CT colonography: what the gastroenterologist needs to know

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CT colonography has evolved rapidly over recent years into the best radiological method for investigating colonic neoplasia. Technological advances enable very fast CT scans (patients hold breath for less than 10 s per scan) with improved spatial resolution and lower radiation dose. User friendly reading software, incorporating computer aided diagnosis, enables radiologists to accurately review data in multiple anatomical planes, utilising both two-dimensional and 'endoluminal' three-dimensional displays. However, as demand for colonic investigation increases (particularly in an older, more frail population), alongside socio-political drives to reduce waiting times, the quality of interaction between endoscopy and radiology becomes of paramount importance. There are pros and cons for both CT colonography and endoscopy and their relative benefits can be fully exploited by closely aligned gastroenterology and radiology teams, potentially improving diagnostic efficiency and patient experience. This review will update gastroenterologists on current CT colonography techniques and will emphasise the need for strong partnership between endoscopy and radiology colon imaging services.

Introduction

CT colonography (or virtual colonoscopy¹) is now regarded as the best radiological method for investigating the colon for neoplasia. Performing CT examinations after colonic insufflation with air (CT pneumocolon) was first described in the early 1980s² but it was the advent of faster computing power in the 1990s which enabled radiologists to develop three-dimensional reconstructions of the colonic mucosa. As a result, virtual 'fly throughs' of the colon were created, simulating views encountered during the passage of an endoscope at optical colonoscopy.^{3,4} Currently, CT colonography describes the technique of combined

two- and three-dimensional review of abdomino-pelvic CT data acquired in two anatomical positions (usually patient lying prone and supine) following colonic preparation and insufflation with gas.

When performed by suitably experienced teams, CT colonography is an accurate and minimally invasive alternative to optical colonoscopy. Where CT colonography and endoscopy teams collaborate closely, patients benefit from a combined complementary colon imaging service with efficient high quality diagnostic pathways.

This review aims to inform gastroenterologists about the latest generation CT colonography technique, reviews the methods for improving patient outcomes and encourages endoscopists to work closely with CT colonography teams for patient benefit.

How is CT colonography performed?

Patient information

CT colonography is a rapid and safe method of examining the colon without the need for sedation. However, tissue biopsy or polypectomy cannot be performed. Patients should be informed of this limitation although reassured that a significant colonic abnormality will be found in only 10% of diagnostic and 5% of screening examinations, on average.^{5,6} As for optical colonoscopy, patients require clear information and explanation of what the examination involves and the potential risks and benefits. Expressed consent should always be sought and, in an increasing number of centres, either a written record is kept of this process or written consent is formally obtained. An example of a patient information booklet for CT colonography can be found accompanying recently published CT colonography standards⁷ or on the St Mark's Hospital website http://www.stmarkshospital.org.uk/uploads/content/docs/virtual-colonoscopy/A5_Colonoscopy_vis01r2.

pdf.⁸ In addition, patients find a ‘frequently asked questions’ document very helpful—for example, LINK <http://www.stmarkshospital.org.uk/uploads/content/docs/VC%20Workshop%202008/Virtual%20Colonoscopy%20-%20FAQ%20-%20NHS%20Patients.pdf>.

Bowel preparation

Experience of barium enema initially led radiologists to use similar laxatives such as picosulphate or phosphosoda for CT colonography, aiming to achieve a relatively dry colon, thus reducing fluid residue which might otherwise obscure bowel mucosa.

Wetter preparations such as polyethylene glycol liquefy faecal residue and therefore improve mucosal visualisation at optical colonoscopy where excess fluid can easily be aspirated.

Although fluid cannot be aspirated at CT colonography, liquid residue can be reliably labelled or ‘tagged’ with either iodine or barium (following oral ingestion) so that residue appears radio-opaque or ‘white’ on CT (figure 1). As a result, faecal residue is rapidly discriminated from colonic neoplasia, enabling detection of polyps in fluid filled segments, thus potentially improving reader confidence and specificity.⁹

Use of faecal tagging agents, combined with either ‘dry’ or ‘wet’ laxatives are now used routinely in several centres around the world and, although more evidence is awaited, expert opinion suggests use of faecal tagging has improved the positive predictive value of CT colonography, decreased interpretation times and reduced examination inadequacy rates (4% to <1% in a recent St Mark’s Hospital audit).

