily absorbed across the colonic mucosa and expired via the lungs leading to quicker desufflation of the colonic distension after imaging. This has been shown to reduce patient discomfort[16] compared to room air, reflecting previous trials using carbon dioxide in colonoscopy and barium enema.[17,18] Most current guidelines recommend routine use of carbon dioxide insufflation by automated devices.[8,9]

Mandatory use of intravenous spasmolytics is not recommended in the United States.[10] Anti-spasmodic use (eg. Hyoscine Butylbromide) mainly occurs outside the United States, and has been shown to improve both bowel distension[19,20] and in 1 study to reduce patient discomfort.[21] Polyp detection rates, however, were not improved with hysocine butylbromide (Buscopan) use in a 2003 study by Bruzzi et al.[22]

The patient must be scanned twice both supine and prone to optimize bowel distension and redistribute fluid and fecal contents to dependent areas of bowel to improve sensitivity. If the patient cannot lie prone, then a decubitus position can be an acceptable alternative. No current recommendations suggest performing CTC only in 1 position, even with the advent of fecal tagging. Dual positioning also has the benefit of improving colonic distension, for example, the rectum is often better distended in the prone position.[23]

Intravenous contrast has not been shown conclusively to increase detection rates of polyps or colonic neoplasms,[24] and is not recommended in UK Bowel Cancer Screening program.[25] However, it still has a role in symptomatic patients or in patients where extracolonic review is important as it allows the detection of important extracolonic findings and allows staging in patients where a colorectal malignancy is found. The use of intravenous contrast, as ever needs to be balanced between the benefit to the patient and the negative effects it can entail, such as a possible contrast reaction, induction of contrast nephropathy, increased radiation dose, and additional cost.

Interpretation

Polyps (Fig. 2) are appreciated as soft tissue densities contrasted against either very low-density gas or high-density fecal tagging solution making them readily identifiable. Polyps generally have a homogenous, soft tissue density with round or lobulated contours when compared with feces that are heterogeneous, may contain gas and can have angulated borders. Unlike feces, polyps should not significantly change position on the prone study whereas feces would move to the