Article published online: 2023-03-06

Imaging Recommendations for Diagnosis, Staging, and Management of Small Bowel and Colorectal Malignancies

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Ind J Med Paediatr Oncol 2023;44:71–76.

Abstract

Small bowel malignancies are rare, though colorectal cancers are common. This article reviews the current imaging recommendations for small bowel and colorectal malignancies. Contrast-enhanced computed tomography (CT) is the imaging modality of choice for diagnosis/staging/response evaluation/follow-up of the small bowel and colonic tumors. Magnetic resonance imaging of the pelvis with high-resolution T2-weighted images in sagittal, oblique axial, and coronal planes is the imaging modality of choice for staging/response evaluation of anorectal tumors. CT colonography may be utilized as a tumor screening modality, alternative to colonoscopy.

Keywords
- bowel malignancies
- gastroenterology
- general surgery
- radiology
- recommendations

Introduction

Small and large bowel tumors are a large heterogeneous group of malignancies with variable presentation and prognosis. We provide a review of various consensus guidelines and imaging recommendations for diagnosis as well as follow-up of bowel malignancies.

Risk Factors and Etiopathogenesis

While most cancers are sporadic, syndromes like familial adenomatous polyposis, Lynch syndrome, and Peutz-Jeghers syndrome have a predilection for gastrointestinal (GI) tumors. Other risk factors include old age, male gender, obesity, inflammatory bowel disease, celiac disease, decreased fiber in diet, alcohol, red or processed meat, smoked food, tobacco, human immunodeficiency virus (HIV) infection, and long-term immunosuppression.[1,2] Adenocarcinoma is by far the most common tumor, with carcinoid, gastrointestinal stromal tumor (GIST), squamous cancer (anal canal), lymphoma, non-GIST sarcoma, and metastasis being the other potential tumors.[1,2] The guidelines below pertain predominantly to adenocarcinoma.

Epidemiology and Clinical Presentation

Large bowel tumors are quite common, accounting for approximately 10% of all cancers in the world.[3] Small bowel

DOI https://doi.org/10.1055/s-0042-1759713.
ISSN 0971-5851.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

tumors are relatively rare, forming less than symbol 2% of all GI tumors.[1] Small bowel tumors are often clinically silent for long, presenting with vague abdominal pain, nausea, vomiting, melena, and weight loss.[1] Colorectal tumors usually present with altered bowel habits, iron-deficiency anemia (especially right colonic primaries), obstruction, and rectal bleeding. Patients with colorectal cancer usually present between 60 and 80 years, while small bowel tumors present a decade earlier. Patients with signet cell cancers may, however, present in the second to fourth decades of life.[1,2,4]

Small Bowel Malignancies

Screening

No imaging study is recommended for screening individuals for small bowel malignancies. Patients with Crohn's disease may undergo regular magnetic resonance imaging/computed tomography (MRI/CT) for evaluating the disease activity status and to look for complications.

Diagnosis and Staging

A single-phase contrast-enhanced CT (CECT) of the thorax, abdomen, and pelvis with oral contrast is the investigation of choice for small bowel tumors (►**Table 1**).[1,5] CT enterography/enteroclysis may be performed if the primary is poorly appreciable with a standard CECT (National Comprehensive Cancer Network [NCCN], category 2A).

A contrast-enhanced MRI (CE-MRI) of the abdomen and pelvis with a noncontrast CT chest may be performed instead of the CECT in patients with a contraindication to iodinated contrast (NCCN, category 2A).

Magnetic resonance cholangiopancreatography may be performed for evaluating a duodenal primary, especially if there is obstructive jaundice (NCCN, category 2A).

MRI may also be used to further evaluate an indeterminate hepatic lesion observed on CT (NCCN, category 2A).

Positron emission tomography/computed tomography (PET/CT) is not recommended for baseline evaluation of small bowel tumors as per NCCN guidelines.[5] It may be used as a problem-solving tool in patients with equivocal CT or MRI findings, and in patients with discordantly high tumor markers and resectable disease on CT to look for occult metastases often detected in the peritoneum.