Figure 1 CT colonography in 65-year-old woman with two-dimensional coronal reformatted image as shown, demonstrating two pedunculated polyps (14 mm and 7 mm) in the ascending colon (green arrow and red arrow, respectively). These are outlined by the residual colonic fluid (T) which is ‘tagged’ and appears radio-opaque compared with soft tissue density polyps. Subsequent histology after polypectomy revealed both were villous adenomas.

National Patient Safety Agency guidance issued in the UK has raised¹⁰ concerns about the potential detrimental effects of using laxatives for bowel preparation in patients undergoing either radiological or endoscopic colon imaging. In response, individual organisations and the British Society of Gastrointestinal and Abdominal Radiology (BSGAR) have issued guidance for CT colonography and barium enema practice and have recommended methods by which a referrer will determine the suitability of a patient to undergo full cathartic preparation (eg, via dedicated referral forms).

Notwithstanding, faecal tagging provides the potential for ‘laxative free’ CT colonography, usually combining a barium or iodine agent (for example gastrografin) with liquid diet for 1–2 days.^{11 12} Consequently, gastroenterologists and other referrers now have the opportunity to refer frail patients for an accurate whole colon investigation, particularly when standard laxative regimens would be poorly tolerated.

Whatever the bowel preparation (or indeed colonic test), patient compliance with the preparation regimen is a prerequisite to high quality examination. Therefore, clear patient instructions using appropriate language are a necessity, ideally with easy telephone access to a member of the CT colonography team who can address any additional concerns.

Scan acquisition

CT scanner technology is rapidly evolving. Multi-detector row (‘multi-slice’) CT platforms reduce respiratory motion artefact and decrease examination time, thus improving the patient experience. As a general rule, a four detector row scanner is adequate for good quality CT colonography, and nearly all CT scanners purchased in the past 5 years will be at least this specification. Latest generation scanners now have at least 64 rows of detectors, permitting very fast breath-hold examinations (approximately 5 s to cover the entire abdomen and pelvis) while minimising radiation dose via improved scan resolution and dose modulation techniques.¹³

For CT colonography, the patient is scanned twice, usually in the prone and supine positions. This approach enables gravity to help optimise distension of colonic segments (depending on their anteroposterior location within the abdomen and pelvis) and allows redistribution of fluid and faecal contents away from the non-dependent mucosa. Colonic distension is usually achieved via automated insufflation of carbon dioxide, which is more comfortable for patients than using air.¹⁴ A thin flexible catheter is used, much smaller and more comfortable than those used for barium enema (figure 2). Hyoscine butylbromide (buscopan 20 mg intravenously) is widely used in Europe (unlicensed in USA) prior to insufflation and significantly improves distension.¹⁵

Routine administration of intravenous contrast is unnecessary where the sole target of investigation is

the colon, as there is no good evidence to show its use improves polyp or cancer detection.¹⁶ However, when extracolonic organ review is deemed important to the referrer—for example, in a symptomatic patient with non-specific abdominal pain or weight loss—intravenous contrast is frequently used. The benefits of intravenous contrast (improved extracolonic organ review or staging, when a cancer is found) should be balanced against the negative effects of administering intravenous contrast—namely, risk of contrast reactions, increased radiation dose, patient discomfort (intravenous cannula insertion) and additional cost.¹⁷

Same visit CT staging

It is worth emphasising that where intravenous contrast is administered, the CT colonography examination combines both full colonic and abdomino-pelvic organ review. In addition, examination of the chest will complete full body staging where a colonic cancer is found. Therefore, when a cancer is found at CT colonography, intravenous contrast can be administered (for either the second scan acquisition or as a third scan if found following the initial complete examination) to complete CT staging.

