Imaging alternatives to colonoscopy: CT colonography and colon capsule. European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastrointestinal and Abdominal Radiology (ESGAR) Guideline - Update 2020

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GUIDELINE

Imaging alternatives to colonoscopy: CT colonography and colon capsule. European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastrointestinal and Abdominal Radiology (ESGAR) Guideline – Update 2020

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Main recommendations

1. ESGE/ESGAR recommend computed tomographic colonography (CTC) as the radiological examination of choice for the diagnosis of colorectal neoplasia. Strong recommendation, high quality evidence. ESGE/ESGAR do not recommend barium enema in this setting. Strong recommendation, high quality evidence.
2. ESGE/ESGAR recommend CTC, preferably the same or next day, if colonoscopy is incomplete. The timing depends on an interdisciplinary decision including endoscopic and radiological factors. Strong recommendation, low quality evidence. ESGE/ESGAR suggests that, in centers with expertise in and availability of colon capsule endoscopy (CCE), CCE preferably the same or the next day may be considered if colonoscopy is incomplete. Weak recommendation, low quality evidence.
3. When colonoscopy is contraindicated or not possible, ESGE/ESGAR recommend CTC as an acceptable and equally sensitive alternative for patients with alarm symptoms. Strong recommendation, high quality evidence. Because of lack of direct evidence, ESGE/ESGAR do not recommend CCE in this situation. Very low quality evidence. ESGE/ESGAR recommend CTC as an acceptable alternative to colonoscopy for patients with non-alarm symptoms. Strong recommendation, high quality evidence. In centers with availability, ESGE/ESGAR suggests that CCE may be considered in patients with non-alarm symptoms. Weak recommendation, low quality evidence.
4. Where there is no organized fecal immunochemical test (FIT)-based population colorectal screening program, ESGE/ESGAR recommend CTC as an option for colorectal cancer screening, providing the screenee is adequately informed about test characteristics, benefits, and risks, and depending on local service- and patient-related factors. Strong recommendation, high quality evidence. ESGE/ESGAR do not suggest CCE as a first-line screening test for colorectal cancer. Weak recommendation, low quality evidence.
5. ESGE/ESGAR recommend CTC in the case of a positive fecal occult blood test (FOBT) or FIT with incomplete or unfeasible colonoscopy, within organized population screening programs. Strong recommendation, moderate quality evidence. ESGE/ESGAR also suggest the use of CCE in this setting based on availability. Weak recommendation, moderate quality evidence.

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6. ESGE/ESGAR suggest CTC with intravenous contrast medium injection for surveillance after curative-intent resection of colorectal cancer only in patients in whom colonoscopy is contraindicated or unfeasible. Weak recommendation, low quality evidence. There is insufficient evidence to recommend CCE in this setting. Very low quality evidence.
7. ESGE/ESGAR suggest CTC in patients with high risk polyps undergoing surveillance after polypectomy only when colonoscopy is unfeasible. Weak recommendation, low quality evidence. There is insufficient evidence to recommend CCE in post-polypectomy surveillance. Very low quality evidence.
8. ESGE/ESGAR recommend against CTC in patients with acute colonic inflammation and in those who have recently undergone colorectal surgery, pending a multidisciplinary evaluation. Strong recommendation, low quality evidence.
9. ESGE/ESGAR recommend referral for endoscopic polypectomy in patients with at least one polyp ≥6 mm detected at CTC or CCE. Follow-up CTC may be clinically considered for 6–9-mm CTC-detected lesions if patients do not undergo polypectomy because of patient choice, comorbidity, and/or low risk profile for advanced neoplasia. Strong recommendation, moderate quality evidence.

Source and scope

This is an update of the 2014–15 Guideline of the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastrointestinal and Abdominal Radiology (ESGAR). It addresses the clinical indications for the use of imaging alternatives to standard colonoscopy. A targeted literature search was performed to evaluate the evidence supporting the use of computed tomographic colonography (CTC) or colon capsule endoscopy (CCE). The Grading of Recommendations Assessment, Development and Evaluation (GRADE) system was adopted to define the strength of recommendations and the quality of evidence.

Abbreviations

ANDR	advanced neoplasia detection rate
CCE	colon capsule endoscopy (CCE-1, first generation; CCE-2, second generation)
CT	computed tomography
CTC	computed tomographic colonography
DCBE	double-contrast barium enema
ECCO	European Cancer Organization
ECF	extracolonic finding
ESGAR	European Society of Gastrointestinal and Abdominal Radiology
ESGE	European Society of Gastrointestinal Endoscopy
FIT	fecal immunochemical test
FOBT	fecal occult blood test
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IBD	inflammatory bowel disease
NPV	negative predictive value
OR	odds ratio
PEG	polyethylene glycol
PICO	population, intervention, comparison/control, outcome
PPV	positive predictive value
RCT	randomized controlled trial
SIGGAR	Special Interest Group in Gastrointestinal and Abdominal Radiology

Introduction

Colorectal cancer represents a major cause of cancer-related morbidity and mortality in European countries [1]. Colonoscopy has a pivotal role in early diagnosis and colorectal cancer prevention because of its high accuracy for detection of precancerous lesions as well as the possibility to remove them [2–6]. Despite incremental technical improvement, colonoscopy is still incomplete in a proportion of patients due to patient and/or endoscopist-related factors. Furthermore, patients may be reluctant to undergo a procedure, namely colonoscopy, that is still perceived as painful, despite the availability of sedation or anesthesia [7].

Computed tomographic colonography (CTC) and colon capsule endoscopy (CCE) have been proposed as alternative imaging modalities to explore the colonic mucosa. CTC is a noninvasive imaging method that uses computed tomography for data acquisition combined with specialized imaging software to examine the colon [8, 9]. CCE, introduced several years later [10], is a painless and radiation-free alternative for the study of the entire colon, in which an ingestible, wireless, disposable capsule is used to explore the colon without sedation or gas insufflation.

In this document, the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastrointestinal and Abdominal Radiology (ESGAR) have updated the previously published guidelines on CTC [11] and CCE [12] and incorporated new evidence.

Methods

ESGE and ESGAR commissioned the update of this guideline and appointed two guideline leaders (C.S., D.R.), who invited the listed authors to participate in the project development. The key questions were prepared by the

coordinating team using PICO methodology (population, intervention, comparison/control, outcome) [13] and were then approved by the other members. The coordinating team formed task force subgroups, based on the statements of the previous guideline, each with its own leader, and divided the key topics among these task forces (Appendix 1s, see online-only Supplementary Material) with a specific focus on the update of literature and revision of the statements. The work included telephone conferences, a face-to-face meeting and online discussions.