Barium or fluoroscopic upper GI studies are not performed.

Other Initial (Nonradiological) Investigations

These include upper GI endoscopy with or without endoscopic ultrasound (for proximal tumors), capsule enteroscopy, serum tumor marker levels (carcinoembryonic antigen [CEA] and carbohydrate antigen 19–9), and biopsy (usually image-guided).

Response Assessment and Follow-Up

In patients with metastatic disease, treatment response should be assessed with a CECT of the thorax, abdomen, and pelvis (NCCN, category 2A).

Table 1 Reporting format for small bowel and colonic tumors

Primary tumor	
Lesion	● Visible
	● Not visible *(i.e., lesions endoscopically resected and subsequently characterized as cancer polyps)*
Site	● Duodenum
	● Jejunum (proximal, distal)
	● Ileum (proximal, distal)
	● Cecum
	● Ascending colon
	● Hepatic flexure
	● Proximal transverse colon
	● Distal transverse colon
	● Splenic flexure
	● Descending colon
	● Sigmoid colon
	● Rectosigmoid junction
Type	● Stenosing
	● Intraluminal polypoidal
	● Infiltrating
	● Other combinations
Size	In two dimensions (D1*D2)
T stage	T2
	T3
	T4a
	T4b (specify organ/s)
Associated findings	Bowel obstruction, perforation, ascites, peritoneal thickening,
Lymph node status	
Locoregional	Yes/no
	If yes: - N1a - N1b - N1c - N2a - N2b Site:
Distant metastases	
Distant metastases	Yes/no If yes:
	- M1a - M1b - M1c
	Specify Liver: Yes/no, Number, size, site, relationship with vascular and biliary structures, and liver hilum and other organs Lung: Yes/no, number, site, size
	Other organs including nonlocoregional lymph nodes
Final stage (TNM)	

Source: Modified from Granata V, Faggioni L, Grassi R, et al. Structured reporting of computed tomography in the staging of colon cancer: a Delphi consensus proposal. Radiol Med. 2022;127[1]:21–29. doi:10.1007/s11547-021-01418-9

PET/CT may have a role in patients with rising tumor markers and a normal CECT study.

Surveillance CECT thorax, abdomen, and pelvis is recommended for patients who have completed curative treatment, similar to the colorectal primary, although enough data on this is lacking. This entails a 6 to 12 monthly surveillance scan for the first 2 years, followed by annual surveillance for 5 years.[2,5]

Principles of Management

Surgery with adequate regional nodal clearance is the bedrock of treating small bowel adenocarcinomas. If the patient has unresectable or metastatic disease, chemotherapy/chemoradiation and a palliative diversion if the patient has obstruction is offered.

Colorectal Malignancies

Colorectal carcinoma is the third most commonly diagnosed malignancy in males and the second most common in females worldwide.[6] It is a major cause of cancer-related morbidity and mortality. Imaging forms an integral part of the screening process as well as the staging of the tumor.

Diagnostic Workup

Right-sided colon cancers usually present with occult blood in stool or iron deficiency anemia, whereas left-sided colon and rectal cancer patients present with features of altered bowel habits, bowel obstruction, or frank bleeding per rectum. Digital rectal examination has a high positive predictive value for the presence of rectal tumors in symptomatic patients. Colonoscopy is usually the first investigation performed, which can visualize the tumor and also facilitate biopsy of the lesion. Serum tumor markers like CEA have low sensitivity and specificity due to significant overlap with various benign entities. However, it can provide important prognostic information and is useful in the follow-up of patients after surgery. A preoperative serum CEA level more than 5 ng/mL indicates a poor prognosis.

Imaging Guidelines

Screening

CT colonography is considered an appropriate screening modality in patients with average and moderate risk of colon cancer with efficacy similar to colonoscopy.[7] It can be repeated every 5 years after an initial negative screen.