CT colonography interpretation

Although some radiologists interpret CT colonography using two-dimensional displays alone, current standards⁷ recommend combined review of both two-dimensional (including multi-planar displays) and 3D endoluminal displays to increase accuracy. While the largest CT colonography trial to date⁶ showed no significant difference in accuracy between primary two-dimensional or three-dimensional reading methods, all readers had access to both types of display to troubleshoot regions where there was uncertainty about the presence or absence of neoplasia. Irrespective of reader preference, examinations will vary in ease of interpretation—for example, significant volumes of retained faecal residue will hamper efficient primary

three-dimensional review whereas two-dimensional review will frequently enable rapid discrimination of faeces from colonic polyps or cancer.

Computer aided detection (CAD) systems are currently available and can be integrated into existing CT colonography software. These systems have been developed to assist radiologists by increasing polyp detection, firstly by extracting the colon from its surroundings and then mathematically analysing the air/wall interface (colonic mucosa) for detection of abnormal shapes—that is, ‘cap-like’ protrusions or ‘polyps’ (distinguishable from ‘trough-like’ normal mucosa or ‘ridge-like’ haustral folds).

A number of classification steps, including assessment of tissue density (polyps are generally more dense than untagged faeces) helps CAD discriminate true polyps from ‘false positive’ faeces. The resulting CAD output will therefore be a number of highlighted/annotated polyp ‘candidates’ which are presented to the reader for review (figure 3). In practice, most cases have false positive candidates (eg, faeces, ileo-caecal valve and rectal tube) with the reader deciding whether to accept or reject them. For regulatory and safety reasons, CAD systems are licensed for use in a ‘second reader’ paradigm (ie, only utilised as a ‘spell check’ following unassisted primary review of an examination). As a result, interpretation time is usually prolonged by approximately 3–5 min.

To date, most studies have shown that CAD improves reader polyp sensitivity by approximately 10% using CAD,¹⁸ particularly for inexperienced readers.¹⁹ In addition, the presence of multiple CAD false positive candidates does not appear to reduce specificity.²⁰

Given the experience above (and in the authors’ opinion), it would appear intuitive that less experienced radiologists should consider using CAD routinely in their practice. That said, experienced radiologists report that the additional time taken to review CAD

Figure 2 Photograph of traditional barium rectal tube (top) compared with CT colonography carbon dioxide insufflation tube (centre) alongside a pen for reference.

Figure 3 (A, B) A 59-year-old man with a history of change of bowel habit undergoing CT colonography with faecal tagging with use of computer aided detection (CAD). (A) Two polyps revealed on two-dimensional axial CT images in the ascending colon. Both are labelled by CAD with the use of numbering (38, 36 in this example) and the visual aid of a yellow ring marker. (B) Three-dimensional endoluminal view of the case above demonstrating the CAD lesion ‘36’ labelled via the use of a three-dimensional yellow arrow. Subsequent polypectomy of both lesions revealed two 6 mm adenomas.

output, particularly where the number of annotations is high (eg, where preparation is suboptimal), is detrimental to efficient interpretation. Multiple CAD annotations are potentially distracting if not switched off during the primary examination review and may add little to the sensitivity of those with excellent 'unassisted' accuracy. Consequently, we recommend CAD for less experienced readers and to be reserved as an optional extra for more experienced radiologists.

Patient management and follow-up

There are limited published data on the natural history of colonic polyps to help guide recommendations for subsequent patient management.^{21,22} However, it is widely accepted that diminutive polyps (5 mm maximal diameter or less) have a very small risk of harbouring malignancy²³ and therefore routine 'blanket' polypectomy for all polyps (irrespective of size) is probably unnecessary, considering the additional cost and risks.^{24,25} In contrast, most patients with large polyps (>10 mm diameter) and without significant comorbidity should be referred for polypectomy. Recommendations for management of patients with polyps measuring 6–9 mm in maximal diameter are less clear. Emerging data suggest interval surveillance by CT colonography may be a safe option for these patients.²⁶ Indeed, such surveillance may be preferable in a small group of patients with significant comorbidity where the risk–benefit ratio of polypectomy is increased.