The task forces conducted a literature search using Medline (via Pubmed) and the Cochrane Central Register of Controlled Trials up to November 2019. New evidence on each key question was summarized in tables using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system [14]. Grading depends on the balance between the benefits and risk or burden of any health intervention [15] (Appendix 2s). Further details on ESGE guideline development have been reported elsewhere [16].

This Guideline applies only to patients undergoing screening or with suspicion of colorectal neoplasia, whilst the role of these techniques in inflammatory bowel disease (IBD) is outside the purpose of this guideline. Technical issues for each technique are considered in Appendix 3s.

The results of the search and guideline statements were presented to all members of the project group during a face-to-face meeting in Vienna, Austria on November 4th, 2019, and were voted on. Consensus was defined as an agreement of at least 80% (Appendix 4s). If consensus was not reached during the first voting session, agreement was sought after further discussion and the modified statement was voted on again, until consensus was reached. After this meeting, drafts were made by the chairs of each task force and distributed between the task force members for revision.

In February 2020, a draft prepared by C.S. and D.R. and the chairs of all the task forces was sent to all group members. After agreement of all members, the manuscript was reviewed by two external reviewers and was sent for further comments to the ESGE and ESGAR national societies and individual members. After this, the manuscript was submitted to the journals *European Radiology* and *Endoscopy* for publication. The final revised manuscript was agreed upon by all the authors. This Guideline was issued in 2020 and will be considered for update in 2025. Any interim updates will be noted on the ESGE website: http://www.esge.com/esge-guidelines.html.

The Appraisal of Guidelines, Research and Evaluation (AGREE) checklist is provided in Appendix 5s.

1. Radiological imaging for the diagnosis of colorectal neoplasia

Recommendation

ESGE/ESGAR recommend CTC as the radiological examination of choice for the diagnosis of colorectal neoplasia.

Strong recommendation, high quality evidence.

ESGE/ESGAR do not recommend barium enema in this setting.

Strong recommendation, high quality evidence.

CTC has been considered the best radiological examination for the diagnosis of colorectal neoplasia. The accuracy for both colorectal cancer and large/advanced polyps has shown to be similar to that of optical colonoscopy in symptomatic and asymptomatic patients and clearly superior to that of barium enema [11].

The literature review provides further evidence to support this statement. Two new European randomized trials [17, 18] and an evaluation of follow-up [19] have shown detection rates for advanced neoplasia being similar to those of optical colonoscopy in asymptomatic individuals invited for screening. A systematic review has shown the rate of interval cancers after a negative CTC (4.5%) compares favorably with that following optical colonoscopy (3%–9%) [20]. In a Japanese multicenter trial, including 1177 patients, sensitivities and specificities of over 90% were achieved for detection of colorectal neoplasia >9 mm by CTC [21].

CTC is superior to double-contrast barium enema (DCBE) for detection of colorectal cancer and large polyps [22]. A review of the recent literature shows no new studies that specifically evaluated the performance of DCBE for the detection of colorectal neoplasia, nor does it provide new evidence supporting the primary use of DCBE for this indication. The continuing decrease in the use of DCBE [21] may further negatively affect its performance quality. Barium studies have also been mainly replaced by either endoscopic or cross-sectional imaging techniques for the evaluation of non-neoplastic conditions such as inflammatory bowel disease (IBD) [23].

Water-soluble contrast enemas are, however, still used in clinical practice for a relatively narrow spectrum of indications. These indications include mainly imaging of post-surgical sites and detection of anastomotic leaking. They vary, depending on local experience and clinical practice. Some of these indications, however, are debated.

2. Completion of a previously incomplete colonoscopy

Recommendation

ESGE/ESGAR recommend CTC, preferably the same or next day, if colonoscopy is incomplete. The timing depends on an interdisciplinary decision including endoscopic and radiological factors.

Strong recommendation, low quality evidence.

ESGE/ESGAR suggests that, in centers with expertise in and availability of CCE, CCE preferably the same or the next day may be considered if colonoscopy is incomplete.
Weak recommendation, low quality evidence.

Incomplete colonoscopy for neoplastic lesions – CTC

Almost all cases of incomplete optical colonoscopy due to occlusive cancer can be examined successfully with CTC [24, 25] and one study showed that preoperative CTC, after an incomplete optical colonoscopy, contributed to a change in the surgical plan in 14 of 65 patients (21.5%). Up to 35.1% (range 22.3%–45.4%) of synchronous neoplasms occur in one or more different segments from the distal tumor so their detection will change management in a significant number of patients [26].

Incomplete colonoscopy for non-neoplastic lesions – CTC

Abdominal symptoms may be due to non-neoplastic colonic conditions, for which both CTC and colonoscopy may be useful. Diverticulosis is more commonly demonstrated at CTC than colonoscopy [27], although the relationship between diverticulosis and symptoms is less clear. Colonoscopy is more sensitive for the detection of colitis and anal pathology [27]; furthermore it offers the possibility of tissue sampling.

In non-obstructing lesions, colonoscopy should be the preferred modality [28]. Colonoscopy allows biopsies and removal of most benign lesions during the same procedure. If active colitis is identified at incomplete colonoscopy, it is reasonable to repeat colonoscopy to facilitate serial colonic biopsies. Moreover, areas of colitis-related dysplasia will be missed at CTC. If there is an obstructing lesion, it is reasonable to refer for CTC.

In the setting of incomplete colonoscopy because of factors such pelvic postoperative adhesions, strictures due to diverticular disease/inflammatory processes, and/or refractory looping, colonoscopy is less likely to be successful. If pain/spasm is the main reason for incomplete colonoscopy, then either repeating the procedure with more sedation or CTC are both reasonable options.

