Diagnostic Imaging Pathways - Colorectal Cancer (Suspected)

Population Covered By The Guidance

This pathway provides guidance on the investigation of patients with symptoms and / or signs of suspected colorectal cancer.

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Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

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<tr>
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Pathway Diagram
**Colonic Polyp**

Image 1 (CT Colonography): Interior view of the colon showing a small colonic polyp.

**Rectal Carcinoma**

Image 2 (Computed Tomography): Thickened rectal wall with invasion of the mesorectal fascia on the right side (arrow). The mesorectal fascia on the left appears normal.

**Rectal Carcinoma**

Image 3 (Endorectal Ultrasound): Rectal carcinoma with infiltration into the
perirectal fat (T3 lesion).

Colonic Carcinoma

Image 4a: Right hemicolectomy specimen showing a large ulcerated and exophytic caecal carcinoma.

Image 4b (H&E, x2.5) and 4c (H&E, x10): Histological sections showing a moderately differentiated colorectal adenocarcinoma composed of malignant glands invading into the bowel wall (blue arrows). The glands are lined by cells showing marked nuclear atypia. Normal colonic mucosa is included for comparison (green arrow).

Teaching Points

- In patients with signs and/or symptoms suggestive of colorectal neoplasm, particularly those with moderate or high clinical pre-test probability, optical colonoscopy is the preferred initial investigation.
- CT colonography is a satisfactory and reliable alternative to optical colonoscopy, especially when there is a lower pre-test probability.
- In patients with contraindications to optical colonoscopy or sedation, or previous incomplete, difficult, or failed colonoscopy, CT colonography (also known as 'virtual colonoscopy') is the recommended investigation.

Suspected Colorectal Cancer (CRC)

- Patients with signs and symptoms of colorectal cancer, e.g. rectal bleeding, iron-deficiency anaemia, altered bowel habit, etc., should have an optical colonoscopy (OC) as the initial investigation where possible.
- Multiple symptoms warrant investigation 1.
- Major symptoms, their associated risks, and predictive values from systematic reviews 1,2,3
  - Rectal bleeding
    - In patients aged ? 50 years - pooled positive predictive value (PPV) 8.1%
    - Accompanied by
      - Weight loss - pooled positive likelihood ratio (PLR) 1.9
      - Change in bowel habit - pooled PLR 1.8
      - Constipation - pooled PLR ? 1
    - In patients with rectal bleeding, higher risk is associated when additional symptoms such as weight loss or change in bowel habit are present.
    - However, investigation of rectal bleeding in primary care is warranted irrespective of any other symptoms.
Anaemia
  - Pooled PPV 9.7%
  - Pooled PLR 3.67, specificity 95% but still only generates a post-test probability of 21.6%
  - Iron deficiency anaemia – specificity range 0.83 - 0.95, median 0.92

Abdominal pain
  - Pooled PPV 3.3%

Change in bowel habit
  - Pooled PLR 1.92

Weight loss
  - Pooled PLR 1.89
  - Specificity range 0.72 - 0.96, median 0.89

Diarrhoea
  - Pooled PLR ≥ 1

It is possible to stratify or triage patients according to their risk of CRC based on clinical criteria and subsequently ascertain the risks that the OC procedure would impose on these patients. This risk stratification would allow patients with high risk of CRC to be expedited for OC. Patients with lower risk, patients more likely to suffer from morbidity due to OC including the elderly, or patients with comorbidities and/or anticoagulants, may be directed to CTC. Although these prediction criteria are imperfect tools for highly precise discrimination between patients with and without CRC, this is not of paramount consequence since both high and lower risk stratified groups of patients will proceed to have an accurate examination, either with OC or CTC. The use of risk stratification is particularly important where there is limited availability of OC or pressures on resources relating to OC. This strategy would also allow frail elderly patients or those with significant co-morbidities to be stratified to undergo the less invasive CTC instead of OC.

**Optical Colonoscopy (OC)**

- Optical Colonoscopy (OC), commonly known as colonoscopy, is the first choice of investigation in the detection of colorectal cancer (CRC) as it provides high diagnostic performance.
- It enables the collection of biopsy samples and allows the operator to perform therapeutic polypectomy when indicated.

