Pattern based approach for differential diagnosis of small bowel neoplasms using MDCT

Poster No.: C-1400  
Congress: ECR 2014  
Type: Educational Exhibit  
Authors: P. Bhari Thippeswamy\textsuperscript{1}, C. Anuradha\textsuperscript{2}, A. Polimood\textsuperscript{1}, A. EAPEN\textsuperscript{3}; \textsuperscript{1}Vellore/IN, \textsuperscript{2}632004, Ta/IN, \textsuperscript{3}VELLORE, TAMILNADU/IN  
Keywords: Abdomen, Gastrointestinal tract, Small bowel, CT, Contrast agent-oral, Neoplasia, Pathology  
DOI: 10.1594/ecr2014/C-1400

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

1. Protocol for imaging small bowel neoplasms
2. Develop a pattern based approach to diagnose common small bowel neoplasms using CT
3. To review key imaging features of common and rare neoplasms of the small bowel.

Background

Small bowel accounts for nearly 75% of the alimentary tract, yet neoplasms are rare representing less than 5% of gastrointestinal tumours [1]. Many patients remain asymptomatic until late stage or may present with nonspecific symptoms which results in delay in clinical and radiological diagnosis. Dreaded consequence of delayed diagnosis is poor prognosis owing to aggressive nature of small bowel neoplasm. It is imperative that radiologist should have adequate knowledge of natural behaviour of small bowel tumours, histopathology, corresponding key CT imaging features for early diagnosis, differentiating and staging of various small bowel tumours.

By studying following characteristic features of the tumours and developing the pattern based approach we will be able to differentiate common small bowel tumours.

1. Site
2. Short segment vs. long segment
3. Obstructing vs. non-obstructing lesions
4. Concentric vs. eccentric/ exophytic
5. Homogenous vs. necrotic
6. Calcification
7. Adjacent mesenteric shortening
8. Nodal metastasis
9. Single or multi-focal

Findings and procedure details

Procedures details:

Small bowel is optimally distended using neutral or low density oral contrast mixture which is followed by abdomino-pelvic CT examination in venous phase after administering intravenous contrast. Patients are closely supervised and encouraged to drink 1.5-2 L of oral contrast in span of 45 - 60 min in order to achieve adequate small bowel distension.
CT enterography has a sensitivity of 85% and specificity of 97% for detecting small bowel neoplasms [2].

Imaging findings:

The salient CT features which help predict the nature of small bowel neoplasms are described below.

A. Site:

Although small bowel neoplasm can involve any segment of the small bowel, most of them have predilection for certain segments in which they commonly manifest [3] as shown in Fig. 1 on page 6.

B. Location in the bowel wall: Fig. 2 on page 6

Imaging features largely depend on the location of the lesion within the bowel wall [3].

Following is a brief classification of small bowel tumors according to the location in the bowel wall.

Submucosal: lipoma, hemangioma, lymphoma, schwannoma, neurifibroma, ganglioneuroma.

Mucosa - adenoma, adenocarcinoma, carcinoid

Intramural- leiomyoma, leiomyosarcoma, GIST

Extramural/serosal - metastasis

Mucosal and submucosal lesions tend to obstruct while intramural and serosal lesions are exophytic and are non-obstructing.

C. Short segment versus long segment involvement:

Coronal images are helpful in assessing the length of involvement [4].

Short segment involvement (<5cms) - Most of the small bowel neoplasms have short segment involvement eg adenocarcinoma, adenomas. (Fig. 3 on page 7)
Segmental involvement (6-40cms) is commonly seen in lymphoma and metastasis (Fig. 4 on page 8). Rarely metastasis to small bowel can be diffuse (>40cms). (Fig. 5 on page 9)

**D. Obstructive versus non obstructive lesions:**

Adenocarcinomas present as concentric transmural tumour with perivisceral desmoplastic reaction and abrupt transition between the normal bowel and tumour. This pattern of growth commonly results in obstruction. (Fig. 3 on page 7, Fig. 6 on page 9)

Lymphoma has long segmental involvement of bowel, which is circumferential and has gradual transition with the normal bowel wall.