Timing of CTC after incomplete colonoscopy

The timing of CTC after incomplete colonoscopy depends on an interdisciplinary decision including endoscopic and radiological factors. O'Shea et al. [29] recently assessed 245 same-day, post-incomplete colonoscopy CTC studies, with routine bowel preparation and 30 ml diatrizoate tagging agent. The mean time from ingestion of tagging agent to CTC was 4 h 26 min. Contrast reached the left hemicolon in 84% of patients; and 99% of studies were considered diagnostically adequate. The effectiveness of reduced 2-h iodinated contrast preparation was evaluated by Chang et al. [30] who found that a reduced 2-h iodinated preparation failed to reach the left hemicolon in 26% of patients. Although Theis et al. [31] suggest that separate CTC is superior for this reason, the vast majority of patients can have a diagnostic study when same-day CTC is performed with a minor increase in the time interval between optical colonoscopy and CTC. In situations where the left hemicolon has been well visualized by optical colonoscopy, the same consideration could be given to reduced preparation time; a thought echoed by other authors [32].

Clinically suspected perforation, possibly moderate/severe diverticulitis, or moderate/ severe colitis are contraindications to same-day CTC [29, 33]. Same-day CTC may be ill-advised after hot snare (snare cautery) or endoscopic mucosal resection (EMR). Lara et al. [34] looked at 198 patients who had same-day CTC (3% of 6260 colonoscopies). They found that 72 polypectomies had been performed in 34 patients (17%). There were no reported complications or perforations associated with same-day CTCs, suggesting that CTC is safe when performed on the same day as the procedure.

Incomplete colonoscopy – CCE (see also appendix 6s)

In the case of non-neoplastic obstruction, CCE can be considered as an alternative to CTC to explore proximal colonic segments. Seven studies using second-generation CCE (CCE-2) have been reported in the literature. Overall, visualization of colonic segments not reached by previous colonoscopy was obtained in 75%–100% of cases with CCE-2 [35–41] and 85%–93% with first-generation CCE (CCE-1) [42–44], with significant findings in 24%–100% in CCE-2 studies, and 34%–59% in CCE-1 studies.

Spada et al. [39] in a prospective, single-blinded, head-to-head study compared CTC with CCE in patients with incomplete colonoscopy. In this study, CCE identified ≥6-mm polyps in 24.5% of patients (95%CI 16.6%–34.4%) and CTC in 12.2% (95%CI 6.8%–20.8%), with a relative sensitivity of 2.0 (95%CI 1.34–2.98), which indicated a significant increase in sensitivity for lesions ≥6 mm when using CCE. Stratifying the analysis for larger polyps, CCE detected ≥10-mm polyps in 5.1% of patients (95%CI 1.9%–12.1%) and CTC in 3.1% (95%CI 0.8%–9.3%), with a relative sensitivity of 1.67 (95%CI 0.69–4.00). Both procedures, namely CTC and CCE, showed similar high positive predictive values (PPVs).

Timing of CCE after incomplete colonoscopy

The optimal timing of CCE after incomplete colonoscopy is still unclear. Two studies analyzed the possibility of

performing CCE on the same day after an incomplete colonoscopy. Hussey et al. [36] used sodium phosphate booster plus 1 L of gastrografin to perform CCE-2 on the same day after the incomplete colonoscopy, with an overall completion rate of 76%, a full colonic visualization in 84%, and a mean colon passage time of 233 min. Image quality was considered suboptimal in 9% of patients.

In the other study, Triantafyllou et al. [42] used 1 L polyethylene glycol (PEG) plus 2 tablets of domperidone as bowel preparation and sodium phosphate as booster to perform CCE-1 the same day after the incomplete colonoscopy. The overall completion rate was 90.7%, while a complete colonic visualization was obtained in 76% of patients. Quality of preparation was considered adequate in 60.3% and 63.4% in the right and left colonic segments, respectively.

3. Patients with symptoms suggestive of colorectal cancer

Recommendation

When colonoscopy is contraindicated or not possible, ESGE/ESGAR recommend CTC as an acceptable and equally sensitive alternative for patients with alarm symptoms suggestive of colorectal cancer.

Strong recommendation, high quality evidence.

Due to lack of direct evidence, ESGE/ESGAR do not recommend CCE in this situation.

Very low quality evidence.

ESGE/ESGAR recommend CTC as an acceptable alternative to colonoscopy for patients with non-alarm symptoms.

Strong recommendation, high quality evidence.

In centers with availability, ESGE/ESGAR suggests that CCE may be considered in patients with non-alarm symptoms.

Weak recommendation, low quality evidence.

Patients with abdominal symptoms suggestive of colorectal cancer require detailed investigation, since neither clinical examination nor fecal testing reliably excludes colorectal cancer [45]. The ideal test would also diagnose non-neoplastic conditions responsible for the symptoms (both within the colon and/or extracolonic).

Colorectal neoplasia detection – CTC

In a recent meta-analysis including 34 studies for a total of 41 680 participants, CTC sensitivity for detection of colorectal cancer was 93% among older patients (>65 years) and 92% among younger patients [46]. These data and the results of the Special Interest Group in Gastrointestinal and Abdominal Radiology (SIGGAR) trial [27] suggest that CTC and colonoscopy have similar sensitivity for detecting colorectal cancer and large polyps in symptomatic patients. Small polyps (6–9 mm) and diminutive polyps (≤5 mm) are less relevant in symptomatic patients, since they cannot explain the patient's symptoms.

Extracolonic findings (ECFs)

ECFs are common in symptomatic patients. A recent meta-analysis [47] reported an incidence of potentially significant ECFs of 5.2% in a cohort with symptoms and of 2.8% in a cohort of patients without symptoms. In patients with ECFs, the rate of recommended further work-up was 8.2%. In the SIGGAR trial 59.6% of patients had at least one extracolonic finding at CTC and the proportion increased with age; a total of 149 patients (8.5%) underwent further work-up. In the same trial [22], significantly more patients randomized to CTC underwent additional investigation than colonoscopy (30% vs. 8.2%; $p < 0.001$) raising concerns of additional costs for CTC. However, of the 1634 patients that underwent CTC, 72 (4.4%) were diagnosed with extracolonic malignancy. Overall in the SIGGAR trial, total costs of CTC and colonoscopy were similar [48].

Colorectal neoplasia detection – CCE

Few studies evaluated the role of CCE in patients at high risk for colorectal cancer, with abdominal or alarm symptoms (rectal bleeding, anemia, weight loss, intestinal subocclusion). One prospective, single-center study [41] included 67 patients at risk of colorectal cancer, unable or unwilling to undergo colonoscopy, who underwent CCE. Colonic and ECFs were detected in 23 patients (34%, 95%CI 21.6%–44.1%). Of these, six patients were diagnosed with cancer, comprising 4 colon cancers, 1 gastric cancer, and 1 small-bowel cancer. The CCE findings were confirmed after surgery in all patients.