Diagnosis

Colonoscopy or sigmoidoscopy helps to localize the tumor in a suspected patient. It also provides guidance for obtaining a biopsy that provides the histopathological diagnosis. It also helps in localizing synchronous tumors, which are not infrequent. CT colonography with adequate bowel preparation can be used for initial diagnosis in intolerant patients or those with tight strictures that do not allow the scope to pass proximal to the site of obstruction.[8]

Table 2 Reporting format for anorectal cancer

Technical details	Use of rectal gel for distension—Yes/no
Tumor visible	Yes/no
Site of tumor	Rectum: upper, mid, lower Anal canal
Distance of lowest tumor margin from anal verge	____ mm / Cannot be measured
Distance of lower tumor margin from anorectal junction	____mm / Cannot be measured
Anterior peritoneal reflection	Involved/ uninvolved
Circumferential tumor location	Completely encircling / Partial (describe 'o clock position)
Longitudinal tumor size	____mm
Shortest tumor distance from mesorectal fascia/levator ani	____mm
Sphincter involvement	Yes/no
Adjacent organ involvement	Yes/no Mention the organ/s involved
Mesorectal lymph node	Yes/no Number and size of nodes
Extramesorectal lymph node spread	Yes/no Number, site, and size of nodes
Extramural venous invasion	Yes/no
Report distant metastases	

Source: Modified from KSAR Study Group for Rectal Cancer. Essential Items for Structured Reporting of Rectal Cancer MRI: 2016 Consensus Recommendation from the Korean Society of Abdominal Radiology. *Korean J Radiol*. 2017;18[1]:132–151. doi:10.3348/kjr.2017.18.1.132.

Staging

- CECT of chest, abdomen, and pelvis should be obtained in all patients with colorectal cancer for the purpose of staging.[8,9] In cases of colon cancer, local extent, as well as distal staging, can be ascertained through a single CT acquisition (►**Table 1**) (European Society for Medical Oncology [ESMO] level 2)[1].
- Pelvic MRI is required for local T and N staging in primary rectal tumors (►**Table 2**).[10] Screening T2-weighted and diffusion-weighted imaging of the liver and retroperitoneum can be done along with to obviate the need for CECT abdomen and pelvis (NCCN category 2A).
- PET/CT is not routinely indicated but can be done as a problem-solving tool to evaluate equivocal findings.

Response Assessment

- A restaging CT chest, abdomen and pelvis should be done after neoadjuvant therapy to determine the resectability of the disease.[9,10] MRI pelvis is also required in addition to CT in patients with rectal carcinoma to look for T and N status. MRI tumor regression grading system has been proposed

Table 3 MRI tumor regression grade

MRI tumor regression grade		
Tumor regression grade 1	Complete response	No residual tumor
Tumor regression grade 2	Good response	> 75% fibrosis with minimal residual tumor
Tumor regression grade 3	Moderate response	>50% fibrosis/mucin with obvious residual intermediate signal intensity tumor
Tumor regression grade 4	Slight response	significant residual tumor with little fibrosis/ mucin
Tumor regression grade 5	No response	No interval change in tumor

Abbreviation: MRI, magnetic resonance imaging.

for response assessment based on degree of fibrosis and residual tumor on post-treatment MRI (►**Table 3**). It has shown a good correlation with pathological tumor regression grade and can help in predicting survival outcomes.[6] PET/CT can be considered in cases of metastatic colon carcinoma for response assessment and recurrence after image-guided therapies like ablation or embolization.

Follow-Up

- Routine follow-up imaging is not recommended in patients with stage I colorectal cancer. For patients with stage II or III disease, CT chest, abdomen, and pelvis is recommended every 6 to 12 months for a period of 5 years (ESMO level 2).
- For stage IV disease CT chest, abdomen and pelvis should be done every 3 to 6 months for initial 2 years followed by 6 to 12 monthly scans up to a total of 5 years.[10,11]