Not usually associated with bowel obstruction, rather results in bowel dilatation some times aneurysmal. Aneurysmal dilatation of the bowel is due to infiltration of the myenteric plexus. [1] (Fig. 7 on page 10).

Hypomotility of the involved segment in lymphoma causes proximal bowel dilatation and there is no mechanical obstruction. [5] If lymphoma presents with bowel obstruction it is usually due to intussusception (Fig. 8 on page 10).

Carcinoid may result in obstruction secondary to bowel wall kinking due to extensive desmoplastic reaction[1].(Fig. 9 on page 11, Fig. 10 on page 16)

Lipoma, GIST, adenoma-are primary non obstructive lesions but can be lead points for intussusception and bowel obstruction. (Fig. 11 on page 11)

**E. Enhancement pattern:**

Enhancement pattern of the small bowel tumor is related to the vascularity and the cellularity of the tumor. [3]

- Markedly homogeneous - leiomyoma, adenoma, carcinoid (Fig. 11 on page 11, Fig. 12 on page 12)
- Marked heterogeneous - hemangioma and GIST (Fig. 13 on page 12, Fig. 14 on page 17)
- Mildly heterogeneous - adenocarcinoma, lymphoma (Fig. 3 on page 7, Fig. 6 on page 9, Fig. 7 on page 10)
- Non enhancing lesion - lipoma (Fig. 15 on page 12)
F. Homogenous versus necrotic:

- Homogeneous - Lymphoma, adenoma, carcinoid, adenocarcinoma. (Fig. 3 on page 7, Fig. 11 on page 11, Fig. 12 on page 12)
- Necrotic - GIST, high grade lymphoma (Fig. 16 on page 13)

G. Calcification:

- Carcinoid is most common small bowel neoplasm with calcification (70%) both in the primary tumour and metastatic lymph nodes [5] (Fig. 17 on page 14)
- GIST less common - 3% (Fig. 18 on page 14)
- Mucin producing adenocarcinoma and treated lymphoma can also have calcification (Fig. 6 on page 9)

H. Adjacent mesenteric changes:

Mesenteric retraction and shortening is seen in carcinoid. Radial speculative pattern desmoplastic reaction from the mesenteric soft tissue results in kinking and clumping of the bowel loops [6]. (Fig. 9 on page 11)

Carcinoid is associated with mesenteric soft tissue with calcification which is due to metastatic mesenteric lymphadenopathy.

Mesenteric fat stranding in circumferential pattern is seen in adenocarcinoma due to local infiltration of the mesentery by the tumour (Fig. 6 on page 9, Fig. 10 on page 16)

Though GIST and lymphoma are exophytic with extensions into adjacent mesentery they are not associated with mesenteric fat stranding or shortening [6] (Fig. 7 on page 10, Fig. 16 on page 13, Fig. 18 on page 14)

I. Nodal metastasis

- Bulky regional and mesenteric nodes- lymphoma [5, 6] (Fig. 19 on page 15)
- Less bulky but significant nodes - adenocarcinoma.
- Enhancing nodes - carcinoid shows enhancing nodes which contains calcification in 70%.
- No nodes - GIST has vascular metastasis more commonly than lymphatic [6].

J. Unifocal or multi-focal:
• Multifocal - lymphoma, carcinoid, metastasis to small bowel, peutz jeghers polyps. (Fig. 20 on page 15, Fig. 21 on page 18)
• Unifocal - adenocarcinoma, GIST, lipoma

Images for this section:

**Fig. 1:** Most common sites for small bowel neoplasms. GIST- Gastrointestinal stromal tumour
Fig. 2: Tumour location within the bowel wall
Fig. 3: Jejunal adenocarcinoma. 47 year old man presented with symptoms suggestive of high bowel obstruction. Multidetector CT axial and coronal images shows short segment circumferential thickening of proximal jejunum (arrows) causing significant luminal narrowing and proximal bowel distention (asterisk).
Fig. 4: Lymphoma. 50 year old man with history of melena and vague abdominal pain. Multidetector CT scan coronal images shows long segment homogenous, mildly enhancing, circumferential thickening of the terminal ileum (arrow). There is no luminal narrowing or proximal bowel obstruction, however perivisceral infiltration is presented which is rare in lymphoma. Histopathology revealed diffuse large B cell lymphoma.