CCE might be considered as an alternative diagnostic tool in this setting. However, the evidence was considered insufficient to recommend CCE in patients with alarm symptoms. In patients with non-alarm symptoms [49] CCE can be considered, this being a weak recommendation.

4. CTC and CCE and screening for colorectal cancer

Recommendation

Where there is no organized fecal immunochemical test (FIT)-based population colorectal screening program, ESGE/ESGAR recommend CTC as an option for colorectal cancer screening, providing the screenee is adequately informed about test characteristics, benefits, and risks, and depending on local service- and patient-related factors.

Strong recommendation, high quality evidence.

ESGE/ESGAR do not suggest CCE as a first-line screening test for colorectal cancer.

Weak recommendation, low quality evidence.

CTC in screening: Participation

Between 2009 and 2014 three European randomized population screening trials have been performed. These trials respectively compared primary CTC screening testing to

colonoscopy (Colonoscopy or Colonography for Screening [COCOS] trial [50], and the SAVE trial [17]), to sigmoidoscopy (the PROTEUS trial [18]) and to FIT (SAVE [17]). Participation rates were: 34% and 22% for CTC and colonoscopy, respectively, in the COCOS trial; 30% and 27% for CTC and sigmoidoscopy, respectively, in the PROTEUS trial; and 28% and 50% respectively for CTC and FIT in the SAVE trial. In the PROTEUS trials, participation was higher in men than in women (35% vs. 27%). Invitation and preparation modalities, which differed between trials, may have affected participation rates [51].

In the COCOS trial almost half of the nonparticipants made an informed decision on participation as they were provided with adequate knowledge of colorectal cancer and colorectal cancer screening, and showed a positive attitude towards screening, but nevertheless declined participation; this suggested that additional barriers to participation were present [50]. In the PROTEUS trial the two main factors affecting participation were screening-related anxiety and belief that screening is ineffective [52].

CTC in screening: Detection rate and yield

In the COCOS trial, advanced neoplasia detection rate (ANDR) per 100 participants was lower for CTC than colonoscopy (6.1 persons vs. 8.7) [50]. However, 6–9-mm polyps detected by CTC underwent surveillance, and with subsequent resections the ANDR for CTC (8.6%) was similar to that of colonoscopy [53]. In the SAVE trial, the CTC ANDR was 4.9–5.5 (depending on bowel preparation) versus 7.2 for colonoscopy, and 1.7 for one round of FIT [17]. In the PROTEUS trial, CTC ANDR was similar to that of sigmoidoscopy (5.1 vs. 4.7 per 100 participants) [18].

However, due to higher CTC participation, in the COCOS trial, ANDR per 100 invitees for CTC (2.1) was similar to that of colonoscopy (1.9), and higher (2.9%) when 6–9-mm polyps were included. A slightly higher per-invitee ANDR was also observed for CTC compared with colonoscopy in the SAVE trial (1.4 vs. 1.1 per 100 invitees) and compared with sigmoidoscopy in the PROTEUS trial (1.6 vs. 1.3 invitees).

In the case of serrated adenomas, the diagnostic yield of colonoscopy was 5 times higher than that of CTC. This is relevant, since approximately 10%–20% of colorectal cancer develops from the serrated pathway [54].

The PROTEUS trial also reported a lower ANDR for CTC in the distal colon compared with sigmoidoscopy (2.9% vs. 3.9%).

Acceptability of CTC screening

As noted above, randomized controlled trial (RCT) data suggests that in general, participation rates for CTC are higher than for colonoscopy or sigmoidoscopy. In the PROTEUS trial, only a small percentage of attendees would not recommend CTC to friends or relatives (6.7%) and would not repeat the test in the future if invited (7.2%) [52]. However, these rates were significantly higher than in the flexible sigmoidoscopy arm. Bowel preparation was considered the most negative aspect of the process, with 17.9% having moderate or severe discomfort, and pain being perceived by 16.8%. Sali et al. [55] reported no preparation-related symptoms in 88% of interviewed screenees undergoing reduced bowel preparation compared to 70% of those undergoing full bowel preparation and an improved participation rate in the former group.

Safety of CTC screening

Adverse events

The risk of major adverse events due to the CTC examination itself (including the bowel preparation) is low and likely lower than for colonoscopy [27, 56–58]. In a meta-analysis [59] including 103 399 asymptomatic and symptomatic patients, the CTC overall perforation rate was estimated to be 0.04%; the rate was 19-fold higher in symptomatic compared with screening individuals. In a randomized trial comparing CTC with colonoscopy screening, serious adverse events were comparable for both procedures (0.2% for CTC; 0.3% for colonoscopy) [50]. Adverse events of CTC screening should also take into account those related to colonoscopy following a positive result; it would be expected that these would be similar to those observed in randomized trials of fecal occult blood testing (FOBT) and of flexible sigmoidoscopy screening [60].

Radiation risk in screening

The topic has been covered in the previous Guideline [11]. Dose-reducing CTC protocols using iterative reconstruction algorithms and lower tube voltage are increasingly being implemented, leading to doses of less than 1 mSv [61].

ECFs in CTC screening

ECFs may be identified in up to half of asymptomatic screenees [62–64] with additional work-up required and rising costs for the screening programs. However, when only indeterminate but likely unimportant ("E3") findings and potentially important ("E4") ECFs are considered, the rate is significantly lower. In the European COCOS trial and in a large opportunistic CTC screening series in the USA, the prevalence of E3+E4 ECFs was around 11%, with rates of E4 ECFs being only 1.2%–5% [2, 3, 51, 52]. Potentially important ECFs included aortic aneurysms, solid or complex cystic renal lesions, pancreatic masses, adnexal masses, and noncalcified lung nodules >10 mm.

In the PROTEUS trial, findings were reviewed by two experienced radiologists to identify ECFs that needed additional examination. With this approach the prevalence of ECFs requiring further work-up was 1.2%.

Cost and cost–effectiveness of CTC screening

Costs per participant of a population-based screening program with CTC, including the invitation process, were €169 in the Netherlands [65] and €197 in Italy [66]; average costs per participant with advanced neoplasia were respectively €2773 [65] and €3777 [66].