**Incomplete Optical Colonoscopy (OC)**

- In some instances patients are unable to complete an OC because they may have contraindications to OC that include:
  - Elderly and/or frail patients
  - Co-morbidities e.g. chronic lung or cardiac disease
  - Anticoagulant therapy (relative contraindication)
  - Previous incomplete or difficult OC
- Patients with tumor related stenosis, older patients, and those with co-morbidities are more likely to have an incomplete or difficult colonoscopy.
- Incomplete colonoscopy has been reported as occurring in 10 - 15% of all colonoscopies.
- Some of the factors associated with incomplete colonoscopy are:
  - Incomplete bowel preparation – in this case repeat colonoscopy is usually considered over
referral for radiological studies

- Increased age per 10 year increment after age 50 years – Odds ratio (OR) 1.2
- Female sex – OR 1.35
- Prior abdominal surgery – OR 1.07
- Prior pelvic surgery – OR 1.04
- Procedure being done in a private clinic/office – OR 3.57

Several studies have investigated CTC as a completion procedure after failed OC and have shown high technical feasibility, relatively high diagnostic yield, and an adequate positive predictive value (PPV), especially at a 10mm threshold 12

CTC is recommended over double contrast barium enema (DCBE) following an incomplete colonoscopy

**OC Contraindicated or Unavailable**

- Contraindications to OC include
  - Elderly and / or frail patients
  - Co-morbidities; e.g. chronic lung or cardiac disease
  - Anticoagulant therapy (relative contraindication)
  - Previous incomplete or difficult OC

**Computed Tomography Colonography (CTC)**

**Indications and Techniques**

- CTC or ‘virtual colonoscopy’ is a minimally invasive imaging examination of the entire colon and rectum using CT to acquire images that can be processed and displayed into 2D and 3D fly-through models for interpretation 13
- CTC has been widely accepted by the radiological community as a reliable imaging tool that detects colorectal lesions 14
- When Optical colonoscopy (OC) is not possible in symptomatic patients, CTC is the next recommended study to investigate suspected colorectal cancer (CRC) 12
- CTC is indicated in the following circumstances
  1. For total colonic evaluation in patients who have had incomplete colonoscopy
  2. In patients with an obstructing carcinoma to rule out a more proximal synchronous lesion
  3. In patients who are unsuitable for colonoscopy i.e. patients medically unfit for sedation, anticoagulated patients, or patients who have had previous difficult colonoscopy
- CTC is contraindicated in acute colonic inflammation and active abdominal conditions including active diverticulitis or inflammatory bowel disease, and in patients who have had recent colorectal surgery with a bowel anastomosis due to the increased risk of perforation 12,15
- CTC is advantageous as it can be performed without sedation, avoiding the potential morbidity of OC 16
- In patients with incomplete OC and / or known CRC, it enables complete assessment of the colon, examination of all abdominal organs, and enables oncological staging for metastatic disease with the use of regular dose CT protocols, commonly known as ‘one-stop shop’ protocols 9
- Historically, patients undergoing CTC have been required to complete adequate bowel preparation prior to this imaging study, a practice similar to preparing for colonoscopy 13
- However, in recent years, novel techniques have been introduced requiring limited or minimal bowel purgation, with labeling of residual stool and fluid by means of oral contrast media and electronic subtraction of the tagged material 17,18,19,20
Such stool tagging with barium and/or iodine based oral agents is becoming more widely used to help decrease the false-positive findings of retained stool, which can mimic polyps. The reduced need for cathartic preparation in CTC may also offer patients a better experience and increase patient acceptability of CTC. Adequate colon distension is achieved by air or carbon dioxide insufflation via the rectum with or without parenteral administration of spasmolytic agents. CT acquisition is usually performed in both supine and prone positions to optimise the distention of the various colon segments depending on gravitational compression by surrounding abdominal structures, as well as to distinguish polyloid lesions that may be fixed to bowel walls from fluid and/or faecal residues.

