Small Bowel Neoplasm: A Guide for the Radiology Trainee

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Learning objectives

We present a pictorial review of the varied imaging appearances of the neoplasms involving the small bowel and describe the features to differentiate them.
Background

Small bowel neoplasms are uncommon, with an incidence of only 1.0 per 100,000 population worldwide and constitute 0.6% of all diagnosed malignancies. Reaching the correct diagnosis can be difficult or prolonged due to their non-specific clinical presentation and patients may sometimes present as an emergency, due to bowel obstruction. Endoscopy can often be difficult for diagnosis of the small bowel and hence cross sectional imaging, in particular CT, is essential for diagnosis.
Findings and procedure details

In this review, we present a range of small bowel tumours with illustration of their characteristic findings on CT.

The neoplasms involving the small bowel are heterogeneous and include malignancies such as adenocarcinoma, lymphoma, carcinoid tumours, GIST tumours and metastases from either direct invasion or peritoneal/haematogenous spread from other malignancies.

Neuroendocrine Tumours - Fig. 1 - Fig. 3

The group of neuroendocrine tumours are the most common form of primary small bowel neoplasm and account for 35-42% of all small bowel malignancies.

The carcinoid tumours are generally a group of low-grade malignancies arising from the neuroendocrine tissue outside the pancreas or thyroid. They mainly originate from the enterochromaffin cells and secrete serotonin or other similar substances. Most of these slow-growing tumours occur in the distal ileum, followed by the jejunum. Primary involvement of the duodenum is rare - up to 2% of cases. Up to 35% of carcinoid tumours also have multiple primary sites.

The CT features of carcinoid are characteristic. It is often demonstrated as an ill-defined, homogenous, stellate, mesenteric mass lesion adjacent to a thickened area of small bowel. The primary carcinoid tumour is often far more difficult to identify than the surrounding desmoplastic reaction (fibrotic areas of stranding) which form the characteristic spiculated appearance. The desmoplastic lesion may also contain calcification, which is another characteristic feature. CT is useful in defining the extent of the tumour and in locating metastatic spread, particularly to the liver. The desmoplastic reaction predisposes to small bowel obstruction and can also involve the mesenteric vessels - either by direct encasement or an inflammatory response caused by the secretions of the primary tumour. Consequently, obstruction and ischaemic events are often a way in which these tumours present.

Adenocarcinoma - Fig. 4 - Fig. 7

Adenocarcinomas are the second most common type of small bowel malignancy, and account for approximately 30-40% of primary neoplasms. The vast majority of these are located at the duodeno-jejunal junction with incidence decreasing distally to this. An exception to this is in patients with a background of Crohn's disease, however, where the ileum is then the most common site of disease.
CT features of small bowel adenocarcinoma are similar to that more widely seen in the colon. There may be annular narrowing of the bowel lumen with heterogeneous attenuation, irregular edges ('apple coring') or a more discrete mass seen within the bowel wall. Ulceration of the lesion is also common. After administration of intravenous contrast, the lesions demonstrate moderate enhancement and often, small segments are involved; and there is no correlation between the size of a lesion and its relative invasiveness. Given the luminal mass or annular narrowing described above, bowel obstruction is a very common presentation of these lesions. Intussusception of the small bowel is a less common presentation usually seen as a complication of polyloid lesions.

CT is useful modality for the detection of the primary lesion, locating the transition point in a case of acute intestinal obstruction due to the intraluminal mass or an intussusception and for demonstrating local lymphadenopathy and distant metastases.

**Lymphoma - Fig. 8 - Fig. 16**

Approximately 15-20% of all primary small bowel malignancy is lymphomatous in nature. Most of these are non-Hodgkin B-cell type disease, accounting for approximately 40% of tumours. Other histological types are seen less commonly, including Burkitt's, follicular and T-cell lymphomas. Risk factors include HIV, immunosuppression, coeliac disease and inflammatory bowel disease. Small bowel lymphomas are most commonly found in the ileum.