In 2005, a USA focused working group published guidance on management strategies²⁷ for asymptomatic screening patients, including referral of patients with polyps ≥6 mm in diameter for polypectomy, and 5–10 year surveillance if no lesion 6 mm or larger is detected. Subsequently, the European Society of Gastrointestinal Radiology also recommended reporting polyps of ≥6 mm, with recommendations for polypectomy subject to local agreement.²⁸

The recently developed CT colonography standards⁷ provide further guidance, emphasising the importance of individualised management strategies depending on a patient's specific circumstances and locally available resources. The authors strongly support the recommendation for patient management strategies to be developed jointly between a cohesive local team

comprising gastroenterologists, radiologists, pathologists and surgeons.

How accurate is CT colonography?

In the first part of this decade, there were three published prospective multicentre studies examining CT colonography performance^{5,29,30} for examinations undertaken between 2000 and 2003. These reported widely variable performance data, with two studies showing relatively poor polyp sensitivity but using older scanner technology and CT protocols, inexperienced readers, manual colonic insufflation and investigator bias (led by gastroenterologists).³¹ However, the largest of these studies, led by Pickhardt (a radiologist), was a landmark in the evolution of CT colonography with excellent performance (large polyp sensitivity 94%) equivalent to expert colonoscopy in a screening patient population²⁹ (table 1).

Kim *et al* subsequently published a study in the *New England Journal of Medicine*³² of two cohorts (approximately 3100 patients in each group) undergoing either screening CT colonography or optical colonoscopy which showed no significant difference in yield of polyps (with higher yield of invasive cancer in the CT colonography cohort, 14 vs 4) but a better safety profile (no significant complication for CT colonography versus seven perforations in optical colonoscopy group; perforation rate for colonoscopy of 0.2%).

Recently, there have been two major studies (see table 1); the first (2531 patients), an intraindividual comparison of CT colonography and colonoscopy (patients undergoing both tests) in asymptomatic screening patients from the USA⁶; and the second, a UK based multicentre randomised comparison of CT colonography and standard investigation (barium enema or colonoscopy determined by individual clinician preference).³³ Notably, the UK study provides level 1 evidence of equivalent performance between CT colonography and colonoscopy for detection of cancer and large polyps (>10 mm). Furthermore, complete colonic wall visualisation was significantly better for CT colonography than colonoscopy with examination completion rates of 4% versus 7% (Halligan S, BSGAR Annual Meeting Bristol, 2010). In addition, CT colonography detected significantly more cancers

Table 1 Summary of major CT colonography trials performance data

Study	Patient population	Study size (n)	Per patient sensitivity (%) 6–9 mm polyps	Per patient sensitivity (%) ≥10 mm polyps
Pickhardt <i>et al</i> ²⁹	Screening	1233	89	94
Cotton <i>et al</i> ⁵	Symptomatic or history of polyps	615	39	55
Rockey <i>et al</i> ³⁰	High risk or family history	614	51	59
Johnson <i>et al</i> ⁶	Screening	2531	78	90
Halligan <i>et al</i> SIGGAR 2010 (presented at BSGAR 2010)	Older, symptomatic population	5025	CT colonography detected an equivalent number of cancers and large polyps compared with colonoscopy, and significantly more when compared with barium enema	

and large polyps than barium enema. The authors acknowledge these data are yet to be subject to peer review but the rigorous methodology employed suggests these data are robust.³³

Flat polyps

Performance characteristics of CT colonography for detection of flat neoplasia are very difficult to ascertain from the literature due to the wide variation in the definition of 'flat' used. The Paris classification (polyp height <2.5 mm) approximates to a widely accepted definition in the radiology community²⁷ of <3 mm. This avoids categorisation of 'sessile polyps' as flat simply because their height is less than half the width (eg, a 30 mm diameter polyp would be classified as flat even though it protrudes up to 15 mm from the surrounding mucosa). Detection of truly flat neoplasia, where there is no protruding component from the surrounding mucosa, is virtually impossible. However, minimally elevated polyps (or those undermining the mucosa due to submucosal invasion) are often detectable with a meticulous examination technique and experienced interpretation (figure 4).