Fig. 5: Metastasis 48 year old lady with history of carcinoma right breast presents with symptoms of subacute bowel obstruction. Contrast-enhanced axial CT image shows long segment eccentric thickening along the surface of the jejunal loops with clumping of the bowel loops and mild proximal bowel distension.
Fig. 6: Adenocarcinoma. 46 year old man presented with acute onset of generalised abdominal pain, distension, non-bilious vomiting for 4 days. There was associated non bilious vomiting. He had significant loss of weight and loss of appetite. Multidetector CT images show short segment circumferential wall thickening and heterogeneous enhancement with luminal narrowing in the terminal ileum. The lesion shows focal calcifications within it (long thin arrow). There is perivisceral infiltration in form of thin linear strands arising from the involved bowel (arrow heads). Dilated small bowel loop (asterisk) due to obstruction can also be identified.

Fig. 7: Lymphoma . 8 year old child presented with history of on and off fever for 20 days with excessive tiredness and pain abdomen. Contrast-enhanced axial CT image shows long segment circumferential homogeneous wall thickening of the proximal ileum (arrows). Despite of thickening there is dilatation of the lumen. No features of perivisceral infiltration (asterisk). Biopsy revealed burkitt's lymphoma.
**Fig. 8:** Lymphoma. 26 year old man paroxysmal nocturnal hemoglobinuria presented with symptoms suggestive of acute intestinal obstruction. Multidetector CT shows multifocal, segmental, homogenous circumferential thickening of the small bowel with mild enhancement involving jejunal and ileal loops (arrows). There is segment of intussusception in the jejunum (asterisk). Also note bulky kidneys with smooth contour, changes related to paroxysmal nocturnal hemoglobinuria.

**Fig. 9:** Carcinoid. 50 year old lady with profuse diarrhea for 6 months, fullness in the abdomen after she eats, constant abdominal pain. Multidetector CT scan shows enhancing stellate shaped mass in the mesentery of the lower abdomen, with calcification and adjacent desmoplastic reaction (arrows) causing tethering of multiple adjacent small bowel loops which show diffuse wall thickening. Also note lesion causing narrowing and marked irregularity of the mesenteric artery (arrow head).
**Fig. 11:** Jejunal adenoma. 58 year old man presented with recurrent episodes of colicky abdominal pain and vomiting. Contrast-enhanced axial CT image shows jejuno-jejunal intussusception with solid well defined homogeneously enhancing mass arising from jejunum. Histopathology revealed adenoma

![Image of Jejunal Adenoma](image-url)

**Fig. 12:** Carcinoid. 65 year old man with diarrhea and weight loss. Contrast-enhanced axial CT image shows intensely enhancing mesenteric mass with speculated margins (arrow head). Adjacent ileal loops shows circumferential homogenous thickening with intense enhancement (arrows).

![Image of Carcinoid](image-url)

**Fig. 13:** GIST. 48 year old man with neurofibromatosis. Multidetector CT images show long segment circumferential thickening of the terminal ileum with intense heterogeneous enhancement in arterial phase without significant luminal narrowing. Lesion also had focal calcifications (video clip). Subcutaneous neurofibroma identified in the right gluteal region (arrow)

![Image of GIST](image-url)
**Fig. 15:** Lipoma. 50 year old man presented with constipation for 7 years. Contrast enhanced CT image shows well defined, non-enhancing, fat density, intraluminal mass lesion suggestive of lipoma (arrows).
**Fig. 16:** GIST. 41 year old man with vague pain in abdomen. Contrast-enhanced axial CT image shows large peripherally enhancing (arrow) mass lesion with central necrosis involving proximal ileum with no features of perivisceral infiltration (asterisk).