Other than average cost per participant, the cost–effectiveness of a screening test is dependent on participation rate and on the number of screening rounds. According to Meulen et al. [67], who based their analysis on unit costs and participation rates in the COCOS trial, CTC was the most cost-effective strategy in participants who underwent more than 2 lifetime screens and was the preferred test for willingness-to-pay thresholds of €3200 per quality-adjusted life-year (QALY) gained. However, with equal participation, colonoscopy was the preferred test independent of willingness-to-pay thresholds. Meulen et al. [67] did not include ECFs in their cost–effectiveness analysis, stating that long-term follow-up data are lacking. A sensitivity analysis was performed, treating ECFs as pure costs, or potentially cost-saving via detection of aortic aneurysms. In both scenarios CTC remained dominant over colonoscopy assuming more than 2 lifetime screens.

In a recent systematic review, CTC every 5 to 10 years was shown to be more cost-effective than no screening [68]. Robust cost–effectiveness data comparing CTC with stool-based tests, notably FIT, are not yet available.

CTC as a primary screening modality for colorectal cancer: Conclusions

In average-risk individuals, screening CTC achieves an ANDR at least matching those of colonoscopy and flexible sigmoidoscopy, in part secondarily to increased participation. The full impact of ECFs, both medically and economically, remains unknown, although the prevalence of ECFs potentially requiring further work-up is 11% or less in European screening populations. Sensitivity analysis based on one European screening trial suggests that even when ECFs are incorporated, CTC remains more cost-effective than colonoscopy if more than 2 lifetime screens are done. Full cost–effectiveness data from trials comparing CTC with flexible sigmoidoscopy and FIT are however awaited. Although radiation exposure is a drawback, this disadvantage seems to be overemphasized especially given the current reduction in radiation exposure with CTC.

Based on these considerations, CTC is not recommended as the primary test for population colorectal cancer screening, pending data showing superior efficacy and cost–effectiveness compared to established alternate strategies, notably stool-based techniques such as FIT. It is recommended as a colorectal cancer screening test on an individual basis, providing the screenees are adequately informed about test characteristics, benefits, and risks.

CCE and screening for colorectal cancer: Participation

A few studies investigated the participation rate for CCE in a colorectal cancer screening population. Participation rates varied from 4.2% to 17.4%, depending on the design of the study and how CCE was used as screening modality, for example as a primary screening modality or as a filter test [69]. The lowest participation rate of 4.2% was reported in a German opportunistic screening study where CCE was offered as an alternative to primary optical colonoscopy screening. In another study [70] where CCE was offered to patients who were unwilling to undergo optical colonoscopy after a positive FIT, a participation rate of 5% was found. Although contradictory data on patient preference are available, recent data from a large Danish series of screening individuals suggests CCE was associated with less discomfort than optical colonoscopy and may be preferable to some individuals [71].

CCE in screening: Detection rate and yield

Only a few studies evaluated the role of CCE as a primary screening test. Rex et al. [72] performed a prospective multicenter study including 695 patients to assess CCE accuracy as a primary screening test in an average-risk screening population. CCE sensitivity and specificity for adenomas ≥6 mm were 88% and 82%, respectively, which seems adequate for patients who cannot undergo colonoscopy or who have had incomplete colonoscopies. Based on these results, a recent multicenter, prospective, randomized study [73] evaluated the diagnostic yield of CCE versus CTC for the identification of colonic polyps in a screening population. Results showed a higher detection rate with CCE (polyps ≥6 mm, 32%; and polyps ≥10 mm, 14%) compared to CTC (polyps ≥6 mm, 9%; and polyps ≥10 mm, 6%). The sensitivity of CCE for polyps ≥6 mm (84%) and polyps ≥10 mm (84%) was higher compared to CTC (32% and 53%, respectively). Specificity for polyps ≥6 mm was higher for CTC versus CCE (99% vs. 93%, respectively) and comparable for polyps ≥10 mm (99% vs. 97%, respectively). These observations add additional evidence to previous comparisons demonstrating CCE to have at least noninferior test performance compared to CTC. Based on available evidence, CCE should be considered an acceptable colorectal cancer screening option in appropriately selected patients.

Few studies evaluated the diagnostic yield (detection of polyps and cancer) of CCE in patients with a positive family history of colorectal cancer. Two studies evaluated the role of CCE in screening of first-degree relatives. Parodi et al. [74] showed that CCE sensitivity and specificity for polyps ≥6 mm are 91% and 88%, respectively, with a PPV and negative predictive value (NPV) of 78% and 95%, respectively. Moreover, restricting the results to polyps ≥10 mm, CCE showed 89% sensitivity and 95% specificity. Also Adrián-de-Ganzo et al. [75] in a prospective study of 329 asymptomatic first-degree relatives, randomly assigned to CCE (n = 165) or colonoscopy (n = 164), assessed screening uptake of CCE vs. colonoscopy. Unexpectedly, 57.4% of individuals crossed over from the CCE group, and 30.2% crossed over from the colonoscopy group, meaning that most preferred to undergo colonoscopy. Although the crossover rate between groups was thus significantly higher in the CCE group than in the colonoscopy group, 16.8% of those who were invited to undergo colonoscopy declined, and when re-offered CCE accepted, and 15.0% actually underwent CCE. The study confirmed that CCE can be as effective as colonoscopy in detecting significant lesions: these were detected in 14 individuals (11.7%) in the CCE group and 13 individuals (11.5%) in the colonoscopy group (odds ratio [OR] 1.02, 95%CI 0.45−2.26; p = 0.96). However, the higher crossover rate from the CCE group to the colonoscopy group, mainly due to unwillingness to repeat bowel preparation in the case of a positive result, suggested better acceptance of screening colonoscopy in this group of patients.

5. Indications and contraindications to CTC/CCE following positive FOBT/FIT

Recommendation

ESGE/ESGAR recommend CTC in the case of a positive FOBT or FIT with incomplete or unfeasible colonoscopy, within organized population screening programs.

Strong recommendation, moderate quality evidence.

ESGE/ESGAR also suggest the use of CCE in this setting based on availability.

Weak recommendation, moderate quality evidence.

Indications and contraindications for CTC following positive FOBT/FIT

Fecal blood testing, whether by guaiac-based or immunochemical methods, is predominantly deployed as a population screening test, as it is safe, cheap, well-tolerated and has been proven to reduce colorectal cancer-specific mortality by approximately 15%–18% (for guaiac testing). Although long-term mortality data for FIT screening are awaited, it will likely have even better results due to higher uptake and superior sensitivity for advanced colorectal lesions. More recently, FIT at a low threshold has been advocated as a possible tool to identify patients with colorectal symptoms who are at very low risk of colorectal cancer, and so might avoid the need for further colonic investigation.