When the definition of flat polyps is restricted to polyp height equal to or less than half polyp width, performance characteristics for CT colonography are potentially very good. Pickhardt showed that CT colonography sensitivity for detecting flat polyps was 80%, similar to that of polypoid lesions (81%) in a series of 1233 asymptomatic screening patients.³⁴ However, Park *et al* reported a series of 23 flat lesions (defined by the Paris classification) and showed that while nine of 10 (90%) flat cancers were detected, only three of eight (38%) flat adenomas (9–30 mm diameter) were found.³⁵

Flat polyps and cancers can be very challenging for both CT colonography and standard optical colonoscopy. For patients who are high risk for flat and subtle neoplasia (eg, those with a genetic predisposition or colitis surveillance), a collaborative approach between radiology and gastroenterology will help ensure that

these patients are initially investigated by expert endoscopy, utilising advanced mucosal visualisation techniques.

Is there still a role for barium enema?

Double contrast barium enema is a very well established technique across most populations but sensitivity and specificity for cancer and large polyps is increasingly considered inadequate. Winawer *et al* in 2000³⁶ showed barium enema sensitivity was approximately half that of expert colonoscopy (53% for 6–10 mm lesions, 48% for >10 mm). A recent meta-analysis³⁷ also showed CT colonography has better sensitivity and specificity for polyps (>5 mm diameter) than barium enema (optical colonoscopy as reference standard). Colorectal cancer detection rates of 85% have remained static in the UK for 15 years^{38,39} but new data from Special Interest Group in Gastrointestinal and Abdominal Radiology (SIGGAR) 1 have shown CT colonography detects significantly more cancers than barium enema (Halligan S, BSGAR Annual Meeting Bristol, 2010).

Patient experience is significantly better with CT colonography than barium enema, with patients preferring CT colonography for subsequent examination.^{40,41} This is perhaps unsurprising given that barium enema requires a wider bore, stiff rectal catheter and the patient must retain a high density liquid enema while undergoing frequent repositioning on a relatively hard examination table.

For patients testing positive to faecal occult blood test in the English Bowel Cancer Screening Programme, the current algorithm recommends barium enema for those unable to undergo colonoscopy. However, following the recent publication of CT colonography standards,⁷ new guidance will recommend CT colonography as the preferred alternative test.

In response to the above, centres are actively replacing older fluoroscopy equipment with additional CT capacity while retraining their barium enema radiographers in CT colonography technique.

Figure 4 A 3 cm flat polyp in the caecum (subsequently confirmed as granular-type laterally spreading tumour following endoscopic removal) detected by CT colonography in a patient with anaemia. Notably, extracolonic review also revealed a left renal cell carcinoma (histology confirmed subsequently following surgical removal), the more likely cause for anaemia in this patient. (A) Two-dimensional 'axial' demonstration of flat adenoma as irregular mucosa with margin shown by red bracket and arrow. (B) Three-dimensional display of polyp. (C) Coronal reformatted CT image of left renal carcinoma (red circle).

Who should report CT colonography?

Since its inception, there has been interest among non-radiologists for reporting CT colonography; firstly, by gastroenterologists made aware of similarities between virtual three-dimensional endoluminal fly through and optical colonoscopy displays; and then by radiographers, who in some centres, currently independently report barium enemas and potentially offer a cost effective alternative to radiologists.^{42 43}

A statement by the American Gastroenterology Association in 2006⁴⁴ declared that colonic investigation is the domain of gastroenterologists, irrespective of modality. This statement also advised that radiologists should not be reimbursed for CT colonography, only gastroenterologists. It was followed by a CT colonography standards document for gastroenterologists, published in 2007.⁴⁵ On the face of it, this stance potentially undermines the otherwise excellent relationship between radiology and endoscopy and undervalues the role of radiology in developing CT colonography. However, such an approach most likely relates to local turf battles in one specific health environment rather than the view of gastroenterologists in general.

The authors support the recent international CT colonography standards⁷ which represents a collaboration of all key stakeholders from countries across the world (including the British Society of Gastroenterology). These state that a radiologist should be responsible for the final CT colonography report. The reasons for this position are outlined in table 2.

Nevertheless, it is widely acknowledged that current core radiology training is insufficient for achieving competence (independent CT colonography reporting) and therefore specific additional 'hands on' training is recommended as a prerequisite prior to offering a service.