**Accuracy of CTC**

Systematic reviews and meta-analyses have indicated that CTC and colonoscopy have similarly high sensitivities for detection of colorectal cancer – CTC sensitivity is 93-97% and specificity is 97%, especially when both cathartic and tagging agents are used. In comparison, the sensitivity of OC for detection of CRC is approximately 95%. The per-patient sensitivity and specificity of CTC in the detection of CRC and significant polyps > 10mm are 85-93% and 97-99% respectively. In the landmark SIGGAR trial in Europe the detection rates of CRC were similar in both CTC and OC cohorts of symptomatic patients. CTC should replace the use of double contrast barium enema (DCBE) as it is superior in sensitivity, specificity, tolerability and delivers a lower effective radiation dose than DCBE.

**Complications of CTC**

**Perforation**

CTC has a low rate of serious complications, particularly perforation of the large bowel. In a recent meta-analysis, the perforation rate of CTC was low at 0.04% in symptomatic patients and as low as 0.002% in asymptomatic subjects, with the overall CTC-induced surgical rate of 0.008%. Most patients with free intra-peritoneal gas following CTC remain asymptomatic and do not require therapeutic intervention. In contrast, the incidence of perforation after diagnostic OC may be higher, ranging from 0.016% to 0.2%. DCBE may also have a higher perforation rate ranging from 0.02-0.24%. This perforation rate following OC may be an underestimate because a number of asymptomatic patients with intra-peritoneal gas may go undetected, as they do not routinely proceed to imaging studies immediately after colonoscopy. The predisposing factors for perforation in CTC are male, older age, symptoms suggestive of CRC, recent biopsy during OC, active inflammatory bowel disease, diverticular disease, obstructing carcinoma, inguinal hernia, and use of rectal tube or rectal catheter with balloon, and air insufflation.

**Ionising Radiation**
CTC employs ionising radiation; therefore there is a radiation-related cancer risk. Currently most centres use low radiation dose CTC protocols that are similar to or less than the dose estimates of DCBE, usually between 5-10mSV – particularly low-dose protocols are employed for screening CTC. It is estimated that an effective body dose of 10mSv may be associated with an average excess risk of induction of a fatal cancer of approximately 1 in 2000. This risk is roughly doubled in young patients and halved in older patients. In older patients the risk is decreased due to the lag time to induction of cancer – up to nearly 10 years – that may be longer than their life expectancy. In symptomatic and often elderly patients with suspected CRC, the risk of ionising radiation dose from a diagnostic CTC may be considered of no relevance.

Other Imaging Modalities

In general, other emerging imaging modalities require further studies before they can be validated for use in current clinical practice. The following are some examples of these emerging modalities.

Magnetic Resonance Colonography (MRC)

MRC is a method of examining the colon similar to CTC, however, this study uses Magnetic Resonance Imaging (MRI), does not require ionising radiation, and would be preferable especially for screening purposes. One systematic review demonstrated that MRC sensitivity and specificity for per-patient detection of large polyps ≥ 10mm were 88% and 99% respectively. In per-polyp analysis, the estimated summary sensitivity of detecting polyps ≥ 10mm was 84% and the sensitivity for detecting CRC overall was 100%, however the data were too heterogeneous for polyps in the 6-9mm and < 6mm categories. While other recent studies have also demonstrated that MRC is accurate for the detection of CRC and large polyps, it still does not compare favourably against CTC due to the lack of evidence, inability to examine polyps 6-9mm, and its relative cost.

Colon Capsule Endoscopy (CCE)

CCE is an innovative, non-invasive, painless technique using an ingestible capsule colonoscopy that enables the colon to be explored without sedation or gas insufflation. CCE sensitivity of 76% for cancerous lesions is sub-optimal when compared to colonoscopy and CTC, however its advantage is that it is not associated with the risk of radiation-related cancer. Further research is required to validate this modality as a reliable investigation for CRC.

Double Contrast Barium Enema (DCBE)