The most common presentation of small bowel lymphoma is that of an annular mass in the small bowel wall with extension in to the mesentery. Large, bulky mesenteric nodal masses are seen, and are often far more extensive than those seen in adenocarcinoma. More distant lymph node metastases are also likely to be large. Bowel obstruction is less common with lymphoma, due to the lack of a desmoplastic reaction.

A further presentation can be an aneurysmal dilatation of the bowel lumen - due to destruction of the autonomic nervous plexus; which is in contrast to the narrowing and occlusion seen with the other neoplasms described. Ulceration with perforation in to the adjacent mesentery can also be a feature.

**Mesenchymal tumours - Fig. 17 - Fig. 18**

Also known as Gastrointestinal Stromal Tumours (GISTs), these tumours account for 15-20% of all primary small bowel malignancy. There is a spectrum of disease, and only around 20% of all GISTs are malignant. Distribution is spread across the whole small bowel, in contrast to carcinoid and adenocarcinoma. Neurofibromatosis type 1 is a large risk factor for the development of multiple, small GISTs.
The dominant CT feature of a small bowel GIST is exophytic growth outside the organ of interest. The masses are typically of low attenuation due to a combination of central liquefactive necrosis, cystic transformation and haemorrhage. Like carcinoid, calcification may also be associated with the primary tumour. Lymph node involvement is very uncommon, however, and is a feature that allows potential distinction from lymphoma and adenocarcinoma. Since much of the disease is exophytic, involvement of surrounding structures is common.

**Metastasis to small bowel - Fig. 19 - Fig. 24**

Metastatic involvement of the small bowel is more common than primary malignancies. Spread to the small bowel may be via direct extension from a local tumour, haematogenous spread or intraperitoneal seeding.

Direct extension is most common in colonic, pancreatic, biliary and bladder primaries. CT will demonstrate extension of disease directly to the small bowel from an adjacent primary malignancy in addition to any complication such as bowel or biliary obstruction.

Haematogenous spread is common with breast, lung, renal cell and melanoma malignancies, while intraperitoneal seeding is often seen with mucinous ovary, appendix and colonic neoplasms.
Fig. 1: This is a case of biopsy proven small bowel carcinoid. The coronal slice demonstrates the characteristic stellate desmoplastic reaction with the presence of calcification in the mesentery (red arrow). The adjacent small bowel is thickened and dilated in keeping with a degree of small bowel obstruction (green arrow).

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Fig. 2: The same case from Fig.1 is demonstrated. The axial slice also illustrates the characteristic desmoplastic reaction (red arrow). The adjacent small bowel is thickened and dilated in keeping with a degree of small bowel obstruction (green arrow).

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Fig. 3: Ill-defined low attenuation lesion in the liver is indicative of metastatic spread of the small bowel carcinoid tumour that has been demonstrated in Fig.1 and Fig.2.

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Fig. 4: This is a case of biopsy proven adenocarcinoma of the jejunum. The axial slice demonstrates irregular, annular thickening of the bowel wall with reduced luminal calibre. The bowel wall is seen to moderately enhance.

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Fig. 5: The same case from Fig 4. Is demonstrated. The coronal slice demonstrates the same characteristic features of irregular, circumferential bowel wall thickening with a reduced luminal calibre.

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Fig. 6: This is a case of biopsy proven duodenal carcinoma. The axial slice demonstrates annular thickening of bowel wall, luminal narrowing and secondary obstruction of the stomach (yellow arrow) and biliary tree (green arrows).

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Fig. 7: The same case from Fig. 6 is shown. Annular thickening of the duodenum is demonstrated with no appreciable patent lumen on this axial slice (red arrow). The distal common bile duct is also markedly distended (green arrow).

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Fig. 8: This is a case of biopsy proven diffuse large B-cell lymphoma (DLBL). The characteristic aneurysmal dilatation of the small bowel lumen is well demonstrated on this axial slice. There is associated bowel wall thickening.