Principles of Management

- In resectable colon cancer without evidence of obstruction, colectomy with en bloc removal of regional lymph nodes is performed. Resection with diversion or primary diversion/stenting followed by colectomy can be performed in patients having obstruction.
- In colon cancer, neoadjuvant therapy with FOLFOX/CAPEOX can be considered in patients with bulky nodes of T4b disease. Systemic therapy is given for inoperable and locally unresectable disease followed by reassessment.
- Resectable rectal cancer with T1 to 2 and N0 disease is managed with transanal or transabdominal resection followed by adjuvant therapy.
- In rectal cancer, neoadjuvant chemotherapy/RT followed by reassessment and surgery is preferred for patients with T3 to 4 disease, presence of nodal metastasis, and surgically inoperable disease.[9–11]

Recurrence

Recurrence can be detected by routine follow-up colonoscopy, imaging, or through elevation of CEA on serial examinations. CECT of the chest, abdomen, and pelvis should be done for suspected recurrence. A PET scan should also be considered to look for metachronous metastasis. Resection or locoregional therapies are preferred for resectable disease followed by adjuvant chemotherapy. For unresectable disease, systemic therapy can be given followed by a re-evaluation for conversion to resectable disease.

Lower Rectum and Anal Canal Malignancy

Tumors with a distal margin less than 5 cm above the anal verge or an epicenter 2 cm above the dentate line are classified as low rectal cancers.[12] Perianal cancers within 5 cm of anal verge are classified and staged as anal cancers.[13] Recommendations in this section pertains to low rectal adenocarcinomas (LRAC) and anal canal squamous cell carcinoma (ASCC).

Clinical/ Diagnostic Workup

Patients present with tenesmus, rectal bleeding, anorectal pain, nonhealing ulcer, discharge, fistula-in-ano, or fecal incontinence. Diagnosis is established with biopsy and histopathology. Recommended diagnostic workup for patients with LRAC includes digital rectal examination, clinical examination of the abdomen and the inguinal regions, colonoscopy and serum CEA levels.[14] In addition, patients with anal SCC require HIV screening and gynecological evaluation, including cervical cancer screening for women.[15]

Imaging Guidelines

Screening and diagnosis

Imaging has no role in screening of anorectal malignancies but may aid in diagnosis.

Staging

Imaging Referral Guidelines

- In biopsy-proven LRAC and ASCC, MRI pelvis is the recommended imaging modality for local staging (NCCN category 2A) (►**Table 2**).
- In patients with clinically suspected early LRAC (cT1), endorectal ultrasound can be done in addition to MRI pelvis to aid T-staging by assessing depth of invasion (NCCN category 2A).
- CECT of the thorax and abdomen is recommended for metastatic workup (ESMO level 3) (►**Table 2**).
- CEMRI of the liver may be appropriate for characterizing indeterminate liver lesions (NCCN category 2A).
- PET/CT is not recommended for staging LRAC.
- PET/CT may be considered for staging ASCC, especially for characterizing lymph node metastases that are not amenable for image-guided sampling and if such information will alter radiotherapy planning.[15,16]

Imaging Protocol Guidelines

- MRI pelvis with high-resolution T2-weighted images in sagittal, oblique coronal and oblique axial planes, parallel and perpendicular to the anal canal, is recommended for evaluating precise local anatomical extent.
- Sagittal T2 MRI is the recommended imaging plane for measuring tumor length and distance of the distal margin from the anorectal junction and anal verge.
- High-resolution axial T2-weighted MRI is recommended to identify the tumor quadrant, extramural spread, mesorectal fascia (MRF) infiltration, extramural vascular invasion (EMVI) and regional nodes.
- In LRAC, it is essential to identify and report the extent of involvement of the internal anal sphincter, external anal sphincter, the intersphincteric plane, and extrasphincteric extension into the ischiorectal fossa.
- Coronal high-resolution T2-weighted MRI is recommended to assess levator ani and puborectalis infiltration.
- In LRAC, involved MRF is defined as a distance of less than or equal to 1 mm between the primary tumor, EMVI, irregular pathological node or tumor deposit and the MRF, puborectalis or levator ani muscle. MRF is not involved if this distance is more than 1mm. The term "threatened MRF" is best avoided.
- Staging system used for LRAC is similar to colorectal cancer with the following additional considerations[17]:
  - Infiltration of internal anal sphincter and intersphincteric plane is reported as T1/2/3 based on the rectal component.
  - Infiltration of the external anal sphincter, puborectalis, levator ani, piriformis, obturator muscle is staged as T4b.
  - Infiltration of extramesorectal fat including ischiorectal fossa, infiltration of neurovascular structures of the pelvic sidewall is staged as T4b.
  - Regional nodes include mesorectal nodes, obturator, and internal iliac nodes. For LRAC extending into the anal canal below the dentate line, inguinal nodes are considered regional nodes (American Joint Committee on Cancer, 8th edition).