Whether derived from a population screening program or via a symptomatic service, patients with positive FOBT or FIT results require further testing to confirm or refute the presence of an underlying cancer or adenoma, permitting subsequent treatment. Colonoscopy combines sensitive diagnosis with therapy by endoscopic resection and is therefore regarded as the preferred test.

However, most patients testing FOBT/FIT-positive will not have advanced neoplasia, meaning that CTC can be considered as a possible triage test to select patients with lesions only of greater size for colonoscopy or surgery. A meta-analysis published in 2014 found 5 studies, together including 622 patients, in whom the average sensitivity of CTC for ≥6-mm adenomas or colorectal cancer was 88.8%, at a specificity of 75.4% [76]. A more recent study of 50 patients [77] found almost identical results (sensitivity 88.2%, specificity 84.8%). However, since the prevalence of ≥6-mm polyps is relatively high in this cohort, NPV is less than might be expected, ranging from 85% to 95% in the studies included. Moreover, many patients still require colonoscopy after CTC since so many polyps are found; a modeling study concluded that the use of CTC as an intermediate after positive FOBT/FIT can only be cost-effective if the costs of CTC were ≤43% of the costs of colonoscopy [78]. These factors mean that CTC should not be offered routinely to those testing FOBT/FIT-positive, and colonoscopy is preferable. One possible exception is where the absolute quantity of fecal blood is low (e.g. quantitative FIT result of <40), where the prevalence of advanced neoplasia may be sufficiently low to render CTC triage cost-effective. However, to date we are not aware of any studies directly assessing this patient population.

Since CTC has good diagnostic performance, it may be considered for those unwilling to undergo colonoscopy or in whom colonoscopy is unfeasible or incomplete, although screenees should be informed that sensitivity (particularly for smaller adenomas) is inferior to that of colonoscopy and no simultaneous treatment is possible. There is some evidence that offering CTC to those who decline colonoscopy increases uptake of colorectal cancer screening [79].

CTC is safe and well-tolerated in this cohort with a positive fecal blood test [57] and therefore may be preferable in those with contraindications to colonoscopy or judged particularly high risk. Some observational data suggest absolute detection rates may be lower than in healthy screenees who are fit for colonoscopy [80], and post-test cancer rates may be higher [81], although this is probably due to patient factors rather than differences in test sensitivity (i.e., patients who are unfit

for colonoscopy are difficult to investigate with any technique, including CTC).

Indications and contraindications for CCE following positive FOBT/FIT

Three studies were performed comparing the accuracy of CCE and colonoscopy in FIT-positive patients in a colorectal cancer screening setting. In two studies, patients with a positive FIT underwent both CCE and colonoscopy. The primary outcome was to assess the polyp detection rate and accuracy of CCE compared to colonoscopy. The polyp detection rate ranged between 69% and 74% for CCE versus 58% and 64% for colonoscopy [69, 77, 82]. The study by Holleran et al. [82] showed that the detection rate of significant lesions was comparable between CCE and colonoscopy. However, in the study of Kobaek-Larsen et al. [69], repeat colonoscopies were performed to explain the high miss rate of colonoscopy. These repeat colonoscopies resulted in the detection of additional polyps, suggesting that the discrepancy in detection rate between CCE and colonoscopy is most likely explained by the false-negative findings of colonoscopy. In the third study, patients with a positive FIT underwent CCE, CTC, and colonoscopy, using colonoscopy as the reference standard [77]. Both CCE and CTC detected polyps of ≥6 mm and larger with high levels of accuracy. Based on these studies, the sensitivity of CCE for polyps >9 mm ranges between 87% and 92.8% and the specificity is around 92% [69, 77].

One study investigated the use of CCE in patients unwilling to undergo a colonoscopy after a positive FIT within the colorectal cancer screening program [70]. The aim of this study was to compare CCE and CTC in terms of detection rate as well as participation outcomes. A total of 756 patients were invited to participate of whom only 5% underwent CCE and 7.4% underwent CTC, showing that participation for both CCE and CTC after a positive FIT in patients unwilling to undergo colonoscopy is very low. However, the detection rate was higher when using CCE compared to CTC, with 60% detection of neoplastic lesions in the CCE group compared to 28.6% in the CTC group.

Finally, only one multicenter prospective study aimed to assess the diagnostic accuracy of CCE-2 for advanced neoplasia in individuals with a positive FIT within an organized screening program [83]. Overall, CCE-2 sensitivity and specificity for advanced neoplasia were 90% and 66.1% with PPV and NPV of 57.4% and 92.9%, respectively, when using a 6-mm cutoff (colonoscopy referral rate 52.8%). Sensitivity and specificity were 76.7% and 90.7%, with PPV and NPV of 80.7% and 88.4% when using a 10-mm cutoff (colonoscopy referral rate 32%)

In conclusion, these data would support the use of CCE as an alternative to CTC in FIT-positive individuals unwilling to undergo colonoscopy or in whom it is unfeasible.

6. CTC or CCE following curative-intent resection of colorectal cancer

Recommendation

ESGE/ESGAR suggest CTC with intravenous contrast medium injection for surveillance after curative-intent resection of colorectal cancer only in patients in whom colonoscopy is contraindicated or unfeasible.
Weak recommendation, low quality evidence.
There is insufficient evidence to recommend CCE in this setting.
Very low quality evidence.

Patients with previous colorectal cancer are at increased risk of future colorectal neoplasia, and therefore require surveillance of the remnant colon. Additionally, contrast-enhanced computed tomography (CT) is the mainstay of surveillance for extraluminal local recurrence and remote metastases. Since CTC combines intraluminal assessment with evaluation of the extracolonic structures for locoregional recurrence and remote metastases, it has the potential to simplify follow-up pathways and reduce costs.

Porté et al. [84] conducted a systematic review and meta-analysis of cohort studies which showed that CTC was highly sensitive (95%, 18/19 cases detected) and 100% specific for anastomotic recurrence following colorectal cancer resection. Moreover, CTC detected all 10 metachronous cancers in these patients. However, no data were provided regarding diagnostic accuracy for polyps or adenomas; only colorectal cancer was considered.

Three single-center prospective cohort studies [85–87] reported on the diagnostic accuracy of CTC for polyps or adenomas after colorectal cancer resection. The largest study [86] with 550 patients, found that CTC was 81.8% sensitive for advanced neoplasia (specificity 93.1%). However, these studies were of variable quality, with incomplete [87] or delayed [86] comparison to reference standard tests such as colonoscopy for the presence/absence of polyps.