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Fig. 9: This is the same case shown in Fig. 8. The characteristic aneurysmal dilatation of the small bowel lumen is well demonstrated on this coronal slice. There is associated bowel wall thickening.

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Fig. 10: This is the same case of DLBL shown in Fig.8 and Fig.9. This coronal slice of a combined PET/CT scan shows the pathological area demonstrated avid uptake of the 18-FDG tracer.

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Fig. 11: The previously demonstrated DLBL is shown here after a complete course of chemotherapy. There has been significant reduction in the size of the mass (axial slice). The characteristic aneurysmal dilatation of the lumen is no longer well demonstrated.

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Fig. 12: The previously demonstrated DLBL is shown here after a complete course of chemotherapy. There has been significant reduction in the size of the mass (coronal slice).

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Fig. 13: This is a case of biopsy proven follicular lymphoma of the small bowel. The coronal slice demonstrates a characteristic enhancing large nodal mass. The extensive, bulky nature of the mass helps to characterise this as a lymphoma.

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**Fig. 14:** The same case from Fig. 13 is demonstrated. This coronal slice of a subsequent PET/CT scan shows avid uptake within the pathological nodal mass.

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Fig. 15: This is a case of suspected small bowel lymphoma that presented acutely with abdominal pain. The coronal image demonstrates a small bowel intussusception. A polypoid mass was found to be the lead point. The intussusceptum (yellow arrow) is seen to invaginate within the intussuscipiens. The proximal small bowel loops are grossly dilated (green arrow).

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Fig. 16: The same case from Fig. 15 is shown. The axial image demonstrates again the small bowel intussusception. The intussusceptum (yellow arrow) is seen to invaginate within the intussuscipiens. The lead point at the intussusceptum contains abnormal soft tissue and is a suspected small bowel lymphoma.

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**Fig. 17:** This is a biopsy proven case of small bowel GIST. A large, predominantly exophytic mass is demonstrated on this coronal slice, and is of characteristic heterogeneous low attenuation. The involved small bowel (green arrow) is of relatively normal calibre.

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Fig. 18: The same case from Fig. 17 is demonstrated. The characteristic, large, exophytic mass is shown here on the axial slice.

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Fig. 19: This is a case of biopsy proven caecal adenocarcinoma. This coronal slice demonstrates pathological annular thickening of the caecum. Subsequent figures demonstrate the direct metastatic invasion of the terminal ileum secondary to this colonic mass.

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Fig. 20: This is the same case as demonstrated in Fig 19. A further coronal slice shows direct invasion of the terminal ileum from the caecal adenocarcinoma (red arrow). The ileum proximal to this is fluid filled and prominent (green arrow), although there is not yet any frank small bowel obstruction.
Fig. 21: This is the same case as demonstrated in Fig 19 and Fig. 20. The axial slice again shows the ileocaecal area with direct invasion of the ileum by the caecal adenocarcinoma.

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Fig. 22: This is a case of biopsy proven transitional cell carcinoma (TCC) of the bladder, which has directly invaded an adjacent small bowel loop. This axial slice demonstrates a collapsed bladder with enhancing soft tissue invasion of the adjacent ileum (red arrow).

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Fig. 23: This is the same case as demonstrated in Fig. 22. The bladder mass is seen to extended from the bladder into the adjacent small bowel (red arrow). This is causing some obstruction of the small bowel, and the proximal loops are seen to be fluid-filled and distended (green arrow).

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Fig. 24: This is the same case as demonstrated in Fig. 22 and Fig. 23. The sagittal image once again demonstrates the bladder TCC invading the local small bowel. Dilated loops of small bowel, with air-fluid levels, are visible due to the degree of obstruction caused by the invading carcinoma (green arrow).

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Conclusion

Small bowel neoplasms are primarily identified by cross sectional imaging, mainly CT, and knowledge of their imaging features is essential for optimal patient management.
Personal information

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References