



Current status on performance of CT colonography and clinical indications

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ABSTRACT

CT colonography (CTC) is a robust and reliable imaging test of the colon. Accuracy for the detection of colorectal cancer (CRC) is as high as conventional colonoscopy (CC). Identification of polyp is size dependent, with large lesions (≥ 10 mm) accurately detected and small lesions (6–9 mm) identified with moderate to good sensitivity. Recent studies show good sensitivity for the identification of nonpolypoid (flat) lesions as well.

Current CTC indications include the evaluation of patients who had undergone a previous incomplete CC or those who are unfit for CC (elderly and frail individuals, patients with underlying severe clinical conditions, or with contraindication to sedation). CTC can also be efficiently used in the assessment of diverticular disease (excluding patients with acute diverticulitis, where the exam should be postponed), before laparoscopic surgery for CRC (to have an accurate localization of the lesion), in the evaluation of colonic involvement in the case of deep pelvic endometriosis (replacing barium enema). CTC is also a safe procedure in patients with colostomy. For CRC screening, CTC should be considered an opportunistic screening test (not available for population, or mass screening) to be offered to asymptomatic average-risk individuals, of both genders, starting at age 50. The use in individuals with positive family history should be discussed with the patient first. Absolute contraindication is to propose CTC for surveillance of genetic syndromes and chronic inflammatory bowel diseases (in particular, ulcerative colitis).

The use of CTC in the follow-up after surgery for CRC is achieving interesting evidences despite the fact that literature data are still relatively weak in terms of numerosity of the studied populations. In patients who underwent previous polypectomy CTC cannot be recommended as first test because debate is still open.

It is desirable that in the future CTC would be the first-line and only diagnostic test for colonic diseases, leaving to CC only a therapeutic role.

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1. Introduction

Seventeen years have passed since the presentation of the first images of CT colonography (CTC) [1] and the debate about diagnostic accuracy is still “hot”, despite the enormous progress in image quality, exam reliability, robustness and, at the end, overall accuracy. This can be explained, at least partly, by the conflicting results published in literatures [2–7], as also confirmed by a meta-analysis stating that “CTC is highly specific for the detection of colorectal polyps and tumors”, but “the results of the studies were highly heterogeneous, while the studied variables explained only part of this discrepancy” [8].

Despite the debate about CTC accuracy, already in 2006 the AGA Clinical Practice and Economics Committee made a

step forward and accepted CTC as the method of choice for colon investigation in cases of incomplete colonoscopy (CC) [9], thus suggesting *de facto* the replacement of barium enema (BE).

And in 2008, the American Cancer Society (ACS), the US Multi-Society Task Force on Colorectal Cancer and the American College of Radiology released consensus guidelines on colorectal cancer (CRC) screening [10], including, for the first time, CTC among the screening tests to be offered to asymptomatic average-risk individuals. This represents a further legitimization of CTC, unfortunately not univocal, as demonstrated by the different positions of other scientific societies [11–13]. Nevertheless, CTC is gaining more and more consensus among clinicians and patients, as testified by the increasing number of examinations per year worldwide.

In the present paper, we will review the data about CTC accuracy for CRC and polyps and we will discuss the current accepted indications and provide arguments for pending issues.

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Table 1

Meta-analyses targeted on mixed population of patients: (a) per-patient sensitivity; (b) per-patient specificity.

Per-patient sensitivity					
	Nr of pts	<6 mm	6–9 mm	>9 mm	Overall
Sosna et al., 2003 [21]	1324	65%	84%	88%	–
Mulhall et al., 2005 [22]	6393	48%	70%	85%	70%
Halligan et al., 2005 [14]	2610	–	86%	93%	–
Rosman et al., 2007 [23]	30 studies	56%	63%	82%	–
Chaparro et al., 2009 [8]	10,546	–	60%	83%	69%
Per-patient specificity					
	Nr of pts	<5 mm	6–9 mm	>9 mm	Overall
Sosna et al., 2003 [21]	1324	–	–	95%	–
Mulhall et al., 2005 [22]	6393	92%	93%	97%	–
Halligan et al., 2005 [14]	2610	–	86%	97%	–
Rosman et al., 2007 [23]	30 studies	–	–	–	–
Chaparro et al., 2009 [8]	10,546	–	–	–	83%

2. CTC performance

2.1. Accuracy for cancer

The most important goal for an imaging test of the colon is the detection of cancer. And literature data strongly favor CTC. A first attempt to pool the data from multiple studies was performed in a publication in 2005 [14]. Despite the fact that a meta-analysis of the data was impossible because of the limited number of CRCs per study, the authors were able to demonstrate a high sensitivity of CTC, with a mean value of 95.9%.