More recently, a prospective, multicenter, cross-sectional study [88] recruited 231 patients scheduled for colonic surveillance 1 year after curative-intent resection of colorectal cancer. Patients underwent CTC and same-day colonoscopy with segmental unblinding (i.e., sequential revelation of the CTC result to the colonoscopist on a segment-by-segment basis, thereby providing an enhanced reference standard for the presence or absence of neoplasia). The sensitivity of CTC was only 44.0% for polyps ≥6 mm (76.9% for polyps ≥10 mm). This is surprisingly low when compared to meta-analyses of the accuracy of CTC in other situations. One possible explanation is the absence of an ileocecal valve in patients with prior right hemicolectomy, thereby permitting gas reflux into the small bowel and reducing the likelihood of optimal colonic distension.

The same cohort of patients was asked which of the two tests they preferred [89]; of the 223 patients who completed their questionnaires, 95 (42.6%) preferred colonoscopy, 79

(35.4%) had no preference, and only 49 (22.0%) preferred CTC.

Limited cost–effectiveness analysis of this cohort, using cost data from a single center, suggests that a CTC-based surveillance strategy is cost-saving relative to colonoscopy; however, as noted above, this comes with the trade-off that fewer adenomas will be detected. Beck et al. [90] estimated that the additional cost for a polyp ≥6 mm detected by using colonoscopy rather than CTC would be $5700 (€4800 approximately) or $28 000 (€24 000 approximately) per additional polyp ≥10 mm detected. Whether these cost data would be replicated in other healthcare systems is uncertain.

7. Post-polypectomy surveillance

Recommendation

ESGE/ESGAR suggest CTC in patients with high risk polyps undergoing surveillance after polypectomy only when colonoscopy is unfeasible.

Weak recommendation, low quality evidence.

There is insufficient evidence to recommend CCE in post-polypectomy surveillance.

Very low quality evidence.

CTC in post-polypectomy surveillance

A previous ESGE Guideline in 2013 recommended endoscopic surveillance only for patients with high risk adenomatous lesions (adenomas with high grade dysplasia, or ≥10 mm in size, or ≥5 in number) or serrated lesions (≥10 mm in size, or with any degree of cytological dysplasia) [91]. Colonoscopy is considered to be the method of choice for post-polypectomy surveillance, with the primary aim of diagnosing and removing polyps either missed at initial examination or newly developed during the time between the index and follow-up examinations. However, compliance with colonoscopic surveillance is relatively low, ranging from 52% to 85%, with the highest levels obtained in research settings [92–95]. Moreover, according to a recently published paper [96], adherence to surveillance ESGE guidelines [91] is dramatically low, at only 13.8%.

The impact of FIT on surveillance was recently investigated. Atkin et al. [97] reported that annual low threshold FIT (10 μg/g) with colonoscopy in positive cases had high sensitivity for colorectal cancer and advanced adenomas (sensitivity and specificity were 84.6% and 70.8%, respectively) and would be cost-saving compared with 3-yearly colonoscopy.

Despite weak evidence supporting CTC for surveillance [98], in patients who are unwilling or unable to undergo colonoscopy, CTC may be a reasonable alternative because of its high sensitivity and NPV for colorectal cancer, outperforming barium enema [98, 99].

CCE in post-polypectomy surveillance

The accuracy of CCE in post-polypectomy surveillance has not been carefully investigated. Only one study investigated CCE as a possible filter test in colonic surveillance in patients scheduled for follow-up colonoscopy [100]. In this study, 102 of 180 patients (57%) who underwent CCE also underwent a supplemental colonoscopy, because either significant pathology was detected on CCE or CCE examination was incomplete. The completion rate for CCE was 66.7% and the polyp detection rate was 69%. CCE detected 120 polyps, of which 60 were found at colonoscopy, meaning that half of the detected polyps could not be removed by supplemental colonoscopy. Colonoscopy detected 16 additional polyps that were not found at CCE. More studies are needed to determine the applicability of CCE as a filter test for surveillance colonoscopy after polypectomy. To date, there are not sufficient data to support the use of CCE in post-polypectomy surveillance.

8. Other indications and contraindications for CTC: diverticular disease, IBD, fragile patient

Recommendation

ESGE/ESGAR recommend against CTC in patients with acute colonic inflammation and in those who have recently undergone colorectal surgery, pending a multidisciplinary evaluation.

Strong recommendation, low quality evidence.

In 2006, large surveys from the UK and USA showed CTC was very safe, with symptomatic perforation occurring in approximately 1 in 3000 to 1 in 20 000 examinations, and an even lower risk for people undergoing CTC for colorectal cancer screening [101, 102]. To date there has been no reported death directly attributable to CTC despite its use in routine practice across the world for over a decade.

In 2015, a Japanese national survey of 147 439 CTC examinations [58] revealed lower perforation rates of 0.014% overall, albeit with a higher rate when CTC was used for preoperative staging (0.028%); and a much lower rate for screening (0.003%; approximately 1 in 30 000 patients). Most patients (81%) with perforation did not require surgical intervention. Vasovagal reaction was reported in 0.081%.

In general, CTC is avoided in patients with acute or subacute colonic mucosal inflammation due to increased risk of colonic perforation [103, 104], difficulty in detecting mucosal dysplasia without biopsies, and inaccurate differentiation of inflammatory polyps or strictures from neoplasia.

A 2014 retrospective study [105] of elderly patients compared 6114 outpatients undergoing initial CTC with 149 202 outpatients undergoing initial optical colonoscopy. It found the odds ratio of complications was higher for colonoscopy compared to CTC as follows: lower gastrointestinal bleeding,

OR 1.9; other gastrointestinal events, OR 1.35; and cardiovascular events, OR 1.38. Risk of colonic perforation was 0.07% for CTC and 0.12% for colonoscopy, but comparisons of perforation risk frequently take no account of asymptomatic perforation in the colonoscopy group (and a large majority of patients with CTC-related perforation are asymptomatic).

Practical advice for radiologists is given below.