Response Assessment

- MRI pelvis is recommended for restaging LRAC 8 to 12 weeks following neoadjuvant chemoradiation and prior to surgery. Purpose of imaging in this setting is to exclude progression to decide on the possibility of sphincter preserving surgical procedure. In a select few patients, MRI facilitates decisions regarding deferral of surgery and watchful waiting (NCCN category 2A).[12,14]
- For ASCC, the optimal time for clinical tumor response assessment after chemoradiation is 6 months. Though response assessment in ASCC is mainly clinical, MRI pelvis is recommended prior to salvage surgery in patients with incomplete clinical response.[14,15]

Principles of Management

The primary aim of treatment of anorectal malignancies is to treat the primary, prevent recurrence, and provide the best possible quality of life.

Low Rectal Adenocarcinoma

- Local excision is a treatment option for select very early LRAC (cT1) without high-risk features.
- Early LRAC (cT2c/T3a/b) are treated with upfront surgery if negative margins can be achieved. Sphincter preserving operations can be performed provided there is sufficient margin and there are no clinical contraindications.
- Locally advanced LRAC (T3c and above) and for those with high-risk features such as involved MRF, EMVI are treated with neoadjuvant chemoradiotherapy (CRT) followed by surgery.
- Restaging MRI at 8 to 12 weeks following CRT is useful to exclude progression to decide on the possibility of sphincter preserving surgical procedures and organ preserving treatment options (deferral of surgery and watchful waiting).
- Surgical treatment consists of abdominoperineal excision (APE) or a low anterior resection.
- Patients with persistent infiltration of adjacent structures will need extended resections including pelvic exenteration.[12,14]

Anal Squamous Cell Carcinoma

- Curative intent CRT with a combination mitomycin C and 5-fluorouracil is the mainstay of treatment of ASCC.
- Patients with incomplete response to CRT are treated with salvage surgery that may be APE or pelvic exenteration.[16]

Follow-Up

- Most recurrences occur within the 3 years following treatment of LRAC. Thus, 6 monthly follow-ups with clinical examination and CEA are recommended for the first 3 years and annually till 5 years. CECT of the thorax, abdomen, and pelvis is recommended for surveillance in the following durations for completion of treatment: 6 months, 1 year, 2 years, 3 years, and 5 years.
- For ASCC patients who had an optimal clinical response at 6 months, follow-up is recommended annually for 3 years with CECT of the thorax, abdomen, and pelvis (ESMO level 2).
- MRI pelvis is recommended for treated LRAC and ASCC patients with confirmed pelvic recurrence when salvage surgery is being planned (NCCN category 2A).
- PET/CT is not recommended for routine follow-up of LRAC PET/CT may be considered in patients with negative CECT and raised tumor markers.[12,16]
- PET/CT may be appropriate to exclude extraperitoneal metastases in patients being considered for pelvic exenteration.

Summary of Recommendations

1. Screening with CT colonography may be utilized as an alternative to colonoscopy for colorectal screening. Screening for small bowel tumors is not recommended.
2. CECT of the chest, abdomen, and pelvis is the imaging modality of choice for staging/response evaluation/follow-up of the small bowel and colonic tumors.
3. MRI of the pelvis with high-resolution T2-weighted images in sagittal, oblique axial, and coronal planes is the imaging modality of choice for staging/response evaluation of anorectal tumors.
4. PET/CT is not routinely recommended for diagnosis or staging of bowel or anorectal tumors.
5. MRI liver can be used as a problem-solving tool in patients with indeterminate liver lesions and to map liver metastases prior to treatment planning.

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