Enthusiasm for radiographer reporting has dampened a little, with published data showing lower accuracy for trained radiographers compared with experienced radiologists.⁴³ However, increasing experience and availability of training for radiographers may indicate a reporting role in the future. Undoubtedly,

radiographers are pivotal for running a high volume, high quality service by performing the examination itself and undertaking initial examination review to detect cancer (requiring same day staging and endoscopic biopsy) and to ensure optimal distension, before the patient leaves the examination room.

Training and accreditation

A detailed review of training needs and a debate about the need for accreditation is beyond the scope of this article. However, it is self evident that the recent publication of standards⁷ is step one to developing a robust quality assurance programme for CT colonography. CT colonography is now part of the core curriculum for radiology training in the UK and this is likely to occur in other countries. However, there are currently insufficient trainers with the necessary experience and skills to respond to this demand. A significant number of 'hands on' workshops have trained delegates over recent years and feedback suggests these provide an excellent learning environment (case review on computer workstations using a wide selection of endoscopically validated CT colonography examinations). Nevertheless, a more strategic approach is required to ensure high quality training occurs throughout the UK, in day to day clinical practice. Lessons can be learnt from the UK's national endoscopy training programme and will help inform a sustainable plan. Aligned to the training programme will be a need to collect data for key performance indicators, which in turn can be derived from published standards.

Is CT colonography really safe?

Potentially serious adverse events are rarely encountered at CT colonography, with no reported deaths or cardiovascular events (myocardial infarction or cerebrovascular accident). However, perforation does occur; for symptomatic patients, a perforation accompanied by symptoms, such as abdominal pain, occurs in approximately 1 in 3000 patients⁴⁶ and appears less frequently in asymptomatic patients undergoing a screening examination, with no reported cases in a US series of 11 707 examinations.⁴⁷

Notably, CT colonography is exquisitely sensitive for detection of extraluminal gas and most cases of perforation are either asymptomatic or have minimal symptoms with no requirement for surgery. This raises a question about the true incidence of perforation at colonoscopy or barium enema for comparison, given that asymptomatic perforation will likely be missed at both.

Risks associated with ionising radiation assume a linear relationship between dose and effect although there is an ongoing debate among physicists of whether very small doses (encountered in medical diagnostics) cause any harm, or may actually confer benefit to patients.⁴⁸ Little evidence exists for risks below 100 mSv. A multicentre study⁴⁹ reported the estimated effective dose for CT colonography from 24 European institutions

Table 2 Why CT colonography requires radiologists to provide the final report

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- ▶ CT colonography involves use of ionising radiation (requiring IRMER certification)
 - ▶ Interpretation is contingent upon rapid troubleshooting of three-dimensional displays with two-dimensional multiplanar reformatted CT images to achieve accurate interpretation
 - ▶ Extracolonic organs require thorough review for pathology which may be simulating colon cancer
 - ▶ Modification of CT protocols according to an individual's specific condition—for example, use of intravenous contrast—and its associated risk/benefit profile require combined medical/radiology experience (ie, the radiologist)
-

to have a median value of 9.1 mSv for symptomatic patients and 5.7 mSv for asymptomatic patients (where intravenous contrast is not utilised and therefore dose parameters can be decreased). These doses are likely to decrease further over time as centres acquire newer generation CT scanner technology. This compares with background radiation in the UK of approximately 2.5–3 mSv although background radiation of greater than 10 mSv is encountered in many populated areas elsewhere in the world.

Accurate assessment of lifetime risk is therefore complex but it has been estimated that a radiation dose of 5–8 mSv (typical of CT colonography in symptomatic patients) at age 50 years produces a lifetime risk of death from cancer of 0.02–0.03%. This equates to a theoretical risk of 1/5000 to 1/3500,⁵⁰ with risk declining dramatically with older age.

Several CT colonography studies^{51–52} have aimed to reduce radiation dose while preserving polyp detection accuracy. Iannaccone and colleagues⁵¹ reported detection rates of 95% for polyps >8 mm with a total effective dose of 0.9 mSv, similar to doses used by other groups.⁵² It is clear that while the risk of radiation is unclear, dose should be kept as low as reasonably achievable. In comparison, barium enema doses vary greatly due to technique but the figure for a typical effective dose given by the Health Protection Agency is 7 mSv.⁵³ Furthermore, CT colonography protocols should be individualised depending on the target of the examination ('colon only' versus 'colon and extracolonic organs', the latter frequently requiring intravenous contrast, which in turn requires higher dose), patient age and overall risk/benefit of the examination. For asymptomatic patients, dose should be kept very low for most patients although it may need to be increased for patients with greater body mass index.