Practical advice for radiologists

1. CTC is very safe but is absolutely contraindicated in patients with generalized peritonitis, acute bowel perforation, mechanical bowel obstruction, and when a competent patient does not provide consent.
2. Relative contraindications include: healing of localized diverticular perforation; acute inflammatory bowel disease; or younger age (children and young adults).
3. When CTC is requested soon after colonoscopy, particularly after polypectomy, we recommend the CTC radiologist communicates directly with the endoscopist to assess an individual's risk of perforation. Risk factors include large, deep colonic wall defects, mucosal inflammation, and patient comorbidity.
4. If a radiologist believes that bowel perforation may have occurred prior to undertaking CTC, then a standard CT of the abdomen and pelvis should be performed prior to colonic insufflation to help exclude extraluminal gas.

9. Work-up after CTC and CCE

Recommendation

ESGE/ESGAR recommend referral for endoscopic polypectomy in patients with at least one polyp ≥6 mm detected at CTC or CCE.

Follow-up CTC may be clinically considered for 6–9-mm CTC-detected lesions if patients do not undergo polypectomy because of patient choice, comorbidity, and/or low risk profile for advanced neoplasia.

Strong recommendation, moderate quality evidence.

The need for additional endoscopy depends on several clinical characteristics. As it is known that with increasing size, an increasing number of polyps appear to be advanced (i.e., advanced adenoma or carcinoma), polyp size is one of the most important factors [106–108]. In two systematic reviews that included large numbers of polyps, only 1.4% of lesions <5 mm were advanced adenomas and only 0.3% malignant, while approximately 8% of 6–9-mm lesions and 80% of lesions ≥10 mm were advanced neoplasia (the remaining polyps being hyperplastic or inflammatory) [107, 108].

Increasing age and male sex are also associated with a higher risk of advanced neoplasia regardless of polyp size [109]. In the case of subcentimeter lesions, number of lesions (>4), occult blood or overt blood in stool, and pedunculated lesions are associated with a higher risk of advanced neoplasia [110].

The natural history of small polyps detected at CTC has been studied in two prospective observational CTC studies. In the first study, 22% of 306 polyps increased in size 2–3 years after the initial CTC, and 6% became >10 mm [111]. However, approximately 28% of polyps regressed. This was also found in another study, in which 35% of 95 polyps progressed, and 26% of polyps regressed (including 15% with apparent resolution) [19]. None of the regressing polyps were advanced adenomas. Longer follow-up of the lesions is not available.

Follow-up of CTC findings

In general, it is suggested to consult a gastroenterologist in the case of colorectal findings, to decide whether colonoscopy and/or follow-up CTC is needed. The gastroenterologist can assess the (future) risk for colorectal cancer based on background risk factors, the actual risk profile, and the possibility of performing colonoscopy in patients with comorbidity. Nevertheless, some general rules can be applied, based on the size of the polyps.

In the case of large polyps (≥10 mm) and suspected masses, colonoscopy should be performed to remove the polyp or take biopsies for a histological diagnosis. In the case of a highly suspicious mass and incomplete colonoscopy without a biopsy (despite optimal bowel preparation and an experienced endoscopist), one could consider treatment without histopathology verification but this should be discussed at a multidisciplinary team.

As stated above, the risk of intermediate polyps (6–9 mm) being advanced neoplasia is low [106, 107] and these might remain stable in size or might (completely) regress [19, 111]. Therefore, in the case of intermediate polyps (6–9 mm) either a subsequent colonoscopy or a follow-up CTC can be considered, depending on the clinical setting, number of polyps, age, male sex, and comorbidity. Colonoscopy is strongly favored in patients with a genetic predisposition (e.g. Lynch syndrome) and in patients with multiple polyps (>3), while substantial comorbidity favors follow-up CTC.

Lesions <6 mm can be mentioned in the CTC report, but the specificity for diminutive lesions is low and the risk of malignancy is low, therefore it is justifiable to ignore them. Radiologists and gastroenterologists should define the local strategy about reporting polyps <6 mm in their hospital.

In the case of a negative colonoscopy following CTC findings a repeat examination should be considered, as in a retrospective study [112] false-negative colonoscopy findings in follow-up to CTC have been reported in up to 21.5% (false-negative findings were more common in the right colon). This repeat examination could be a second colonoscopy or a follow-up CTC; an immediate repeat CTC can be considered. To prevent the need for a repeat examination, it is strongly advised to perform a high quality colonoscopy procedure with adequate information on the location of the lesion found on CTC, to be able to perform a "second look" during the initial colonoscopy.

Follow-up of CCE findings

Regarding findings, most colonic polyps discovered at screening are diminutive, with negligible risk of harboring advanced features (high grade dysplasia, villous component, or malignancy) [107, 108, 113, 114]. Moreover, 40% of diminutive colonic polyps are hyperplastic rather than adenomatous [115]. Diminutive lesions identified by a noninvasive test may also be missed by a subsequent colonoscopy, because of the relatively low sensitivity of the latter for diminutive lesions [116, 117]. By extrapolating data from CTC studies that modeled the impact of colonoscopy or continued surveillance for diminutive polyps discovered at CTC, it can be concluded that referral for removal of diminutive lesions found at CCE might carry an unjustified burden of costs and complications relative to a minimal gain in clinical efficacy [118]. Moreover, studies on second-generation CCE have provided accuracy data in relation to lesions ≥6mm in size; specificity for diminutive lesions is largely unknown [118].

The only exception regarding post-CCE referral for diminutive polyps is the presence of at least 3 diminutive polyps. Polyp multiplicity has appeared to be a strong predictive factor of subsequent advanced neoplasia development in post-polypectomy follow-up studies [119].

Most advanced neoplasia has been shown to be restricted to the relatively small proportion of patients with polyps ≥6 mm in size [107]. Consequently, post-CCE colonoscopy referral of these patients may be expected to lead to a substantial reduction of the prevalence of advanced neoplasia in patients initially evaluated with CCE. Using a cutoff of significant findings defined as no more than 2 polyps of 10 mm, 43% of patients have avoided colonoscopy; however, high risk findings were detected in only 10.7% of patients who underwent colonoscopy [100]. This approach entails that small polyps will be left untreated until the subsequent follow-up. Polyps of 6–9 mm may be safely followed for a relatively short period of time [118].

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Compliance with ethical standards

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Disclaimer ESGE/ESGAR Guidelines represent a consensus of best practice based on the available evidence at the time of preparation. They may not apply to all situations and should be interpreted in the setting of specific clinical situations and resource availability. They are intended to be an educational tool to provide information that may support endoscopists in providing care to patients. They are not rules and should not be utilized to establish a legal standard of care.

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