**Fig. 17:** Carcinoid. 73 year old man with past history of radical right nephrectomy for renal cell carcinoma who presented with 2 months history of diarrhea. Contrast enhanced CT scan shows intensely enhancing spiculated mesenteric mass with focal chunky calcifications (arrow heads). There is intensely enhancing focal lesion in the liver (arrows) which also shows calcifications (arrow heads) suggestive of metastasis.
**Fig. 18:** GIST. 54 year old man with fever since 3 months, on clinical examination suspected lower abdominal mass. Contrast-enhanced axial CT image shows circumferential thickening with exophytic component and heterogeneous enhancement arising from distal ileal loop (red arrows). Lesion shows central necrosis and calcifications (arrow heads). Adjacent mesentery is clear despite of large mass suggesting no perivisceral infiltration (white arrows).

**Fig. 19:** Figure 17. Lymphoma 46 year old man with history low grade fever and abdominal pain. Contrast-enhanced axial CT image shows long segment homogenous, mildly enhancing, and circumferential thickening of the jejunum (arrow). Homogenously enhancing bulky regional nodes present which is typical of lymphoma (asterisk).
Fig. 20: Peutz Jeghers syndrome. 25 year old female with Peutz Jeghers Syndrome complaints of pain abdomen and vomiting. Multidetector CT shows multiple soft tissue density homogenously enhancing polypoid lesions (arrows) throughout small and large bowel loops with predominance in the jejunal loops. One of the lesions in the small bowel shows pedunculation
Fig. 10: Small bowel carcinoid
Fig. 14: GIST in a patient with neurofibromatosis I.
**Fig. 21:** Multiple pedunculated and sessile small and large bowel polyps in Peutz Jeghers syndrome.
Conclusion

CT enterography is excellent modality for evaluation of small bowel neoplasm. Location, site, features of tumour as well as extent and accompanying findings are best depicted by multidetector CT examination. In spite of overlapping features of various small bowel neoplasms, focused differential diagnosis can be derived when there are typical features in specific locations. Fig. 22 on page 20

By reviewing this exhibit, users will be able to diagnose and develop systematic approach in differentiating various common small bowel tumours.

Images for this section:

<table>
<thead>
<tr>
<th>CT FINDINGS</th>
<th>Adenocarcinoma</th>
<th>Lymphoma*</th>
<th>Carcinoid</th>
<th>GIST#</th>
<th>Leiomyoma¹</th>
<th>Adenoma¹</th>
<th>Hemangioma</th>
<th>Lipoma¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBSTRUCTIVE or NON OBSTRUCTIVE</td>
<td>+++</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>--/+</td>
<td>--/+</td>
<td>-</td>
<td>--/+</td>
</tr>
<tr>
<td>ENHANCEMENT</td>
<td>Homogeneous</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Markedly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>heterogenous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mildly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>heterogeneous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non enhancing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOMOGENOUS OR NECROSIS</td>
<td>Homogeneous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Necrosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ulcerative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALCIFICATION</td>
<td>+ in mucinous</td>
<td>+ post</td>
<td>+ (75%)</td>
<td>+ (3%)</td>
<td></td>
<td></td>
<td>(phleboliths)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tumor</td>
<td>treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MESENTERIC CHANGES</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NODAL METASTASIS</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NUMBER</td>
<td>Single site</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Multifocal</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Fig. 22: Pattern fit approach to small bowel tumors. GIST - gastrointestinal stromal tumours * Lymphoma - may show calcification post treatment # GIST - can be multiple in patients with neurofibromatosis $ - may present with obstruction due to intussusception
Personal information

B.T. Pushpa, DMRD,DNB

Department of Radiology, Christian Medical College, Vellore, India.

email: docpushpa@gmail.com

Anuradha C, MD,DNB, FRCR

Department of Radiology, Christian Medical College, Vellore, India.

email: anuradhachandramohan@gmail.com

Anu Eapen, DMRD,DNB

Department of Radiology, Christian Medical College, Vellore, India.

email: anuepn@yahoo.com

A.Polimood, MD, Department of Pathology, Christian Medical College, Vellore, India.

References