Overall, CT colonography used appropriately in older patients appears to be relatively safe and therefore many centres offer CT colonography as a firstline test to older symptomatic patients or those with comorbidity. In addition, outside the English NHS, some patients will opt for CT colonography as a primary colorectal screening test (as 95% of examinations are normal),

particularly when same day endoscopy can be organised if cancer or a polyp is found. Of course, where available, patients may choose CT colonography over colonoscopy or vice versa, but either way they should be fully informed about the pros and cons and possible risks of both.

While there are limited data on the relative benefit of CT colonography compared with colonoscopy for sporadic colorectal cancer surveillance, interval CT colonography may be an attractive option for some patients. The incidence of significant yet covert colonic neoplasia (such as truly flat neoplasia) is low (eg, 0.91 per 1000 screened individuals in the UK⁵⁴) and CT colonography enables both colonic and extracolonic review for evidence of recurrence or metastatic disease. As a result, use of high quality CT colonography may be a safe, accurate and efficient strategy for some patient groups. Notwithstanding, young patients (<50 years) or patients with either inflammatory bowel disease or genetic predisposition to cancer will continue to warrant endoscopic surveillance.

Interaction between radiology and gastroenterology

Close collaboration between colonoscopy and CT colonography services is a natural step, given the complementary relationship of both examinations. Currently, physically and strategically aligned departments can offer patients 'same day' endoscopy for biopsy when cancer is found at CT colonography (figure 5) and conversely 'same day' CT colonography when colonoscopy is incomplete. Such a service avoids the need for repeat bowel preparation and a second hospital visit, thus improving diagnostic efficiency and patient experience.

Furthermore, CT colonography can help predict difficult colonoscopy and whether additional expertise or time will be required, perhaps where complex polypectomy is considered a likely outcome or the patient has a long tortuous colon downstream of the lesion. Such knowledge will help planning of more efficient therapeutic colonoscopy lists while improving the quality of patient consent.

Figure 5 Circumferential sigmoid cancer detected by CT colonography which underwent same day CT staging and endoscopy for biopsy confirmation. (A) Two-dimensional CT colonography image with long axis of cancer indicated by the yellow arrow. (B) Three-dimensional CT colonography. (C) Endoscopic displays of distal cancer margin with polypoid excrescence.

Finally, morphological information (eg, polyps with central depression have an increased likelihood of harbouring malignancy) can be provided to help determine appropriate waiting time intervals between CT and endoscopy.

The UK's All Party Parliamentary Group for cancer, recently reporting about socioeconomic and geographical inequalities in cancer morbidity/mortality, emphasised the need to improve speed of diagnostic pathways, patient experience and patient information. In support, the UK Secretary of State for Health (in December 2009) reinforced the new government led diagnostic waiting time target of 1 week (from GP referral to patient knowing the outcome of the test). It would therefore seem timely to consider expanding CT colonography capacity nationally while improving links between radiology and endoscopy to optimise diagnostic pathways (and perhaps also develop a combined interface for referral). Such a strategy would potentially improve access to rapid, whole colon investigation (diagnosis and same day staging) and use of minimal laxative regimens (without the need for sedation or intravenous cannulation), and may increase patient compliance. However, any new pathway would require thorough and formal evaluation.

Conclusion

CT colonography is now established as the preferred radiological test for detection of colorectal neoplasia and provides new opportunities for collaboration between radiology and endoscopy. The findings of SIGGAR 1 and publication of standards for CT colonography are fundamental to the evolution of CT colonography into a credible alternative firstline test to colonoscopy. However, the radiological community must now move rapidly to adopt quality assurance measures (adapted from those developed for endoscopy), backed by a robust training programme, to ensure CT colonography is truly generalisable across both academic and non-academic centres.

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