Very recently, a systematic review and meta-analysis showed an average CRC sensitivity for CTC and CC of 96% and 95%, respectively [15]. And the authors concluded, “*not only does the average sensitivity of CTC for CRC appear similar to CC, but sensitivity is maintained despite wide variation in technique, which is important with regard to generalizability and widespread implementation of CTC*”. Moreover, “*given the relatively low prevalence of CRC, even among symptomatic cohorts, primary CTC may be more suitable than CC for initial investigation of suspected CRC*”.

In the same paper possible causes for missed cancers at CTC were analyzed with the results that there are substantial differences compared with CC. Whereas the largest number of lesions missed at CC are located in the right colon [16], at CTC they are mostly in the sigmoid region. This is a further confirmation to the fact that the sigmoid colon is the most difficult segment to be explored at CTC because of concomitant diverticular disease, poor distention and possible spasm. Another important finding was that more than 90% of CRC were missed in patients not prepared with fecal/fluid tagging. And reader experience emerges as a possible important reason for CTC failure.

Those data are confirmed by another study where over 3800 patients who underwent CTC during a time period of four years were followed-up using National Cancer Registry database [17]. Seven cancers were missed (five because of technical limitations and two because of perceptive errors; systems errors and severe patient co-morbidity contributed to three of the cases) with an overall missed rate for CTC of around 5.3%. These data are very similar to those collected with the same study design in previous papers on BE (missed rate for CRC, 6.7%) [18] and CC (miss rate for CRC, 5.9%) [19].

Conclusive results on CTC accuracy for CRC cancer are expected from a large UK randomized trial, the Special Interest Group in Gastrointestinal and Abdominal Radiology (SIGGAR) study, whose data are still under peer-reviewing [20]. The aim of the SIGGAR study was to compare the detection rate of CTC versus BE and CTC versus CC for CRC and colonic polyps measuring 1 cm or larger.

SIGGAR targeted individuals aged 55 or older with symptoms or signs considered suggestive of CRC by the referring physician.

2.2. Accuracy for polyps

Several studies have demonstrated the accuracy of CTC in the identification and characterization of colonic polyps [2–5]. Heterogeneity of patient populations as well as differences in technical approaches and readers experience have generated a wide variability of clinical results, especially with regards to sub-centimeter lesions [6,7].

Five different meta-analyses [8,14,21–23], targeted on mixed populations (Table 1), and one study [24] (Table 2), including only average-risk individuals, came to similar conclusions: (1) CTC sensitivity for clinically significant polyps (larger than 10 mm) is high (>85%); it is intermediate for small (6–9 mm) polyps and it is definitely low for diminutive lesions (<6 mm); (2) specificity and negative predictive value, even for small polyps, are good, especially if fecal/fluid tagging techniques are used; (3) variability of the results among different series is mostly due to perceptual errors and consequently due to readers' inexperience. This has been clearly demonstrated by a study [25] where the authors used an initial unblinded review of CTC data to generate reconciliation reports for all false-negative polyp candidates 6 mm or larger. Data from the prospective reading were quite poor, with per-patient sensitivity of 70% for 10 mm lesions. After retrospective analysis, it was demonstrated that the major contributor to error at CTC was observer perceptual error; and after the exclusion of any potentially correctable observer error per-patient sensitivity increased to 91%.

The latter conclusion was also confirmed by a recent publication [26], a multicenter nationwide study designed to assess the accuracy of CTC in detecting polyps or cancers larger than 6 mm after a preliminary training and qualifying program for radiologists. The most relevant finding of the study was that radiologist's polyp detection rate with the training set was the only significant factor in predicting accuracy at CTC for detecting polyps.

Despite the good results there are still some open issues under debate within radiological as well as gastroenterological

Table 2

Meta-analysis targeted on asymptomatic screening population (Ref. [24]).

Per patient analysis	Sensitivity (%)	Specificity (%)
Polyps > 6 mm	75.9	94.6
Adenomas > 6 mm	82.9	91.4
Polyps > 10 mm	83.3	98.7
Adenomas > 10 mm	87.9	97.6

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