DCBE requires the administration of high-density, low-viscosity barium and air or carbon dioxide into the colon to produce a double-contrast effect in which a thin layer of barium coats the mucosa while the lumen is distended with gas. Relatively few studies have assessed the performance of DCBE alone or in comparison with other methods since its inception in clinical practice in 1923. DBCE continues to be a valuable, generally safe, cost-effective and reliable adjunct imaging tool that can be performed where colonoscopy is unavailable or cannot be completed due to patient factors or technical factors.
However, there is general expert consensus and evidence that DCBE should be superseded by CTC \cite{7,26,35}. CTC is superior to DCBE in sensitivity, specificity, tolerability, and delivers a lower effective radiation dose than DCBE \cite{12}. It is likely that DCBE will gradually become obsolete, however, it remains a reasonable alternative to CTC when this is unavailable. DCBE has been associated with rare but serious complications such as colon perforation and barium peritonitis \cite{25,29}. The incidence of perforation from DCBE is 0.02-0.24\% and may be due to traumatic insertion of the rectal tube in preparation for the procedure, barotrauma due to over inflation of the intra-rectal retention balloon, and may also occur in patients with friable colon secondary to various causes such as bowel ischaemia, corticosteroid use, or recent deep colonic biopsy \cite{25,29}. Radiation-related cancer risks due to DCBE are likely similar to those associated with CTC because effective radiation dose estimates between the two methods are comparable \cite{25}

**No Cancer**

- The sensitivity of CTC for colorectal cancer is 96-97\% \cite{21,22}.  
- Per-patient NPV of a negative CTC for advanced neoplasia proximal to a stenosing cancer is 97\% \cite{37}

**Follow-up As Indicated**

- If the patient has suspected CRC and the completed OC demonstrates no CRC, seek further advice from the colonoscopist or clinician.  
- The colonoscopist or clinician may recommend follow-up or other investigations as appropriate to the clinical presentation or patient-specific issues for diagnosis; for example, the colonoscopist may suggest an endoscopy to investigate upper gastrointestinal causes of symptoms if concerned about ongoing mixed bright and dark red rectal bleeding.

**Follow-up As Indicated**

- Follow-up in these situations is dependent on the main reasons for performing the CTC.  
- If the CTC is performed as a primary investigation in a reasonably fit patient due to contraindications to OC or because OC is unavailable, the follow-up for the following are \cite{38}:
  - Normal CTC  
    - Routine screening program depending on whether patient is clinically considered high or low risk.  
    - For polyps ≥10mm diagnosed at CTC  
      - Colonoscopic polypectomy is advised where possible (dependent on age, co-morbidities, etc.), otherwise seek further advice from either a gastroenterologist or surgeon.  
  - For polyps 6-9mm diagnosed at CTC  
    - Options are dependent on whether patient has increased risk of developing CRC
      - If ≥three synchronous 6–9mm polyps are detected at CTC, proceed to therapeutic colonoscopy with polypectomy where possible, otherwise seek further advice from either a gastroenterologist or surgeon.
If no advanced adenomas are found during this polypectomy and patient has no increased risk, proceed to surveillance CTC every five years or seek advice from the colonoscopist

- If < three synchronous 6-9mm polyps are detected at CTC and patient has no increased risk, proceed to interval surveillance CTC – can be delayed up to three years
- For polyps ≤ 5mm diagnosed at CTC
  - Usually follow routine screening program unless ≤ three polyps, in which case follow-up as per recommendation for ≤ three 6-9mm polyps (see above)

- If the CTC is performed as a secondary investigation due to incomplete OC or failed OC and no CRC is identified on this imaging study, follow-up may be recommended by either a gastroenterologist or surgeon as appropriate to the clinical presentation or patient-specific issues
  - For example, the patient may be symptomatic, unwell or haemodynamically unstable, frail with co-morbidities, etc
  - Depending on the clinical situation, other imaging modalities or investigations may need to be considered for diagnosis

Completion Computed Tomography Colonography (CTC)

- May be delayed after the incomplete OC, or may be performed on the same day as the incomplete OC
- However, if a polypectomy has been performed that day during the incomplete OC, delay the completion CTC for 2 weeks

References

Date of literature search: December 2015

The search methodology is available on request. Email

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document


22. Halligan S, Altman DG, Taylor SA, Mallett S, Deeks JJ, Bartram CI, et al. CT colonography in the...


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<table>
<thead>
<tr>
<th>Information from this website</th>
<th>Information from the Royal Australian and New Zealand College of Radiologists’ website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consent to Procedure or Treatment</td>
<td>Computed Tomography (CT)</td>
</tr>
<tr>
<td>Colorectal (Bowel) Cancer Screening</td>
<td>Contrast Medium (Gadolinium versus Iodine)</td>
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<td>Radiation Risk of Medical Imaging for Adults and Children</td>
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<td>CT Colonography</td>
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